AS/400e

DB2 UDB for AS/400 SQL Reference

Version 4

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About DB2 UDB for AS/400 SQL Reference

This book defines Structured Query Language (SQL) as supported by DB2 Query Manager and SQL Development Kit. It contains reference information for the tasks of system administration, database administration, application programming, and operation. This manual includes syntax, usage notes, keywords, and examples for each of the SQL statements used on the AS/400 system.

Standards Compliance

DB2 UDB for AS/400 Version 4 Release 5 complies with the following IBM and Industry SQL Standards:

- ISO (International Standards Organization) 9075: 1992, Database Language SQL - Entry Level
- ISO (International Standards Organization) 9075-4: 1996, Database Language SQL - Part 4: Persistent Stored Modules (SQL/PSM)
- ANSI (American National Standards Institute) X3.135-1992, Database Language SQL - Entry Level
- ANSI (American National Standards Institute) X3.135–4: 1996, Database Language SQL - Part 4: Persistent Stored Modules (SQL/PSM)
- *IBM SQL Reference Version 2*, SC26-8416.

Who should read the SQL Reference book

This book is intended for programmers who want to write applications that will use SQL to access an AS/400 database.

It is assumed that you possess an understanding of system administration, database administration, or application programming for the AS/400, as provided by the SQL Programming Concepts book and that you have some knowledge of the following:

- COBOL for AS/400
- ILE C for AS/400
- VisualAge C++ for OS/400
- ILE COBOL for AS/400
- AS/400 Toolbox for Java or AS/400 Developer Kit for Java
- ILE RPG for AS/400
- AS/400 PL/I
- REXX
- RPG III (part of RPG for AS/400)
- Structured Query Language (SQL)

References in this book to RPG and COBOL refer to the RPG or COBOL language in general. References to COBOL for AS/400, ILE COBOL for AS/400, ILE RPG for AS/400, or RPG III (part of RPG for AS/400) refer to specific elements of the product where they differ from each other.

This manual is a reference rather than a tutorial. It assumes you are already familiar with SQL programming. This manual also assumes that you will be writing applications solely for the AS/400.

If you need more information about using SQL statements, statement syntax, and parameters, see the SQL Programming Concepts book.

If you are planning applications that are portable to other IBM environments, it will be necessary for you to refer to books for those environments in addition to this one (such as *IBM SQL Reference Version 2*, SC26-8416).

Assumptions Relating to Examples of SQL Statements

The examples of SQL statements shown in this guide are based on the sample tables in Appendix A of the SQL Programming Concepts book and assume the following:

- They are shown in the interactive SQL environment or written in COBOL. EXEC SQL and END-EXEC are used to delimit an SQL statement in a COBOL program. A description of how to use SQL statements in a COBOL program is provided in the SQL Programming with Host Languages book.
- Each SQL example is shown on several lines, with each clause of the statement on a separate line.
- SQL keywords are highlighted.
- Table names provided in Appendix A of the SQL Programming Concepts book use the collection CORPDATA. Table names that are not provided in that appendix should use collections that you create.
- Calculated columns are enclosed in parentheses, ().
- The SQL naming convention is used.
- The APOST and APOSTSQL precompiler options are assumed (although they are not the default in COBOL). Character-string constants within SQL and host language statements are delimited by apostrophes (’).
- A sort sequence of *HEX is used.

Whenever the examples vary from these assumptions, it is stated.

How to Read Syntax Diagrams

Throughout this book, syntax is described using the structure defined as follows:

- Read the syntax diagrams from left to right, from top to bottom, following the path of the line.

  The ►►─── symbol indicates the beginning of a statement.

  The ───► symbol indicates that the statement syntax is continued on the next line.

  The ►─── symbol indicates that a statement is continued from the previous line.

  The ───►◄ symbol indicates the end of a statement.

  Diagrams of syntactical units other than complete statements start with the ►─── symbol and end with the ───► symbol.
- Required items appear on the horizontal line (the main path).

```
►►──required_item─────────────────────────────────────────────────────►◄
```

- Optional items appear below the main path.

```
►►──required_item──┬───────────────┬──────────────────────────────►◄
                   └─optional_item─┘
```

If an optional item appears above the main path, that item has no effect on the execution of the statement and is used only for readability.

```
                   ┌─optional_item─┐
►►──required_item──┴───────────────┴──────────────────────────────►◄
```

- If you can choose from two or more items, they appear vertically, in a stack.

  If you *must* choose one of the items, one item of the stack appears on the main path.

```
►►──required_item──┬─required_choice1─┬───────────────────────────►◄
                   └─required_choice2─┘
```

  If choosing one of the items is optional, the entire stack appears below the main path.

```
►►──required_item──┬──────────────────┬───────────────────────────►◄
                   ├─optional_choice1─┤
                   └─optional_choice2─┘
```

  If one of the items is the default, it will appear above the main path and the remaining choices will be shown below.

```
                   ┌─default_choice──┐
►►──required_item──┼─────────────────┼────────────────────────────►◄
                   ├─optional_choice─┤
                   └─optional_choice─┘
```

- An arrow returning to the left, above the main line, indicates an item that can be repeated.

```
                   ┌─────────────────┐
                   ▼                 │
►►──required_item────repeatable_item─┴────────────────────────────►◄
```

  If the repeat arrow contains a comma, you must separate repeated items with a comma.

```
                   ┌─,───────────────┐
                   ▼                 │
►►──required_item────repeatable_item─┴────────────────────────────►◄
```

  A repeat arrow above a stack indicates that you can repeat the items in the stack.

- Keywords appear in uppercase (for example, `FROM`). They must be spelled exactly as shown. Variables appear in all lowercase letters (for example, *column-name*). They represent user-supplied names or values.
- If punctuation marks, parentheses, arithmetic operators, or other such symbols are shown, you must enter them as part of the syntax.

Conventions for Describing Mixed Data Values

When mixed data values are shown in the examples, the following conventions apply:

Convention	**Meaning**
S_O	Represents the EBCDIC *shift-out* control character (X’0E’)
S_I	Represents the EBCDIC *shift-in* control character (X’0F’)
sbcs-string	Represents a string of zero or more single-byte characters
dbcs-string	Represents a string of zero or more double-byte characters
’	Represents a DBCS apostrophe (EBCDIC X’427D’)
Ｇ	Represents a DBCS G (EBCDIC X’42C7’)

What’s new for V4R5 in the SQL Reference book

The major new features covered in this book include:

- BIGINT data type
- COUNT_BIG column function
- ATAN2, CEILING, DIFFERENCE, RADIANS, RAND, ROUND, SIGN, SOUNDEX, and TRUNCATE scalar functions
- Java Procedures
- Expressions in INSERT with a VALUES clause
- Several SQL procedure and function enhancements (GET DIAGNOSTICS, GO TO, SIGNAL, RESIGNAL, RETURN in procedures

A vertical line (|) to the left of the text indicates a change or addition.

Chapter 1. Concepts

Relational Database

A relational database is a database that can be perceived as a set of tables and can be manipulated in accordance with the relational model of data. The relational database contains a set of objects used to store, access, and manage data. The set of objects includes tables, views, indexes, and packages.

There is only one relational database on any AS/400 system. It consists of all the database objects stored locally on the AS/400 system. The name of the local relational database can be assigned through the use of the ADDRDBDIRE (Add RDB Directory Entry) command. Other relational databases on other systems can be accessed remotely.

The database manager is the name used generically to identify the AS/400 Licensed Internal Code and the DB2 UDB for AS/400 portion of the code that manages the relational database.

Structured Query Language

Structured Query Language (SQL) is a standardized language for defining and manipulating data ina relational database. In accordance with the relational model of data, the database is perceived as a set of tables, relationships are represented by values in tables, and data is retrieved by specifying a result table that can be derived from one or more base tables.

SQL statements are executed by a database manager. One of the functions of the database manager is to transform the specification of a result table into a sequence of internal operations that optimize data retrieval. This transformation occurs when the SQL statement is *prepared*. This transformation is also known as *binding*.

All executable SQL statements must be prepared before they can be executed. The result of preparation is the executable or operational form of the statement. The method of preparing an SQL statement and the persistence of its operational form distinguish static SQL from dynamic SQL.

Static SQL

The source form of a *static* SQL statement is embedded within an application program written in a host language such as COBOL. The statement is prepared before the program is executed and the operational form of the statement persists beyond the execution of the program.

A source program containing static SQL statements must be processed by an SQL precompiler before it is compiled. The precompiler checks the syntax of the SQL statements, turns them into host language comments, and generates host language statements to call the database manager.

The preparation of an SQL application program includes precompilation, the preparation of its static SQL statements, and compilation of the changed source program.

Dynamic SQL

A *dynamic* SQL statement is prepared during the execution of an SQL application. The operational form of the statement persists until the last SQL program leaves the call stack. The source form of the statement is a character string that is passed to the database manager by the program using the static SQL statement PREPARE or EXECUTE IMMEDIATE.

SQL statements embedded in a REXX application are dynamic SQL statements. SQL statements submitted to the interactive SQL facility are also dynamic SQL statements.

Extended Dynamic SQL

An extended dynamic SQL statement is neither fully static nor fully dynamic. The QSQPRCED API provides users with extended dynamic SQL capability. Like dynamic SQL, statements can be prepared, described, and executed using this API. Unlike dynamic SQL, SQL statements prepared into a package by this API persist until the package or statement is explicitly dropped. For more information, see the OS/400 APIs information in the **Programming** category of the AS/400 Information Center.

Interactive SQL

An interactive SQL facility is associated with every database manager. Essentially, every interactive SQL facility is an SQL application program that reads statements from a terminal, prepares and executes them dynamically, and displays the results to the user. Such SQL statements are said to be issued *interactively*. The interactive facilities for DB2 UDB for AS/400 are invoked by the STRSQL command, the STRQM command, or the SQL Script support of Operations Navigator. For more information on the interactive facilities for SQL, see the Query Manager Use and SQL Programming Concepts books.

SQL Call Level Interface

DB2 UDB for AS/400 supports the X/Open SQL Call Level Interface. This allows users of any of the ILE languages to access SQL functions directly through procedure calls to a service program provided by DB2 UDB for AS/400. Using the SQL Call Level Interface, one can perform all the SQL functions without the need for a precompile. This is a standard set of procedure calls to prepare SQL statements, execute SQL statements, fetch rows of data, and even do advanced functions such as accessing the catalogs, and binding program variables to output columns.

For a complete description of all the available functions, and their syntax, see SQL Call Level Interfaces (ODBC) book.

Collections

The objects in a relational database are organized into sets called collections. A collection provides a logical classification of objects in the database. A collection is also called a schema.

When a table, view, index, alias, procedure, user-defined function, or user-defined data type is created, it is assigned to exactly one collection. The collection to which an object is assigned is determined by the name of the object. For example, CREATE TABLE C.X creates table X in collection C.

Tables

A table is an object that stores user data. Tables are logical structures maintained by the database manager. Tables are made up of columns and rows. There is no inherent order of the rows within a table. At the intersection of every column and row is a specific data item called a *value*. A *column* is a set of values of the same type. A *row* is a sequence of values such that the *n*th value is a value of the *n*th column of the table.

A *base table* is created with the CREATE TABLE statement and is used to hold persistent user data. A *result table* is a set of rows that the database manager selects or generates from one or more base tables.

A base table has a name and may have a different system name. The system name is the name used by OS/400. Either name is acceptable wherever a table-name is specified in SQL statements. For more information see "CREATE TABLE" on page 340.

A column of a base table has a name and may have a differentsystem column name. The system column name is the name used by OS/400. Either name is acceptable wherever column-name is specified in SQL statements. For more information see "CREATE TABLE" on page 340.

A *nodegroup* is an object that provides a logical grouping of a set of two or more AS/400 systems. A *distributed table* is a table whose data is partitioned across a nodegroup. A *partitioning key* is a set of one or more columns in a distributed table that are used to determine on which AS/400 system a row belongs. For more information on distributed tables, see the DB2 Multisystem book.

Keys

A *key* is one or more columns that are identified as such in the description of an index, unique constraint, or a referential constraint. The same column can be part of more than one key. A key composed of more than one column is called a composite key.

A *composite key* is an ordered set of columns of the same table. The ordering of the columns is not constrained by their ordering within the table. The term *value* when used with respect to a composite key denotes a composite value. Thus, a rule such as "the value of the foreign key must be equal to the value of the primary key" means that each component of the value of the foreign key must be equal to the corresponding component of the value of the primary key.

Primary Keys and Unique Keys

A *unique constraint* is the rule that the values of a key are valid only if they are unique. A key that is constrained to have unique values is called a *unique key* and can be defined by using the CREATE UNIQUE INDEX statement. The resulting unique index is used by the database manager to enforce the uniqueness of the key during the execution of INSERT and UPDATE statements. Alternatively, unique keys can be defined:

- As a primary key using a CREATE TABLE or ALTER TABLE statement. A table cannot have more than one primary key. A CHECK constraint will be added implicitly to enforce the rule that the NULL value is not allowed in the columns that make up the primary key. A unique index on a primary key is called a primary index.

- Using the UNIQUE clause of the CREATE TABLE or ALTER TABLE statement. A table can have an arbitrary number of UNIQUE keys.

A unique key that is referenced by the foreign key of a referential constraint is called the parent key. A parent key is either a primary key or a UNIQUE key. When a table is defined as a parent in a referential constraint, the default parent key is its primary key.

Referential Integrity

Referential integrity is the state of a database in which all values of all foreign keys are valid. A *foreign key* is a key that is part of the definition of a referential constraint. A *referential constraint* is the rule that the values of the foreign key are valid only if:

- They appear as values of a parent key, or
- Some component of the foreign key is null.

The table containing the parent key is called the *parent table* of the referential constraint, and the table containing the foreign key is said to be a *dependent* of that table.

Referential constraints are optional and can be defined in CREATE TABLE statements and ALTER TABLE statements. Referential constraints are enforced by the database manager during the execution of INSERT, UPDATE, and DELETE statements. The enforcement is effectively performed at the completion of the statement except for delete and update rules of RESTRICT which are enforced as rows are processed.

Referential constraints with a delete or update rule of RESTRICT are always enforced before any other referential constraints. Other referential constraints are enforced in an order independent manner. That is, the order does not affect the result of the operation. Within an SQL statement:

- A row can be marked for deletion by any number of referential constraints with a delete rule of CASCADE.
- A row can only be updated by one referential constraint with a delete rule of SET NULL or SET DEFAULT.
- A row that was updated by a referential constraint cannot also be marked for deletion by another referential constraint with a delete rule of CASCADE.

The rules of referential integrity involve the following concepts and terminology:

Parent key	A primary key or unique key of a referential constraint.
Parent row	A row that has at least one dependent row.
Parent table	A table that is a parent in at least one referential constraint. A table can be defined as a parent in an arbitrary number of referential constraints.
Dependent table	A table that is a dependent in at least one referential constraint. A table can be defined as a

	dependent in an arbitrary number of referential constraints. A dependent table can also be a parent table.
Descendent table	A table is a descendent of table T if it is a dependent of T or a descendent of a dependent of T.
Dependent row	A row that has at least one parent row.
Descendent row	A row is a descendent of row p if it is a dependent of p or a descendent of a dependent of p.
Referential cycle	A set of referential constraints such that each table in the set is a descendent of itself.
Self-referencing row	A row that is a parent of itself.
Self-referencing table	A table that is a parent and a dependent in the same referential constraint. The constraint is called a *self-referencing constraint*.

The insert rule of a referential constraint is that a nonnull insert value of the foreign key must match some value of the parent key of the parent table. The value of a composite foreign key is null if any component of the value is null.

The update rule of a referential constraint is specified when the referential constraint is defined. The choices are NO ACTION and RESTRICT. The update rule applies when a row of the parent or dependent table is updated. The update rule is that a nonnull update value of a foreign key must match some value of the parent key of the parent table. The value of a composite foreign key is null if any component of the value is null.

The delete rule of a referential constraint is specified when the referential constraint is defined. The choices are NO ACTION, RESTRICT, CASCADE, SET NULL or SET DEFAULT. SET NULL can be specified only if some column of the foreign key allows null values.

The delete rule of a referential constraint applies when a row of the parent table is deleted. More precisely, the rule applies when a row of the parent table is the object of a delete or propagated delete operation (defined below) and that row has dependents in the dependent table of the referential constraint. Let P denote the parent table, let D denote the dependent table, and let p denote a parent row that is the object of a delete or propagated delete operation. If the delete rule is:

- RESTRICT or NO ACTION, an error occurs and no rows are deleted
- CASCADE, the delete operation is propagated to the dependents of p in D
- SET NULL, each nullable column of the foreign key of each dependent of p in D is set to null
- SET DEFAULT, each column of the foreign key of each dependent of p in D is set to its default value

Each referential constraint in which a table is a parent has its own delete rule, and all applicable delete rules are used to determine the result of a delete operation. Thus, a row cannot be deleted if it has dependents in a referential constraint with a delete rule of RESTRICT or NO ACTION, or if the deletion cascades to any of its descendants that are dependents in a referential constraint with the delete rule of RESTRICT or NO ACTION.

The deletion of a row from parent table P involves other tables and may affect rows of these tables:

- If table D is a dependent of P and the delete rule is RESTRICT or NO ACTION, D is involved in the operation but is not affected by the operation.
- If D is a dependent of P and the delete rule is SET NULL, D is involved in the operation, and rows of D may be updated during the operation.
- If D is a dependent of P and the delete rule is SET DEFAULT, D is involved in the operation, and rows of D may be updated during the operation.
- If D is a dependent of P and the delete rule is CASCADE, D is involved in the operation and rows of D may be deleted during the operation.

If rows of D are deleted, the delete operation on P is said to be propagated to D. If D is also a parent table, the actions described in this list apply, in turn, to the dependents of D.

Any table that may be involved in a delete operation on P is said to be *delete-connected* to P.Thus, a table is delete-connected to table P if it is a dependent of P or a dependent of a table to which delete operations from P cascade.

Check Constraints

A *check constraint* is a rule that specifies the values allowed in one or more columns of every row of a table. Check constraints are optional and can be defined using the SQL statements CREATE TABLE and ALTER TABLE. The definition of a check constraint is a restricted form of a search condition. One of the restrictions is that a column name in a check constraint on a table T must identify a column of T.

A table can have an arbitrary number of check constraints. They are enforced by the database manager when:

- A row is inserted into the table.
- A row of the table is updated.

A check constraint is enforced by applying its search condition to each row that is inserted or updated. An error occurs if the result of the search condition is FALSE for any row.

Triggers

A *trigger* is a set of actions that are executed automatically whenever a specified event occurs to a specified base table. A trigger can be defined to be executed before the event or after the event. The event can be an insert, update, or delete operation.

The set of actions can include almost any operation allowed on the AS/400 system. A few operations are not allowed, such as:

- Commit or rollback (if the same commitment definition is used for the trigger actions and the triggering event)
- CONNECT, SET CONNECTION, DISCONNECT, and RELEASE statements

For a complete list of restrictions, see the Database Programming book.

Because the database manager automatically executes a trigger, if a set of actions must occur whenever a specified operation occurs, applications do not have to duplicate the actions in every application program that performs the operation.

This can result in better programmer productivity, better consistency, and in the case of distributed applications, better performance.

The actions performed in the trigger are considered to be part of the operation that caused the trigger to be executed. Thus, when the isolation level is anything other than NC (No Commit) and the trigger actions are performed using the same commitment definition as the trigger event:

- The database manager ensures that the operation and the triggers executed as a result of that operation either all complete or are backed out. Operations that occurred prior to the triggering operation are not affected.
- The database manager effectively checks all constraints (except for a constraint with a RESTRICT delete rule) after the operation and the associated triggers have been executed.

A trigger has an attribute that specifies whether it is allowed to delete or update a row that has already been inserted or updated within the SQL statement that caused the trigger to be executed.

- If ALWREPCHG(*YES) is specified when the trigger is defined, then within an SQL statement:
  - The trigger is allowed to update or delete any row that was inserted or already updated by that same SQL statement. This also includes any rows inserted or updated by a trigger or referential constraint caused by the same SQL statement.
- If ALWREPCHG(*NO) is specified when the trigger is defined, then within an SQL statement:
  - A row can be deleted by a trigger only if that row has not been inserted or updated by that same SQL statement. If the isolation level is anything other than NC (No Commit) and the trigger actions are performed using the same commitment definition as the trigger event, this also includes any inserts or updates by a trigger or referential constraint caused by the same SQL statement.
  - A row can be updated by a trigger only if that row has not already been inserted or updated by that same SQL statement. If the isolation level is anything other than NC (No Commit) and the trigger actions are performed using the same commitment definition as the trigger event, this also includes any inserts or updates by a trigger or referential constraint caused by the same SQL statement.

A trigger may perform operations that cause other triggers to be fired. Also, operations performed in a trigger may cause referential constraint rules to be executed.

A trigger is not allowed on a table that contains a LOB column.

Triggers are defined using the ADDPFTRG (Add Physical File Trigger) CL command. Triggers are dropped using the RMVPFTRG (Remove Physical File Trigger) CL command. For more information, see the Database Programming book.

Indexes

An *index* is a set of pointers to rows of a base table. Each index is based on the values of data in one or more table columns. An *index* is an object that is separate from the data in the table. When you request an index, the database manager builds this structure and maintains it automatically.

An index has a name and may have a different system name. The system name is the name used by OS/400. Either name is acceptable wherever an index-name is specified in SQL statements. For more information see "CREATE INDEX" on page 324.

The database manager uses two types of indexes:

- Binary radix tree index

  Binary radix tree indexes provide a specific order to the rows of a table. The database manager uses them to:

  - Improve performance. In most cases, access to data is faster than without an index.
  - Ensure uniqueness. A table with a unique index cannot have rows with identical keys.
- Encoded vector index

  Encoded vector indexes do not provide a specific order to the rows of a table. The database manager only uses these indexes to improve performance.

An encoded vector access path works with the help of encoded vector indexes and provides access to a database file by assigning codes to distinct key values and then representing these values in an array. The elements of the array can be 1, 2, or 4 bytes in length, depending on the number of distinct values that must be represented. Because of their compact size and relative simplicity, encoded vector access paths provide for faster scans that can be more easily processed in parallel.

You create encoded vector access paths by using the SQL CREATE INDEX statement. For more information about accelerating your queries with encoded vector indexes ➜, go to the DB2 UDB for AS/400 webpages.

Views

A *view* provides an alternative way of looking at the data in one or more tables.

A view is a named specification of a result table. The specification is a SELECT statement that is effectively executed whenever the view is referenced in an SQL statement. Thus, a view can be thought of as having columns and rows just like a base table. For retrieval, all views can be used just like base tables. Whether a view can be used in an insert, update, or delete operation depends on its definition as explained in the description of CREATE VIEW. (See "CREATE VIEW" on page 362 for more information.)

An index cannot be created for a view. However, an index created for a table on which a view is based may improve the performance of operations on the view.

When the column of a view is directly derived from a column of a base table, that column inherits any constraints that apply to the column of the base table. For example, if a view includes a foreign key of its base table, INSERT and UPDATE operations using that view are subject to the same referential constraints as the base table. Likewise, if the base table of a view is a parent table, DELETE operations using that view are subject to the same rules as DELETE operations on the base table. A view also inherits any triggers that apply to its base table. For example, if the base table of a view has an update trigger, the trigger is fired when an update is performed on the view.

A view has a name and may have a different system name. The system name is the name used by OS/400. Either name is acceptable wherever a view-name is specified in SQL statements. For more information see "CREATE VIEW" on page 362.

A column of a view has a name and may have a different system column name. The system column name is the name used by OS/400. Either name is acceptable wherever column-name is specified in SQL statements. For more information see "CREATE VIEW" on page 362.

Aliases

An *alias* is an alternate name for a table or view. You can use an alias to reference a table or view in those cases where an existing table or view can be referenced.[1] Like tables and views, an alias may be created, dropped, and have a comment or label associated with it. No authority is necessary to use an alias. Access to the tables and views that are referred to by the alias, however, still require the appropriate authorization for the current statement.

An alias has a name and may have a different system name. The system name is the name used by OS/400. Either name is acceptable wherever an alias-name is specified in SQL statements. For more information see "CREATE ALIAS" on page 291.

Packages and Access Plans

For distributed SQL programs, a *package* is an object that contains control structures used to execute SQL statements. Packages are produced during program preparation. The control structures can be thought of as the bound or operational form of SQL statements. All control structures in a package are derived from the SQL statements embedded in a single source program.

A package can also be created by the QSQPRCED API. Packages created by the QSQPRCED API can only be used by the QSQPRCED API. They cannot be used at an application server through DRDA protocols. For more information, see the OS/400 APIs information in the **Programming** category of the AS/400 Information Center.

The QSQPRCED API is used by AS/400 Client Access for Windows 95/NT to create packages for caching SQL statements executed via ODBC, JDBC and SQLJ interfaces.

For non-distributed SQL programs, the control structures used to execute SQL statements are stored in the associated space of the non-distributed SQL program.

The term *access plan* is used in general to describe the control structures in the associated space of an SQL program or SQL package used to execute SQL statements.

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[1] You cannot use an alias in all contexts. For example, an alias that refers to an individual member of a database file cannot be used in data definition language (DDL) statements.

Procedures

A procedure (often called a stored procedure) is a programming construct that can be called to perform a set of operations. The operations can contain host language statements and SQL statements.

Procedures are typically classified as either SQL procedures or external procedures. SQL procedures contain only SQL statements. External procedures reference a host language program (or in the case of REXX, a source file member) which may or may not contain SQL statements. Both external procedures and SQL procedures are supported in DB2 UDB for AS/400.

Procedures in SQL provide the same benefits as procedures in a host language. That is, a common piece of code need only be written and maintained once and can be called from several programs. Both host languages and SQL can call procedures that exist on the local system. However, SQL can also call a procedure that exists on a remote system. In fact, the major benefit of procedures in SQL is that they can be used to enhance the performance characteristics of distributed applications.

Assume several SQL statements must be executed at a remote system. When the first SQL statement is executed, the application requester will send a request to an application server to perform the operation. It will then wait for a reply that indicates whether the statement executed successfully or not and optionally returns results. When the second and each subsequent SQL statement is executed, the application requester will send another request and wait for another reply. If the same SQL statements are stored in a procedure at an application server, a CALL statement can be executed that references the remote procedure. When the CALL statement is executed, the application requester will send a single request to the current server to call the procedure. It will then wait for a single reply that indicates whether the procedure executed successfully or not and optionally returns results.

The following two figures illustrate the way stored procedures can be used in a distributed application to eliminate some of the remote requests.

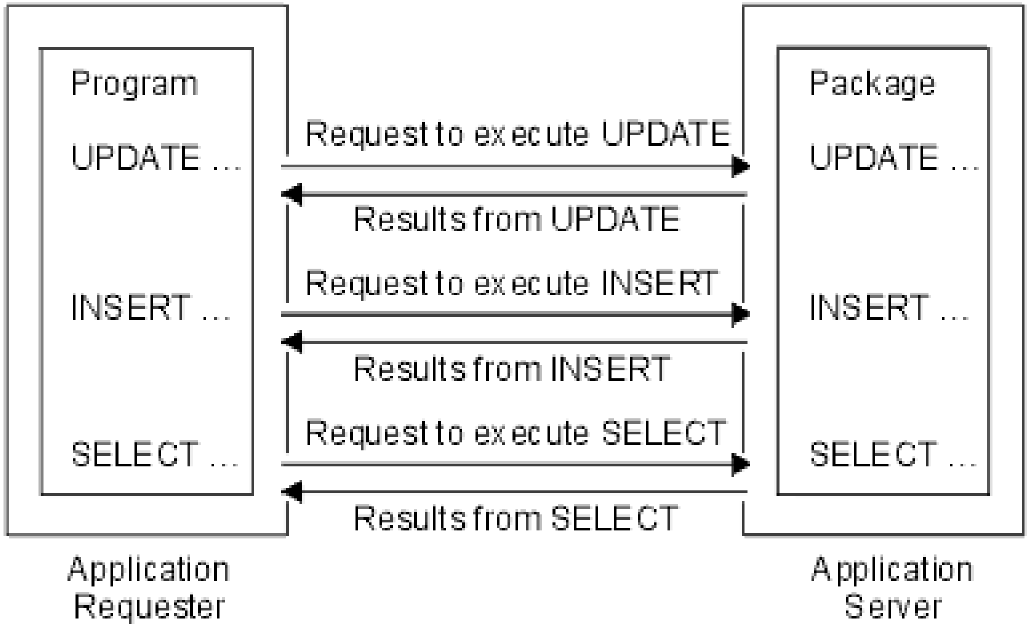


Figure 1. Application Without Remote Procedure

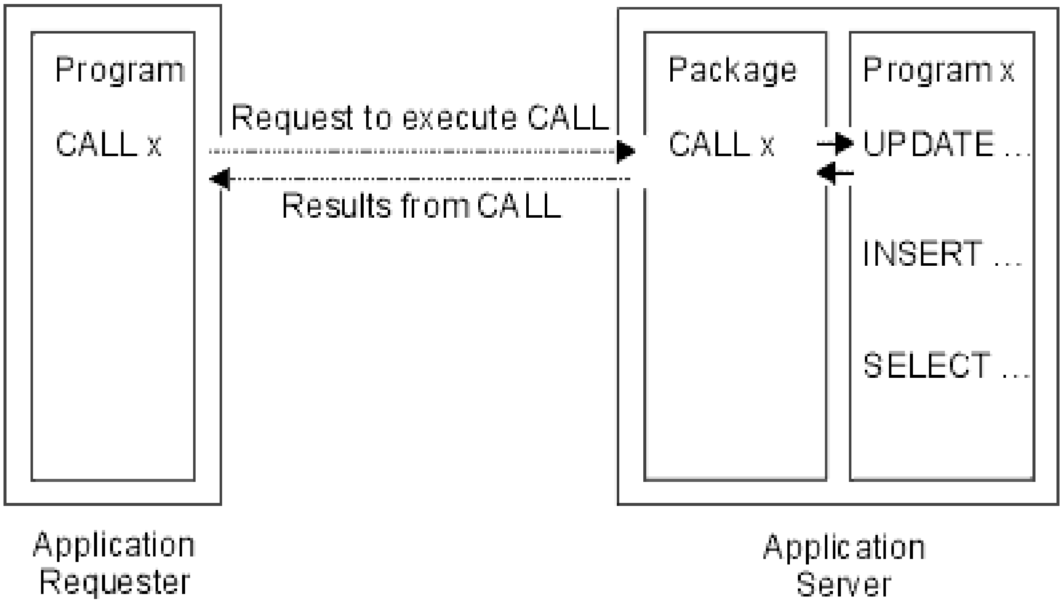


Figure 2. Application With Remote Procedure

Catalog

The database manager maintains a set of tables containing information about the data in the database. These tables are collectively known as the *catalog*. The *catalog tables* contain information about tables, parameters, procedures, packages, views, indexes, and constraints on the AS/400 system.

The database manager provides views over the catalog tables. The views provide more consistency with the catalog views of other IBM SQL products and with the catalog views of the ANSI and ISO standard (called Information Schema in the standard). The catalog views in QSYS2 contain information about all tables, packages, views, indexes, and constraints on the AS/400 system. Additionally, an SQL collection will contain a set of these views that only contains information about tables, packages, views, indexes, and constraints in the collection.

Tables and views in the catalog are like any other database tables and views. If you have authorization, you can use SQL statements to look at data in the catalog views in the same way that you retrieve data from any other table in the AS/400 system. The database manager ensures that the catalog contains accurate descriptions of the objects in the database at all times.

For more information about catalog tables and views, see “Appendix G. DB2 UDB for AS/400 Catalog Views” on page 591.

Application Processes, Concurrency, and Recovery

All SQL programs execute as part of an application process. In OS/400, an application process is called a job. An application process is made up of one or more activation groups. Each activation group involves the execution of one or more programs. Programs run under a non-default activation group or the default activation group. All programs except those created by ILE compilers run under the default activation group.

For more information on activation groups, see the book *ILE Concepts*, SC41-5606-04.

An application process that uses commitment control can run with one or more commitment definitions. A commitment definition provides a means to scope commitment control at an activation group level or at a job level. At any given time, an activation group that uses commitment control is associated with only one of the commitment definitions.

A commitment definition can be explicitly started through the Start Commitment Control (STRCMTCTL) command. If not already started, a commitment definition is implicitly started when the first SQL statement is executed under an isolation level different than COMMIT(*NONE). More than one activation group can share a job commitment definition.

Figure 3 on page 13 shows the relationship of an application process, the activation groups in that application process, and the commitment definitions. Activation groups A and B run with commitment control scoped to the activation group. These activation groups have their own commitment definitions. Activation group C does not run with any commitment control and does not have a commitment definition.

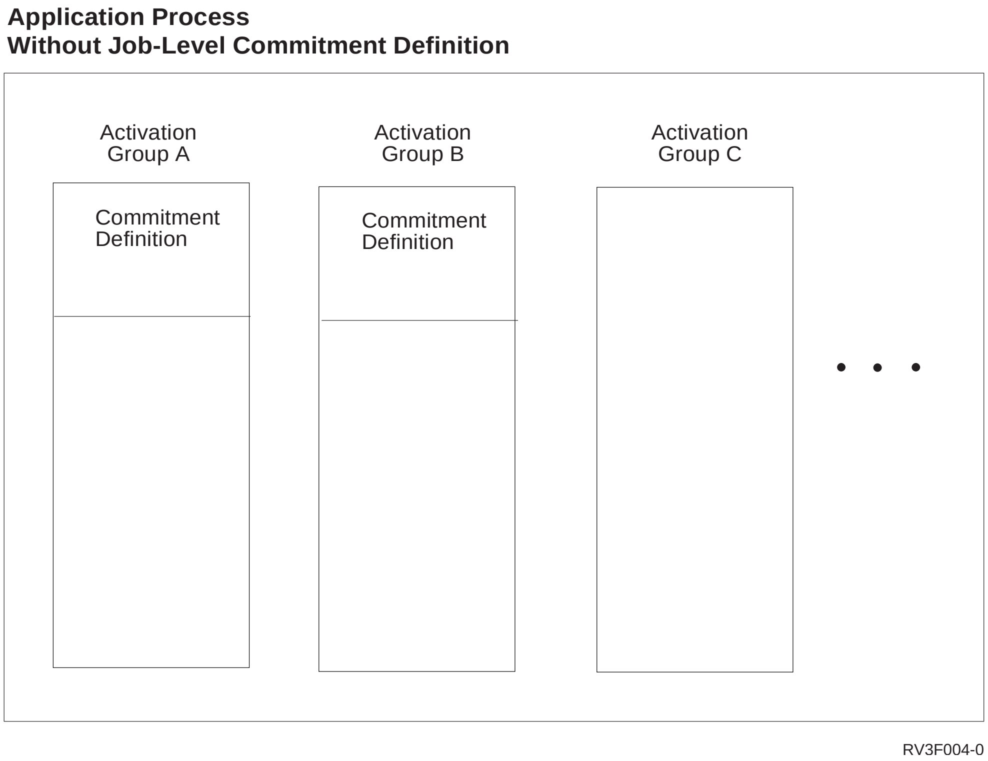


Figure 3. Activation Groups without Job Commitment Definition

Figure 4 on page 14 shows an application process, the activation groups in that application process, and the commitment definitions. Some of the activation groups are running with the job commitment definition. Activation groups A and B are running under the job commitment definition. Any commit or rollback operation in activation group A or B affects both because the commitment control is scoped to the same commitment definition. Activation group C in this example has a separate commitment definition. Commit and rollback operations performed in this activation group only affect operations within C.

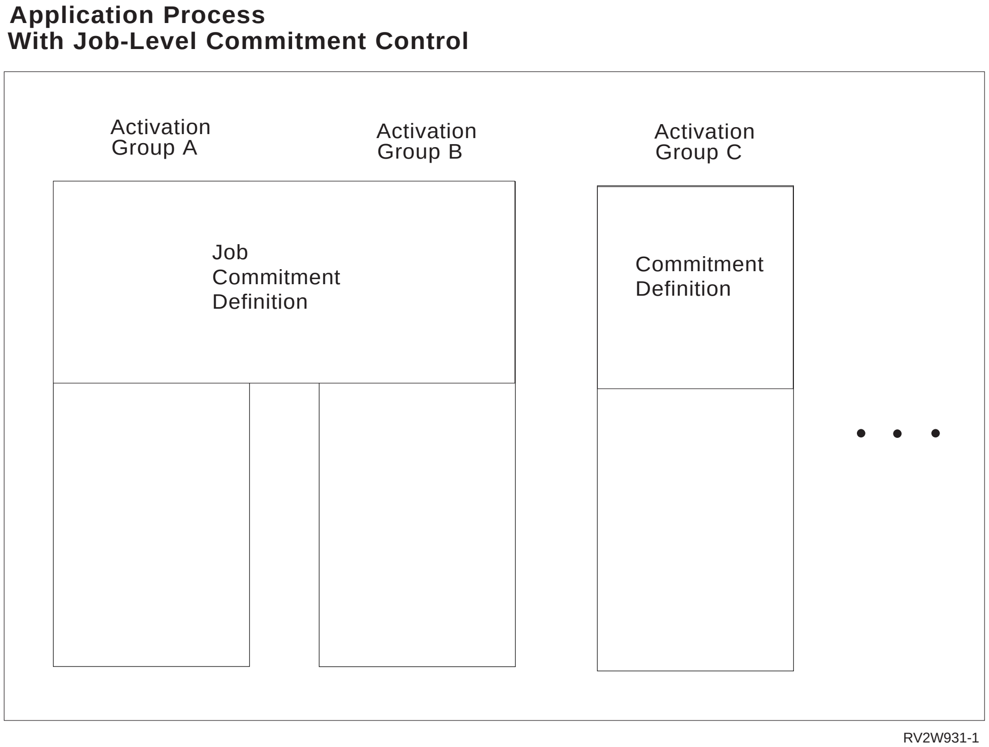


Figure 4. Activation Groups with Job Commitment Definition

For more information on commitment definitions, see the book *Backup and Recovery*, SC41-5304-04.

Each commitment definition involves the execution of one of more units of work. A unit of work (also known as a logical unit of work and unit of recovery) is a recoverable sequence of operations. At any given time, a commitment definition has a single unit of work. A unit of work is started either when the commitment definition is started, or when the previous unit of work is ended by a commit or rollback operation.

A unit of work is ended by a commit operation, a rollback operation, or the ending of the activation group. A commit or rollback operation affects only the database changes made within the unit of work that the commit or rollback ends. While changes remain uncommitted, other activation groups using different commitment definitions running under isolation levels COMMIT(*CS), COMMIT(*RS), and COMMIT(*RR) cannot perceive the changes. The changes can be backed out until they are committed. Once changes are committed, other activation groups running in different commitment definitions can access them, and the changes can no longer be backed out.

Application processes and activation groups that use different commitment definitions can request access to the same data at the same time. Locking is used to maintain data integrity under such conditions. Locking prevents such things as two application processes updating the same row of data simultaneously.

The database manager acquires locks to keep the uncommitted changes of one activation group undetected by activation groups that use a different commitment definition. Object locks and other resources are allocated to an activation group. Row locks are allocated to a commitment definition.

When an activation group other than the default activation group ends *normally*, the database manager releases all locks obtained by the activation group. A user can also explicitly request that most locks be released sooner. This operation is called commit. Object locks associated with cursors that remain open after commit are not released.

The recovery functions of the database manager provide a means of backing out of uncommitted changes made in a commitment definition. The database manager may implicitly back out uncommitted changes under the following situations:

- When the application process ends, all changes performed under the commitment definition associated with the default activation group are backed out. When an activation group other than the default activation group ends *abnormally*, all changes performed under the commitment definition associated with that activation group are backed out.
- When using Distributed Unit of Work and a failure occurs while attempting to commit changes on a remote system, all changes performed under the commitment definition associated with remote connection are backed out.
- When using Distributed Unit of Work and a request to back out is received from a remote system because of a failure at that site, all changes performed under the commitment definition associated with remote connection are backed out.

A user can also explicitly request that their database changes be backed out. This operation is called rollback.

Locks acquired by the database manager on behalf of an activation group are held until the unit of work is ended. A lock explicitly acquired by a LOCK TABLE statement can be held past the end of a unit of work if COMMIT HOLD or ROLLBACK HOLD is used to end the unit of work.

A cursor can implicitly lock the row at which the cursor is positioned. This lock prevents:

- Other cursors associated with a different commitment definition from locking the same row.
- A DELETE or UPDATE statement associated with a different commitment definition from locking the same row.

The start and end of a unit of work defines points of consistency within an activation group. For example, a banking transaction might involve the transfer of funds from one account to another. Such a transaction would require that these funds be subtracted from the first account, and added to the second. Following the subtraction step, the data is inconsistent. Only after the funds are added to the second account is consistency established again. When both steps are complete, the commit operation can be used to end the unit of work. After the commit operation, the changes are available to activation groups that use different commitment definitions.

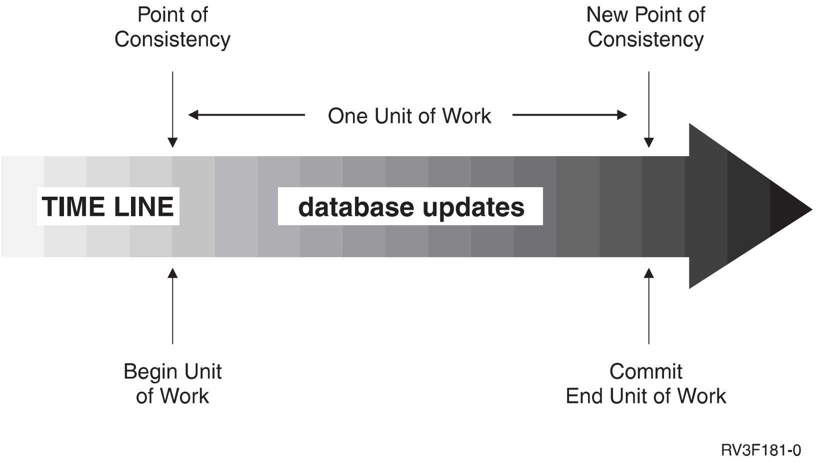


Figure 5. Unit of Work with a Commit Statement

If a failure occurs before the unit of work ends, the database manager backs out uncommitted changes to restore the data consistency that it assumes existed when the unit of work started.

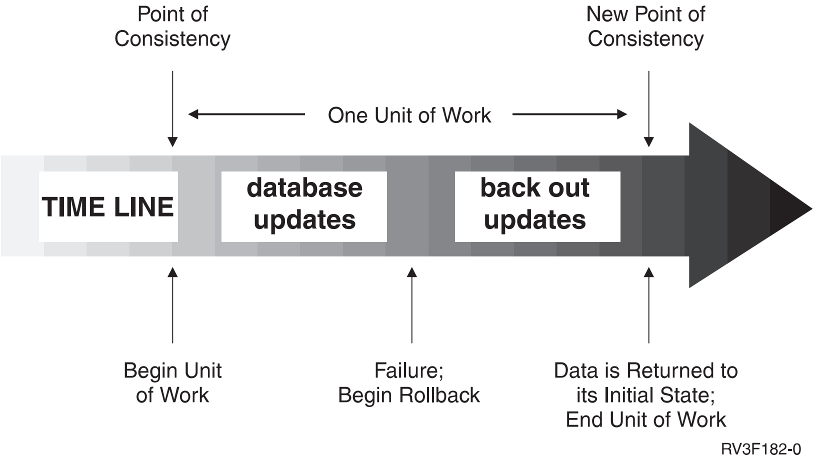


Figure 6. Unit of Work with a Rollback Statement

Threads

In OS/400, an application process can also consist of one or more threads. By default, a thread shares the same commitment definitions and locks as the other threads in the job. Thus, each thread can operate on the same unit of work so that when one thread commits or rolls back, it can commit or rollback all changes performed by all threads. This type of processing is useful if multiple threads are cooperating to perform a single task in parallel.

In other cases, it is useful for a thread to perform changes independent from other threads in the job. In this case, the thread would not want to share commitment definitions or lock with the other threads. Furthermore, a job can use SQL server mode in order to take more fine grain control of multiple database connections and transaction information. A typical multi-threaded job may require this control. There are several ways to accomplish this type of processing:

- Make sure the programs running in the thread use a separate activation group (be careful not to use ACTGRP(*NEW)).

- Make sure that the job is running in SQL server mode before issuing the first SQL statement. SQL server mode can be activated for a job by using one of the following mechanisms before data access occurs in the application:
  - Use the ODBC API, SQLSetEnvAttr() and set the SQL_ATTR_SERVER_MODE attribute to SQL_TRUE before doing any data access.
  - Use the Change Job API, QWTCHGJB(), and set the 'Server mode for Structured Query Language' key before doing any data access.
  - Use JAVA to access the database via JDBC. JDBC automatically uses server mode to preserve required semantics of JDBC.

When SQL server mode is established, all SQL statements are passed to an independent server job that will handle the requests. Server mode behavior for SQL behavior includes:

- For embedded SQL, each thread in a job implicitly gets one and only one connection to the database (and thus its own commitable transaction).
- For ODBC/CLI and JDBC, each connection represents a stand-alone connection to the database and can be committed and used as a separate entity.

For more information, see the SQL Call Level Interface (ODBC) book.

The following SQL support is not threadsafe:

- Remote access through DRDA
- ALTER TABLE
- COMMENT ON
- CREATE ALIAS
- CREATE COLLECTION
- CREATE DISTINCT TYPE
- CREATE FUNCTION
- CREATE INDEX
- CREATE PROCEDURE
- CREATE SCHEMA
- CREATE TABLE
- CREATE VIEW
- DROP
- GRANT
- LABEL ON
- RENAME
- REVOKE

For more information, see ″Multithreaded applications″ in the Programming topic of the AS/400 Information Center.

Isolation Level

The *isolation level* used during the execution of SQL statements determines the degree to which the activation group is isolated from concurrently executing activation groups. Thus, when activation group P executes an SQL statement, the isolation level determines:

- The degree to which rows retrieved by P and database changes made by P are available to other concurrently executing activation groups.

- The degree to which database changes made by concurrently executing activation groups can affect P.

Isolation level is specified as an attribute of an SQL program or SQL package and applies to the activation groups that use the SQL package or SQL program. DB2 UDB for AS/400 provides several ways to specify the isolation level:

- Use the COMMIT parameter on the CRTSQLxxx, STRSQL, and RUNSQLSTM commands to specify the default isolation level.
- Use the SET OPTION statement to specify the default isolation level within the source of a module or program that contains embedded SQL.
- Use the SET TRANSACTION statement to override the default isolation level within a unit of work. When the unit of work ends, the isolation level returns to the value it had at the beginning of the unit of work.
- Use the isolation-clause on the SELECT, SELECT INTO, INSERT, UPDATE, DELETE, and DECLARE CURSOR statements to override the default isolation level for a specific statement or cursor. The isolation level is in effect only for the execution of the statement containing the isolation-clause and has no effect on any pending changes in the current unit of work.

These isolation levels are supported by automatically locking the appropriate data. Depending on the type of lock, this limits or prevents access to the data by concurrent activation groups that use different commitment definitions. Each database manager supports at least two types of locks:

Share Limits concurrent activation groups that use different commitment definitions to read-only operations on the data.

Exclusive

Prevents concurrent activation groupsusing different commitment definitions from updating or deleting the data. Prevents concurrent activation groups using different commitment definitions that are running COMMIT(*RS), COMMIT(*CS), or COMMIT(*RR) from reading the data. Concurrent activation groups using different commitment definitions that are running COMMIT(*UR) or COMMIT(*NC) are allowed to read the data.

The following descriptions of isolation levels refer to locking data in row units. Individual implementations can lock data in larger physical units than base table rows. However, logically, locking occurs at the base-table row level across all products. Similarly, a database manager can escalate a lock to a higher level. An activation group is guaranteed at least the minimum requested lock level.

DB2 UDB for AS/400 supports five isolation levels. For all isolation levels except No Commit, the database manager places exclusive locks on every row that is inserted, updated, or deleted. This ensures that any row changed during a unit of work is not changed by any other activation group that uses a different commitment definition until the unit of work is complete. The isolation levels are:

- Repeatable Read (RR)

  Level RR ensures:

  - Any row read during a unit of work is not changed by other activation groups that use different commitment definitions until the unit of work is complete.[2]

---

[2] For **WITH HOLD** cursors, these rules apply to when the rows were actually read. For read-only **WITH HOLD** cursors, the rows may have actually been read in a prior unit of work.

  - Any row changed (or a row that is currently locked with an UPDATE row lock) by another activation group using a different commitment definition cannot be read until it is committed.

  In addition to any exclusive locks, an activation group running at level RR acquires at least share locks on all the rows it reads. Furthermore, the locking is performed so that the activation group is completely isolated from the effects of concurrent activation groups that use different commitment definitions.

  DB2 UDB for AS/400 supports repeatable-read through COMMIT(*RR). Repeatable-read isolation level is supported by exclusively locking the tables containing any rows that are read or updated. In the ANS and ISO standards, Repeatable Read is called Serializable.

- Read Stability (RS)

  Like level RR, level RS ensures that:

  - Any row read during a unit of work is not changed by other activation groups that use different commitment definitions until the unit of work is complete. [2]
  - Any row changed (or a row that is currently locked with an UPDATE row lock) by another activation group using a different commitment definition cannot be read until it is committed.

  Unlike RR, RS does not completely isolate the activation group from the effects of concurrent activation groups that use a different commitment definition. At level RS, activation groups that issue the same query more than once might see additional rows. These additional rows are called *phantom rows*.

  For example, a phantom row can occur in the following situation:

  1. Activation group P1 reads the set of rows *n* that satisfy some search condition.
  2. Activation group P2 then INSERTs one or more rows that satisfy the search condition and COMMITs those INSERTs.
  3. P1 reads the set of rows again with the same search condition and obtains both the original rows and the rows inserted by P2.

  In addition to any exclusive locks, an activation group running at level RS acquires at least share locks on all the rows it reads.

  DB2 UDB for AS/400 supports read stability through COMMIT(*ALL) or COMMIT(*RS). In the ANS and ISO standards, Read Stability is called Repeatable Read.

- Cursor Stability (CS)

  Like levels RR and RS, level CS ensures that any row that was changed (or a row that is currently locked with an UPDATE row lock) by another activation group using a different commitment definition cannot be read until it is committed. Unlike RR and RS, level CS only ensures that the current row of every updateable cursor is not changed by other activation groups using different commitment definitions. Thus, the rows that were read during a unit of work can be changed by other activation groups that use a different commitment definition. In addition to any exclusive locks, an activation group running at level CS has at least a share lock for the current row of every cursor.

  DB2 UDB for AS/400 supports cursor stability through COMMIT(*CS). In the ANS and ISO standards, Cursor Stability is called Read Committed.

- Uncommitted Read (UR)

For a SELECT INTO, a FETCH with a read-only cursor, subquery, or subselect used in an INSERT statement, level UR allows:

  - Any row read during the unit of work to be changed by other activation groups that run under a different commitment definition.
  - Any row changed (or a row that is currently locked with an UPDATE row lock) by another activation group running under a different commitment definition to be read even if the change has not been committed.

For other operations, the rules of level CS apply.

DB2 UDB for AS/400 supports uncommitted read through COMMIT(*CHG) or COMMIT(*UR). In the ANS and ISO standards, Uncommitted Read is called Read Uncommitted.

- No Commit (NC)

  For all operations, the rules of level UR apply except:

  - Commit and rollback operations have no effect on SQL statements. Cursors are not closed, and LOCK TABLE locks are not released. However, connections in the release-pending state are ended.
  - Any changes are effectively committed at the end of each successful change operation and can be immediately accessed or changed by other application groups using different commitment definitions.

  DB2 UDB for AS/400 supports No Commit through COMMIT(*NONE) or COMMIT(*NC).

  For a detailed description of record lock durations, see the discussion and table in the commitment control topic of the SQL Programming Concepts book.

Note: *(For distributed applications.)* When a requested isolation level is not supported by an application server, the isolation level is escalated to the next highest supported isolation level. For example, if RS is not supported by an application server, the RR isolation level is used.

Distributed Relational Database

A *distributed relational database* consists of a set of tables and other objects that are spread across different but interconnected computer systems. Each computer system has a relational database manager that manages the tables in its environment. The database managers communicate and cooperate with each other in a way that allows a database manager to execute SQL statements on another computer system.

Distributed relational databases are built on formal requester-server protocols and functions. An *application requester* supports the application end of a connection. It transforms a database request from the application into communication protocols suitable for use in the distributed database network. These requests are received and processed by an *application server* at the other end of the connection. Working together, the application requester and application server handle the communication and location considerations so that the application is isolated from these considerations and can operate as if it were accessing a local database. A simple distributed relational database environment is illustrated in Figure 7 on page 21.

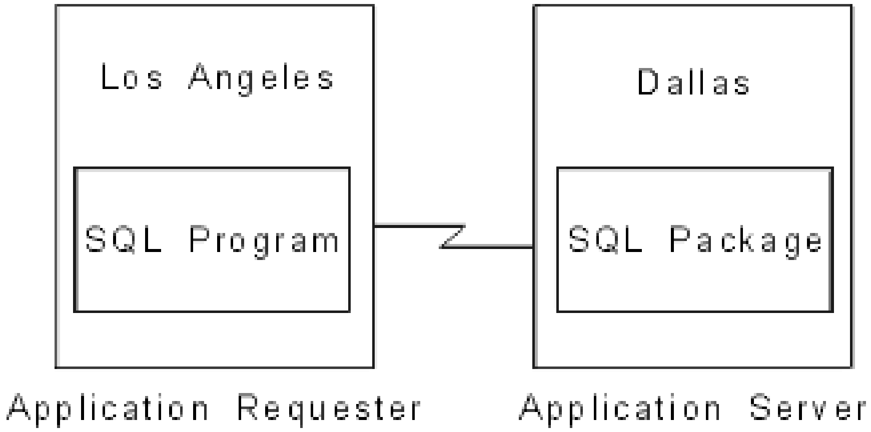


Figure 7. A Distributed Relational Database Environment

For more information on Distributed Relational Database Architecture (DRDA) communication protocols, see *Distributed Relational Database Architecture Reference*, SC26-4651.

Application Servers

An activation group must be connected to the application server of a database manager before SQL statements that reference tables or views can be executed.

A *connection* is an association between an activation group and a local or remote application server. Connections are managed by the application. The CONNECT statement can be used to establish a connection to an application server and make that application server the current server of the activation group.

An application server can be local to, or remote from, the environment where the activation group is started. (An application server is present, even when distributed relational databases are not used.) This environment includes a local directory that describes the application servers that can be identified in a CONNECT statement. For more information about the directory, see the directory commands (ADDRDBDIRE, CHGRDBDIRE, DSPRDBDIRE, RMVRDBDIRE, and WRKRDBDIRE) in the following AS/400 Information Center topics:

- SQL Programming Concepts
- Distributed Database Programming
- CL commands

To execute a static SQL statement that references tables or views, an application server uses the bound form of the statement. This bound statement is taken from a package that the database manager previously created through a bind operation. The appropriate package is determined by the combination of:

- The name of the package specified by the SQLPKG parameter on the CRTSQLxxx commands. See the SQL Programming with Host Languages book for a description of the CRTSQLxxx commands.
- The internal consistency token that makes certain the package and program were created from the same source at the same time.

All IBM relational database products support extensions to IBM SQL. Some of these extensions are product-specific, and some are shared by more than one product.

For the most part, an application can use the statements and clauses that are supported by the database manager of the application server to which it is currently connected, even though that application is running via the application requester of a database manager that does not support some of those statements and clauses. Restrictions are listed in "Appendix F. Considerations for Using Distributed Relational Database" on page 583.

CONNECT (Type 1) and CONNECT (Type 2)

There are two types of CONNECT statements with the same syntax but different semantics:

- CONNECT (Type 1) is used for remote unit of work. See "CONNECT (Type 1)" on page 283.
- CONNECT (Type 2) is used for distributed unit of work. See "CONNECT (Type 2)" on page 287.

See "CONNECT (Type 1) and CONNECT (Type 2) Differences" on page 588 for a summary of the differences.

Remote Unit of Work

The *remote unit of work* facility provides for the remote preparation and execution of SQL statements. An activation group at computer system A can connect to an application server at computer system B. Then, within one or more units of work, that activation group can execute any number of static or dynamic SQL statements that reference objects at B. After ending a unit of work at B, the activation group can connect to an application server at computer system C, and so on.

Most SQL statements can be remotely prepared and executed with the following restrictions:

- All objects referenced in a single SQL statement must be managed by the same application server.
- All of the SQL statements in a unit of work must be executed by the same application server.

Remote Unit of Work Connection Management

An activation group is in one of three states at any time:

Connectable and connected
Unconnectable and connected
Connectable and unconnected

The following diagram shows the state transitions:

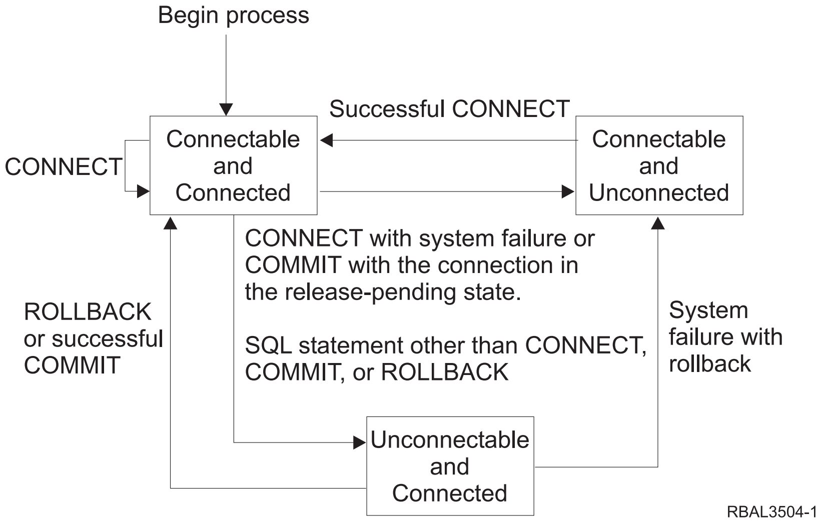

Begin process
Successful CONNECT
Connectable and Connected
Connectable and Unconnected
CONNECT
CONNECT with system failure or COMMIT with the connection in the release-pending state.
SQL statement other than CONNECT, COMMIT, or ROLLBACK
ROLLBACK or successful COMMIT
System failure with rollback
Unconnectable and Connected
RBAL3504-1

Figure 8. Remote Unit of Work Activation Group Connection State Transition

The initial state of an activation group is *connectable* and *connected*. The application server to which the activation group is connected is determined by the RDB parameter on the CRTSQLxxx and STRSQL commands and may involve an implicit CONNECT operation. An implicit CONNECT operation cannot occur if an implicit or explicit CONNECT operation has already successfully or unsuccessfully occurred. Thus, an activation group cannot be implicitly connected to an application server more than once.

The connectable and connected state: An activation group is connected to an application server and CONNECT statements can be executed. The activation group enters this state when it completes a rollback or successful commit from the unconnectable and connected state, or a CONNECT statement is successfully executed from the connectable and unconnected state.

The unconnectable and connected state: An activation group is connected to an application server, but a CONNECT statement cannot be successfully executed to change application servers. The activation group enters this state from the connectable and connected state when it executes any SQL statement other than CONNECT, COMMIT, or ROLLBACK.

The connectable and unconnected state: An activation group is not connected to an application server. The only SQL statement that can be executed is CONNECT.

The activation group enters this state when:

- The connection was previously released and a successful COMMIT is executed.
- The connection is disconnected using the SQL DISCONNECT statement.
- The connection was in a connectable state, but the CONNECT statement was unsuccessful.

Consecutive CONNECT statements can be executed successfully because CONNECT does not remove the activation group from the connectable state. A CONNECT to the application server to which the activation group is currently connected is executed like any other CONNECT statement. CONNECT cannot execute successfully when it is preceded by any SQL statement other than CONNECT, COMMIT, DISCONNECT, SET CONNECTION, RELEASE, or

ROLLBACK (unless running with COMMIT(*NC)). To avoid an error, execute a commit or rollback operation before a CONNECT statement is executed.

Application-Directed Distributed Unit of Work

The *application-directed distributed unit of work facility* also provides for the remote preparation and execution of SQL statements in the same fashion as remote unit of work. Like remote unit of work, an activation group at computer system A can connect to an application server at computer system B and execute any number of static or dynamic SQL statements that reference objects at B before ending the unit of work. All objects referenced in a single SQL statement must be managed by the same application server. However, unlike remote unit of work, any number of application servers can participate in the same unit of work. A commit or rollback operation ends the unit of work.

Distributed unit of work is fully supported for APPC connections. If a TCP/IP connection is used, only one application server can participate in the unit of work, and any other application servers are read-only.

Application-Directed Distributed Unit of Work Connection Management

At any time:

- An activation group is always in the *connected* or *unconnected* state and has a set of zero or more connections. Each connection of an activation group is uniquely identified by the name of the application server of the connection.
- An SQL connection is always in one of the following states:
  - Current and held
  - Current and release-pending
  - Dormant and held
  - Dormant and release-pending

Initial state of an activation group: An activation group is initially in the connected state and has exactly one connection. The initial state of a connection is *current and held*.

The following diagram shows the state transitions:

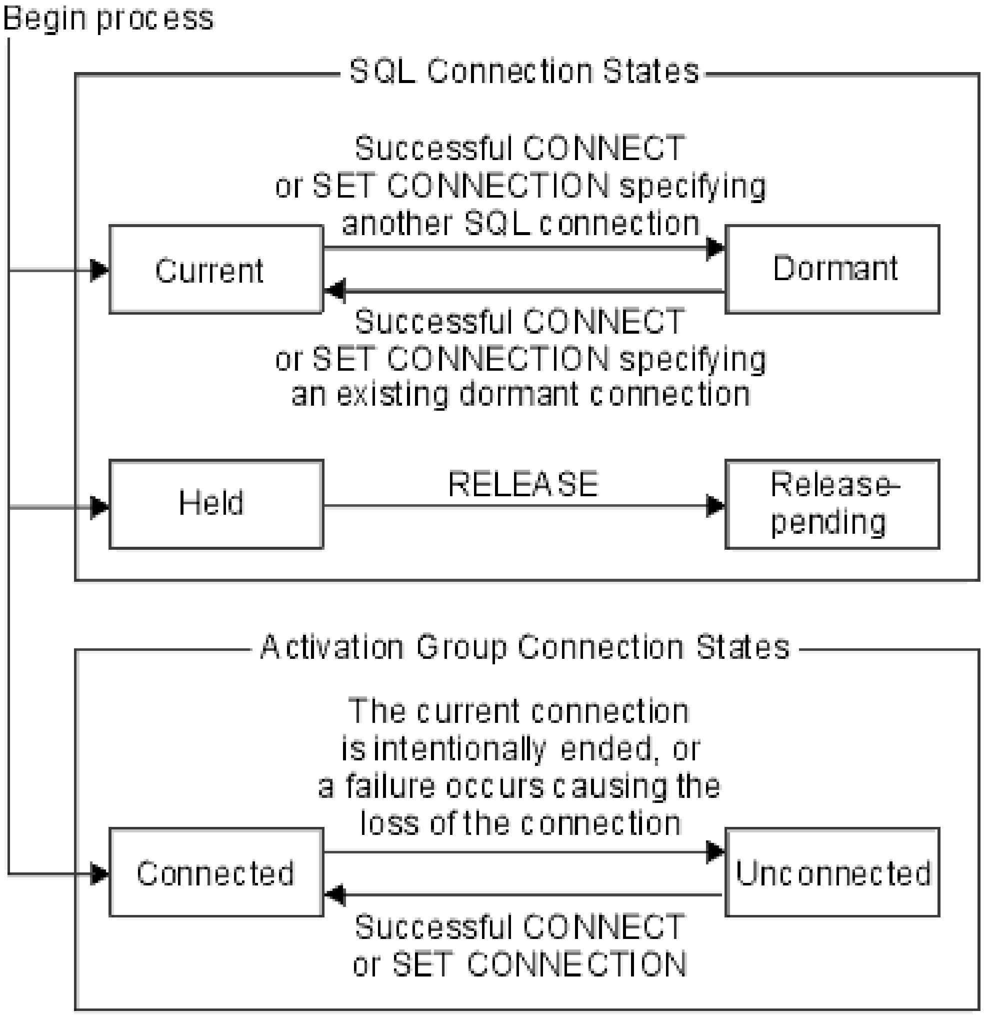

Begin process
SQL Connection States
Successful CONNECT or SET CONNECTION specifying another SQL connection
Current
Dormant
Successful CONNECT or SET CONNECTION specifying an existing dormant connection
Held
RELEASE
Release-pending
Activation Group Connection States
The current connection is intentionally ended, or a failure occurs causing the loss of the connection
Connected
Unconnected
Successful CONNECT or SET CONNECTION

Figure 9. Application-Directed Distributed Unit of Work Connection and Activation Group Connection State Transitions

Connection States

If an application process successfully executes a CONNECT statement:

- The current connection is placed in the dormant state and held state.
- The server name is added to the set of connections and the new connection is placed in the current and held state.

If the server name is already in the set of existing connections of the activation group, an error occurs.

A connection in the dormant state is placed in the current state using the SET CONNECTION statement. When a connection is placed in the current state, the previous current connection, if any, is placed in the dormant state. No more than one connection in the set of existing connections of an activation group can be current at any time. Changing the state of a connection from current to dormant or from dormant to current has no effect on its held or release-pending state.

A connection is placed in the release-pending state by the RELEASE statement. When an activation group executes a commit operation, every release-pending connection of the activation group is ended. Changing the state of a connection from held to release-pending has no effect on its current or dormant state. Thus, a connection in the release-pending state can still be used until the next commit operation. There is no way to change the state of a connection from release-pending to held.

Activation Group Connection States

A different application server can be established by the explicit or implicit execution of a CONNECT statement. The following rules apply:

- An activation group cannot have more than one connection to the same application server at the same time.
- When an activation group executes a SET CONNECTION statement, the specified location name must be an existing connection in the set of connections of the activation group.
- When an activation group executes a CONNECT statement, the specified server name must not be an existing connection in the set of connections of the activation group.

If an activation group has a current connection, the activation group is in the *connected* state. The CURRENT SERVER special register contains the name of the application server of the current connection. The activation group can execute SQL statements that refer to objects managed by that application server.

An activation group in the unconnected state enters the connected state when it successfully executes a CONNECT or SET CONNECTION statement.

If an activation group does not have a current connection, the activation group is in the *unconnected* state. The CURRENT SERVER special register contents are equal to blanks. The only SQL statements that can be executed are CONNECT, DISCONNECT, SET CONNECTION, RELEASE, COMMIT, and ROLLBACK.

An activation group in the connected state enters the unconnected state when its current connection is intentionally ended or the execution of an SQL statement is unsuccessful because of a failure that causes a rollback operation at the current server and loss of the connection. Connections are intentionally ended when an activation group successfully executes a commit operation and the connection is in the release-pending state, or when an application process successfully executes the DISCONNECT statement.

When a Connection is Ended

When a connection is ended, all resources that were acquired by the activation group through the connection and all resources that were used to create and maintain the connection are deallocated. For example, if application process P has placed the connection to application server X in the release-pending state, all cursors of P at X will be closed and deallocated when the connection is ended during the next commit operation.

A connection can also be ended as a result of a communications failure in which case the activation group is placed in the unconnected state. All connections of an activation group are ended when the activation group ends.

Data Representation Considerations

Different systems represent data in different ways. When data is moved from one system to another, data conversion must sometimes be performed. Products supporting DRDA will automatically perform any necessary conversions at the receiving system.

With numeric data, the information needed to perform the conversion is the data type and the sending system’s environment type. For example, when a floating-point variable from a DB2 UDB for AS/400 application requester is assigned to a column of a table at an OS/390 application server, the number is converted from IEEE format to System/370* format.

With character and graphic data, the data type and the environment type of the sending system are not sufficient. Additional information is needed to convert character and graphic strings. String conversion depends on both the coded character set of the data and the operation to be done with that data. String conversions are done in accordance with the IBM Character Data Representation Architecture (CDRA). For more information on character conversion, refer to the book *Character Data Representation Architecture Level 1 Reference,* SC09-1390.

Character Conversion

A *string* is a sequence of bytes that may represent characters. Within a string, all the characters are represented by a common coding representation. In some cases, it might be necessary to convert these characters to a different coding representation. The process of conversion is known as *character conversion*.[3]

Character conversion can occur when an SQL statement is executed remotely. Consider, for example, these two cases:

- The values of host variables sent from the application requester to the current server.
- The values of result columns sent from the current server to the application requester.

In either case, the string could have a different representation at the sending and receiving systems. Conversion can also occur during string operations on the same system.

The following list defines some of the terms used when discussing character conversion.

character set	A defined set of characters.For example, the following character set appears in several code pages: • 26 non-accented letters A through Z • 26 non-accented letters a through z • digits 0 through 9 • . , : ; ? ( ) ′ ″ / - _ (underscore) & + % * = < >
code page	A set of assignments of characters to code points.In EBCDIC, for example, "A" is assigned code point

---

[3] Character conversion, when required, is automatic and is transparent to the application when it is successful. A knowledge of conversion is, therefore, unnecessary when all the strings involved in a statement’s execution are represented in the same way. Thus, for many readers, character conversion may be irrelevant.

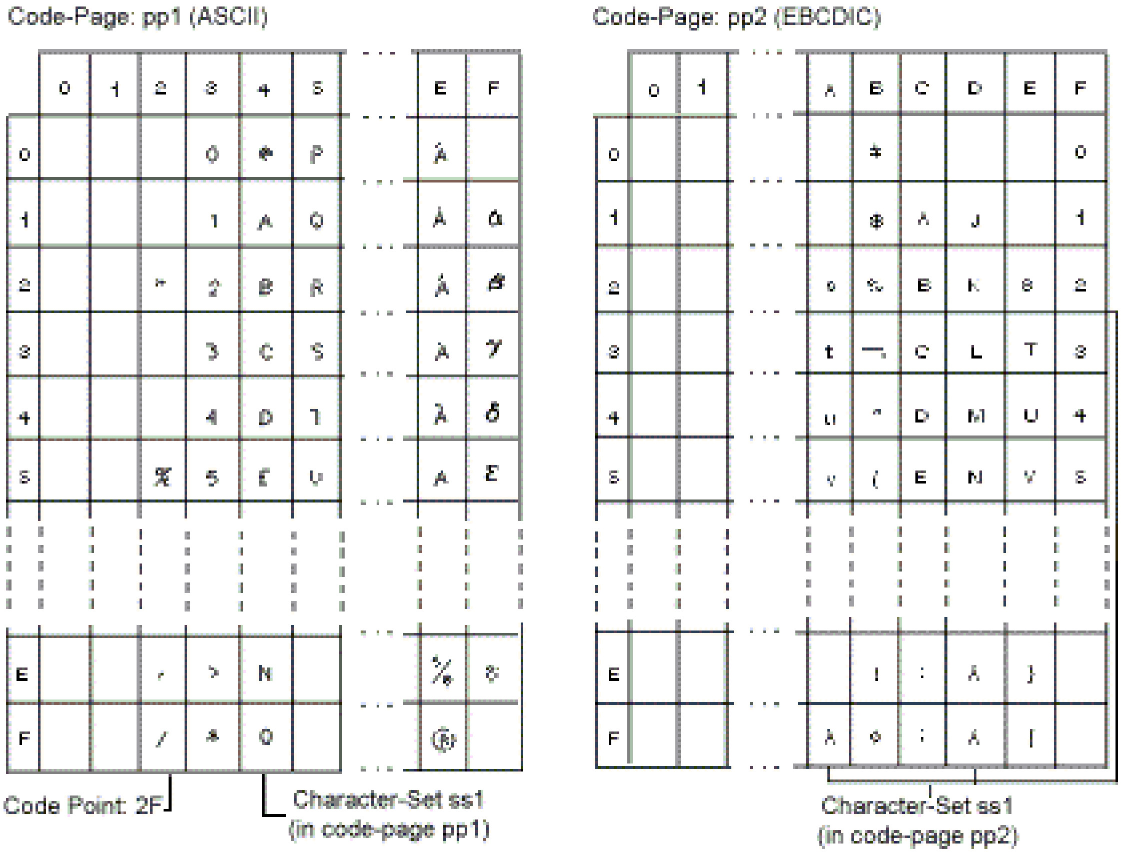
	X'C1' and "B" is assigned code point X'C2'. Within a code page, each code point has only one specific meaning.
code point	A unique bit pattern that represents a character.
coded character set	A set of unambiguous rules that establish a character set and the one-to-one relationships between the characters of the set and their coded representations.
encoding scheme	A set of rules used to represent character data.For example: • Single-byte EBCDIC • Single-byte ASCII[4] • Mixed single- and double-byte EBCDIC • Mixed single- and double-byte ASCII • UCS-2 (universal coded character set).
substitution character	A unique character that is substituted during character conversion for any characters in the source coding representation that do not have a match in the target coding representation.

Character Sets and Code Pages

The following example shows how a typical character set might map to different code points in two different code pages.

---

[4] The term ASCII is used throughout this book to refer to IBM-PC data or ISO 8 data.



Even with the same encoding scheme there are many different coded character sets, and the same code point can represent a different character in different coded character sets. Furthermore, a byte in a character string does not necessarily represent a character from a single-byte character set (SBCS). Character strings are also used for mixed data (a mixture of single-byte characters and double-byte characters) and for data that is not associated with any character set (called bit data). This is not the case with graphic strings; the database manager assumes that every pair of bytes in every graphic string represents a character from a double-byte character set (DBCS) or universal coded character set (UCS-2).

A CCSID in a native encoding scheme is one of the coded character sets in which data may be stored at that site. A CCSID in a foreign encoding scheme is one of the coded character sets in which data cannot be stored at that site. For example, DB2 UDB for AS/400 can store data in a CCSID with an EBCDIC encoding scheme, but not in an ASCII encoding scheme.

A host variable containing data in a foreign encoding scheme is always converted to a CCSID in the native encoding scheme when the host variable is used in a function or in the select-list. A host variable containing data in a foreign encoding scheme is also effectively converted to a CCSID in the native encoding scheme when used in comparison or in an operation that combines strings. Which CCSID in the native encoding scheme the data is converted to is based on the foreign CCSID and the default CCSID.

For details on character conversion, see:
- “Conversion Rules for Assignments” on page 70
- “Conversion Rules for Comparison” on page 76

- “Conversion Rules for Operations That Combine Strings” on page 81
- “Appendix F. Considerations for Using Distributed Relational Database” on page 583

Coded Character Sets and CCSIDs

IBM’s Character Data Representation Architecture (CDRA) deals withthe differences in string representation and encoding. The Coded Character Set Identifier (CCSID) is a key element of this architecture. A CCSID is a 2-byte (unsigned) binary number that uniquely identifies an encoding scheme and one or more pairs of character sets and code pages.

A CCSID is an attribute of strings, just as length is an attribute of strings. All values of the same string column have the same CCSID.

In each database manager, character conversion involves the use of a *CCSID Conversion Selection Table*. The Conversion Selection Table contains a list of valid source and target combinations. For each pair of CCSIDs, the Conversion Selection Table contains information used to perform the conversion from one coded character set to the other. This information includes an indication of whether conversion is required. (In some cases, no conversion is necessary even though the strings involved have different CCSIDs.)

Default CCSID

Every application server and application requester has a default CCSID (or default CCSIDs in installations that support DBCS data). The CCSID of the following types of strings is determined at the current server:

- String constants (including string constants that represent datetime values) when the CCSID of the source is in a foreign encoding scheme
- Special registers with string values (such as USER and CURRENT SERVER)
- Results of CAST, CHAR, DIGITS, and HEX scalar functions[5]
- Results of VARCHAR and VARGRAPHIC scalar functions when a CCSID is not specified as an argument
- Results of the CLOB and DBCLOB scalar functions when a CCSID is not specified as an argument
- String columns defined by the CREATE TABLE or ALTER TABLE statements when an explicit CCSID is not specified for the column[6]

In a distributed SQL program, the default CCSID of host variables is determined by the application requester. In a non-distributed SQL program, the default CCSID of host variables is determined by the application server. On OS/400, the default CCSID is determined by the CCSID job attribute. For more information on CCSIDs, see the book *International Application Development*, SC41-5603-01.

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[5] If the default CCSID is 65535, and the function is a CAST to a CLOB or DBCLOB, the CCSID used will be the value of the DFTCCSID job attribute.

[6] If the default CCSID is 65535, the character string columns will not use 65535. Instead, the CCSID used will be the value of the DFTCCSID job attribute.

Sort Sequence

A sort sequence defines how characters in a character set relate to each other when they are compared and ordered. Different sort sequences are useful for those who want their data ordered for a specific language. For example, lists can be ordered as they are normally seen for a specific language. A sort sequence can also be used to treat certain characters as equivalent, for instance, **a** and **A**. A sort sequence works on all comparisons that involve:

- SBCS character data (including bit data)
- the SBCS portion of mixed data
- UCS-2 graphic data.

SBCS sort sequence support is implemented using a 256-byte table. Each byte in the table corresponds to a code point or character in a SBCS code page. Because the sort sequence is applicable to character data, a CCSID must be associated with the table. The bytes in the sort sequence table are set based on how each code point is to compare to other code points in that code page. For example, if the characters **a** and **A** are to be treated as equivalents for comparisons, the bytes in the sort sequence table for their code points contain the same value, or weight.

UCS-2 sort sequence support is implemented using a multi-byte table. A pair of bytes within the table corresponds to a character in the UCS-2 code page. Only a subset of the thousands of characters in UCS-2 are typically represented in the table. Only those characters that are to compare differently (and possibly other characters in the same ward) will be represented in the table. The bytes in the sort sequence table are set based on how each character is to compare with other characters in UCS-2.

When two or more bytes (or pair of bytes for UCS-2) in a sort sequence table have the same value, the sort sequence is a shared-weight sort sequence. If every byte (or pair of bytes for UCS-2) in a sort sequence table has a unique value, the sort sequence is a unique-weight sort sequence. For many languages, unique- and shared-weight sort sequences are shipped on the AS/400 system as part of the operating system. If you need sort sequences for other languages or needs, you define them using the Create Table (CRTTBL) command.

It is important to remember that the data itself is not altered by the sort sequence. A weighted representation of the data is used for the comparison. In SQL, a sort sequence is specified on the CRTSQLxxx, STRSQL, and RUNSQLSTM commands. The SET OPTION statement can be used to specify the sort sequence within the source of a program containing embedded SQL. The sort sequence applies to all character comparisons performed in the SQL statements. The default sort sequence on the AS/400 system is the internal sequence that occurs when the hexadecimal representation of characters are used. This is the sequence you get when the SRTSEQ(*HEX) is specified. For programs precompiled with a release of the product that is earlier than Version 2 Release 3, the sort sequence is *HEX.

For more information on CCSIDs, see the book *International Application Development*, SC41-5603-01. For more information on sort sequences and the sequences shipped with the system, see the book *National Language Support*, SC41-5101-01.

Authorization and Privileges

Users can successfully execute SQL statements only if they have the authority to do the specified function. To create a table, a user must be authorized to create tables; to drop a table, a user must be authorized to drop the table, and so on.

The people holding administrative authority are charged with the task of controlling the database manager and are responsible for the safety and integrity of the data. Those with administrative authority control both who has access to the database manager and the extent of that access. Those with administrative authority have the authority to perform all operations on all objects regardless of whether they have been granted specific privileges or not. The security officer and all users with *ALLOBJ authority have administrative authority.

Privileges are those activities that the administrative authority has allowed a user to perform. Authorized users can create any object, have access to objects they own, and can pass on privileges on their own objects to other users by using the GRANT statement. The REVOKE statement can be used to revoke previously granted privileges.

When an object is created, one authorization ID is assigned*ownership* of the object. Ownership gives the user complete control over the object, including the privilege to drop the object. The owner may revoke a privilege to an object that he owns from himself. In this case, the owner may temporarily be unable to perform an operation that requires that privilege. Because he is the owner, however, he is always allowed to grant the privilege back to himself.

Authority granted to *PUBLIC on SQL objects depends on the naming convention that is used at the time of object creation. If *SYS naming convention is used, *PUBLIC acquires the authority of the library into which the object was created. If *SQL naming convention is used, *PUBLIC acquires *EXCLUDE authority.

In the Authorization sections of this book, it is assumed that the owner of an object has not had any privileges revoked from that object since it was initially created. If the object is a view, it is also assumed that the owner of the view has not had the system authority *READ revoked from any of the tables or views that this view is directly or indirectly dependent on. The owner has system authority *READ for all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth. For more information on authority and privileges, see the book *Security - Reference*, SC41-5302-04.

Storage Structures

The AS/400 system is an object-based system. All database objects in DB2 UDB for AS/400 (tables and indexes for example) are objects in OS/400. The single-level storage manager manages all storage of objects of the database, so database specific storage structures (for example, table spaces) are unnecessary.

A partitioned or distributed table allows data to be spread across different database partitions. The partitions included are determined by the nodegroup specified when the table is created or altered. A nodegroup is a group of one or more AS/400 systems. A partitioning map is associated with each nodegroup. The partitioning map is used by the database manager to determine which AS/400 system from the nodegroup will store a given row of data. For more information on nodegroups and data partitioning see the DB2 Multisystem book.

A table can also include columns that register links to data that are stored in external files. The mechanism for this is the DataLink data type. A DataLink value which is recorded in a regular table points to a file that is stored in an external file server.

The DB2 File Manager on a file server works in conjunction with DB2 to provide the following optional functionality:

- Referential integrity to ensure that files currently linked to DB2 are not deleted or renamed.
- Security to ensure that only those with suitable SQL privileges on the DataLink column can read the files linked to that column.

The DataLinker comprises the following facilities:

DataLinks File Manager
Registers all the files in a particular file server that are linked to DB2.

DataLinks Filter
Filters file system commands to ensure that registered files are not deleted or renamed. Optionally, filters commands to ensure that proper access authority exists.

Chapter 2. Language Elements

This chapter defines the basic syntax of SQL and language elements that are common to many SQL statements.

Characters

The basic symbols of keywords and operators in the SQL language are single-byte characters[7] that are part of all character sets supported by the IBM relational database products. Characters of the language are classified as letters, digits, or special characters.

A *letter* is any of the 26 uppercase (A through Z) and 26 lowercase (a through z) letters of the English alphabet. [8]

A *digit* is any of the characters 0 through 9.

A *special character* is any of the characters listed below: [9]

	space	-	minus sign
″	quotation mark or double-quote	.	period
%	percent	/	slash
&	ampersand	:	colon
′	apostrophe or single quote	;	semicolon
(	left parenthesis	<	less than
)	right parenthesis	=	equals
*	asterisk	>	greater than
+	plus sign	?	question mark
,	comma	_	underline or underscore
| [10]	vertical bar		

Tokens

The basic syntactical units of the language are called *tokens*. A token consists of one or more characters, excluding blanks, control characters, and characters within a string constant or delimited identifier. (These terms are defined later.)

Tokens are classified as *ordinary* or *delimiter* tokens:

- An *ordinary token* is a numeric constant, an ordinary identifier, a host identifier, or a keyword.

---

[7] Note that if the SQL statement is encoded as UCS-2 data, all characters of the statement except for string constants will be converted to single-byte characters prior to processing. Tokens representing string constants will be processed as UCS-2 graphic strings without conversion to single-byte.

[8] Letters also include three code points reserved as alphabetic extenders for national languages (#, @, and $ in the United States). These three code points should be avoided because they represent different characters depending on the CCSID.

[9] The not symbol (¬) and the exclamation point symbol (!) are also special characters used by DB2 UDB for AS/400. You should avoid using them because they are variant characters.

[10] Using the vertical bar (|) character might inhibit code portability between IBM relational database products. It is preferable to use the CONCAT operator instead of the concatenation operator (||). Use of the vertical bar should be avoided because it is a variant character.

- A *delimiter token* is a string constant, a delimited identifier, an operator symbol, or any of the special characters shown in the syntax diagrams. A question mark (?) is also a delimiter token when it serves as a parameter marker, as explained under "PREPARE" on page 453.

Spaces: A *space* is a sequence of one or more blank characters.

Control Characters: A *control character* is a special character that is used for string alignment. The following table contains the control characters that are handled by the database manager:

Table 1. Control Characters

Control Character	EBCDIC Hex Value	UCS-2 Hex Value
Tab	05	0009
Form Feed	0C	000C
Carriage Return	0D	000D
New Line	15	0085
Line Feed (New line)	25	000A

Tokens, other than string constants and certain delimited identifiers, must not include a control character or space. A control character or space can follow a token. A delimiter token, a control character, or a space *must* follow every ordinary token. If the syntax does not allow a delimiter token to follow an ordinary token, then a control character or a space must follow that ordinary token. The following examples illustrate the rule that is stated in this paragraph.

Here are some examples of ordinary tokens:

```
1       .1       +2       SELECT       E       3
```

Here are some examples of combinations of the above ordinary tokens that, in effect, change the tokens:

```
1.1       .1+2       SELECTE       .1E       E3       SELECT1
```

This demonstrates why ordinary tokens must be followed by a delimiter token or a space.

Here are some examples of delimiter tokens:

```
,       'string'       "fld1"       =       .
```

Here are some examples of combinations of the above ordinary tokens and the above delimiter tokens that, in effect, change the tokens:

```
1.       .3
```

The period (.) is a delimiter token when it is used as a separator in the qualification of names. Here the dot is used in combination with an ordinary token of a numeric constant. Thus, the syntax does not allow an ordinary token to be followed by a delimiter token. Instead, the ordinary token must be followed by a space.

If the decimal point has been defined to be the comma, as described in "Decimal Point" on page 86, the comma is interpreted as a decimal point in numeric constants. Here are some examples of these numeric constants:

```
1,2       ,1       1,       1,e1
```

If '1,2' and '1,e1' are meant to be two items, both the ordinary token (1) and the delimiter token (,) must be followed by a space, to prevent the comma from being interpreted as a decimal point. Although the comma is usually a delimiter token, the comma is part of the number when it is interpreted as a decimal point. Therefore, the syntax does not allow an ordinary token (1) to be followed by a delimiter token (,). Instead, an ordinary token must be followed by a space.

Comments: Static SQL statements can include host language comments or SQL comments. Dynamic SQL statements can include SQL comments. Either type of comment can be specified wherever a space may be specified, except within a delimiter token or between the keywords EXEC and SQL. There are two types of SQL comments:

simple comments
Simple comments are introduced by two consecutive hyphens (--). Simple comments cannot continue past the end of the line. For more information, see “SQL Comments” on page 245.

bracketed comments
Bracketed comments are introduced by `/*` and end with `*/`. A bracketed comment can continue past the end of the line. For more information, see “SQL Comments” on page 245.

Uppercase and Lowercase: Lowercase letters used in an ordinary token other than a C host variable will be folded to uppercase. Delimiter tokens are never folded to uppercase. Thus, the statement:

```
select * from EMP where lastname = 'Smith';
```

is equivalent, after folding, to:

```
SELECT * FROM EMP WHERE LASTNAME = 'Smith';
```

Identifiers

An *identifier* is a token used to form a name. An identifier in an SQL statement is either an SQL identifier, a system identifier, or a host identifier.

Note: $, @, #, and all other variant characters should not be used in identifiers because the code points used to represent them vary depending on the CCSID of the string in which they are contained. If they are used, unpredictable results may occur. For more information on variant characters, see the book *National Language Support*, SC41-5101-01.

SQL Identifiers

There are two types of SQL identifiers: *ordinary identifiers* and *delimited identifiers*.

- An *ordinary identifier* is an uppercase letter followed by zero or more characters, each of which is an uppercase letter, a digit, or the underscore character. Note that ordinary identifiers are converted to uppercase. An ordinary identifier should not be a reserved word. See “Appendix D. Reserved Words” on page 567 for a list of reserved words. If a reserved word is used as an identifier in SQL, it should be specified in uppercase and enclosed within the SQL escape characters.
- A *delimited identifier* is a sequence of one or more characters enclosed within SQL escape characters. The sequence must consist of one or more characters. Leading blanks in the sequence are significant. Trailing blanks in the sequence are not significant. The length of a delimited identifier includes the two SQL escape characters for column names, but not for other SQL names. Note that delimited

identifiers are not converted to uppercase. The escape character is the quotation mark (") except in the following cases where the escape character is the apostrophe ('):

- Interactive SQL when the SQL string delimiter is set to the quotation mark in COBOL syntax checking statement mode
- Dynamic SQL in a COBOL program when the CRTSQLCBL or CRTSQLCBLI parameter OPTION(*QUOTESQL) specifies that the string delimiter is the quotation mark (")
- COBOL application program when the CRTSQLCBL or CRTSQLCBLI parameter OPTION(*QUOTESQL) specifies that the string delimiter is the quotation mark (")

The following characters are not allowed within delimited identifiers:

- X'00' through X'3F' and X'FF'

System identifiers

A system identifier is used to form the name of system objects in OS/400. There are two types of system identifiers: ordinary identifiers and delimited identifiers.

- The rules for forming a system ordinary identifier are identical to the rules for forming an SQL ordinary identifier.
- The rules for forming a system delimited identifier are identical to those for forming SQL delimited identifiers, except:
  - The following special characters are not allowed in a delimited system identifier:
    - A blank (X'40')
    - An asterisk (X'5C')
    - An apostrophe (X'7D')
    - A question mark (X'6F')
    - A quotation mark (X'7F')
  - The bytes required for the escape characters are included in the length of the identifier unless the characters within the delimiters would form an ordinary identifier.

    For example, “PRIVILEGES” is in uppercase and the characters within the delimiters form an ordinary identifier; therefore, it has a length of 10 bytes and is a valid system name for a column. On the other hand, “privileges” is in lowercase, has a length of 12 bytes, and is not a valid system name for a column because the bytes required for the delimiters must be included in the length of the identifier.

Examples

```
WKLYSAL    WKLY_SAL    "WKLY_SAL"    "UNION"    "wkly_sal"
```

Host Identifiers

A *host-identifier* is a name declared in the host program. The rules for forming a host-identifier are the rules of the host language; except that DBCS characters cannot be used. For example, the rules for forming a host-identifier in a COBOL program are the same as the rules for forming a user-defined word in COBOL.

---

11. 'SQ' is allowed in C, COBOL, and PL/I; it should not be used in RPG.

Names beginning with the characters 'SQ'[11], 'SQL', 'sql', 'RDI', or 'DSN' should not be used because precompilers generate host variables that begin with these characters.

Naming Conventions

The rules for forming a name depend on the type of the object designated by the name and the naming option (*SQL or *SYS). The naming option is specified on the CRTSQLxxx, RUNSQLSTM, and STRSQL commands. The SET OPTION statement can be used to specify the naming option within the source of a program containing embedded SQL. The syntax diagrams use different terms for different types of names. The following list defines these terms.

alias-name	A qualified or unqualified name that designates an alias. The qualified form of an alias-name depends on the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45. An alias-name can specify either the name of the alias or the system object name of the alias.
authorization-name	A system identifier that designates a user or group of users. An authorization name is a user profile name on the AS/400. It must not be a delimited identifier that includes lowercase letters or special characters. See "Authorization IDs and Authorization-Names" on page 48 for the distinction between an authorization name and an authorization ID.
collection-name	A qualified or unqualified name that provides a logical grouping for SQL objects. A collection name is used as a qualifier of the name of a table, view, index, procedure, or package. The unqualified form of a collection-name is a system identifier. The qualified form of a collection-name depends on the naming option. For SQL names, the unqualified collection name in an SQL statement is implicitly qualified by the server-name. The qualified form is a server-name followed by a (.) and a system identifier. The server-name must identify the current server. For system names, the unqualified collection name in an SQL statement is implicitly qualified by the server-name. The qualified form is a server-name followed by a slash (/) and a system identifier. The server-name must identify the current server.

	Note: Collection-name refers to either a collection created by the CREATE COLLECTION or CREATE SCHEMA statement or to an OS/400 library.
column-name	A qualified or unqualified name that designates a column of a table or a view. The unqualified form of a column name is an SQL identifier. The qualified form is a qualifier followed by a period and an SQL identifier. The qualifier is a table name, a view name, or a correlation name. Column names cannot be qualified with system names in the form *collection-name/table-name.column-name*, except in the COMMENT ON and LABEL ON statements. If column names need to be qualified, and correlation names are allowed in the statement, a correlation name must be used to qualify the column. A column-name can specify either the column name or the system column name of a column of a table or view.
constraint-name	A qualified or unqualified name that designates a constraint on a table. The qualified form of a constraint name depends on the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and a system identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45.
correlation-name	An SQL identifier that designates a table, a view, or individual rows of a table or view.
cursor-name	An SQL identifier that designates an SQL cursor.
data-type-name	A qualified or unqualified name that designates a data type. The qualified form of a data-type-name depends upon the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45.
descriptor-name	A colon followed by a host-identifier that designates an SQL descriptor area (SQLDA). See "References to Host Variables" on page 94 for a description of a host identifier. A host variable that

designates an SQL descriptor area must not have an indicator variable. The form *:host-variable:indicator-variable* is not allowed.

external-program-name

A qualified name, unqualified name, or a character string that designates an external program. The qualified form of an external-program-name depends on the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and a system identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by a system identifier.

The unqualified form is a system identifier. The unqualified form is implicitly qualified based on the rules specified in “Qualification of Unqualified Object Names” on page 45.

The format of the character string form is either:

- An OS/400 qualified program name (’library-name/program-name’).
- An OS/400 qualified source file name, followed by a left parenthesis, followed by an OS/400 member name, and a right parenthesis (’library-name/source-file-name(member-name)’). This form is only valid when calling a REXX procedure.
- An OS/400 qualified service program name, followed by a left parenthesis, followed by an OS/400 entry-point-name, followed by a right parenthesis (’library-name/service-program-name(entry-point-name)’). This form is only valid for functions.
- A class identifier, followed by an exclamation point or period, followed by a method identifier (’class-id!method-id’ or ’class-id.method-id’).

  The class-id identifies the class identifier of the Java object. If the class is part of a package, the class identifier must include the complete package prefix. For example, if the class identifier is ’myPackage.StoredProcs’, the Java Virtual machine will look in the following directory for the StoredProcs class:

  ```
  '/QIBM/ProdData/OS400/SQLLib/
    Function/myPackage/StoredProcs/'
  ```

  The method-id identifies the method name of the Java object to be invoked.

  This form is only valid for Java Procedures.

function-name

A qualified or unqualified name that designates a user-defined function, a cast function that was generated when a distinct type was created, or a built-in function. The qualified form of a function-name depends upon the naming option.

	For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45. For system naming, functions names can only be qualified in the form collection-name/function-name when the name is used in a CREATE, COMMENT ON, DROP, GRANT, or REVOKE statement.
host-label	A token that designates a label in a host program.
host-variable	A sequence of tokens that designates a host variable. A host-variable includes at least one host-identifier, as explained in "References to Host Variables" on page 94.
index-name	A qualified or unqualified name that designates an index. The qualified form of an index-name depends upon the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45.
nodegroup-name	A qualified or unqualified name that designates a nodegroup. A nodegroup is a group of AS/400's across which a table will be distributed. For more information about distributed tables and nodegroups, see the DB2 Multisystem book. The qualified form of a nodegroup-name depends on the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and a system identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by a system identifier. The unqualified form is a system identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45.
package-name	A qualified or unqualified name that designates a package. The qualified form of a package-name depends upon the naming option. For SQL naming, the qualified form is a collection-name followed by

	a period (.) and a system identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by a system identifier. The unqualified form is a system identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45.
parameter-name	An ordinary identifier that designates a parameter for a function or procedure. If the parameter is for a procedure, the identifier may be preceded by a colon.
procedure-name	A qualified or unqualified name that designates a procedure. The qualified form of a procedure-name depends upon the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45.
server-name	An SQL identifier that designates an application server. The identifier must not include lowercase letters or special characters.
specific-name	A qualified or unqualified name that uniquely identifies a procedure. The qualified form of a specific-name depends upon the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45.
SQL-label	An unqualified name that designates a label in an SQL procedure or SQL function body. An SQL label name is an ordinary identifier.
SQL-parameter-name	A qualified or unqualified name that designates a parameter in an SQL routine body. The unqualified form of an SQL parameter name is an SQL identifier. It must not be a delimited identifier that includes lowercase letters or special characters. The qualified form is a procedure-name followed by a period (.) and an SQL ordinary identifier.
SQL-variable-name	A qualified or unqualified name that designates a variable in an SQL routine body. The unqualified

	form of an SQL variable name is an SQL identifier. It must not be a delimited identifier that includes lowercase letters or special characters. The qualified form is an SQL label followed by a period (.) and an SQL ordinary identifier.
statement-name	An SQL identifier that designates a prepared SQL statement.
system-column-name	An unqualified name that designates the OS/400 column name of a table or a view. A system-column-name is a system identifier. System-column-names can be delimited identifiers, but the characters within the delimiters must not include lowercase letters or special characters.
system-object-name	An unqualified name that designates the OS/400 name of a table, view, index, or alias. A system-object-name is a system identifier. If the unqualified name of the table, view, index, or alias is a valid system identifier, the system-object-name of the table, view, index, or alias is the unqualified name of the table, view, index, or alias.
table-name	A qualified or unqualified name that designates a table. The qualified form of a table-name depends upon the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45. A table-name can specify either the name of the table or the system object name of the table.
view-name	A qualified or unqualified name that designates a view. The qualified form of a view-name depends upon the naming option. For SQL naming, the qualified form is a collection-name followed by a period (.) and an SQL identifier. For system naming, the qualified form is a collection-name followed by a slash (/) followed by an SQL identifier. The unqualified form is an SQL identifier. The unqualified form is implicitly qualified based on the rules specified in "Qualification of Unqualified Object Names" on page 45. A view-name can specify either the name of the view or the system object name of the view.

Table 2. Identifier Length Limits (in bytes)

Identifier Type	Maximum Length
Alias name	128
Authorization name	10
Correlation name	128
Cursor name	18
Host identifier	64
Server name	18
SQL label	64
Statement name	18
Unqualified collection name	10
Unqualified column name	30
Unqualified constraint name	128
Unqualified data type name	128
Unqualified external program name [12]	10
Unqualified function name	128
Unqualified nodegroup name	10
Unqualified package name	10
Unqualified parameter name	128
Unqualified procedure name	128
Unqualified specific name	128
Unqualified SQL parameter name	30
Unqualified SQL variable name	30
Unqualified system column name	10
Unqualified system object name	10
Unqualified table, view, and index name	128

Qualification of Unqualified Object Names

Unqualified object names are implicitly qualified. The rules for qualifying a name differ depending on the type of object that the name identifies.

Unqualified Alias, Constraint, External Program, Index, Nodegroup, Package, Table, and View Names

Unqualified alias, constraint, external program, index, nodegroup, package, table, and view names are implicitly qualified as follows:

- For static SQL statements:
  - If the DFTRDBCOL parameter is specified on the CRTSQLxxx command (or with the SET OPTION statement), the implicit qualifier is the collection-name that is specified for that parameter.
  - In all other cases, the implicit qualifier is based on the naming convention.
    - For SQL naming, the implicit qualifier is the authorization identifier of the statement.
    - For system naming, the implicit qualifier is the job library list (*LIBL).

---

[12] For REXX procedures, the limit is 33.

- For dynamic SQL statements the implicit qualifier depends on whether or not a default collection name has been explicitly specified. The mechanism for explicitly specifying this depends on the interface used to dynamically prepare and execute SQL statements.
  - If a default collection name is not explicitly specified:
    - For SQL naming, the implicit qualifier is the run-time authorization identifier.
    - For system naming, the implicit qualifier is the job library list (*LIBL).
  - If a default collection name is explicitly specified, the implicit qualifier is that default collection. The default collection name can be specified through the following interfaces:

Table 3. Default Collection Interfaces

SQL Interface	Specification
Embedded SQL	DFTRDBCOL parameter and DYNDFTCOL(*YES) on the CRTSQLxxx commands. The SET OPTION statement can also be used to set the DFTRDBCOL and DYNDFTCOL values. (For more information on CRTSQLxxx commands, see the SQL Programming with Host Languages book.)
Call Level Interface (CLI) on the server	SQL_ATTR_DEFAULT_LIB environment or connection variable (For more information on CLI, see the SQL Call Level Interfaces (ODBC) book.)
JDBC or SQLJ on the server using AS/400 Developer Kit for Java	libraries property object (For more information on JDBC and SQLJ, see the Java topic in the *AS/400 Information Center*, SK3T-2027-03.)
ODBC on a client using the Client Access ODBC Driver	Default Libraries List in ODBC Setup (For more information on ODBC, see the Client Access Express category in the AS/400 Information Center.)
JDBC on a client using the AS/400 Toolbox for Java	Default Libraries List in ODBC Setup (For more information on ODBC, see the Client Access Express category in the AS/400 Information Center.) (For more information on the AS/400 Toolbox for Java, see the Java topic in the *AS/400 Information Center*, SK3T-2027-03.)
All interfaces	QSQCHGDC (Change Dynamic Default Collection) API (For more information on ODBC, see the File APIs category in the AS/400 Information Center.)

Unqualified Function, Procedure, Specific, and Data Type Names

The qualification of data type (both built-in and distinct type), function, procedure, and specific names depends on the SQL statement in which the unqualified name appears:

- If an unqualified name is the main object of a CREATE, COMMENT ON, DROP, GRANT, or REVOKE statement, the name is implicitly qualified using the same rules as for qualifying unqualified table names (See “Unqualified Alias, Constraint, External Program, Index, Nodegroup, Package, Table, and View Names” on page 45).
- Otherwise, the implicit collection name is determined as follows:

  - For data type names, the database manager searches the SQL path and selects the first collection in the path such that the data type exists in the collection.
  - For procedure names, the database manager searches the SQL path and selects the first collection in the path such that the collection contains a procedure with the same name and number of parameters.
  - For function names and for specific names specified for sourced functions, the database manager uses the SQL path in conjunction with function resolution, as described under “Function Resolution” on page 102.

SQL Names and System Names: Special Considerations

The CL command Override Database File (OVRDBF) can be specified to override an SQL or system name with another object name for local data manipulation SQL statements. Overrides are ignored for data definition SQL statements and data manipulation SQL statements executing at a remote relational database. See the File Management book for more information about the override function.

Collections and the SQL Path

The SQL path is an ordered list of collection names. The database manager uses the path to resolve the collection name for unqualified data type names (both built-in and distinct types), function names, and procedure names that appear in any context other than as the main object of a CREATE, DROP, COMMENT ON, GRANT or REVOKE statement. Searching through the path from left to right, the database manager implicitly qualifies the object name with the first collection name in the path that contains the same object with the same unqualified name. For procedures, the database manager selects a matching procedure name only if the number of parameters is also the same. For functions, the database manager uses a process called function resolution in conjunction with the SQL path to determine which function to choose because several functions with the same name can reside in a collection. (For details, see “Function Resolution” on page 102.)

For example, if the SQL path is SMITH, XGRAPHIC, QSYS, QSYS2 and an unqualified distinct type name MYTYPE was specified, the database manager looks for MYTYPE first in collection SMITH, then XGRAPHIC, and then QSYS and QSYS2.

The path used is determined as follows:

- For all static SQL statements (except for a CALL *:host-variable* statement), the path used is the path specified in the SQLPATH parameter on the CRTSQLxxx command. The SQLPATH can also be set using the SET OPTION statement.
- For dynamic SQL statements (and for a CALL *:host-variable* statement), the path used is the path specified in the CURRENT PATH special register (For more information on the CURRENT PATH special register, see “CURRENT PATH, CURRENT_PATH, or CURRENT FUNCTION PATH” on page 87.

Aliases

Think of an *alias* as an alternative name for a table, view, or member of a database file. Aliases help you avoid using file overrides. Not only does an alias perform better than an override, but an alias is also a permanent object that you only need to create once.

Aliases

You can refer to a table or view in an SQL statement by its name or by a table alias. You can only refer to a database file member in an SQL statement through using an alias. An alias can only refer to a table, view, or database file member within the same relational database.

You can use an alias wherever you would use a table or view name, except:

- Do not use an alias name where a new table or view name is expected, such as in the CREATE TABLE or CREATE VIEW statements. For example, if an alias name of PERSONNEL is created, then a subsequent statement such as CREATE TABLE PERSONNEL will cause an error.
- An alias that refers to an individual member of a database file member can only be used in a select statement, DELETE, INSERT, SELECT INTO, or UPDATE statement.

You can create an alias even though the object the alias refers to does not exist. However, the object must exist when a statement that references the alias is executed. A warning is returned if the object does not exist when you create the alias. An alias cannot refer to another alias. An alias can only refer to a table, view, or database file member within the same relational database.

The option of referring to a table, view, or database file member by an alias name is not explicitly shown in the syntax diagrams or mentioned in the description of the SQL statements.

A new alias cannot have the same fully-qualified name as an existing table, view, index, file, or alias.

The effect of using an alias in an SQL statement is similar to that of text substitution. The alias, which you must define when you execute the SQL statement, is replaced by the qualified base table, view, or database file member name. For example, if PBIRD.SALES is an alias for DSPN014.DIST4_SALES_148, then at statement run time:

```
SELECT * FROM PBIRD.SALES
```

effectively becomes

```
SELECT * FROM DSPN014.DIST4_SALES_148
```

If an alias is dropped and recreated to refer to another table, any SQL statements that refer to that alias will be implicitly rebound when they are next run. If a CREATE VIEW or CREATE INDEX statement refers to an alias, dropping and re-creating the alias has no effect on the view or index.

For syntax toleration of existing DB2 UDB for OS/390 applications, you can use SYNONYM in place of ALIAS in the CREATE ALIAS and DROP ALIAS statements.

Authorization IDs and Authorization-Names

An *authorization ID* is a character string that is obtained by the database manager when a connection is established between the database manager and either an application process or a program preparation process. It designates a set of privileges. It may also designate a user or a group of users, but this property is not controlled by the database manager.

Authorization ID’s apply to every statement and are used by the database manager to provide:

- Implicit qualifiers for the names of tables, views, constraints, packages, and indexes.
- Authorization checking of SQL statements

An authorization ID applies to every SQL statement. The implicit qualification depends on whether you use static or dynamic SQL:

- For static SQL, the implicit qualifier is the owner of the program.
- For dynamic SQL, the implicit qualifier is the user running the program.

The authorization ID that is used for authorization checking for a static SQL statement depends on the USRPRF value specified on the precompiler command:

- If USRPRF(*OWNER) is specified, or if USRPRF(*NAMING) is specified and SQL naming mode is used, the authorization ID of the statement is the owner of the non-distributed SQL program. For distributed SQL programs, it is the owner of the SQL package.
- If USRPRF(*USER) is specified, or if USRPRF(*NAMING) is specified and system naming mode is used, the authorization ID of the statement is the authorization ID of the user running the non-distributed SQL program. For distributed SQL programs, it is the authorization ID of the user at the current server.

The authorization ID that is used for authorization checking for a dynamic SQL statement also depends on where and how the statement is executed:

- If the statement is prepared and executed from a non-distributed program:
  - If the USRPRF value is *USER and the DYNUSRPRF value is *USER for the program, the authorization ID that applies is the ID of the user running the non-distributed program. This is called the *run-time authorization ID*.
  - If the USRPRF value is *OWNER and the DYNUSRPRF value is *USER for the program, the authorization ID that applies is the ID of the user running the non-distributed program.
  - If the USRPRF value is *OWNER and the DYNUSRPRF value is *OWNER for the program, the authorization ID that applies is the ID of the owner of the non-distributed program.
- If the statement is prepared and executed from a distributed program:
  - If the USRPRF value is *USER and the DYNUSRPRF value is *USER for the SQL package, the authorization ID that applies is the ID of the user running the SQL package at the current server. This is also called the run-time authorization ID.
  - If the USRPRF value is *OWNER and the DYNUSRPRF value is *USER for the SQL package, the authorization ID that applies is the ID of the user running the SQL package at the current server.
  - If the USRPRF value is *OWNER and the DYNUSRPRF value is *OWNER for the SQL package, the authorization ID that applies is the ID of the owner of the SQL package at the current server.
- If the statement is issued interactively, the authorization ID that applies is the ID of the user that issued the Start SQL (STRSQL) command.
- If the statement is executed from the RUNSQLSTM command, the authorization ID that applies is the ID of the user that issued the RUNSQLSTM command.
- If the statement is executed from REXX, the authorization ID that applies is the ID of the user that issued the STRREXPRC command.

Authorization IDs and Names

On OS/400, the run-time authorization ID is the user profile of the job.

An *authorization-name* specified in an SQL statement should not be confused with the authorization ID of the statement. An authorization-name is an identifier that is used in GRANT and REVOKE statements to designate a target of the grant or revoke. The premise of a grant of privileges *X* is that *X* will subsequently be the authorization ID of statements which require those privileges. A group user profile can also be used when checking authority for an SQL statement. For information on group user profiles, see the book *Security - Reference*, SC41-5302-04 .

Examples

- Assume SMITH is your user ID; then SMITH is the authorization ID when you execute the following statement interactively:

  ```
  GRANT SELECT ON TDEPT TO KEENE
  ```

  SMITH is the authorization ID of the statement. Thus, the authority to execute the statement is checked against SMITH and SMITH is the implicit qualifier of TDEPT.

  KEENE is an authorization-name specified in the statement. KEENE is given the SELECT privilege on SMITH.TDEPT.
- Assume SMITH has administrative authority and is the authorization ID of the following statements:

  ```
  DROP TABLE TDEPT
  ```

  Removes the `SMITH.TDEPT` table.

  ```
  DROP TABLE SMITH.TDEPT
  ```

  Removes the `SMITH.TDEPT` table.

  ```
  DROP TABLE KEENE.TDEPT
  ```

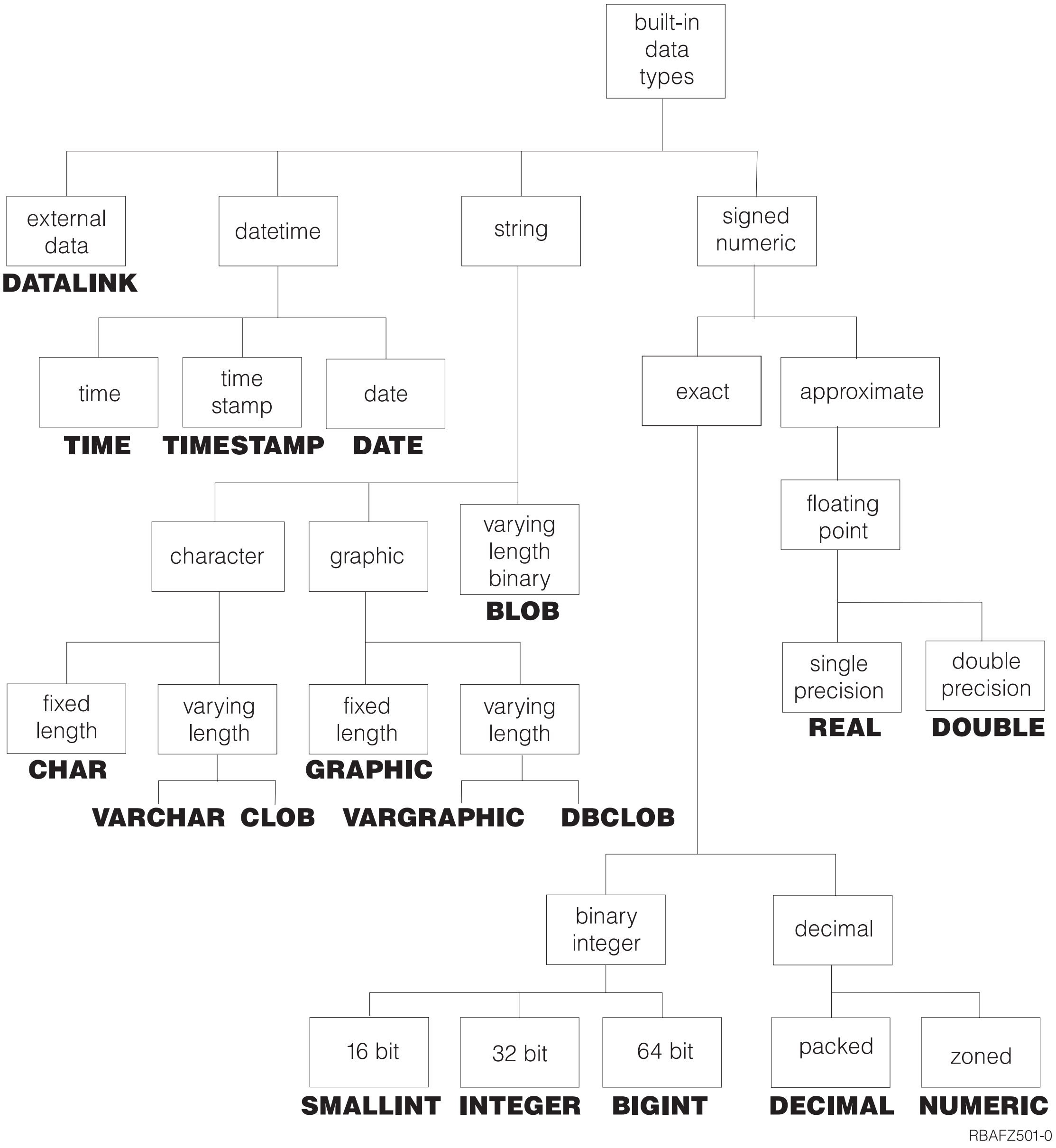
  Removes the `KEENE.TDEPT` table.

Data Types

The smallest unit of data that can be manipulated in SQL is called a *value.* How values are interpreted depends on the data type of their source. The sources of values are:

- Columns
- Constants
- Expressions
- Functions
- Host variables
- Special registers

The following figure illustrates the various data types supported by the DB2 UDB for AS/400 program.



Nulls: All data types include the null value. The null value is a special value that is distinct from all nonnull values and thereby denotes the absence of a (nonnull) value. Although all data types include the null value, columns defined as NOT NULL cannot contain null values.

For information about specifying the data types of columns, see "CREATE TABLE" on page 340.

Binary Strings

A *binary string* is a sequence of bytes. The length of a binary string (BLOB string) is the number of bytes in the sequence. A binary string has a CCSID of 65535.

For a BLOB column, the length attribute must be between 1 and 15 728 640 bytes inclusive. For more information about BLOBs, see "Large Objects (LOBs)" on page 55.

A host variable with a BLOB string type can be defined in all host languages except REXX, RPG/400, and COBOL/400.

Character Strings

A *character string* is a sequence of bytes. The length of the string is the number of bytes in the sequence. If the length is zero, the value is called the *empty string*. The empty string should not be confused with the null value.

Fixed-Length Character Strings

All values of a fixed-length character-string column have the same length. This is determined by the length attribute of the column. The length attribute must be between 1 through 32766 inclusive.

Varying-Length Character Strings

The types of varying-length character strings are:

- VARCHAR (or synonyms CHAR VARYING and CHARACTER VARYING)
- CLOB (or synonyms CHAR LARGE OBJECT and CHARACTER LARGE OBJECT

The values of a column with any one of these string types can have different lengths. The length attribute of the column determines the maximum length a value can have.

For a VARCHAR column, the length attribute must be between 1 through 32740 inclusive. For a CLOB column, the length attribute must be between 1 through 15 728 640 inclusive. For more information about CLOBs, see “Large Objects (LOBs)” on page 55.

Character-String Host Variables

- Fixed-length character-string variables can be used in all host languages except REXX. (In C, fixed-length character-string variables are limited to a length of 1.)
- VARCHAR varying-length character-string variables can be used in C, COBOL, PL/I, REXX, and RPG:
  - In PL/I, REXX, and ILE RPG, there is a varying-length character-string data type.
  - In COBOL and C, varying-length character strings are represented as structures.
  - In C, varying-length character-string variables can also be represented by NUL-terminated strings.
  - In RPG/400, varying-length character-string variables can only be represented by VARCHAR columns included as a result of an externally described data structure.
- CLOB varying-length character-string variables can be defined in all host languages except REXX, RPG/400, and COBOL/400.
  - In ILE RPG, a CLOB varying-length character string is represented as a structure.
  - In all other languages, an SQL TYPE IS CLOB clause is used.

Character Subtypes

Each character string is further defined as one of:

bit data Data that is not associated with a coded character set and is never converted. The CCSID for bit data is 65535.

SBCS data	Data in which every character is represented by a single byte. Each SBCS data character string has an associated CCSID. If necessary, an SBCS data character string is converted before it is used in an operation with a character string that has a different CCSID.
mixed data	Data that may contain a mixture of characters from a single-byte character set (SBCS) and a double-byte character set (DBCS). Each mixed data character string has an associated CCSID. If necessary, a mixed data character string is converted before an operation with a character string that has a different CCSID. If mixed data contains a DBCS character, it cannot be converted to SBCS data.

The database manager does not recognize subclasses of double-byte characters, and it does not assign any specific meaning to particular double-byte codes. However, if you choose to use mixed data, then two single-byte EBCDIC codes are given special meanings:

- X'0E', the “shift-out” character, is used to mark the beginning of a sequence of double-byte codes.
- X'0F', the “shift-in” character, is used to mark the end of a sequence of double-byte codes.

In order for the database manager to recognize double-byte characters in a mixed data character string, the following condition must be met:

> Within the string, the double-byte characters must be enclosed between paired shift-out and shift-in characters.
>
> The pairing is detected as the string is read from left to right. The code X'0E' is recognized as a shift out character if X'0F' occurs later; otherwise, it is invalid. The first X'0F' following the X'0E' that is on a double-byte boundary is the paired shift-in character. Any X'0F' that is not on a double-byte boundary is not recognized.
>
> There must be an even number of bytes between the paired characters, and each pair of bytes is considered to be a double-byte character. There can be more than one set of paired shift-out and shift-in characters in the string.

The length of a mixed data character string is its total number of bytes, counting two bytes for each double-byte character and one byte for each shift-out or shift-in character.

When the job CCSID indicates that DBCS is allowed, CREATE TABLE will create character columns as DBCS-Open fields, unless FOR BIT DATA, FOR SBCS DATA, or an SBCS CCSID is specified. The SQL user will see these as character fields, but the system database support will see them as DBCS-Open fields. For a definition of a DBCS-Open field, see the Database Programming book.

Graphic Strings

A graphic string is a sequence of two-byte characters. The length of the string is the number of its characters. Like character strings, graphic strings can be empty.

Fixed-Length Graphic Strings

All values of a fixed-length graphic-string column have the same length, which is determined by the length attribute of the column. The length attribute must be between 1 through 16383 inclusive.

Varying-Length Graphic Strings

The types of varying-length graphic strings are:

- VARGRAPHIC
- DBCLOB

The values of a column with any one of these string types can have different lengths. The length attribute of the column determines the maximum length a value can have.

For a VARGRAPHIC column, the length attribute must be between 1 through 16370 inclusive. For a DBCLOB column, the length attribute must be between 1 through 7 864 320 inclusive. For more information about DBCLOBs, see “Large Objects (LOBs)” on page 55.

Graphic-String Host Variables

- Fixed-length graphic-string host variables can be defined in C, ILE COBOL, and ILE RPG/400. (In C, fixed-length graphic-string host variables are limited to a length of 1.)

  Although fixed-length graphic-string host variables cannot be defined in PL/I, COBOL/400, and RPG/400, a character-string host variable will be treated like a fixed-length graphic-string host variable if it was generated in the source from a GRAPHIC column in the external definition of a file.
- Varying-length graphic-string host variables can be defined in C, ILE COBOL, REXX, and ILE RPG.
  - In REXX and ILE RPG, there is a varying-length graphic-string data type.
  - In C and ILE COBOL, varying-length graphic strings are represented as structures.
  - In C, varying-length graphic-string variables can also be represented by NUL-terminated graphic strings.
  - Although varying-length graphic-string host variables cannot be defined in PL/I, COBOL/400, and RPG/400, a character-string host variable will be treated like a varying-length graphic-string host variable if it was generated in the source from a VARGRAPHIC column in the external definition of a file.
- DBCLOB varying-length character-string variables can be defined in all host languages except REXX, RPG/400, and COBOL/400.
  - In ILE RPG, a DBCLOB varying-length character string is represented as a structure.
  - In all other languages, an SQL TYPE IS DBCLOB clause is used.

Graphic Subtypes

Each graphic string is further defined as DBCS data or UCS-2 data.

DBCS data	Data in which every character is represented by a character from the double-byte character set (DBCS) that does not include the shift-out or shift-in characters. Every DBCS graphic string has a CCSID that identifies a double-byte coded character set. If necessary, a DBCS graphic string is converted before it is used in an operation with a DBCS graphic string that has a different DBCS CCSID.
UCS-2 data	Data in which every character is represented by a character from the Universal Coded Character Set (UCS-2).

When graphic-string host variables are not explicitly tagged with a CCSID, the associated DBCS CCSID for the job CCSID is used. If no associated DBCS CCSID exists, the host variable is tagged with 65535. A graphic-string host variable is never implicitly tagged with a UCS-2 CCSID. See the DECLARE VARIABLE statement for information on how to tag a graphic host variable with a CCSID.

Large Objects (LOBs)

The term *large object (LOB)* refers to any of the following data types:

Binary Large Object (BLOB) Strings

A *Binary Large OBject (BLOB)* is a varying-length string with a maximum length of 15 728 640. A BLOB is designed to store non-traditional data such as pictures, voice, and mixed media. BLOBs can also store structured data for use by distinct types and user-defined functions. A BLOB is considered to be a binary string.

Although BLOB strings and FOR BIT DATA character strings might be used for similar purposes, the two data types are not compatible. The BLOB function can be used to change a FOR BIT DATA character string into a binary string.

The CCSID of a BLOB is 65535.

Character Large Object (CLOB) Strings

A *Character Large OBject (CLOB)* is a varying-length character string with a maximum length of 15 728 640. A CLOB is designed to store large SBCS data or mixed data, such as lengthy documents. For example, you can store information such as an employee resume, the script of a play, or the text of novel in a CLOB.

The CCSID of a CLOB cannot be 65535.

Double-byte Character Large Object (DBCLOB) Strings

A *Double-Byte Character Large OBject (DBCLOB)* is a varying-length graphic string with a maximum length of 7 864 320 double-byte characters. A DBCLOB is designed to store large DBCS data, such as lengthy documents in UCS-2.

The CCSID of a DBCLOB cannot be 65535.

Manipulating Large Objects (LOBs) With Locators

When an application does not want an entire LOB value to be moved into a host variable, the application can use a large object locator (LOB locator) to reference the LOB value.

A LOB locator is a host variable with a value that represents a single LOB value in the database server. LOB locators provide users with a mechanism by which very large objects can be manipulated in application programs without requiring the entire LOB value to be stored in a host variable or transferred to the application requester (client) where the application program may be running.

For example, when selecting a LOB value, an application program could select the entire LOB value and place it into an equally large host variable (which is acceptable if the application program is going to process the entire LOB value at once), or it could instead select the LOB value into a LOB locator. Then, using the LOB locator, the application program can issue subsequent database operations on the LOB value (such as applying the scalar functions SUBSTR, CONCAT, VALUE, LENGTH, doing an assignment, searching the LOB with LIKE or POSSTR, or applying UDFs against the LOB) by supplying the locator value as input. The resulting output of the locator operation, for example the amount of data assigned to a client host variable, would then typically be a small subset of the input LOB value.

A LOB locator can also represent a LOB expression, such as:

```
SUBSTR((lob1) CONCAT (lob2) CONCAT (lob3), start, length)
```

For normal host variables in an application program, when a null value is selected into that host variable, the indicator variable is set to -1, signifying that the value is null. In the case of LOB locators, however, the meaning of indicator variables is slightly different. Since a locator host variable itself can never be null, a negative indicator variable value indicates that the LOB value represented by the LOB locator is null. The null information is kept local to the client by virtue of the indicator variable value -- the server does not track null values with valid locators.

It is important to understand that a LOB locator represents a value, not a row or location in the database. Once a value is selected into a locator, there is no operation that one can perform on the original row or table that will affect the value which is referenced by the locator. The value associated with a locator is valid until the transaction ends, or until the locator is explicitly freed, whichever comes first.

A LOB locator is only a mechanism used to refer to a LOB value during a transaction; it does not persist beyond the transaction in which it was created. Also, it is not a database type; it is never stored in the database and, as a result, cannot participate in views or check constraints. However, since a locator is a representation of a LOB type, there are SQLTYPEs for LOB locators so that they can be described within an SQLDA structure that is used by FETCH, OPEN, CALL, and EXECUTE statements.

Numbers

All numbers have a sign and a precision. The precision is the total number of binary or decimal digits excluding the sign. The sign is positive if the value is zero.

Small Integer

A *small integer* is a binary number composed of 2 bytes (16 bits) with a precision of 5 digits. The range of small integers is −32768 to +32767.

For small integers, decimal precision and scale are supported by COBOL, RPG, and AS/400 system files. For information concerning the precision and scale of binary integers, see the DDS Reference book.

Large Integer

A *large integer* is a binary number composed of 4 bytes (32 bits) with a precision of 10 digits. The range of large integers is −2147483648 to +2147483647.

For large integers, decimal precision and scale are supported by COBOL, RPG, and AS/400 system files. For information concerning the precision and scale of binary integers, see the DDS Reference book.

Big Integer (BIGINT)

A *big integer* is a binary number composed of 8 bytes (64 bits) with a precision of 19 digits. The range of big integers is −9223372036854775808 to +9223372036854775807.

Floating-Point

A *single-precision floating-point* number is a 32-bit approximate representation of a real number. The range of magnitude is approximately $1.17549436 \times 10^{-38}$ to $3.40282356 \times 10^{38}$.

A *double-precision floating-point* number is a IEEE 64-bit approximate representation of a real number. The range of magnitude is approximately $2.2250738585072014 \times 10^{-308}$ to $1.7976931348623158 \times 10^{308}$.

Decimal

A *decimal* value is a packed-decimal or zoned-decimal number with an implicit decimal point. The position of the decimal point is determined by the precision and the scale of the number. The scale, which is the number of digits in the fractional part of the number, cannot be negative or greater than the precision. The maximum precision is 31 digits.

All values of a decimal column have the same precision and scale. The range of a decimal variable or the numbers in a decimal column is $-n$ to $+n$, where the absolute value of n is the largest number that can be represented with the applicable precision and scale. The maximum range is negative $10^{31}+1$ to 10^{31} minus 1.

Numeric Host Variables

Small and large binary integer variables can be used in all host languages. Big integer variables can only be used in C, C++, ILE COBOL, and ILE RPG. Floating-point variables can be used in all host languages except RPG/400 and COBOL/400. Decimal variables can be used in all supported host languages.

Datetime Values

The datetime data types are described in the following sections. Although datetime values can be used in certain arithmetic and string operations and are compatible with certain strings, they are neither strings nor numbers. However, strings can represent datetime values; see “String Representations of Datetime Values” on page 58.

Date

A *date* is a three-part value (year, month, and day) designating a point in time under the Gregorian calendar[13], which is assumed to have been in effect from the year 1 A.D. The range of the year part is 0001 to 9999. The date formats *JUL, *MDY, *DMY, and *YMD can only represent dates in the range 1940 through 2039. The range of the month part is 1 to 12. The range of the day part is 1 to x, where x is 28, 29, 30, or 31, depending on the month and year.

The internal representation of a date is a string of 4 bytes that contains an integer. The integer (called the Scaliger number) represents the date.

The length of a DATE column as described in the SQLDA is 6, 8, or 10 bytes, depending on which format is used. These are the appropriate lengths for character-string representations for the value.

---

[13] Note that historical dates do not always follow the Gregorian calendar. Dates between 1582-10-04 and 1582-10-15 are accepted as valid dates although they never existed in the Gregorian calendar.

Time

A *time* is a three-part value (hour, minute, and second) designating a time of day using a 24-hour clock. The range of the hour part is 0 to 24, while the range of the minute and second parts is 0 to 59. If the hour is 24, the minute and second specifications are both zero.

The internal representation of a time is a string of 3 bytes. Each byte consists of two packed decimal digits. The first byte represents the hour, the second byte the minute, and the last byte the second.

The length of a TIME column as described in the SQLDA is 8 bytes, which is the appropriate length for a character-string representation of the value.

Timestamp

A *timestamp* is a seven-part value (year, month, day, hour, minute, second, and microsecond) that designates a date and time as defined previously, except that the time includes a fractional specification of microseconds.

The internal representation of a timestamp is a string of 10 bytes. The first 4 bytes represent the date, the next 3 bytes the time, and the last 3 bytes the microseconds (the last 3 bytes contain 6 packed digits).

The length of a TIMESTAMP column as described in the SQLDA is 26 bytes, which is the appropriate length for the character-string representation of the value.

String Representations of Datetime Values

Values whose data types are DATE, TIME, or TIMESTAMP are represented in an internal form that is transparent to the user of SQL. Dates, times, and timestamps, however, can also be represented by character strings. These representations directly concern the user of SQL since there are no constants whose data types are DATE, TIME, or TIMESTAMP. Only ILE RPG for AS/400 and ILE COBOL for AS/400 support datetime variables. To be retrieved, a datetime value can be assigned to a character-string variable. The format of the resulting string will depend on the date format (DATFMT), the date separator (DATSEP), the time format (TIMFMT), and the time separator (TIMSEP) parameters in effect when the statement was prepared.

When a valid string representation of a datetime value is used in an operation with an internal datetime value, the string representation is converted to the internal form of the date, time, or timestamp before the operation is performed. If the CCSID of the string represents a foreign encoding scheme (for example, ASCII), it is first converted to the coded character set identified by the default CCSID before the string is converted to the internal form of the datetime value.

The following sections define the valid string representations of datetime values.

Date Strings: A string representation of a date is a character string that starts with a digit and has a length of at least 6 characters. Trailing blanks can be included. Leading zeros can be omitted from the month and day portions when using the IBM SQL standard formats. Each IBM SQL standard format is identified by name and includes an associated abbreviation (for use by the CHAR function). Other formats do not have an abbreviation to be used by the CHAR function. The separators for two-digit year formats are controlled by the date separator (DATSEP) parameter. Valid string formats for dates are listed in Table 4 on page 59.

The database manager recognizes the string as a date when it is either:

- In the format specified by the date format (DATFMT) and date separator (DATSEP) parameters, or
- In one of the IBM SQL standard date formats, or
- In the unformatted Julian format

The DATFMT and DATSEP parameters are specified on the CRTSQLxxx, RUNSQLSTM, and STRSQL commands. The SET OPTION statement can be used to specify DATFMT and DATSEP within the source of a program containing embedded SQL.

Table 4. Formats for String Representations of Dates

Format Name	Abbreviation	Date Format	Example
International Standards Organization (*ISO)	ISO	yyyy-mm-dd	1987-10-12
IBM USA standard (*USA)	USA	mm/dd/yyyy	10/12/1987
IBM European standard (*EUR)	EUR	dd.mm.yyyy	12.10.1987
Japanese industrial standard Christian era (*JIS)	JIS	yyyy-mm-dd	1987-10-12
Unformatted Julian	–	yyyyddd	1987285
Julian (*JUL)	–	yy/ddd	87/285
Month, day, year (*MDY)	–	mm/dd/yy	10/12/87
Day, month, year (*DMY)	–	dd/mm/yy	12/10/87
Year, month, day (*YMD)	–	yy/mm/dd	87/12/10

Time Strings: A string representation of a time is a character string that starts with a digit and has a length of at least 4 characters. Trailing blanks can be included; a leading zero can be omitted from the hour part of the time and seconds can be omitted entirely. If you choose to omit seconds, an implicit specification of 0 seconds is assumed. Thus, 13.30 is equivalent to 13.30.00.

Valid string formats for times are listed in Table 5 on page 60. Each IBM SQL standard format is identified by name and includes an associated abbreviation (for use by the CHAR function). The other format (*HMS) does not have an abbreviation to be used by the CHAR function. The separator for the *HMS format is controlled by the time separator (TIMSEP) parameter.

The database manager recognizes the string as a time when it is either:
- In the format specified by the time format (TIMFMT) and time separator (TIMSEP) parameters, or
- In one of the IBM SQL standard time formats

The TIMFMT and TIMSEP parameters are specified on the CRTSQLxxx, RUNSQLSTM, and STRSQL commands. The SET OPTION statement can be used to specify TIMFMT and TIMSEP within the source of a program containing embedded SQL.

Table 5. Formats for String Representations of Times

Format Name	Abbreviation	Time Format	Example
International Standards Organization (*ISO)	ISO	hh.mm.ss [14]	13.30.05
IBM USA standard (*USA)	USA	hh:mm AM or PM	1:30 PM
IBM European standard (*EUR)	EUR	hh.mm.ss	13.30.05
Japanese industrial standard Christian era (*JIS)	JIS	hh:mm:ss	13:30:05
Hours, minutes, seconds (*HMS)	–	hh:mm:ss	13:30:05

In the USA time format, the hour must not be greater than 12 and cannot be 0 except for the special case of 00:00 AM. Using the 24-hour clock, the correspondence between the USA format and the 24-hour clock is as follows:

Table 6. USA Time Format

USA Format	24-Hour Clock
12:01 AM through 11:59 AM	00.01.00 through 00.59.00
01:00 AM through 11:59 AM	01:00.00 through 11:59.00
12:00 PM (noon) through 11:59 PM	12:00.00 through 23.59.00
12:00 AM (midnight)	24.00.00
00:00 AM (midnight)	00.00.00

In the USA format, a single space character exists between the minutes portion of the time of day and the AM or PM.

Timestamp Strings: A string representation of a timestamp is a character string that starts with a digit and has a length of at least 16 characters. The complete string representation of a timestamp has the form *yyyy-mm-dd-hh.mm.ss.nnnnnn* or *yyyymmddhhmmss*. Trailing blanks can be included. Leading zeros can be omitted from the month, day, and hour part of the timestamp when using the timestamp form with separators. Trailing zeros can be truncated or omitted entirely from microseconds. If you choose to omit any digit of the microseconds portion, an implicit specification of 0 is assumed. Thus, *1990-3-2-8.30.00.10* is equivalent to *1990-03-02-08.30.00.100000*.

A timestamp whose time part is 24.00.00.000000 is also accepted.

DataLink Values

A DataLink value is an encapsulated value that contains a logical reference from the database to a file stored outside the database. The attributes of this encapsulated value are as follows:

link type
The currently supported type of link is a URL (Uniform Resource Locator).

---

[14] This is an earlier version of the ISO format. JIS can be used to get the current ISO format.

scheme
For URLs, this is a value such as HTTP or FILE. The value, no matter what case it is entered in, is stored in the database in upper case.

file server name
The complete address of the file server. The value, no matter what case it is entered in, is stored in the database in upper case.

file path
The identity of the file within the server. The value is case sensitive and therefore it is not converted to upper case when stored in the database.

access control token
When appropriate, the access token is embedded within the file path. It is generated dynamically and is not a permanent part of the DataLink value that is stored in the database.

comment
Up to 254 bytes of descriptive information. This is intended for application specific uses such as further or alternative identification of the location of the data.

The characters used in a DataLink value are limited to the set defined for a URL. These characters include the uppercase (A through Z) and lower case (a through z) letters, the digits (0 through 9) and a subset of special characters ($, -, _, @, ., &, +, !, *, ″, ′, (,), =, ;, /, #, ?, :, space, and comma).

The first four attributes are collectively known as the linkage attributes. It is possible for a DataLink value to have only a comment attribute and no linkage attributes. Such a value may even be stored in a column but, of course, no file will be linked to such a column.

It is important to distinguish between these DataLink references to files and the LOB file reference variables described in “References to LOB File Reference Variables” on page 98. The similarity is that they both contain a representation of a file. However:

- DataLinks are retained in the database and both the links and the data in the linked files can be considered as a natural extension of data in the database.
- File reference variables exist temporarily and they can be considered as an alternative to a host program buffer.

Built-in scalar functions are provided to build a DataLink value (DLVALUE) and to extract the encapsulated values from a DataLink value (DLCOMMENT, DLLINKTYPE, DLURLCOMPLETE, DLURLPATH, DLURLPATHONLY, DLURLSCHEME, DLURLSERVER).

User-Defined Types

Distinct Types

A *distinct type* is a user-defined data type that shares its internal representation with a built-in data type (its ″source type″), but is considered to be a separate and incompatible type for most operations. For example, the semantics for a picture type, a text type, and an audio type that all use the built-in data type BLOB for their internal representation are quite different. A distinct type is created with the SQL statement CREATE DISTINCT TYPE.

For example, the following statement creates a distinct type named AUDIO:

```
CREATE DISTINCT TYPE AUDIO AS BLOB (1M)
```

Although AUDIO has the same representation as the built-in data type BLOB, it is considered to be a separate type that is not comparable to a BLOB or to any other type. This inability to compare AUDIO to other data types allows functions to be created specifically for AUDIO and assures that these functions cannot be applied to other data types.

The name of a distinct type is qualified with a collection name. The implicit collection name for an unqualified name depends upon the context in which the distinct type appears. If an unqualified distinct type name is used:

- In a CREATE DISTINCT TYPE or the object of DROP, COMMENT ON, GRANT, or REVOKE statement, the database manager uses the normal process of qualification by authorization ID to determine the collection name. For more information about qualification rules, see “Unqualified Function, Procedure, Specific, and Data Type Names” on page 46.
- In any other context, the database manager uses the SQL path to determine the collection name. The database manager searches the collections in the path, in sequence, and selects the first collection that has a distinct type that matches. For a description of the SQL path, see “CURRENT PATH, CURRENT_PATH, or CURRENT FUNCTION PATH” on page 87.

A distinct type does not automatically acquire the functions and operators of its source type, since these may not be meaningful. (For example, the LENGTH function of the AUDIO type might return the length of its object in seconds rather than in bytes.) Instead, distinct types support *strong typing*. Strong typing ensures that only the functions and operators that are explicitly defined for a distinct type can be applied to that distinct type. However, a function or operator of the source type can be applied to the distinct type by creating an appropriate user-defined function. The user-defined function must be sourced on the existing function that has the source type as a parameter.

A distinct type is subject to the same restrictions as its source type. For example, the maximum length of a distinct type sourced on a DataLink is 32718.

The comparison operators are automatically generated for distinct types, except for distinct types that are sourced on a DataLink. In addition, the database manager automatically generates functions for a distinct type that support casting from the source type to the distinct type and from the distinct type to the source type. For example, for the AUDIO type created above, these cast functions are generated:

```
FUNCTION collection-name.BLOB (collection-name.AUDIO) RETURNS BLOB (1M)

FUNCTION collection-name.AUDIO (BLOB (1M)) RETURNS AUDIO
```

Promotion of Data Types

Data types can be classified into groups of related data types. Within such groups, an order of precedence exists in which one data type is considered to precede another data type. This precedence enables the database manager to support the *promotion* of one data type to another data type that appears later in the precedence order. For example, the database manager can promote the data type CHAR to VARCHAR and the data type INTEGER to DOUBLE PRECISION; however, the database manager cannot promote a CLOB to a VARCHAR.

The database manager considers the promotion of data types when:

- Performing function resolution (see “Function Resolution” on page 102)
- Casting distinct types (see “Casting Between Data Types”)
- Assigning distinct types to built-in data types (see “Distinct Type Assignments” on page 73)

For each data type, Table 7 shows the precedence list (in order) that the database manager uses to determine the data types to which each data type can be promoted. The table indicates that the best choice is the same data type and not promotion to another data type. Note that the table also shows data types that are considered equivalent during the promotion process. For example, CHARACTER and GRAPHIC are considered to be equivalent data types.

Table 7. Precedence of Data Types

Data Type *	Data Type Precedence List (in best-to-worst order)
CHAR or GRAPHIC	CHAR or GRAPHIC, VARCHAR or VARGRAPHIC, CLOB or DBCLOB
VARCHAR or VARGRAPHIC	VARCHAR or VARGRAPHIC, CLOB or DBCLOB
CLOB or DBCLOB	CLOB or DBCLOB
BLOB	BLOB
SMALLINT	SMALLINT, INTEGER, BIGINT, DECIMAL or NUMERIC, REAL, DOUBLE
INTEGER	INTEGER, BIGINT, DECIMAL or NUMERIC, REAL, DOUBLE
BIGINT	BIGINT, DECIMAL or NUMERIC, REAL, DOUBLE
DECIMAL or NUMERIC	DECIMAL or NUMERIC, REAL, DOUBLE
REAL	REAL, DOUBLE
DOUBLE	DOUBLE
DATE	DATE
TIME	TIME
TIMESTAMP	TIMESTAMP
DATALINK	DATALINK
A distinct type	The same distinct type
Notes: * Other synonyms for the listed data types are considered to be the same as the synonym listed.	

Casting Between Data Types

There are many occasions when a value with a given data type needs to be cast (changed) to a different data type or to the same data type with a different length, precision, or scale. Data type promotion, as described in “Promotion of Data Types” on page 62, is one example of when a value with one data type needs to be cast to a new data type. A data type that can be changed to another data type is *castable* from the source data type to the target data type.

The casting of one data type to another can occur implicitly or explicitly. You can use cast functions or CAST specifications to explicitly cast a data type. The database manager might implicitly cast data types during assignments that involve a distinct type (see “Distinct Type Assignments” on page 73). In addition, when you create a sourced user-defined function, the data types of the parameters of the source function must be castable to the data types of the function that you are creating (see “CREATE FUNCTION” on page 301).

Casting Between Data Types

If truncation occurs when a character or graphic string is cast to another data type, a warning occurs if any nonblank characters are truncated. This truncation behavior is unlike the assignment of character or graphic strings to a target when an error occurs if any nonblank characters are truncated.

For casts that involve a distinct type as either the data type to be cast to or from, Table 8 shows the supported casts. For casts between built-in data types, Table 9 on page 65 shows the supported casts.

Table 8. Supported Casts When a Distinct Type is Involved

Data Type ...	**Is Castable to Data Type ...**
Distinct type DT	Source data type of distinct type DT
Source data type of distinct type DT	Distinct type DT
Distinct type DT	Distinct type DT
Data type A	Distinct type DT where A is promotable to the source data type of distinct type DT (see “Promotion of Data Types” on page 62)
INTEGER	Distinct type DT if DT’s source type is SMALLINT
DOUBLE	Distinct type DT if DT’s source data type is REAL
VARCHAR or VARGRAPHIC	Distinct type DT if DT’s source data type is CHAR or GRAPHIC

When a distinct type that is not explicitly qualified with a collection name is involved in a cast, the database manager uses the SQL path to determine a collection name. The database manager chooses the name of the first collection in the SQL path that contains a distinct type by that name. For more information on the SQL path, see “Collections and the SQL Path” on page 47.

The following table describes the supported casts between data types:

Table 9. Supported Casts Between Built-In Data Types

Source Data Type	**SMALLINT INTEGER BIGINT**	**DECIMAL NUMERIC**	**REAL DOUBLE**	**CHAR VARCHAR CLOB**	**GRAPHIC VARGRAPHIC DBCLOB**	**DATE**	**TIME**	**TIME STAMP**	**BLOB**
SMALLINT	Y	Y	Y	Y	—	—	—	—	—
INTEGER	Y	Y	Y	Y	—	—	—	—	—
BIGINT	Y	Y	Y	Y	—	—	—	—	—
DECIMAL	Y	Y	Y	Y	—	—	—	—	—
NUMERIC	Y	Y	Y	Y	—	—	—	—	—
REAL	Y	Y	Y	Y	—	—	—	—	—
DOUBLE	Y	Y	Y	Y	—	—	—	—	—
CHAR	Y	Y	Y	Y	*	Y	Y	Y	Y
VARCHAR	Y	Y	Y	Y	*	Y	Y	Y	Y
CLOB	Y	Y	Y	Y	*	—	—	—	Y
GRAPHIC	—	—	—	*	Y	—	—	—	Y
VARGRAPHIC	—	—	—	*	Y	—	—	—	Y
DBCLOB	—	—	—	*	Y	—	—	—	Y
DATE	—	—	—	Y**	—	Y	—	Y	—
TIME	—	—	—	Y**	—	—	Y	Y	—
TIMESTAMP	—	—	—	Y**	—	Y	Y	Y	—
BLOB	—	—	—	—	—	—	—	—	Y

Notes:

* Conversion is only supported for UCS-2 graphic.

** Casting from DATE, TIME, and TIMESTAMP to CLOB is not supported.

Only a DATALINK can be cast to a DATALINK type.

The following table describes the rules for casting to a data type:

Casting Between Data Types

Table 10. Rules for Casting to a Data Type

Target Data Type	Source Data Type	Rules
SMALLINT	Any	See the SMALLINT scalar function.
INTEGER	Any	See the INTEGER scalar function.
BIGINT	Any	See the BIGINT scalar function.
DECIMAL	Any	See the DECIMAL scalar function.
NUMERIC	Any	See the ZONED scalar function.
REAL	Any	See the REAL scalar function.
DOUBLE	Any	See the DOUBLE scalar function.
CHAR	Any	See the CHAR scalar function.
VARCHAR	Any	See the VARCHAR scalar function.
CLOB	Any	See the CLOB scalar function.
GRAPHIC	Any	See the rules for string assignment to a host variable.
VARGRAPHIC	Any	See the rules for string assignment to a host variable.
DBCLOB	Any	See the DBCLOB scalar function.
DATE	Any	See the DATE scalar function.
TIME	Any	See the TIME scalar function.
TIMESTAMP	CHAR	See the TIMESTAMP scalar function, where one operand is specified.
TIMESTAMP	DATE	The timestamp is composed of the specified date and a time of 00:00:00.
TIMESTAMP	TIME	The timestamp is composed of the CURRENT_DATE and the specified time.
BLOB	Any	See the BLOB scalar function.
DATALINK	DATALINK	See the rules for DataLink assignments.

Assignments and Comparisons

The basic operations of SQL are assignment and comparison. Assignment operations are performed during the execution of CALL, INSERT, UPDATE, FETCH, SELECT, SET variable, and VALUES INTO statements. Comparison operations are performed during the execution of statements that include predicates and other language elements such as MAX, MIN, DISTINCT, GROUP BY, and ORDER BY.

The basic rule for both operations is that the data type of the operands involved must be compatible. The compatibility rule also applies to UNION, concatenation, CASE expressions, and the CONCAT, VALUE, COALESCE, IFNULL, MIN, and MAX scalar functions. The compatibility matrix is as follows:

Table 11. Data Type Compatibility

Operands	Binary Integer	Decimal Number[4]	Floating Point	Character String	Graphic String	Binary String	Date	Time	Timestamp	Distinct Type
Binary Integer	Yes	Yes	Yes	No	No	No	No	No	No	2
Decimal Number	Yes	Yes	Yes	No	No	No	No	No	No	2
Floating Point	Yes	Yes	Yes	No	No	No	No	No	No	2
Character String	No	No	No	Yes	Yes 5	No 3	1	1	1	2
Graphic String	No	No	No	Yes 5	Yes	No	No	No	No	2
Binary String	No	No	No	No 3	No	Yes	No	No	No	2
Date	No	No	No	1	No	No	Yes	No	No	2
Time	No	No	No	1	No	No	No	Yes	No	2
Timestamp	No	No	No	1	No	No	No	No	Yes	2
Distinct Type	2	2	2	2	2	2	2	2	2	2

Notes:

1. The compatibility of datetime values and character strings is limited to assignment, comparison, and the VALUE, COALESCE, IFNULL, MIN, and MAX scalar functions.
   - Datetime values can be assigned to character-string columns and to character-string variables as explained in "Datetime Assignments" on page 71.
   - A valid string representation of a date can be assigned to a date column, compared with a date, or used in a VALUE, COALESCE, IFNULL, MIN, or MAX scalar function with a date.
   - A valid string representation of a time can be assigned to a time column, compared with a time, or used in a VALUE, COALESCE, IFNULL, MIN, or MAX scalar function with a time.
   - A valid string representation of a timestamp can be assigned to a timestamp column, compared with a timestamp, or used in a VALUE, COALESCE, IFNULL, MIN, or MAX scalar function with a timestamp.
2. A value with a distinct type is comparable only to a value that is defined with the same distinct type. In general, the database manager supports assignments between a distinct type value and its source data type. For additional information, see "Distinct Type Assignments" on page 73.
3. All character strings, even those with subtype FOR BIT DATA, are not compatible with binary strings.
4. Decimal refers to both packed and zoned decimal.
5. Bit data and graphic strings are not compatible.
6. A DATALINK operand can only be assigned to another DATALINK operand. The DATALINK value can only be assigned to a column if the column is defined with NO LINK CONTROL or the file exists and is not already under file link control. A DATALINK operand can not be directly compared to any data type. The DLCOMMENT, DLLINKTYPE, DLURLCOMPLETE, DLURLPATH, DLURLPATHONLY, DLURLSCHEME, and DLURLSERVER scalar functions can be used to extract character string values from a datalink which can then be compared to other strings.

A basic rule for assignment operations is that a null value cannot be assigned to a column that cannot contain null values, nor to a host variable that does not have an associated indicator variable. See "References to Host Variables" on page 94 for a discussion of indicator variables.

Numeric Assignments

The basic rule for numeric assignments is that the whole part of a decimal or integer number cannot be truncated. If necessary, the fractional part of a decimal number is truncated. In the case of the assignment to a host variable, a positive value may be returned in the SQLCODE.

An error occurs if:

- Truncation of the whole part of the number occurs on assignment to a column
- Truncation of the whole part of the number occurs on assignment to a host variable that does not have an indicator variable

A warning occurs if:

Truncation of the whole part of the number occurs on assignment to a host variable with an indicator variable. In this case, the number is not assigned to the host variable and the indicator variable is set to negative 2.

Note: Decimal refers to both packed and zoned decimal.

Note: When fetching decimal data from a file that was *not* created by an SQL CREATE TABLE statement, a decimal field may contain data that is not valid. In this case, the data will be returned as stored, without any warning or error message being issued. A table that is created by the SQL CREATE TABLE statement does not allow decimal data that is not valid.

Decimal or Integer to Floating-Point

Floating-point numbers are approximations of real numbers. Hence, when a decimal or integer number is assigned to a floating-point column or variable, the result may not be identical to the original number.

The approximation is more accurate if the receiving column or variable is defined as double precision (64 bits) rather than single precision (32 bits).

Floating-Point or Decimal to Integer

When a decimal or floating-point number is assigned to a binary integer column or variable, the number is converted, if necessary, to the precision and the scale of the target. If the scale of the target is zero, the fractional part of the number is lost. The necessary number of leading zeros is added or eliminated, and, in the fractional part of the number, the necessary number of trailing zeros is added, or the necessary number of trailing digits is eliminated.

Decimal to Decimal

When a decimal number is assigned to a decimal column or variable, the number is converted, if necessary, to the precision and the scale of the target. The necessary number of leading zeros is added or eliminated, and, in the fractional part of the number, the necessary number of trailing zeros is added, or the necessary number of trailing digits is eliminated.

Integer to Decimal

When an integer is assigned to a decimal column or variable, the number is converted first to a temporary decimal number and then, if necessary, to the precision and scale of the target. If the scale of the integer is zero, the precision of the temporary decimal number is 5,0 for a small integer, 11,0 for a large integer, or 19,0 for a big integer.

Floating-Point to Decimal

When a floating-point number is assigned to a decimal column or variable, the number is first converted to a temporary decimal number of precision 31 and then, if necessary, truncated to the precision and scale of the target. In this conversion, the number is rounded (using floating-point arithmetic) to a precision of 31 decimal digits. As a result, a number less than $0.5*10^{-31}$ is reduced to 0. The scale is given the largest possible value that allows the whole part of the number to be represented without loss of significance.

To COBOL and RPG Integers

Assignment to COBOL and RPG small or large integer host variables takes into account any scale specified for the host variable. However, assignment to integer host variables uses the full size of the integer. Thus, the value placed in the COBOL data item or RPG field may be larger than the maximum precision specified for the host variable.

In COBOL, for example, if COL1 contains a value of 12345, the statements:

```
01  A  PIC  S9999  BINARY.
EXEC SQL SELECT COL1
         INTO :A
         FROM TABLEX
END-EXEC.
```

result in the value 12345 being placed in `A`, even though `A` has been defined with only 4 digits.

Notice that the following COBOL statement:

```
MOVE 12345 TO A.
```

results in 2345 being placed in `A`.

String Assignments

The following rules apply when both the source and the target are strings. When a datetime data type is involved, see “Datetime Assignments” on page 71.

There are two types of string assignments:

- *Storage assignment* is when a value is assigned to a column or a parameter of a function or stored procedure.
- *Retrieval assignment* is when a value is assigned to a host variable.

The rules differ for storage and retrieval assignment.

Storage Assignment

The basic rule is that the length of a string assigned to a column or parameter of a function or procedure must not be greater than the length attribute of the column or parameter. If the string is longer than the length attribute of that column, a negative SQLCODE is returned. (Trailing blanks are normally included in the length of the string. For storage assignments, however, trailing blanks are not included in the length of the string.)

For a description of the SQLCA, see “Appendix B. SQL Communication Area” on page 541.

When a string is assigned to a fixed-length string column or parameter and the length of the string is less than the length attribute of the target, the string is padded on the right with the necessary number of single-byte, double-byte, or UCS-2 blanks.[15] The pad character is always a blank, even for bit data.

Retrieval Assignment

The length of a string assigned to a host variable can be greater than the length attribute of the host variable. When a string is assigned to a variable and the string is longer than the length attribute of the variable, the string is truncated on the right by the necessary number of characters. When this occurs, the value 'W' is assigned to the SQLWARN1 field of the SQLCA. Furthermore, if an indicator variable is provided, it is set to the original length of the string. If only the NUL-terminator is truncated for a C NUL-terminated host variable and the *NOCNULRQD option was specified on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*NO) on the SET OPTION statement), the value of 'N' is assigned to the SQLWARN1 field of the SQLCA and a NUL is not placed in the variable.

When a string is assigned to a fixed-length variable and the length of the string is less than the length attribute of the target, the string is padded on the right with the necessary number of single-byte, double-byte, or UCS-2 blanks.[15] The pad character is always a blank, even for bit data.

When a string of length *n* is assigned to a varying-length string variable with a maximum length greater than *n*, the characters after the *n*th character of the variable are undefined.

Assignments Involving Mixed Strings

If a string contains mixed data, the assignment rules may require truncation within a sequence of double-byte codes. To prevent the loss of the shift-in character that ends the double-byte sequence, additional characters may be truncated from the end of the string, and a shift-in character added. In the truncated result, there is always an even number of bytes between each shift-out character and its matching shift-in character.

Assignments Involving C NUL-terminated Strings

When a string of length *n* is assigned to a C NUL-terminated string variable with a length greater than *n+1*:

- If the *CNULRQD option was specified on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*YES) on the SET OPTION statement), the string is padded on the right with x-n-1 blanks where x is the length of the variable. The padded string is then assigned to the variable and the NUL-terminator is placed in the next character position.
- If the *NOCNULRQD precompiler option was specified on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*NO) on the SET OPTION statement), the string is not padded on the right. The string is assigned to the variable and the NUL-terminator is placed in the next character position.

Conversion Rules for Assignments

A string assigned to a column or host variable is first converted, if necessary, to the coded character set of the target. Character conversion is necessary only if all of the following are true:

- The CCSIDs are different.
- Neither CCSID is 65535.

---

[15] UCS-2 defines a blank character at code point X’0020’ and X’3000’. The database manager pads with the blank at code point X’0020’.

- The string is neither null nor empty.
- The CCSID Conversion Selection Table indicates that conversion is necessary.

An error occurs if:

- The CCSID Conversion Selection Table is used but does not contain any information about the pair of CCSIDs.
- A character of the string cannot be converted, and the operation is assignment to a column or assignment to a host variable without an indicator variable. For example, a double-byte character (DBCS) cannot be converted to a column or host variable with a single-byte character (SBCS) CCSID.

A warning occurs if:

- A character of the string is converted to the substitution character.
- A character of the string cannot be converted, and the operation is assignment to a host variable with an indicator variable. For example, a DBCS character cannot be converted to a host variable with an SBCS CCSID. In this case, the string is not assigned to the host variable and the indicator variable is set to −2.

Datetime Assignments

A value assigned to a DATE column must be a date or a valid string representation of a date. A date can only be assigned to a DATE column, a character-string column, a character-string variable or an ILE RPG/400 timestamp variable. A value assigned to a TIME column must be a time or a valid string representation of a time. A time can only be assigned to a TIME column, a character-string column, a character-string variable or an ILE RPG/400 timestamp variable. A value assigned to a TIMESTAMP column must be a timestamp or a valid string representation of a timestamp. A timestamp can only be assigned to a TIMESTAMP column, a character-string column, a character-string variable or an ILE RPG/400 timestamp variable.

When a datetime value is assigned to a character-string variable or column, it is converted to its string representation. Leading zeros are not omitted from any part of the date, time, or timestamp. The required length of the target varies depending on the format of the string representation. If the length of the target is greater than required, it is padded on the right with blanks. If the length of the target is less than required, the result depends on the type of datetime value involved and on the type of target.

- If the target is a character-string column, truncation is not allowed. The following rules apply:

  DATE
  The length attribute of the column must be at least 10 if the date format is *ISO, USA, *EUR, or *JIS. If the date format is *YMD, *MDY, or *DMY, the length attribute of the column must be at least 8. If the date format is *JUL, the length of the host variable must be at least 6.

  TIME
  The length attribute of the column must be at least 8.

  TIMESTAMP
  The length attribute of the column must be at least 26.

- When the target is a host variable, the following rules apply:

  DATE

The length of the host variable must be at least 10 if the date format is *ISO, *USA, *EUR, or *JIS. If the date format is *YMD, *MDY, or *DMY, the length of the host variable must be at least 8. If the date format is *JUL, the length of the host variable must be at least 6.

TIME

- If the *USA format is used, the length of the host variable must not be less than 8. This format does not include seconds.
- If the *ISO, *EUR, *JIS, or *HMS time format is used, the length of the host variable must not be less than 5. If the length is 5, 6, or 7, the seconds part of the time is omitted from the result, and SQLWARN1 is set to 'W'. In this case, the seconds part of the time is assigned to the indicator variable if one is provided, and, if the length is 6 or 7, blank padding occurs so that the value is a valid string representation of a time.

TIMESTAMP

The length of the host variable must not be less than 19. If the length is between 19 and 25, the timestamp is truncated like a string, causing the omission of one or more digits of the microsecond part. If the length is 20, the trailing decimal point is replaced by a blank so that the value is a valid string representation of a timestamp.

DataLink Assignments

The assignment of a value to a DataLink column results in the establishment of a link to a file unless the linkage attributes of the value are empty or the column is defined with NO LINK CONTROL. In cases where a linked value already exists in the column, that file is unlinked. Assigning a null value where a linked value already exists also unlinks the file associated with the old value.

If the application provides the same data location as already exists in the column, the link is retained. There are two reasons that this might be done:

- the comment is being changed
- if the table is placed in link pending state, the links in the table can be reinstated by providing linkage attributes identical to the ones in the column.

A DataLink value may be assigned to a column by using the DLVALUE scalar function. The DLVALUE scalar function creates a new DataLink value which can then be assigned a column. Unless the value contains only a comment or the URL is exactly the same, the act of assignment will link the file.

When assigning a value to a DataLink column, the following error conditions can occur:

- Data Location (URL) format is invalid
- File server is not registered with this database
- Invalid link type specified
- Invalid length of comment or URL

  Note that the size of a URL parameter or function result is the same on both input or output and is bound by the length of the DataLink column. However, in some cases the URL value returned has an access token attached. In situations where this is possible, the output location must have sufficient storage space for the access token and the length of the DataLink column. Hence, the actual length of the comment and URL in its fully expanded form provided on input should be restricted to accommodate the output storage space. If the restricted length is exceeded, this error is raised.

When the assignment is also creating a link, the following errors can occur:
- File server not currently available.
- File does not exist.
- Referenced file cannot be accessed for linking.
- File already linked to another column.

  Note that this error will be raised even if the link is to a different relational database.

In addition, when the assignment removes an existing link, the following errors can occur:
- File server not currently available.
- File with referential integrity control is not in a correct state according to the DB2 DataLinks File Manager.

A DataLink value may be retrieved from the database through the use of scalar functions (such as DLLINKTYPE and DLURLPATH). The results of these scalar functions can then be assigned to host variables.

Note that usually no attempt is made to access the file server at retrieval time. [16]It is therefore possible that subsequent attempts to access the file server through file system commands might fail.

A warning may be returned when retrieving a DataLink value because the table is in link pending state.

Distinct Type Assignments

The rules that apply to the assignments of user-defined types to host variables are different than the rules for all other assignments that involve distinct types.

Assignments to Host Variables

The assignment of a distinct type to a host variable is based on the source data type of the distinct type. Therefore, the value of a distinct type is assignable to a host variable only if the source data type of the distinct type is assignable to the host variable.

Example: Assume that distinct type AGE was created with the following SQL statement and column STU_AGE in table STUDENTS was defined with that distinct type. Using the CL_SCHED table, select all the classes (CLASS_CODE) that start (STARTING) later today. Today’s classes have a value of 3 in the DAY column.

```
CREATE DISTINCT TYPE AGE AS SMALLINT WITH COMPARISONS
```

Next, consider this valid assignment of a student’s age to host variable HV_AGE, which has an INTEGER data type.

```
SELECT  STU_AGE INTO :HV_AGE FROM STUDENTS WHERE STU_NUMBER = 200
```

---

[16] It may be necessary to access the file server to determine the prefix name associated with a path. This can be changed at the file server when the mount point of a file system is moved. First access of a file on a server will cause the required values to be retrieved from the file server and cached at the database server for the subsequent retrieval of DataLink values for that file server. An error is returned if the file server cannot be accessed.

The distinct type value is assignable to the host variable HV_AGE because the source data type of the distinct type (SMALLINT) is assignable to the host variable (INTEGER). If distinct type AGE had been sourced on a character data type such as CHAR(5), the above assignment would be invalid because a character type cannot be assigned to an integer type.

Assignments Other Than to Host Variables

A distinct type can be either the source or target of an assignment. Assignment is based on whether the data type of the value to be assigned is castable to the data type of the target. "Casting Between Data Types" on page 63 shows which casts are supported when a distinct type is involved. Therefore, a distinct type value can be assigned to any target other than a host variable when:

- The target of the assignment has the same distinct type, or
- The distinct type is castable to the data type of the target

Any value can be assigned to a distinct type when:

- The value to be assigned has the same distinct type as the target, or
- The data type of the assigned value is castable to the target distinct type

Example: Assume that the source data type for distinct type AGE is SMALLINT:

```
CREATE DISTINCT TYPE AGE AS SMALLINT WITH COMPARISONS
```

Next, assume that two tables TABLE1 and TABLE2 were created with four identical column descriptions:

```
AGECOL    AGE
SMINTCOL  SMALLINT
INTCOL    INTEGER
DECCOL    DEC(6,2)
```

Using the following SQL statement and substituting various values for X and Y to insert values into various columns of TABLE1 from TABLE2, Table 12 shows whether the assignments are valid.

```
INSERT INTO  TABLE1 (Y) SELECT X FROM TABLE2
```

Table 12. Assessment of various assignments (for example on INSERT)

TABLE2.X	TABLE1.Y	Valid	Reason
AGECOL	AGECOL	Yes	Source and target are same distinct type
SMINTCOL	AGECOL	Yes	SMALLINT can be cast to AGE (because AGE's source type is SMALLINT)
INTCOL	AGECOL	Yes	INTEGER can be cast to AGE (because AGE's source type is SMALLINT)
DECCOL	AGECOL	No	DECIMAL cannot be cast to AGE
AGECOL	SMINTCOL	Yes	AGE can be cast to its source type SMALLINT
AGECOL	INTCOL	No	AGE cannot be cast to INTEGER
AGECOL	DECCOL	No	AGE cannot be cast to DECIMAL

Numeric Comparisons

Numbers are compared algebraically; that is, with regard to sign. For example, negative 2 is less than +1.

If one number is an integer and the other number is decimal, the comparison is made with a temporary copy of the integer, which has been converted to decimal.

When decimal or nonzero scale binary numbers with different scales are compared, the comparison is made with a temporary copy of one of the numbers that has been extended with trailing zeros so that its fractional part has the same number of digits as the other number.

If one number is floating point and the other number is integer, decimal, or single-precision floating point, the comparison is made with a temporary copy of the second number converted to a double-precision floating-point number. However, if a single-precision floating-point column is compared to a constant and the constant can be represented by a single-precision floating-point number, the comparison is made with a single-precision form of the constant.

Two floating-point numbers are equal only if the bit configurations of their normalized forms are identical.

String Comparisons

Binary String Comparisons

Binary string comparisons always use a sort sequence of *HEX and the corresponding bytes of each string are compared. Additionally, two binary strings are equal only if the length of the two strings is identical.

Character and Graphic String Comparisons

Character and UCS-2 graphic string comparisons use the sort sequence in effect when the statement is executed for all SBCS data and the single-byte portion of mixed data. If the sort sequence is *HEX, the corresponding bytes of each string are compared. For all other sort sequences, the corresponding bytes of the weighted value of each string are compared. If the strings have different lengths, a temporary copy of the shorter string is padded on the right with blanks before comparison. The padding makes each string the same length. The pad character is always a blank, regardless of the sort sequence. For bit data, the pad character is also a blank. For DBCS graphic data, the pad character is a DBCS blank (x’4040’). For UCS-2 graphic data, the pad character is a UCS-2 blank. [17]

Two strings are equal if any of the following are true:

- Both strings are empty.
- A *HEX sort sequence is used and all corresponding bytes are equal.
- A sort sequence other than *HEX is used and all corresponding bytes of the weighted value are equal.

An empty string is equal to a blank string. The relationship between two unequal strings is determined by a comparison of the first pair of unequal bytes (or bytes of the weighted value) from the left end of the string. This comparison is made according to the sort sequence in effect when the statement is executed.

---

[17] UCS-2 defines a blank character at code point X’0020’ and X’3000’. The database manager pads with the blank at code point X’0020’.

Assignments and Comparisons

Two varying-length strings with different lengths are equal if they differ only in the number of trailing blanks. In operations that select one value from a set of such values, the value selected is arbitrary. The operations that can involve such an arbitrary selection are DISTINCT, MAX, MIN, UNION and references to a grouping column. See the description of GROUP BY for further information about the arbitrary selection involved in references to a grouping column.

Conversion Rules for Comparison

When two strings are compared, one of the strings is first converted, if necessary, to the coded character set of the other string. Character conversion is necessary only if all of the following are true:

- The CCSIDs of the two strings are different.
- Neither CCSID is 65535.
- The string selected for conversion is neither null nor empty.
- The CCSID Conversion Selection Table indicates that conversion is necessary.

If two strings with different encoding schemes are compared and the operands are the same type, any necessary conversion applies to the string as follows:

Table 13. Selecting the Encoding Scheme for Character Conversion

	Second Operand			
First Operand	**SBCS Data**	**DBCS Data**	**Mixed Data**	**UCS-2 Data**
SBCS Data	See below	Second	Second	Second
DBCS Data	First	See below	Second	Second
Mixed Data	First	First	See below	Second
UCS-2 Data	First	First	First	See below

Otherwise, the string selected for conversion depends on the type of each operand. The following table shows which operand is selected for conversion, given the operand types:

Table 14. Selecting the Operand for Character Conversion

	Second Operand				
First Operand	**Column Value**	**Derived Value**	**Special Register**	**Constant**	**Host Variable**
Column Value	Second	Second	Second	Second	Second
Derived Value	First	Second	Second	Second	Second
Special Register	First	First	Second	Second	Second
Constant	First	First	First	Second	Second
Host Variable	First	First	First	First	Second

A host variable containing data in a foreign encoding scheme is always effectively converted to the native encoding scheme before it is used in any operation. The above rules are based on the assumption that this conversion has already occurred.

An error occurs if a character of the string cannot be converted or the CCSID Conversion Selection Table is used but does not contain any information about the pair of CCSIDs. A warning occurs if a character of the string is converted to the substitution character.

Datetime Comparisons

A DATE, TIME, or TIMESTAMP value can be compared either with another value of the same data type or with a string representation of that data type. All comparisons are chronological, which means the farther a point in time is from January 1, 0001, the *greater* the value of that point in time.

Comparisons involving TIME values and string representations of time values always include seconds. If the string representation omits seconds, zero seconds are implied. The time 24:00:00 compares greater than the time 00:00:00.

Comparisons involving TIMESTAMP values are chronological without regard to representations that might be considered equivalent. Thus, the following predicate is true:

```
TIMESTAMP('1990-02-23-00.00.00') > '1990-02-22-24.00.00'
```

Distinct Type Comparisons

A value with a distinct type can be compared only to another value with exactly the same distinct type.

For example, assume that distinct type YOUTH and table CAMP_DB2_ROSTER table were created with the following SQL statements:

```
CREATE DISTINCT TYPE YOUTH AS INTEGER WITH COMPARISONS

CREATE TABLE CAMP_DB2_ROSTER
  ( NAME              VARCHAR(20),
    ATTENDEE_NUMBER   INTEGER NOT NULL,
    AGE               YOUTH,
    HIGH_SCHOOL_LEVEL YOUTH)
```

The following comparison is valid because AGE and HIGH_SCHOOL_LEVEL have the same distinct type:

```
SELECT * FROM CAMP_DB2_ROSTER
  WHERE AGE > HIGH_SCHOOL_LEVEL
```

The following comparison is not valid:

```
SELECT * FROM CAMP_DB2_ROSTER
  WHERE AGE > ATTENDEE_NUMBER
```

However, AGE can be compared to ATTENDEE_NUMBER by using a cast function or CAST specification to cast between the distinct type and the source type. All of the following comparisons are valid:

```
SELECT * FROM CAMP_DB2_ROSTER
  WHERE AGE > YOUTH(ATTENDEE_NUMBER)

SELECT * FROM CAMP_DB2_ROSTER
  WHERE AGE > CAST( ATTENDEE_NUMBER AS YOUTH)

SELECT * FROM CAMP_DB2_ROSTER
  WHERE INTEGER(AGE) > ATTENDEE_NUMBER

SELECT * FROM CAMP_DB2_ROSTER
  WHERE CAST(AGE AS INTEGER) > ATTENDEE_NUMBER
```

Rules for Result Data Types

The data types of a result are determined by rules which are applied to the operands in an operation. This section explains those rules.

These rules apply to:

- Corresponding columns in UNION or UNION ALL operations
- Result expressions of a CASE expression
- Arguments of the scalar functions COALESCE, IFNULL, MAX, MIN, and VALUE
- Expression values of the IN list of an IN predicate

The data type of the result is determined by the data type of the operands. The data types of the first two operands determine an intermediate result data type, this data type and the data type of the next operand determine a new intermediate result data type, and so on. The last intermediate result data type and the data type of the last operand determine the data type of the result. For each pair of data types, the result data type is determined by the sequential application of the rules summarized in the following table:

If neither operand column allows nulls, the result does not allow nulls. Otherwise, the result allows nulls. If the description of any operand column is not the same as the description of the result, its values are converted to conform to the description of the result.

The conversion operation is exactly the same as if the values were assigned to the result. For example,

- If one operand column is CHAR(10), and the other operand column is CHAR(5), the result is CHAR(10), and the values derived from the CHAR(5) column are padded on the right with five blanks.
- An error occurs if the whole part of a number cannot be preserved.

Binary String Operands

Binary strings (BLOBs) are compatible only with other binary strings (BLOBs). The data type of the result is a BLOB. Other data types can be treated as a BLOB data type by using the BLOB scalar function to cast the data type to a BLOB. The length of the result BLOB is the largest length of all the data types.

If one operand column is...	**And the other operand is...**	**The data type of the result column is...**
BLOB(x)	BLOB(y)	BLOB(z) where z = max(x,y)

Character and Graphic String Operands

| Character and graphic strings are compatible with other character and graphic
| strings when there is a defined conversion between their corresponding CCSIDs.

If one operand column is...	And the other operand is...	The data type of the result column is...
DBCLOB(x)	CHAR(y) or VARCHAR(y) or CLOB(y) or GRAPHIC(y) or VARGRAPHIC(y) or DBCLOB(y)	DBCLOB(z) where z = max(x,y)
CLOB(x)	GRAPHIC(y) or VARGRAPHIC(y)	DBCLOB(z) where z = max(x,y)
VARGRAPHIC(x)	VARGRAPHIC(y) or GRAPHIC(y) or VARCHAR(y) or CHAR(y)	VARGRAPHIC(z) where z = max(x,y)
VARCHAR(x)	GRAPHIC(y)	VARGRAPHIC(z) where z = max(x,y)
GRAPHIC(x)	GRAPHIC(y) or CHAR(y)	GRAPHIC(z) where z = max(x,y)
CLOB(x)	CLOB(y) or VARCHAR(y) or CHAR(y)	CLOB(z) where z = max(x,y)
VARCHAR(x)	VARCHAR(y) or CHAR(y)	VARCHAR(z) where z = max(x,y)
CHAR(x)	CHAR(y)	CHAR(z) where z = max(x,y)

The CCSID of the result also determines the resulting subtypes based on the following table:

If one operand column is...	And the other operand is...	The subtype of the result column is...
UCS-2 data	DBCS or mixed or SBCS data	UCS-2 data
DBCS data	DBCS or mixed or SBCS data	DBCS data
bit data	mixed, SBCS, or bit data	bit data
mixed data	mixed or SBCS data	mixed data
SBCS data	SBCS data	SBCS data

Numeric Operands

Numeric types are compatible only with other numeric types.

If one operand column is...	And the other operand is...	The data type of the result column is...
FLOAT (double)	any numeric type	FLOAT (double)
FLOAT (single)	FLOAT (single)	FLOAT (single)
FLOAT (single)	DECIMAL, NUMERIC, BIGINT, INTEGER, or SMALLINT	FLOAT (double)

Rules for Result Data Types

If one operand column is...	And the other operand is...	The data type of the result column is...
DECIMAL(w,x)	DECIMAL(y,z) or NUMERIC(y,z,)	DECIMAL(p,s) where p = min(31, max(x,z)+max(w-x,y-z)) s = max(x,z)
DECIMAL(w,x)	BIGINT	DECIMAL(p,x) where p = min(31, x+max(w-x,19))
DECIMAL(w,x)	INTEGER	DECIMAL(p,x) where p = min(31, x+max(w-x,11))
DECIMAL(w,x)	SMALLINT	DECIMAL(p,x) where p = min(31, x+max(w-x,5))
NUMERIC(w,x)	NUMERIC(y,z)	NUMERIC(p,s) where p = min(31, max(x,z) + max(w-x, y-z)) s = max(x,z)
NUMERIC(w,x)	BIGINT	NUMERIC(p,x) where p = min(31, x + max(w-x,19))
NUMERIC(w,x)	INTEGER	NUMERIC(p,x) where p = min(31, x + max(w-x,11))
NUMERIC(w,x)	SMALLINT	NUMERIC(p,x) where p = min(31, x + max(w-x,5))
BIGINT	BIGINT	BIGINT
BIGINT	INTEGER	BIGINT
BIGINT	SMALLINT	BIGINT
INTEGER	INTEGER	INTEGER
INTEGER	SMALLINT	INTEGER
SMALLINT	SMALLINT	SMALLINT
NONZERO SCALE BINARY	NONZERO SCALE BINARY	NONZERO SCALE BINARY (If either operand is nonzero scale binary, both operands must be binary with the same scale.)

Datetime Operands

A DATE type is compatible with another DATE type, or any CHAR or VARCHAR expression that contains a valid string representation of a date. The data type of the result is DATE.

A TIME type is compatible with another TIME type, or any CHAR or VARCHAR expression that contains a valid string representation of a time. The data type of the result is TIME.

A TIMESTAMP type is compatible with another TIMESTAMP type, or any CHAR or VARCHAR expression that contains a valid string representation of a timestamp. The data type of the result is TIMESTAMP.

If one operand column is...	And the other operand is...	The data type of the result column is...
DATE	DATE	DATE
TIME	TIME	TIME
TIMESTAMP	TIMESTAMP	TIMESTAMP

DATALINK Operands

A DataLink is compatible with another DataLink. However, DataLinks with NO LINK CONTROL are only compatible with other DataLinks with NO LINK CONTROL; DataLinks with FILE LINK CONTROL READ PERMISSION FS are only compatible with other DataLinks with FILE LINK CONTROL READ PERMISSION FS; and DataLinks with FILE LINK CONTROL READ PERMISSION DB are only compatible with other DataLinks with FILE LINK CONTROL READ PERMISSION DB. The data type of the result is DATALINK. The length of the result DATALINK is the largest length of all the data types.

If one operand column is...	And the other operand is...	The data type of the result column is...
DATALINK(x)	DATALINK(y)	DATALINK(z) where z = max(x,y)

DISTINCT Type Operands

A distinct type is compatible only with itself. The data type of the result is the distinct type.

If one operand column is...	And the other operand is...	The data type of the result column is...
Distinct Type	Distinct Type	Distinct Type

Conversion Rules for Operations That Combine Strings

The operations that combine strings are concatenation, UNION, and UNION ALL. (These rules also apply to the MAX, MIN, VALUE, COALESCE, IFNULL, and CONCAT scalar functions and CASE expressions.) In each case, the CCSID of the result is determined at bind time, and the execution of the operation may involve conversion of strings to the coded character set identified by that CCSID.

The CCSID of the result is determined by the CCSIDs of the operands. The CCSIDs of the first two operands determine an intermediate result CCSID, this CCSID and the CCSID of the next operand determine a new intermediate result CCSID, and so on. The last intermediate result CCSID and the CCSID of the last operand determine the CCSID of the result string or column. For each pair of CCSIDs, the result CCSID is determined by the sequential application of the following rules:

- If the CCSIDs are equal, the result is that CCSID.
- If either CCSID is 65535, the result is 65535.[18]
- If one CCSID denotes data in an encoding scheme different from the other CCSID, the result is determined by the following table:

Table 15. Selecting the Encoding Scheme of the Intermediate Result

	Second Operand			
First Operand	**SBCS Data**	**DBCS Data**	**Mixed Data**	**UCS-2 Data**
SBCS Data	See below	Second	Second	Second
DBCS Data	First	See below	Second	Second
Mixed Data	First	First	See below	Second
UCS-2 Data	First	First	First	See below

---

[18] If either operand is a CLOB or DBCLOB, the resulting CCSID is the job default CCSID.

- Otherwise, the resulting CCSID is determined by the following table:

Table 16. Selecting the CCSID of the Intermediate Result

	Second Operand				
First Operand	**Column Value**	**Derived Value**	**Constant**	**Special Register**	**Host Variable**
Column Value	First	First	First	First	First
Derived Value	Second	First	First	First	First
Constant	Second	Second	First	First	First
Special Register	Second	Second	First	First	First
Host Variable	Second	Second	Second	Second	First

However, a host variable containing data in a foreign encoding scheme is effectively converted to the native encoding scheme before it is used in any operation. The above rules are based on the assumption that this conversion has already occurred.

Note that an intermediate result is considered to be a derived value operand. For example, assume COLA, COLB, and COLC are columns with CCSIDs 37, 278, and 500, respectively. The result CCSID of COLA CONCAT COLB CONCAT COLC is determined as follows:

1. The result CCSID of COLA CONCAT COLB is first determined to be 37 because both operands are columns, so the CCSID of the first operand is chosen.
2. The result CCSID of the concatenation of the result from step 1 and COLC is determined to be 500. The result CCSID of 500 is determined because the first operand is a derived value and the second operand is a column, so the CCSID of the second operand is chosen.

An operand of concatenation or the selected argument of the MAX, MIN, VALUE, COALESCE, IFNULL, and CONCAT scalar function is converted, if necessary, to the coded character set of the result string. Each string of an operand of UNION or UNION ALL is converted, if necessary, to the coded character set of the result column. Character conversion is necessary only if all of the following are true:

- The CCSIDs are different.
- Neither CCSID is 65535.
- The string is neither null nor empty.
- The CCSID Conversion Selection Table indicates that conversion is necessary.

An error occurs if a character of a string cannot be converted or if the CCSID Conversion Selection Table is used but does not contain any information about the CCSID pair. A warning occurs if a character of a string is converted to the substitution character.

Constants

A *constant* (sometimes called a *literal*) specifies a value. Constants are classified as string constants or numeric constants. String constants are further classified as character or graphic. Numeric constants are further classified as integer, floating point, or decimal.

All constants have the attribute NOT NULL. A negative sign in a numeric constant with a value of zero is ignored.

Integer Constants

An *integer constant* specifies an integer as a signed or unsigned number with a maximum of 19 digits that does not include a decimal point. The data type of an integer constant is large integer if its value is within the range of a large integer. The data type of an integer constant is big integer if its value is outside the range of a large integer, but within the range of a big integer. A constant that is defined outside the range of big integer values is considered a decimal constant.

In syntax diagrams, the term *integer* is used for a large integer constant that must not include a sign.

Examples

```
64      -15     +100        32767     720176     12345678901
```

Floating-Point Constants

A *floating-point constant* specifies a double-precision floating-point number as two numbers separated by an E. The first number can include a sign and a decimal point; the second number can include a sign but not a decimal point. The value of the constant is the product of the first number and the power of 10 specified by the second number; it must be within the range of floating-point numbers. The number of characters in the constant must not exceed 24. Excluding leading zeros, the number of digits in the first number must not exceed 17 and the number of digits in the second must not exceed 3.

Examples

```
15E1    2.E5    2.2E-1     +5.E+2
```

Decimal Constants

A *decimal constant* specifies a decimal number as a signed or unsigned number that includes at most 31 digits. The constant must either:

- Include a decimal point, or
- Be larger than 2147483647 or smaller than -2147483647

The precision is the total number of digits (including leading and trailing zeros); the scale is the number of digits to the right of the decimal point (including trailing zeros).

Examples

```
25.5    1000.    -15.    +37589.3333333333    12345678901
```

Binary-String Constants

A *binary-string constant* specifies a varying-length binary string. The form of a binary-string constant follows:

- An X followed by a sequence of characters that starts and ends with a string delimiter. The characters between the string delimiters must be an even number of hexadecimal digits. The number of hexadecimal digits must not exceed 32740. A hexadecimal digit is a digit or any of the letters A through F (uppercase or lowercase).

The CCSID assigned to the constant is 65535.

Note that the syntax of a binary string constant is identical to the second form of a character constant. A constant of this form is only treated as a binary string constant if the SET OPTION statement was specified with the binary string option (`SQLCURRULE = *STD`).

Example

```
X'FFFF'
```

Character-String Constants

A *character-string constant* specifies a varying-length character string. The two forms of character-string constant follow:

- A sequence of characters that starts and ends with a string delimiter. The number of bytes between the string delimiters cannot be greater than 32740. Two consecutive string delimiters are used to represent one string delimiter within the character string. Two consecutive string delimiters that are not contained within a string represent the empty string.
- An X followed by a sequence of characters that starts and ends with a string delimiter. The characters between the string delimiters must be an even number of hexadecimal digits. The number of hexadecimal digits must not exceed 32740. A hexadecimal digit is a digit or any of the letters A through F (uppercase or lowercase). Under the conventions of hexadecimal notation, each pair of hexadecimal digits represents a character. This form of string constant allows you to specify characters that do not have a keyboard representation.

Character-string constants can contain mixed data. If the job CCSID supports mixed data, a character-string constant is classified as mixed data if it includes a DBCS substring. In all other cases, a character-string constant is classified as SBCS data.

The CCSID assigned to the constant is the CCSID of the source containing the constant unless the source is encoded in a foreign encoding scheme (such as ASCII). The data in the host variable is converted from the foreign encoding scheme to the default CCSID of the current server. In this case, the CCSID assigned to the constant is the default CCSID of the current server.

The CCSID of the source is determined by the application requester. The CCSID of the source is:

- For STRSQL, the default CCSID of the application requester
- For the RUNSQLSTM or STRREXPRC commands, the CCSID of the specified source file
- For CRTSQLxxx:
  - For static SQL, the CCSID of the source is the CCSID of the source file used on the CRTSQLxxx command.
  - For dynamic SQL, the CCSID of the source is the CCSID of the host variable specified on the PREPARE statement, or if a string constant is specified on the PREPARE statement, the default CCSID of the current server.

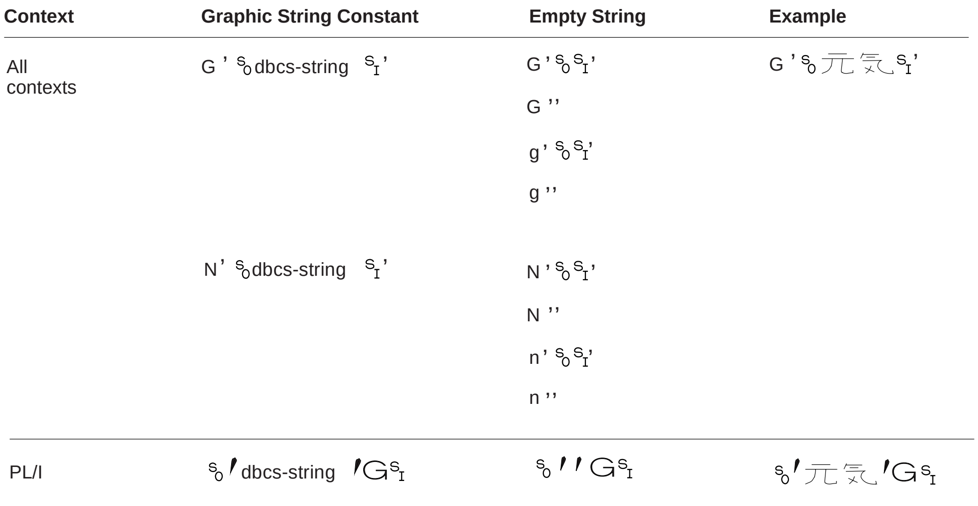
Examples

```
'Peggy'    '14.12.1990'    '32'    'DON''T CHANGE'    ''    X'FFFF'
```

Graphic-String Constants

DBCS Graphic-String Constants

A *graphic-string constant* is a varying-length graphic string. The length of the specified string cannot be greater than 16370. The three forms of DBCS graphic-string constants are:



Context	Graphic String Constant	Empty String	Example
All contexts	G'$S_O$dbcs-string S_I'	G'$S_O S_I$' G'' g'$S_O S_I$' g''	G'S_O元気S_I'
	N'$S_O$dbcs-string S_I'	N'$S_O S_I$' N'' n'$S_O S_I$' n''	
PL/I	S_O'dbcs-string 'GS_I	S_O''GS_I	S_O'元気'GS_I

RV3F000-0

In the normal form, the SQL delimiters and the G or the N are SBCS characters. The SBCS ′ is the EBCDIC apostrophe, X′7D′.

In the PL/I form, the apostrophes and the G are DBCS characters. Two consecutive DBCS string delimiters are used to represent one string delimiter within the string. Note that this PL/I form is only valid for static statements embedded in PL/I programs.

A hexadecimal DBCS graphic constant is also supported. The form of the hexadecimal DBCS graphic constant is:

GX′ssss′

In the constant, **ssss** represents a string from 0 to 32766 hexadecimal digits. The number of characters between the string delimiters must be an even multiple of 4. Each group of 4 digits represents a single DBCS graphic character. The hexadecimal for shift-in and shift-out (′0E′X and ′0F′X) are not included in the string.

The CCSID assigned to constants is the DBCS CCSID associated with the CCSID of the source unless the source is encoded in a foreign encoding scheme (such as ASCII). In this case, the CCSID assigned to the constant is the DBCS CCSID associated with the default CCSID of the current server when the SQL statement containing the constant is prepared. If there is no DBCS CCSID associated with the CCSID of the source, the CCSID is 65535.

For information on associated DBCS CCSIDs, see the *International Application Development* book. For information on the CCSID of the source, see Character String Constants.

UCS-2 Graphic-String Constants

A hexadecimal UCS-2 graphic constant is supported. The form of the hexadecimal UCS-2 graphic constant is:

UX’ssss’

In the constant, **ssss** represents a string from 0 to 32766 hexadecimal digits. The number of characters between the string delimiters must be an even multiple of 4. Each group of 4 digits represents a single UCS-2 graphic character.

Decimal Point

You have the option of specifying whether the decimal point in a numeric constant is represented by a period or a comma.

- For SQL statements in any language except REXX, the decimal point can be specified by using either the *JOB, *PERIOD, *COMMA, or *SYSVAL precompiler options in the OPTION parameter.
- The SET OPTION statement can be used to specify the decimal point within the source of a program containing embedded SQL.
- For SQL statements in Interactive SQL, the decimal point can be specified by using the DECPNT parameter on the STRSQL command or by changing the session attributes.
- For SQL statements processed by the RUNSQLSTM command, the decimal point can be specified by the DECMPT parameter.

If the comma is the decimal point, the following rules apply:

- A period will also be allowed as a decimal point.
- A comma intended as a separator of numeric constants in a SELECT statement or a VALUES clause must be followed by a space.
- A comma intended as a decimal point in any other context must not be followed by a space.

Thus, to specify a decimal constant without a fractional part, the trailing comma must be followed by a nonblank character. The nonblank character can be a separator comma, as in:

```
VALUES(9999999999,, 111)
```

Delimiters

*APOST and *QUOTE are mutually exclusive COBOL precompiler options that name the string delimiter within COBOL statements. *APOST names the apostrophe (') as the string delimiter; *QUOTE names the quotation mark ("). *APOSTSQL and *QUOTESQL are mutually exclusive COBOL precompiler options that play a similar role for SQL statements embedded in COBOL programs. *APOSTSQL names the apostrophe (') as the SQL string delimiter; with this option, the quotation mark (") is the SQL escape character. *QUOTESQL names the quotation mark as the SQL string delimiter; with this option, the apostrophe is the SQL escape character. The values of *APOSTSQL and *QUOTESQL are respectively the same as the values of *APOST and *QUOTE.

In host languages other than COBOL, the usages are fixed. The string delimiter for the host language and for static SQL statements is the apostrophe ('); the SQL escape character is the quotation mark (").

Special Registers

A *special register* is a storage area that is defined for an application process by the database manager and is used to store information that can be referenced in SQL statements. A reference to a special register is a reference to a value provided by the current server. If the value is a string, its CCSID is a default CCSID of the current server. DB2 UDB for AS/400 includes the following special registers.

CURRENT DATE or CURRENT_DATE

The CURRENT DATE special register specifies a date that is based on a reading of the time-of-day clock when the SQL statement is executed at the current server. All values are based on a single clock reading in the following situations:

- this special register is used more than once within a single SQL statement
- this special register is used with the CURRENT TIME or CURRENT TIMESTAMP special registers or the CURDATE, CURTIME, or NOW scalar functions within a single statement

Example

Using the PROJECT table, set the project end date (PRENDATE) of the MA2111 project (PROJNO) to the current date.

```
UPDATE PROJECT
  SET PRENDATE = CURRENT DATE
  WHERE PROJNO = 'MA2111'
```

CURRENT PATH, CURRENT_PATH, or CURRENT FUNCTION PATH

The CURRENT PATH special register specifies the SQL path used to resolve unqualified data type names (both built-in and distinct type), procedure names, and function names in dynamically prepared SQL statements. It is also used to resolve unqualified procedure names that are specified as host variables in SQL CALL statements (CALL host-variable). The data type is VARCHAR(558).

The CURRENT PATH special register contains a list of one or more collection names, where each collection name is enclosed in delimiters and separated from the following collection by a comma. The delimiters and commas are included in the 558 character length.

For information on when the SQL path is used to resolve unqualified names in both dynamic and static SQL statements and the effect of its value, see “Collections and the SQL Path” on page 47.

The initial value of the CURRENT PATH special register in an activation group is established by the first SQL statement that is executed.

- If the first SQL statement in an activation group is executed from an SQL program or SQL package and the SQLPATH parameter was specified on the CRTSQLxxx command, the path is the value specified in the SQLPATH parameter. The SQLPATH value can also be specified using the SET OPTION statement.
- Otherwise,
  - For SQL naming, "QSYS", "QSYS2", *"the value of the authorization ID of the statement"* .
  - For system naming, "*LIBL".

You can change the value of the register by executing the statement SET PATH. For details about this statement, see "SET PATH" on page 493.

Example

Set the special register so that collection SMITH is searched before collections QSYS and QSYS2 (SYSTEM PATH).

```
SET CURRENT PATH SMITH, SYSTEM PATH
```

CURRENT SERVER or CURRENT_SERVER

The CURRENT SERVER special register specifies a VARCHAR(18) value that identifies the current application server.

CURRENT SERVER can be changed by the CONNECT (Type 1), CONNECT (Type 2), or SET CONNECTION statements, but only under certain conditions. See the description in "CONNECT (Type 1)" on page 283, "CONNECT (Type 2)" on page 287, and "SET CONNECTION" on page 478.

CURRENT SERVER cannot be specified unless the local relational database is named by adding the entry to the relational database directory using the ADDRDBDIRE or WRKRDBDIRE command.

Example

Set the host variable APPL_SERVE (VARCHAR(18)) to the name of the current server.

```
SELECT CURRENT SERVER
  INTO :APPL_SERVE
  FROM ROW1_TABLE
```

CURRENT TIME or CURRENT_TIME

The CURRENT TIME special register specifies a time that is based on a reading of the time-of-day clock when the SQL statement is executed at the current server. All values are based on a single clock reading in the following situations:

- this special register is used more than once within a single SQL statement
- this special register is used with the CURRENT DATE or CURRENT TIMESTAMP special registers or the CURDATE, CURTIME, or NOW scalar functions within a single statement

Example

Using the CL_SCHED table, select all the classes (CLASS_CODE) that start (STARTING) later today. Today's classes have a value of 3 in the DAY column.

```
SELECT CLASS_CODE FROM CL_SCHED
  WHERE STARTING > CURRENT TIME  AND DAY = 3
```

CURRENT TIMESTAMP or CURRENT_TIMESTAMP

The CURRENT TIMESTAMP special register specifies a timestamp that is based on a reading of the time-of-day clock when the SQL statement is executed at the current server. All values are based on a single clock reading in the following situations:

- this special register is used more than once within a single SQL statement
- this special register is used with the CURRENT DATE or CURRENT TIME special registers or the CURDATE, CURTIME, or NOW scalar functions within a single statement

Example

Insert a row into the IN_TRAY table. The value of the RECEIVED column should be a timestamp that indicates when the row was inserted. The values for the other three columns come from the host variables SRC (CHAR(8)), SUB (CHAR(64)), and TXT (VARCHAR(200)).

```
INSERT INTO IN_TRAY
  VALUES (CURRENT TIMESTAMP, :SRC, :SUB, :TXT)
```

CURRENT TIMEZONE or CURRENT_TIMEZONE

The CURRENT TIMEZONE special register specifies the difference between Universal Time Coordinated (UTC)[19] and local time at the current server. The difference is represented by a time duration (a decimal number in which the first two digits are the number of hours, the next two digits are the number of minutes, and the last two digits are the number of seconds). The number of hours is between -24 and 24 exclusive. Subtracting CURRENT TIMEZONE from a local time converts that local time to UTC.

Example

Using the IN_TRAY table, select all the rows from the table and adjust the value to UTC.

```
SELECT RECEIVED - CURRENT TIMEZONE, SOURCE,
      SUBJECT, NOTE_TEXT FROM IN_TRAY
```

USER

The USER special register specifies the run-time authorization ID at the current server. The data type of the special register is VARCHAR(18).

Example

Select all notes from the `IN_TRAY` table that the user placed there himself.

```
SELECT * FROM IN_TRAY
  WHERE SOURCE = USER
```

Column Names

The meaning of a column name depends on its context. A column name can be used to:

- Declare the name of a column, as in a CREATE TABLE statement.
- Identify a column, as in a CREATE INDEX statement.
- Specify values of the column, as in the following contexts:
  - In a *column function* a column name specifies all values of the column in the group or intermediate result table to which the function is applied. Groups and intermediate result tables are explained under “SELECT INTO” on page 476. For example, MAX(SALARY) applies the function MAX to all values of the column SALARY in a group.
  - In a *GROUP BY or ORDER BY clause,* a column name specifies all values in the intermediate result table to which the clause is applied. For example, ORDER BY DEPT orders an intermediate result table by the values of the column DEPT.
  - In an *expression,* a *search condition,* or a *scalar function,* a column name specifies a value for each row or group to which the construct is applied. For example,

---

[19] Formerly known as Greenwich Mean Time (GMT).

when the search condition CODE = 20 is applied to some row, the value specified by the column name CODE is the value of the column CODE in that row.

Qualified Column Names

A qualifier for a column name can be a table name, a view name, an alias name, or a correlation name.

Whether a column name can be qualified depends on its context:

- In the COMMENT ON and LABEL ON statements, the column name must be qualified.
- Where the column name specifies values of the column, a column name can be qualified at the user’s option.
- In all other contexts, a column name must not be qualified.

Where a qualifier is optional it can serve two purposes. See “Column Name Qualifiers to Avoid Ambiguity” on page 92 and “Column Name Qualifiers in Correlated References” on page 93 for details.

Correlation Names

A *correlation name* can be defined in the FROM clause of a query and in the first clause of an UPDATE or DELETE statement. For example, the clause shown below establishes Z as a correlation name for X.MYTABLE:

```
FROM X.MYTABLE Z
```

A correlation name is associated with a table, view, or alias only within the context in which it is defined. Hence, you can define the same correlation name for different purposes in different statements, or in different clauses of the same statement.

As a qualifier, you can use a correlation name to avoid ambiguity or to establish a correlated reference. You can also use a correlation name as a shorter name for a table, view, or alias. In the example that is shown above, Z might have been used merely to avoid having to enter X.MYTABLE more than once.

If a correlation name is specified for a table name, view name or alias name, any qualified reference to a column of that instance of the table, view or alias must use the correlation name, rather than the table name, view name, or alias name. For example, the reference to EMPLOYEE.PROJECT in the following example is incorrect, because a correlation name has been specified for EMPLOYEE:

```
FROM EMPLOYEE E                          ***INCORRECT***
  WHERE EMPLOYEE.PROJECT='ABC'
```

The qualified reference to PROJECT should instead use the correlation name, “E”, as shown below:

```
FROM EMPLOYEE E
  WHERE E.PROJECT='ABC'
```

Names specified in a FROM clause are either *exposed* or *non-exposed*. A correlation name is always an exposed name. A table name, view name, or alias name is said to be *exposed* in that FROM clause if a correlation name is not specified. For example, in the following FROM clause, a correlation name is specified for EMPLOYEE but not for DEPARTMENT, so DEPARTMENT is an exposed name, and EMPLOYEE is not:

```
FROM EMPLOYEE E, DEPARTMENT
```

A table name, view name, or alias name that is exposed in a FROM clause must not be the same as any other table name or view name exposed in that FROM clause or any correlation name in the FROM clause. The names are compared after qualifying any unqualified table or view names.

The first two FROM clauses shown below are correct, because each one contains no more than one reference to EMPLOYEE that is exposed:

1. Given the FROM clause:

   ```
   FROM EMPLOYEE E1, EMPLOYEE
   ```

   a qualified reference such as EMPLOYEE.PROJECT denotes a column of the second instance of EMPLOYEE in the FROM clause. A qualified reference to the first instance of EMPLOYEE must use the correlation name "E1" (E1.PROJECT).
2. Given the FROM clause:

   ```
   FROM EMPLOYEE, EMPLOYEE E2
   ```

   a qualified reference such as EMPLOYEE.PROJECT denotes a column of the first instance of EMPLOYEE in the FROM clause. A qualified reference to the second instance of EMPLOYEE must use the correlation name "E2" (E2.PROJECT).
3. Given the FROM clause:

   ```
   FROM EMPLOYEE, EMPLOYEE                    ***INCORRECT***
   ```

   the two exposed table names included in this clause (EMPLOYEE and EMPLOYEE) are the same, and this is not allowed.
4. Given the following statement:

   ```
   SELECT *
     FROM EMPLOYEE E1, EMPLOYEE E2            ***INCORRECT***
     WHERE EMPLOYEE.PROJECT='ABC'
   ```

   the qualified reference EMPLOYEE.PROJECT is incorrect, because both instances of EMPLOYEE in the FROM clause have correlation names. Instead, references to PROJECT must be qualified with either correlation name (E1.PROJECT or E2.PROJECT).
5. Given the FROM clause:

   ```
   FROM EMPLOYEE, X.EMPLOYEE
   ```

   a reference to a column in the second instance of EMPLOYEE must use X.EMPLOYEE (X.EMPLOYEE.PROJECT). This FROM clause is only valid if the authorization ID of the statement is not X.

A correlation name specified in a FROM clause must not be the same as:

- Any other correlation name in that FROM clause
- Any unqualified table name or view name exposed in the FROM clause
- The second SQL identifier of any qualified table name or view name in the FROM clause.

For example, the following FROM clauses are incorrect:

```
FROM EMPLOYEE E, EMPLOYEE E
FROM EMPLOYEE DEPARTMENT, DEPARTMENT           ***INCORRECT***
FROM X.T1, EMPLOYEE T1
```

The following FROM clause is technically correct, though potentially confusing:

```
FROM EMPLOYEE DEPARTMENT, DEPARTMENT EMPLOYEE
```

The use of a correlation name in the FROM clause also allows the option of specifying a list of column names to be associated with the columns of the result table. As with a correlation name, these listed column names become the exposed names of the columns that must be used for references to the columns throughout the query. If a column name list is specified, then the column names of the underlying table become non-exposed.

Given the FROM clause:

```
FROM DEPARTMENT D (NUM,NAME,MGR,ANUM,LOC)
```

a qualified reference such as D.NUM denotes the first column of the DEPARTMENT table that is defined in the table as DEPTNO. A reference to D.DEPTNO using this FROM clause is incorrect since the column name DEPTNO is a non-exposed column name.

If a list of columns is specified, it must consist of as many names as there are columns in the table-reference. Each column name must be unique and unqualified.

Column Name Qualifiers to Avoid Ambiguity

In the context of a function, a GROUP BY clause, ORDER BY clause, an expression, or a search condition, a column name refers to values of a column in some table or view. The tables and views that might contain the column are called the *object tables* of the context. Two or more object tables might contain columns with the same name. One reason for qualifying a column name is to designate the object from which the column comes.

Table Designators

A qualifier that designates a specific object table is called a *table designator*. The clause that identifies the object tables also establishes the table designators for them. For example, the object tables of an expression in a SELECT clause are named in the FROM clause that follows it:

```
SELECT CORZ.COLA, OWNY.MYTABLE.COLA
  FROM OWNX.MYTABLE CORZ, OWNY.MYTABLE
```

This is how you establish table designators in the FROM clause:

- A name that follows a table or view name is both a correlation name and a table designator. Thus, CORZ is a table designator. CORZ is used to qualify the first column name in the select list.
- In SQL naming, an exposed table or view name is a table designator. Thus, OWNY.MYTABLE is a table designator. OWNY.MYTABLE is used to qualify the second column name in the select list.
- In system naming, the table designator for an exposed table or view name is the unqualified table or view name. In the following example MYTABLE is the table designator for OWNY/MYTABLE.

  ```
  SELECT CORZ.COLA, MYTABLE.COLA
    FROM OWNX/MYTABLE CORZ, OWNY/MYTABLE
  ```

Avoiding undefined or ambiguous references

When a column name refers to values of a column, exactly one object table must include a column with that name. The following situations are considered errors:

- No object table contains a column with the specified name. The reference is undefined.
- The column name is qualified by a table designator, but the table designated does not include a column with the specified name. Again the reference is undefined.
- The name is unqualified and more than one object table includes a column with that name. The reference is ambiguous.

Avoid ambiguous references by qualifying a column name with a uniquely defined table designator. If the column is contained in several object tables with different names, the object table names can be used as designators.

Two or more object tables can be instances of the same table. In this case, distinct correlation names must be used to unambiguously designate the particular instances of the table. In the following FROM clause, X and Y are defined to refer, respectively, to the first and second instances of the table CORPDATA.EMPLOYEE:

```
FROM CORPDATA.EMPLOYEE X, CORPDATA.EMPLOYEE Y
```

When qualifying a column with the exposed table name form of a table designator, either the qualified or unqualified form of the exposed table name may be used. However, the qualifier used and the table used must be the same after fully qualifying the table name or view name and the table designator.

1. If the authorization ID of the statement is CORPDATA, then:

   ```
   SELECT CORPDATA.EMPLOYEE.WORKDEPT
     FROM EMPLOYEE
   ```

   is a valid statement.
2. If the authorization ID of the statement is REGION, then:

   ```
   SELECT CORPDATA.EMPLOYEE.WORKDEPT
     FROM EMPLOYEE                          ***INCORRECT***
   ```

   is invalid, because EMPLOYEE represents the table REGION.EMPLOYEE, but the qualifier for WORKDEPT represents a different table, CORPDATA.EMPLOYEE.

Column Name Qualifiers in Correlated References

A *subselect* is a form of a query that can be used as a component of various SQL statements. Refer to “Chapter 4. Queries” on page 219 for more information on subselects. A subselect used within a search condition of any statement is called a *subquery*.

A subquery can include search conditions of its own, and these search conditions can, in turn, include subqueries. Therefore, an SQL statement can contain a hierarchy of subqueries. Those elements of the hierarchy that contain subqueries are said to be at a higher level than the subqueries they contain.

Every element of the hierarchy has a clause that establishes one or more table designators. This is the FROM clause, except in the highest level of an UPDATE or DELETE statement. A search condition of a subquery can reference not only columns of the tables identified by the FROM clause of its own element of the hierarchy, but also columns of tables identified at any level along the path from its own element to the highest level of the hierarchy. A reference to a column of a table identified at a higher level is called a *correlated reference*.

A correlated reference to column C of table T can be of the form C, T.C, or Q.C, if Q is a correlation name defined for T. However, a correlated reference in the form of an unqualified column name is not good practice. The following explanation is based on the assumption that a correlated reference is always in the form of a qualified column name and that the qualifier is a correlation name.

Q.C is a correlated reference only if these three conditions are met:

- Q.C is used in a search condition of a subquery.
- Q does not designate a table used in the FROM clause of that subquery.
- Q does designate a table used at some higher level.

Q.C refers to column C of the table or view at the level where Q is used as the table designator of that table or view. Because the same table or view can be identified at many levels, unique correlation names are recommended as table designators. If Q is used to designate a table at more than one level, Q.C refers to the lowest level that contains the subquery that includes Q.C.

In the following statement, Q is used as a correlation name for T1 and T2, but Q.C refers to the correlation name associated with T2, because it is the lowest level that contains the subquery that includes Q.C.

```
SELECT *
  FROM T1 Q
  WHERE A < ALL (SELECT B
                   FROM T2 Q
                   WHERE B < ANY (SELECT D
                                    FROM T3
                                    WHERE D = Q.C))
```

Unqualified Column Names

An unqualified column name can also be a correlated reference if the column:

- Is used in a search condition of a subquery
- Is not contained in a table used in the FROM clause of that subquery
- Is contained in a table used at some higher level

Unqualified correlated references are not recommended because it makes the SQL statement difficult to understand. The column will be implicitly qualified when the statement is prepared depending on which table the column was found in. Once this implicit qualification is determined it will not change until the statement is re-prepared. An SQL precompiler issues a warning message in the precompile listing and the database manager issues a positive SQLCODE (+12) and SQLSTATE (01545) when an SQL statement that has an unqualified correlated reference is prepared or executed.

References to Host Variables

A *host variable* is a COBOL data item, an RPG field, or a PLI, REXX, C++, or C variable that is referenced in an SQL statement. Host variables are defined by statements of the host language. Host variables cannot be referenced in dynamic SQL statements; parameter markers must be used instead. See “Parameter markers” on page 456. For more information about how to refer to host structures in C, C++, COBOL, PL/I, and RPG, see “Host Structures in C, C++, COBOL, PL/I, and RPG" on page 99. For more information on host variables in REXX, see the SQL Programming with Host Languages book.

A *host-variable* in an SQL statement must identify a host variable described in the program according to the rules for declaring host variables. All host variables used in an SQL statement should be declared in an SQL declare section in all host languages other than REXX and RPG. (Variables do not have to be declared in REXX. In RPG, there is no declare section, and host variables may be declared throughout the program.) No variables may be declared outside an SQL declare section with names identical to variables declared inside an SQL declare section. An SQL declare section begins with BEGIN DECLARE SECTION and ends with END DECLARE SECTION.

For further information about using host variables, see the SQL Programming Concepts book.

The term *host-variable*, as used in the syntax diagrams, shows a reference to a host variable. A *host-variable* in the INTO clause of a FETCH, SELECT INTO, SET variable, or VALUES INTO statement identifies a host variable to which a value from a column of a row is assigned. A host variable in a CALL statement or in an EXECUTE statement identifies either or both a host variable to which an output parameter value is assigned, and a host variable that specifies an input argument value to be passed to the database manager from the application program. In all other contexts a *host-variable* specifies a value to be passed to DB2 UDB for AS/400 from the application program.

The general form of a *host-variable* reference is:

```
►►──:host-identifier──┬──────────────────────────────────┬──────────────►◄
                      │ ┌─INDICATOR─┐                    │
                      └─┴───────────┴──:host-identifier──┘
```

Each *host-identifier* must be declared in the source program. The variable designated by the second *host-identifier* must have a data type of *small integer* with zero scale.

The first *host-identifier* designates the *main variable*; the second *host-identifier* designates its *indicator variable*. The purposes of the indicator variable are to:

- Specify the null value. A negative value of the indicator variable specifies the null value.
- Indicate one of the following data mapping errors:
  - Characters could not be converted
  - Numeric conversion error (underflow or overflow)
  - Arithmetic expression error (division by 0)
  - Date or timestamp conversion error (a date or timestamp that is not within the valid range of the dates for the specified format)
  - String representation of the datetime value is not valid
  - Mixed data not properly formed
  - A numeric value that is not valid
  - Argument of SUBSTR scalar function is out of range
- Record the original length of a truncated string.

- Record the seconds portion of a time if the time is truncated on assignment to a host variable.

For example, if :V1:V2 is used to specify an insert or update value, and if V2 is negative, the value specified is the null value. If V2 is not negative the value specified is the value of V1.

Similarly, if :V1:V2 is specified in a CALL, FETCH, or SELECT INTO statement and the value returned is null, V1 is undefined, and V2 is set to a negative value. The negative value is:

- -1 if the value selected was the null value, or
- -2 if the null value was returned due to data mapping errors in the select list of an outer subselect. [20]

If the value returned is not null, that value is assigned to V1 and V2 is set to zero (unless the assignment to V1 requires string truncation, in which case, V2 is set to the original length of the string). If an assignment requires truncation of the seconds part of time, V2 is set to the number of seconds.

If the second host-identifier is omitted, the *host variable* does not have an indicator variable. The value specified by the *host-variable* :V1 is always the value of V1, and null values cannot be assigned to the variable. Thus, this form should not be used in an INTO clause unless the corresponding result column cannot contain null values. If this form is used and the column contains nulls, the database manager returns a negative value (-407) in the SQLCODE field of the SQLCA. If your data is truncated and there is no indicator variable, no error condition results.

A host variable must always be preceded by a colon when it is used in an SQL statement.

In PL/I, C, and C++, an SQL statement that references host variables must be within the scope of the declaration of those host variables. For host variables referenced in the SELECT statement of a cursor, that rule applies to the OPEN statement rather than to the DECLARE CURSOR statement.

The CCSID of a string host variable is either:

- The CCSID specified in the DECLARE VARIABLE statement, or
- If a DECLARE VARIABLE with a CCSID clause is not specified for the host variable, the default CCSID of the application requester at the time the SQL statement that contains the host variable is executed unless the CCSID is for a foreign encoding scheme (such as ASCII). In this case, the host variable is converted to the default CCSID of the current server.

Example

Using the PROJECT table, set the host variable PNAME (varchar(26)) to the project name (PROJNAME), the host variable STAFF (dec(5,2)) to the mean staffing level (PRSTAFF), and the host variable MAJPROJ (char(6)) to the major project (MAJPROJ) for project (PROJNO) 'IF1000'. Columns PRSTAFF and MAJPROJ may contain null values, so provide indicator variables STAFF_IND (smallint) and MAJPROJ_IND (smallint).

---

[20] It should be noted that although the null value returned for data mapping errors can be returned on certain scalar functions and for arithmetic expressions, the result column is not considered null capable unless an argument of the arithmetic expression or scalar function is null capable.

```
SELECT PROJNAME, PRSTAFF, MAJPROJ
  INTO :PNAME, :STAFF :STAFF_IND, :MAJPROJ :MAJPROJ_IND
  FROM PROJECT
  WHERE PROJNO = 'IF1000'
```

Host Variables in Dynamic SQL

In dynamic SQL statements, parameter markers are used instead of host variables. A parameter marker is a question mark (?) that represents a position in a dynamic SQL statement where the application will provide a value; that is, where a host variable would be found if the statement string were a static SQL statement. The following examples shows a static SQL that uses host variables and a dynamic statement that uses parameter markers:

```
INSERT INTO DEPT VALUES( :HV_DEPTNO, :HV_DEPTNAME, :HV_MGRNO, :HV_ADMRDEPT)

INSERT INTO DEPT VALUES( ?, ?, ?, ? )
```

For more information on parameter markers, see “Parameter markers” on page 456.

References to LOB Host Variables

Regular LOB variables, LOB locator variables (see “References to LOB Locator Variables”) and LOB file reference variables (see “References to LOB File Reference Variables” on page 98), can be defined in the following host languages:

- C
- C++
- ILE RPG
- ILE COBOL
- PL/I

Where LOBs are allowed, the term *host-variable* in a syntax diagram can refer to a regular host variable, a locator variable, or a file reference variable. Since these variables are not native data types in host programming languages, SQL extensions are used and the precompilers generate the host language constructs necessary to represent each variable.

When it is possible to define a host variable that is large enough to hold an entire LOB value and the performance benefit of delaying the transfer of data from the server is not required, a LOB locator is not needed. However, it is often not acceptable to store an entire LOB value in temporary storage due to host language restrictions, storage restrictions, or performance requirements. When storing a entire LOB value at one time is not acceptable, a LOB value can be referred to by a LOB locator and portions of the LOB value can be selected into or updated from host variables that contain only a portion of the LOB value.

Like all other host variables, a LOB locator variable or LOB file reference variable can have an associated indicator variable. Indicator variables for LOB locator variables and LOB file reference variables behave in the same way as indicator variables for other data types. When a null value is returned from the database, the indicator variable is set and the host variable is unchanged. This means that a locator can never point to a null value.

References to LOB Locator Variables

A LOB *locator variable* is a host variable that contains the locator representing a LOB value on the application server, which can be defined in the following host languages:

- C
- C++
- ILE RPG
- ILE COBOL
- PL/I

See “Manipulating Large Objects (LOBs) With Locators” on page 55 for information on how locators can be used to manipulate LOB values.

A locator variable in an SQL statement must identify a LOB locator variable described in the program according to the rules for declaring locator variables. This is always indirectly through an SQL statement. For example, in C:

```
static volatile SQL TYPE IS CLOB_LOCATOR *loc1;
```

The term *locator-variable*, as used in the syntax diagrams, shows a reference to a LOB locator variable. The meta-variable *locator-variable* can be expanded to include a *host-identifier* the same as that for *host-variable*.

When the indicator variable associated with a LOB locator is null, the value of the referenced LOB is null.

If a locator variable does not currently represent any value, an error occurs when the locator variable is referenced.

At transaction commit or any transaction termination, all LOB locators that were acquired by the transaction are released.

It is the application programmer’s responsibility to guarantee that any LOB locator is only used in SQL statements that are executed at the same application server that originally generated the LOB locator. For example, assume that a LOB locator is returned from one application server and assigned to a LOB locator variable. If that LOB locator variable is subsequently used in an SQL statement that is executed at a different application server, unpredictable results will occur.

References to LOB File Reference Variables

A LOB *file reference variable* is used for direct file input and output for a LOB, which can be defined in the following host languages:

- C
- C++
- ILE RPG
- ILE COBOL
- PL/I

Since these are not native data types, SQL extensions are used and the precompilers generate the host language constructs necessary to represent each variable.

A file reference variable represents (rather than contains) the file, just as a LOB locator represents, rather than contains, the LOB data. Database queries, updates, and inserts may use file reference variables to store or to retrieve single column values. The file referenced must exist at the application requester.

As with all other host variables, a file reference variable may have an associated indicator variable.

The length attribute of a file reference variable is assumed to be the maximum length of a LOB.

File reference variables are currently supported in the root (/), QOpenSys, and UDFS file systems. When a file is created, it is given the CCSID of the data that is being written to the file. Currently, mixed CCSIDs are not supported. To use a file created with a file reference variable, the file should be opened in binary mode.

For more information on file reference variables, see the SQL Programming Concepts book.

Host Structures in C, C++, COBOL, PL/I, and RPG

A host structure is a COBOL group, PL/I, C, or C++ structure, or RPG data structure that is referenced in an SQL statement. Host structures are defined by statements of the host language, as explained in the SQL Programming with Host Languages book. As used here, the term host structure does not include an SQLCA or SQLDA.

The form of a host structure reference is identical to the form of a host variable reference. The reference :S1:S2 is a host structure reference if S1 names a host structure. If S1 designates a host structure, S2 must be either a small integer variable, or an array of small integer variables. S1 is the host structure and S2 is its indicator array.

A host structure can be referenced in any context where a list of host variables can be referenced. A host structure reference is equivalent to a reference to each of the host variables contained within the structure in the order which they are defined in the host language structure declaration. The *n*th variable of the indicator array is the indicator variable for the *n*th variable of the host structure.

In PL/I, for example, if V1, V2, and V3 are declared as variables within the structure S1, the statement:

```
EXEC SQL FETCH CURSOR1 INTO :S1;
```

is equivalent to:

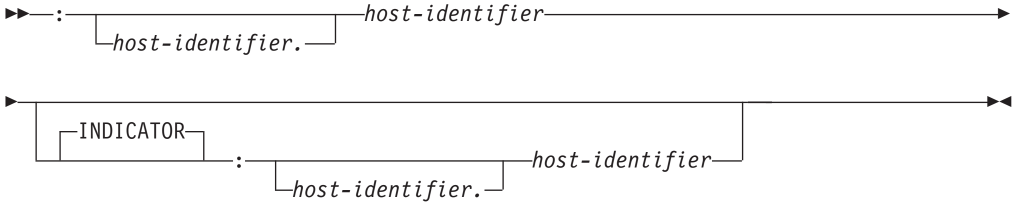
```
EXEC SQL FETCH CURSOR1 INTO :V1, :V2, :V3;
```

If the host structure has *m* more variables than the indicator array, the last *m* variables of the host structure do not have indicator variables. If the host structure has *m* fewer variables than the indicator array, the last *m* variables of the indicator array are ignored. These rules also apply if a reference to a host structure includes an indicator variable or if a reference to a host variable includes an indicator array. If an indicator array or indicator variable is not specified, no variable of the host structure has an indicator variable.

In addition to structure references, individual host variables in the host structure or indicator variables in the indicator array can be referenced by qualified names. The qualified form is a host identifier followed by a period and another host identifier. The first host identifier must name a host structure, and the second host identifier must name a host variable within that host structure.

The following diagram specifies the syntax of references to host variables and host structures:

Host Structures in C, C++, COBOL, PL/I, and RPG



A host-variable in an expression must identify a host variable (not a structure) described in the program according to the rules for declaring host variables.

Host structures are not supported in REXX.

The following examples show references to host variables and host structures:

```
:V1    :S1.V1    :S1.V1:V2    :S1.V2:S2.V4
```

Host Structure Arrays in C, C++, COBOL, PL/I, and RPG

In PL/I, C++, and C, a host structure array is a structure name having a dimension attribute. In COBOL, it is a one-dimensional table. In RPG, it is an occurrence data structure. A host structure array can only be referenced in the FETCH statement when using a multiple-row fetch, or in an INSERT statement when using a blocked insert. Host structure arrays are defined by statements of the host language, as explained in the SQL Programming with Host Languages book.

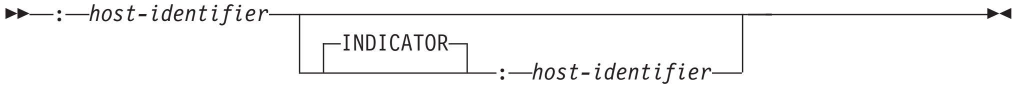
The form of a host structure array is identical to the form of a host variable reference. The reference :S1:S2 is a reference to host structure array if S1 names a host structure array. If S1 designates a host structure, S2 must be either a small integer host variable, an array of small integer host variables, or a two dimensional array of small integer host variables. In the following example, S1 is the host structure array and S2 is its indicator array.

```
EXEC  SQL FETCH CURSOR1 FOR 5 ROWS
          INTO :S1:S2;
```

The dimension of the host structure and the indicator array must be equal.

If the host structure has *m* more variables than the indicator array, the last *m* variables of the host structure do not have indicator variables. If the host structure has *m* fewer variables than the indicator array, the last *m* variables of the indicator array are ignored. If an indicator array or variable is not specified, no variable of the host structure array has an indicator variable.

The following diagram specifies the syntax of references to an array of host structures:



Arrays of host structures are not supported in REXX.

Functions

A *function* is an operation denoted by a function name followed by one or more operands that are enclosed in parentheses. It represents a relationship between a set of input values and a set of result values. The input values to a function are called *arguments*. For example, a function can be passed two input arguments that have date and time data types and return a value with a timestamp data type as the result.

Types of Functions

There are several ways to classify functions. One way to classify functions is as built-in, user-defined, or user-defined functions that are generated for distinct types.

- *Built-in functions* are IBM-supplied functions that come with DB2 UDB for AS/400. These functions provide a single-value result. Built-in functions include operator functions such as ″+″, column functions such as AVG, and scalar functions such as SUBSTR. For a list of the built-in column and scalar functions and information on these functions, see “Chapter 3. Built-In Functions” on page 131.[21]
- *User-defined functions* are functions that are created using the CREATE FUNCTION statement and registered to the database manager in catalog view QSYS2.SYSROUTINES and QSYS2.SYSFUNCS. These functions allow users to extend the function of the database manager by adding their own or third party vendor function definitions.

  A user-defined function is either *SQL*, *external*, or *sourced*. An SQL function is defined to the database using only SQL statements. An external function is defined to the database with a reference to an external program or service program that is executed when the function is invoked. A sourced function is defined to the database with a reference to a built-in function or another user-defined function. Sourced functions can be used to extend built-in column and scalar functions for use on distinct types.

  A user-defined function resides in the collection in which it was created. The collection cannot be QSYS, QSYS2, or QTEMP.
- The database manager automatically generates some user-defined functions when a distinct type is created using the CREATE DISTINCT TYPE statement. These functions support casting from the distinct type to the source type and from the source type to the distinct type. The ability to cast between the data types is important because a distinct type is compatible only with itself.

  The generated cast functions reside in the same collection as the distinct type for which they were created. The collection cannot be QSYS, QSYS2, or QTEMP. For more information on the functions that are generated for a distinct type, see “CREATE DISTINCT TYPE” on page 295.

Another way to classify functions is as column or scalar functions, depending on the input data values and result values.

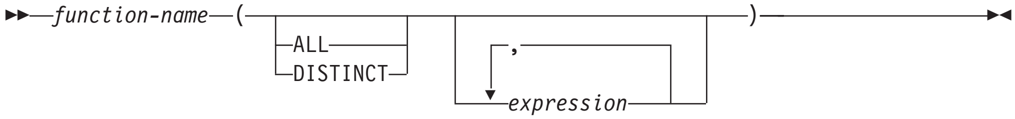
A *column function* receives a set of values for each argument (such as the values of a column) and returns a single-value result for the set of input values. Column functions are sometimes called aggregating functions. Built-in functions and user-defined sourced functions can be column functions.

---

[21] *Built-in functions* are implemented internally by the database manager, so an associated program or service program object does not exist for a *built-in function*. Furthermore, the catalog does not contain information about *built-in functions*. However, *built-in functions* can be treated as if they exist in QSYS2 and a *built-in function* name can be qualified with QSYS2.

A *scalar function* receives a single value for each argument and returns a single-value result. Built-in functions and user-defined functions can be scalar functions. The functions that are created for distinct types are also scalar functions.

Each reference to a scalar or column function (either built-in or user-defined) conforms to the following syntax:



The ALL or DISTINCT keyword can only be specified for a column function or a user-defined function that is sourced on a column function.

Function Resolution

A function is invoked by its function name, which is implicitly or explicitly qualified with a collection name, followed by parentheses that enclose the arguments to the function. Within the database, each function is uniquely identified by its function signature, which is its collection name, function name, the number of parameters, and the data types of the parameters. Thus, a collection can contain several functions that have the same name but each of which have a different number of parameters, or parameters with different data types. Or, a function with the same name, number of parameters, and types of parameters can exist in multiple collections. When you invoke any function, the database manager must determine which function to execute. This process is called function resolution.

Function resolution is similar for functions that are invoked with a qualified or unqualified function name with the exception that for an unqualified name, the database manager needs to search more than one collection.

Qualified function resolution: When a function is invoked with a function name and a collection name, the database manager only searches the specified collection to resolve which function to execute. The database manager finds the appropriate function instance when all of the following conditions are true:

- The name of the function instance matches the name in the function invocation.
- The number of input parameters in the function instance matches the number of arguments in the function invocation.
- The data type of each input argument of the function invocation matches or is *promotable* to the data type of the corresponding parameter of the function instance.

  This comparison of data types results in one best fit, which is the choice for execution (see “Method of Finding the Best Fit” on page 103). For information on the promotion of data types, see “Promotion of Data Types” on page 62.

  If no function in the collection meets these criteria, an error occurs.

Unqualified function resolution: When a function is invoked with only a function name, the database manager needs to search more than one collection to resolve the function instance to execute. The SQL path contains the list of collections to search. For each collection in the path (for information on paths see “Collections and the SQL Path” on page 47), the database manager selects a candidate function based on the following criteria:

- The name of the function instance matches the name in the function invocation.
- The number of input parameters in the function instance matches the number of function arguments in the function invocation.
- The data type of each input argument of the function invocation matches or is *promotable* to the data type of the corresponding parameter of the function instance.

  This comparison of data types results in one best fit, which is the choice for execution (see "Method of Finding the Best Fit"). For information on the promotion of data types, see "Promotion of Data Types" on page 62.

  If no function in the collection meets these criteria, an error occurs.

A candidate function is not selected for a collection if one or more of the criteria is not met.

After the database manager identifies the candidate functions, it selects the candidate with the best fit as the function instance to execute (see "Method of Finding the Best Fit"). If more than one collection contains the function instance with the best fit (the function signatures are identical except for the collection name), the database manager selects the function whose collection is earliest in the SQL path.

Function resolution applies to all functions, including built-in functions. Built-in functions logically exist in collection QSYS2. If collection QSYS2 is not explicitly specified in the SQL path, the collection is implicitly assumed at the front of the path. Therefore, when an unqualified function name is specified, ensure that the path is specified so that the intended function is selected.

Method of Finding the Best Fit

There might be more than one function with the same name that is a candidate for execution. In that case, the database manager determines which function is the best fit for the invocation by comparing the argument and parameter data types. Note that neither the data type of the result of the function nor the type of function (column or scalar) under consideration enters into this determination.

If the data types of all the parameters for a given function are the same as those of the arguments in the function invocation, that function is the best fit. If there is no exact match, the database manager compares the data types in the parameter lists from left to right, using the following method:

1. Compare the data type of the first argument in the function invocation to the data type of the first parameter in each function. (Any length, precision, scale, and CCSID attributes of the data types are not considered in the comparison.)
2. For this argument, if one function has a data type that fits the function invocation better than the data types in the other functions, that function is the best fit. The precedence list for the promotion of data types in "Promotion of Data Types" on page 62 shows the data types that fit each data type in best-to-worst order.
3. If the data type of the first parameter for more than one candidate function fits the function invocation equally well, repeat this process for the next argument of the function invocation. Continue for each argument until a best fit is found.

The following examples illustrate function resolution.

Example 1: Assume that MYSCHEMA contains two functions, both named FUNA, that were created with these partial CREATE FUNCTION statements.

```
CREATE FUNCTION MYSCHEMA.FUNA (VARCHAR(10), INT, DOUBLE) ...
CREATE FUNCTION MYSCHEMA.FUNA (VARCHAR(10), REAL, DOUBLE) ...
```

Also assume that a function with three arguments of data types VARCHAR(10), SMALLINT, and DECIMAL is invoked with a qualified name:

```
MYSCHEMA.FUNA( VARCHARCOL, SMALLINTCOL, DECIMALCOL ) ...
```

Both MYSCHEMA.FUNA functions are candidates for this function invocation because they meet the criteria specified in “Function Resolution” on page 102. The data types of the first parameter for the two function instances in the collection, which are both VARCHAR, fit the data type of the first argument of the function invocation, which is VARCHAR, equally well. However, for the second parameter, the data type of the first function (INT) fits the data type of the second argument (SMALLINT) better than the data type of second function (REAL). Therefore, the database manager selects the first MYSCHEMA.FUNA function as the function instance to execute.

Example 2: Assume that functions were created with these partial CREATE FUNCTION statements:

```
1. CREATE FUNCTION SMITH.ADDIT (CHAR(5), INT, DOUBLE) ...
2. CREATE FUNCTION SMITH.ADDIT (INT, INT, DOUBLE) ...
3. CREATE FUNCTION SMITH.ADDIT (INT, INT, DOUBLE, INT) ...
4. CREATE FUNCTION JOHNSON.ADDIT (INT, DOUBLE, DOUBLE) ...
5. CREATE FUNCTION JOHNSON.ADDIT (INT, INT, DOUBLE) ...
6. CREATE FUNCTION TODD.ADDIT (REAL) ...
7. CREATE FUNCTION TAYLOR.SUBIT (INT, INT, DECIMAL) ...
```

Also assume that the SQL path at the time an application invokes a function is ″TAYLOR″, ″JOHNSON″, ″SMITH″. The function is invoked with three data types (INT, INT, DECIMAL) as follows:

```
SELECT  ... ADDIT(INTCOL1, INTCOL2, DECIMALCOL) ...
```

Function 5 is chosen as the function instance to execute based on the following evaluation:

- Function 6 is eliminated as a candidate because collection TODD is not in the SQL path.
- Function 7 in collection TAYLOR is eliminated as a candidate because it does not have the correct function name.
- Function 1 in collection SMITH is eliminated as a candidate because the INT data type is not promotable to the CHAR data type of the first parameter of Function 1.
- Function 3 in collection SMITH is eliminated as a candidate because it has the wrong number of parameters.
- Function 2 is a candidate because the data types of its parameters match or are promotable to the data types of the arguments.
- Both Function 4 and 5 in collection JOHNSON are candidates because the data types of their parameters match or are promotable to the data types of the arguments. However, Function 5 is chosen as the better candidate because although the data types of the first parameter of both functions (INT) match the first argument (INT), the data type of the second parameter of Function 5 (INT) is a better match of the second argument (INT) than the data type of Function 4 (DOUBLE).
- Of the remaining candidates, Function 2 and 5, the database manager selects Function 5 because collection JOHNSON comes before collection SMITH in the SQL path.

Example 3: Assume that functions were created with these partial CREATE FUNCTION statements:

```
1. CREATE FUNCTION BESTGEN.MYFUNC (INT, DECIMAL(9,0)) ...
2. CREATE FUNCTION KNAPP.MYFUNC (INT, NUMERIC(8,0))...
3. CREATE FUNCTION ROMANO.MYFUNC (INT, FLOAT) ...
```

Also assume that the SQL path at the time an application invokes a function is ″ROMANO″, ″KNAPP″, ″BESTGEN″. The function is invoked with two data types (SMALLINT, DECIMAL) as follows:

```
SELECT  ... MYFUNC(SINTCOL1, DECIMALCOL) ...
```

Function 2 is chosen as the function instance to execute based on the following evaluation:

- All three functions are candidates for this function invocation because they meet the criteria specified in “Function Resolution” on page 102.
- Function 3 in collection ROMANO is eliminated because the second parameter (FLOAT) is not as good a fit for the second argument (DECIMAL) as the second parameter of either Function 1 (DECIMAL) or Function 2 (NUMERIC).
- The second parameters of Function 1 (DECIMAL) and Function 2 (NUMERIC) are equally good fits for the second argument (DECIMAL).
- Function 2 is finally chosen because ″KNAPP″ precedes ″BESTGEN″ in the SQL path.

Function Invocation

Once the function is selected, there are still possible reasons why the use of the function may not be permitted. Each function is defined to return a result with a specific data type. If this result data type is not compatible within the context in which the function is invoked, an error will occur. For example, given functions named STEP defined with different data types as the result:

```
STEP(SMALLINT) RETURNS CHAR(5)
STEP(DOUBLE) RETURNS INTEGER
```

and the following function reference (where S is a SMALLINT column):

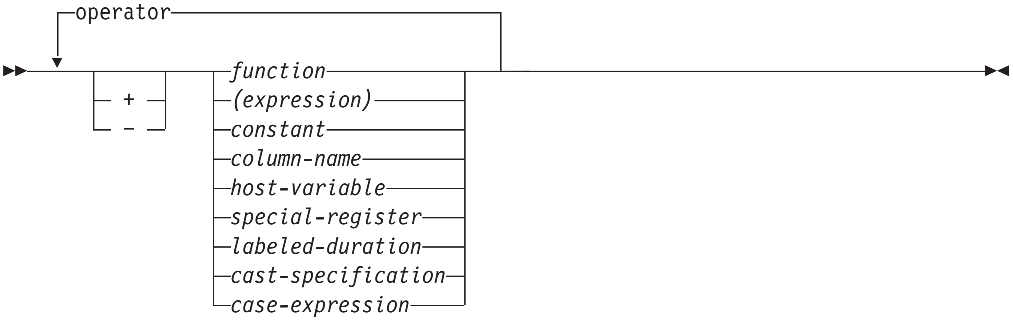
```
SELECT ... 3 +STEP(S)
```

then, because there is an exact match on argument type, the first STEP is chosen. An error occurs on the statement because the result type is CHAR(5) instead of a numeric type as required for an argument of the addition operator.

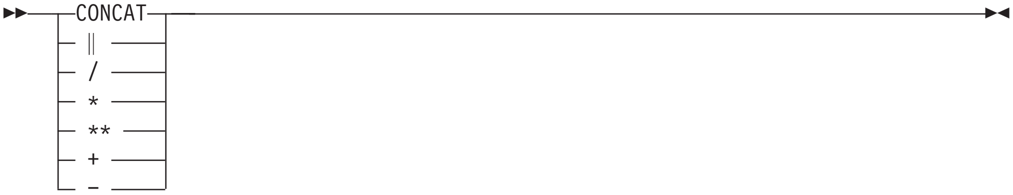
In cases where the arguments of the function invocation were not an exact match to the data types of the parameters of the selected function, the arguments are converted to the data type of the parameter at execution using the same rules as assignment to columns (see “Assignments and Comparisons” on page 66). This includes the case where precision, scale, length, or CCSID differs between the argument and the parameter.

Expressions

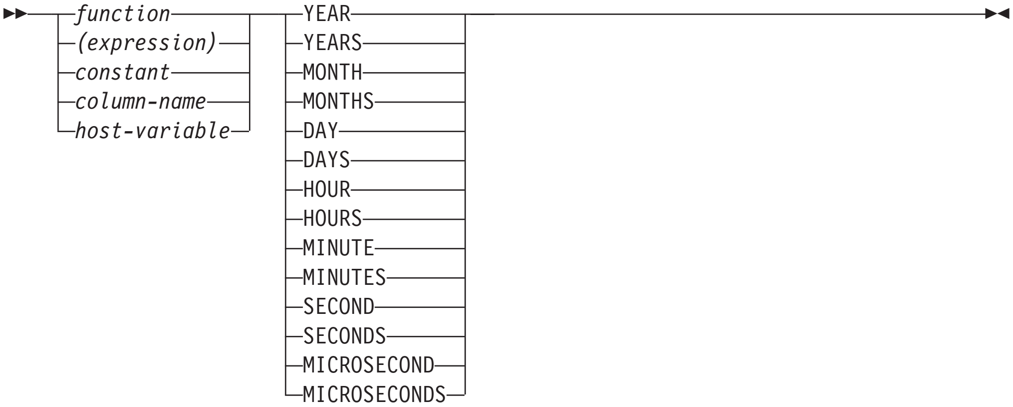
An expression specifies a value.



operator:



labeled-duration:



Without Operators

If no operators are used, the result of the expression is the specified value.

Example

```
SALARY     :SALARY     'SALARY'    MAX(SALARY)
```

With the Concatenation Operator

The concatenation operator (CONCAT or `||`) combines two strings. The result of the expression is a string.

The operands of concatenation must be compatible strings. Binary strings are only compatible with other binary strings.

The data type of the result is determined by the data types of the operands. The data type of the result is summarized in the following table:

Table 17. Result Data Types With Concatenation

If one operand column is ...	And the other operand is ...	The data type of the result column is ...
DBCLOB(x)	CHAR(y) or VARCHAR(y) or CLOB(y) or GRAPHIC(y) or VARGRAPHIC(y) or DBCLOB(y)	DBCLOB(z) where z = x + y
CLOB(x)	GRAPHIC(y) or VARGRAPHIC(y)	DBCLOB(z) where z = x + y
VARGRAPHIC(x)	CHAR(y) or VARCHAR(y) or GRAPHIC(y) or VARGRAPHIC(y)	VARGRAPHIC(z) where z = x + y
VARCHAR(x)	GRAPHIC(y)	VARGRAPHIC(z) where z = x + y
GRAPHIC(x)	CHAR(y) mixed data	VARGRAPHIC(z) where z = x + y
GRAPHIC(x)	CHAR(y) SBCS data or GRAPHIC(y)	GRAPHIC(z) where z = x + y
UCS-2 data	UCS-2 or DBCS or mixed or SBCS data	UCS-2 data
DBCS data	DBCS or mixed or SBCS data	DBCS data
CLOB(x)	CHAR(y) or VARCHAR(y) or CLOB(y)	CLOB(z) where z = x + y
VARCHAR(x)	CHAR(y) or VARCHAR(y)	VARCHAR(z) where z = x + y
CHAR(x) mixed data	CHAR(y)	VARCHAR(z) where z = x + y
CHAR(x) SBCS data	CHAR(y)	CHAR(z) where z = x + y
bit data	mixed or SBCS or bit data	bit data
mixed data	mixed or SBCS data	mixed data
SBCS data	SBCS data	SBCS data
BLOB(x)	BLOB(y)	BLOB(z) where z = x + y

The sum of the lengths of the operands must not exceed the maximum length attribute of the resulting data type.

If either operand can be null, the result can be null, and if either is null, the result is the null value. Otherwise, the result consists of the first operand string followed by the second.

With mixed data this result will not have redundant shift codes “at the seam”. Thus, if the first operand is a string ending with a “shift-in” character (X'0F'), while the second operand is a character string beginning with a “shift-out” character (X'0E'), these two bytes are eliminated from the result.

The length of the result is the sum of the lengths of the operands unless redundant shifts are eliminated; in which case, the length is two less than the sum of the lengths of the operands.

The CONCAT operator should be used instead of the || operator. The code point for the | character varies, depending on the CCSID.

The CCSID of the result is determined by the CCSID of the operands as explained under "Conversion Rules for Operations That Combine Strings" on page 81. Note that as a result of these rules:

- If any operand is bit data, the result is bit data.
- If one operand is mixed data and the other is SBCS data, the result is mixed data. However, this does not necessarily mean that the result is well-formed mixed data.

Example

Concatenate the column FIRSTNME with a blank and the column LASTNAME.

```
FIRSTNME CONCAT ' ' CONCAT LASTNAME
```

With Arithmetic Operators

If arithmetic operators are used, the result of the expression is a number derived from the application of the operators to the values of the operands.

If any operand can be null, the result can be null. If any operand has the null value, the result of the expression is the null value. Arithmetic operators must not be applied to character strings. For example, USER+2 is invalid.

The prefix operator + (*unary plus*) does not change its operand. The prefix operator - (*unary minus*) reverses the sign of a nonzero operand. If the data type of A is small integer, the data type of - A is large integer. The first character of the token following a prefix operator must not be a plus or minus sign.

The *infix operators*, +, -, *, /, and **, specify addition, subtraction, multiplication, division, and exponentiation, respectively. The value of the second operand of division must not be zero.

The result of an exponentiation (**) operator is a double-precision floating-point number. The result of the other operators depends on the type of the operand.

Two Integer Operands

If both operands of an arithmetic operator are integers with zero scale, the operation is performed in binary, and the result is a large integer unless either (or both) operand is a big integer, in which case the result is a big integer. Any remainder of division is lost. The result of an integer arithmetic operation (including unary minus) must be within the range of large integers. If either integer operand has nonzero scale, it is converted to a decimal operand with the same precision and scale.

Integer and Decimal Operands

If one operand is an integer with zero scale and the other is decimal, the operation is performed in decimal using a temporary copy of the integer that has been converted to a decimal number with precision and scale 0 as defined in the following table:

Operand	Precision of Decimal Copy
Column or variable: big integer	19
Column or variable: large integer	11
Column or variable: small integer	5
Constant (including leading zeros)	Same as the number of digits in the constant

If one operand is an integer with nonzero scale, it is first converted to a decimal operand with the same precision and scale.

Two Decimal Operands

If both operands are decimal, the operation is performed in decimal. The result of any decimal arithmetic operation is a decimal number with a precision and scale that are dependent on the operation and the precision and scale of the operands. If the operation is addition or subtraction and the operands do not have the same scale, the operation is performed with a temporary copy of one of the operands. The copy of the shorter operand is extended with trailing zeros so that its fractional part has the same number of digits as the longer operand.

Unless specified otherwise, all functions and operations that accept decimal numbers allow a precision of up to 31 digits. The result of a decimal operation must not have a precision greater than 31.

Decimal Arithmetic in SQL

The following formulas define the precision and scale of the result of decimal operations in SQL. The symbols p and s denote the precision and scale of the first operand and the symbols p' and s' denote the precision and scale of the second operand.

Addition and Subtraction

The scale of the result of addition and subtraction is max (s,s'). The precision is min(31,max$(p-s,p'-s')$ +max(s,s')+1).

Multiplication

The precision of the result of multiplication is min $(31,p+p')$ and the scale is min$(31,s+s')$.

Division

The precision of the result of division is 31. The scale is $31-p+s-s'$. The scale must not be negative.

Floating-Point Operands

If either operand of an arithmetic operator is floating point, the operation is performed in floating point. The operands are first converted to double-precision floating-point numbers, if necessary. Thus, if any element of an expression is a floating-point number, the result of the expression is a double-precision floating-point number.

An operation involving a floating-point number and an integer is performed with a temporary copy of the integer converted to double-precision floating point. An operation involving a floating-point number and a decimal number is performed with a temporary copy of the decimal number converted to double-precision floating point. The result of a floating-point operation must be within the range of floating-point numbers.

User-Defined Types as Operands

A user-defined type cannot be used with arithmetic operators even if its source data type is numeric. To perform an arithmetic operation, create a function with the arithmetic operator as its source. For example, if there were distinct types INCOME and EXPENSES, both of which had DECIMAL(8,2) data types, then the following user-defined function, REVENUE, could be used to subtract one from the other.

```
CREATE FUNCTION REVENUE ( INCOME, EXPENSES )
  RETURNS DECIMAL(8,2) SOURCE "-" ( DECIMAL, DECIMAL)
```

Alternately, the - (minus) operator could be overloaded using a user-defined function to subtract the new data types.

```
CREATE FUNCTION "-" ( INCOME, EXPENSES )
  RETURNS DECIMAL(8,2) SOURCE "-" ( DECIMAL, DECIMAL)
```

Datetime Operands and Durations

Datetime values can be incremented, decremented, and subtracted. These operations may involve decimal numbers called *durations*. A *duration* is a positive or negative number representing an interval of time. There are four types of durations:

Labeled Durations (see diagram on page 106)

A *labeled duration* represents a specific unit of time as expressed by a number (which can be the result of an expression) followed by one of the seven duration keywords: YEARS, MONTHS, DAYS, HOURS, MINUTES, SECONDS, or MICROSECONDS[22]. The number specified is converted as if it were assigned to a DECIMAL(15,0) number. A labeled duration can only be used as an operand of an arithmetic operator in which the other operand is a value of data type DATE, TIME, or TIMESTAMP. Thus, the expression HIREDATE + 2 MONTHS + 14 DAYS is valid whereas the expression HIREDATE + (2 MONTHS + 14 DAYS) is not. In both of these expressions, the labeled durations are 2 MONTHS and 14 DAYS.

Date Duration

A *date duration* represents a number of years, months, and days, expressed as a DECIMAL(8,0) number. To be properly interpreted, the number must have the format *yyyymmdd*, where *yyyy* represents the number of years, *mm* the number of months, and *dd* the number of days. The result of subtracting one date value from another, as in the expression HIREDATE - BRTHDATE, is a date duration.

Time Duration

A *time duration* represents a number of hours, minutes, and seconds, expressed as a DECIMAL(6,0) number. To be properly interpreted, the number must have the format *hhmmss* where *hh*

---

[22] Note that the singular form of these keywords is also acceptable: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, and MICROSECOND.

	represents the number of hours, *mm* the number of minutes, and *ss* the number of seconds. The result of subtracting one time value from another is a time duration.
Timestamp duration	A *timestamp duration* represents a number of years, months, days, hours, minutes, seconds, and microseconds, expressed as a DECIMAL(20,6) number. To be properly interpreted, the number must have the format *yyyymmddhhmmsszzzzzz,* where *yyyy, mm, dd, hh, mm, ss,* and *zzzzzz* represent, respectively, the number of years, months, days, hours, minutes, seconds, and microseconds. The result of subtracting one timestamp value from another is a timestamp duration.

Datetime Arithmetic in SQL

The only arithmetic operations that can be performed on datetime values are addition and subtraction. If a datetime value is the operand of addition, the other operand must be a duration. The specific rules governing the use of the addition operator with datetime values follow:

- If one operand is a date, the other operand must be a date duration or labeled duration of years, months, or days.
- If one operand is a time, the other operand must be a time duration or a labeled duration of hours, minutes, or seconds.
- If one operand is a timestamp, the other operand must be a duration. Any type of duration is valid.
- Neither operand of the addition operator can be a parameter marker.

The rules for the use of the subtraction operator on datetime values are not the same as those for addition because a datetime value cannot be subtracted from a duration, and because the operation of subtracting two datetime values is not the same as the operation of subtracting a duration from a datetime value. The specific rules governing the use of the subtraction operator with datetime values follow:

- If the first operand is a date, the second operand must be a date, a date duration, a string representation of a date, or a labeled duration of years, months, or days.
- If the second operand is a date, the first operand must be a date, or a string representation of a date.
- If the first operand is a time, the second operand must be a time, a time duration, a string representation of a time, or a labeled duration of hours, minutes, or seconds.
- If the second operand is a time, the first operand must be a time, or string representation of a time.
- If the first operand is a timestamp, the second operand must be a timestamp, a string representation of a timestamp, or a duration.
- If the second operand is a timestamp, the first operand must be a timestamp or a string representation of a timestamp.
- Neither operand of the subtraction operator can be a parameter marker.

Date Arithmetic

Dates can be subtracted, incremented, or decremented.

Subtracting Dates: The result of subtracting one date (DATE2) from another (DATE1) is a date duration that specifies the number of years, months, and days between the two dates. The data type of the result is DECIMAL(8,0). If DATE1 is greater than or equal to DATE2, DATE2 is subtracted from DATE1. If DATE1 is less than DATE2, however, DATE1 is subtracted from DATE2, and the sign of the result is made negative. The following procedural description clarifies the steps involved in the operation RESULT = DATE1 - DATE2.

```
If DAY(DATE2) <= DAY(DATE1)
    then DAY(RESULT) = DAY(DATE1) - DAY(DATE2).

If DAY(DATE2) > DAY(DATE1)
      then DAY(RESULT) = N + DAY(DATE1) - DAY(DATE2)
        where N = the last day of MONTH(DATE2).
    MONTH(DATE2) is then incremented by 1.

If MONTH(DATE2) <= MONTH(DATE1)
    then MONTH(RESULT) = MONTH(DATE1) - MONTH(DATE2).

If MONTH(DATE2) > MONTH(DATE1)
    then MONTH(RESULT) = 12 + MONTH(DATE1) - MONTH(DATE2).
    YEAR(DATE2) is then incremented by 1.

YEAR(RESULT) = YEAR(DATE1) - YEAR(DATE2).
```

For example, the result of DATE('3/15/2000') - '12/31/1999' is 215 (or, a duration of 0 years, 2 months, and 15 days).

Incrementing and Decrementing Dates: The result of adding a duration to a date, or of subtracting a duration from a date, is itself a date. (For the purposes of this operation, a month denotes the equivalent of a calendar page. Adding months to a date, then, is like turning the pages of a calendar, starting with the page on which the date appears.) The result must fall between the dates January 1, 0001 and December 31, 9999 inclusive. If a duration of years is added or subtracted, only the year portion of the date is affected. The month is unchanged, as is the day unless the result would be February 29 of a non-leap-year. In this case, the day is changed to 28, and SQLWARN6 in the SQLCA is set to ’W’ to indicate the end-of-month adjustment.

Similarly, if a duration of months is added or subtracted, only months and, if necessary, years are affected. The day portion of the date is unchanged unless the result would be invalid (September 31, for example). In this case, the day is set to the last day of the month, and SQLWARN6 in the SQLCA is set to ’W’ to indicate the end-of-month adjustment.

Adding or subtracting a duration of days will, of course, affect the day portion of the date, and potentially the month and year. Adding a labeled duration of DAYS will not cause an end-of-month adjustment.

Date durations, whether positive or negative, may also be added to and subtracted from dates. As with labeled durations, the result is a valid date, and a warning indicator is set in the SQLCA whenever an end-of-month adjustment is necessary.

When a positive date duration is added to a date, or a negative date duration is subtracted from a date, the date is incremented by the specified number of years, months, and days, in that order. Thus DATE1 + X, where X is a positive DECIMAL(8,0) number, is equivalent to the expression:

```
DATE1 + YEAR(X) YEARS + MONTH(X) MONTHS + DAY(X) DAYS
```

When a positive date duration is subtracted from a date, or a negative date duration is added to a date, the date is decremented by the specified number of days, months, and years, in that order. Thus, DATE1 - X, where X is a positive DECIMAL(8,0) number, is equivalent to the expression:

```
DATE1 - DAY(X) DAYS - MONTH(X) MONTHS - YEAR(X) YEARS
```

When adding durations to dates, adding one month to a given date gives the same date one month later *unless* that date does not exist in the later month. In that case, the date is set to that of the last day of the later month. For example, January 28 plus one month gives February 28; and one month added to January 29, 30, or 31 results in either February 28 or, for a leap year, February 29.

Note: If one or more months is added to a given date and then the same number of months is subtracted from the result, the final date is not necessarily the same as the original date.

Time Arithmetic

Times can be subtracted, incremented, or decremented.

Subtracting Times: The result of subtracting one time (TIME2) from another (TIME1) is a time duration that specifies the number of hours, minutes, and seconds between the two times. The data type of the result is DECIMAL(6,0). If TIME1 is greater than or equal to TIME2, TIME2 is subtracted from TIME1. If TIME1 is less than TIME2, however, TIME1 is subtracted from TIME2, and the sign of the result is made negative. The following procedural description clarifies the steps involved in the operation RESULT = TIME1 - TIME2.

```
If SECOND(TIME2) <= SECOND(TIME1)
    then SECOND(RESULT) = SECOND(TIME1) - SECOND(TIME2).

If SECOND(TIME2) > SECOND(TIME1)
    then SECOND(RESULT) = 60 + SECOND(TIME1) - SECOND(TIME2).
    MINUTE(TIME2) is then incremented by 1.

If MINUTE(TIME2) <= MINUTE(TIME1)
    then MINUTE(RESULT) = MINUTE(TIME1) - MINUTE(TIME2).

If MINUTE(TIME2) > MINUTE(TIME1)
    then MINUTE(RESULT) = 60 + MINUTE(TIME1) - MINUTE(TIME2).
    HOUR(TIME2) is then incremented by 1.

HOUR(RESULT) = HOUR(TIME1) - HOUR(TIME2).
```

For example, the result of TIME('11:02:26') - '00:32:56' is 102930 (a duration of 10 hours, 29 minutes, and 30 seconds).

Incrementing and Decrementing Times: The result of adding a duration to a time, or of subtracting a duration from a time, is itself a time. Any overflow or underflow of hours is discarded, thereby ensuring that the result is always a time. If a duration of hours is added or subtracted, only the hours portion of the time is affected. The minutes and seconds are unchanged.

Similarly, if a duration of minutes is added or subtracted, only minutes and, if necessary, hours are affected. The seconds portion of the time is unchanged.

Adding or subtracting a duration of seconds will, of course, affect the seconds portion of the time, and potentially the minutes and hours.

Time durations, whether positive or negative, also can be added to and subtracted from times. The result is a time that has been incremented or decremented by the specified number of hours, minutes, and seconds, in that order. `TIME1 + X`, where "X" is a DECIMAL(6,0) number, is equivalent to the expression:

```
TIME1 + HOUR(X) HOURS + MINUTE(X) MINUTES + SECOND(X) SECONDS
```

Timestamp Arithmetic

Timestamps can be subtracted, incremented, or decremented.

Subtracting Timestamps: The result of subtracting one timestamp (TS2) from another (TS1) is a timestamp duration that specifies the number of years, months, days, hours, minutes, seconds, and microseconds between the two timestamps. The data type of the result is DECIMAL(20,6). If TS1 is greater than or equal to TS2, TS2 is subtracted from TS1. If TS1 is less than TS2, however, TS1 is subtracted from TS2 and the sign of the result is made negative. The following procedural description clarifies the steps involved in the operation RESULT = TS1 - TS2.

```
If MICROSECOND(TS2) <= MICROSECOND(TS1)
      then MICROSECOND(RESULT) = MICROSECOND(TS1) -
      MICROSECOND(TS2).

If MICROSECOND(TS2) >MICROSECOND(TS1)
       then MICROSECOND(RESULT) = 1000000 +
       MICROSECOND(TS1) - MICROSECOND(TS2)
       and SECOND(TS2) is incremented by 1.
```

The seconds and minutes part of the timestamps are subtracted as specified in the rules for subtracting times.

```
If HOUR(TS2) <= HOUR(TS1)
      then HOUR(RESULT) = HOUR(TS1) - HOUR(TS2).

If HOUR(TS2) > HOUR(TS1)
      then HOUR(RESULT) = 24 + HOUR(TS1) - HOUR(TS2)
      and DAY(TS2) is incremented by 1.
```

The date part of the timestamps is subtracted as specified in the rules for subtracting dates.

Incrementing and Decrementing Timestamps: The result of adding a duration to a timestamp, or of subtracting a duration from a timestamp, is itself a timestamp. Date and time arithmetic is performed as previously defined, except that an overflow or underflow of hours is carried into the date part of the result, which must be within the range of valid dates. Microseconds overflow into seconds.

Precedence of Operations

Expressions within parentheses are evaluated first. When the order of evaluation is not specified by parentheses, exponentiation is applied after prefix operators (such as -, unary minus) and before multiplication and division. Multiplication and division are applied before addition and subtraction. Operators at the same precedence level are applied from left to right. The following table shows the priority of all operators.

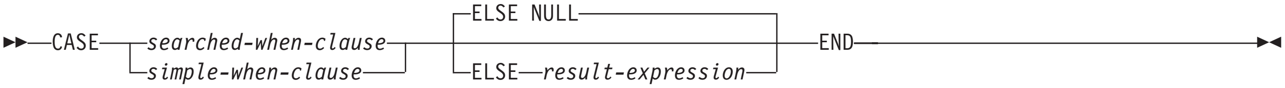
Priority	Operators
1	+, - (when used for signed numeric values)
2	**
3	*, /, CONCAT, ||
4	+, - (when used between two operands)

Example

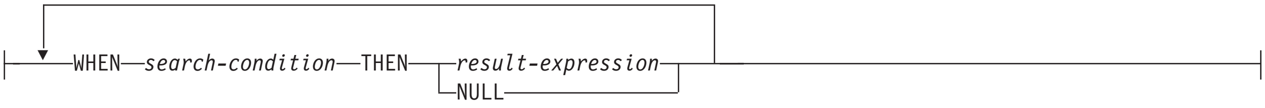
In the following example, operators are applied in the order shown by the numbers in the second row.

```
1.10 * (SALARY + BONUS) + SALARY / :VAR3
     2         1        4        3
```

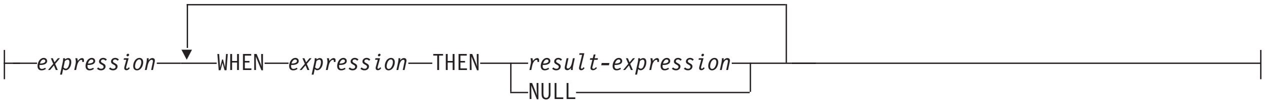
CASE Expressions



searched-when-clause:



simple-when-clause:



CASE expressions allow an expression to be selected based on the evaluation of one or more conditions. In general, the value of the case-expression is the value of the *result-expression* following the first (leftmost) when-clause that evaluates to true. If no when-clause evaluates to true and the ELSE keyword is present then the result is the value of the ELSE *result-expression* or NULL. If no when-clause evaluates to true and the ELSE keyword is not present then the result is NULL. Note that when a when-clause evaluates to unknown (because of nulls), the when-clause is not true and hence is treated the same way as a when-clause that evaluates to false.

The *search-condition* in a *searched-when-clause* cannot contain a basic predicate with a subselect, a quantified predicate, an IN predicate using a subselect, or an EXISTS predicate.

When using the *simple-when-clause*, the value of the *expression* prior to the first WHEN keyword is tested for equality with the value of the *expression* following the

WHEN keyword(s). The data type of the *expression* prior to the first WHEN keyword must therefore be compatible with the data types of each *expression* following the WHEN keyword(s).

A *result-expression* is an *expression* following the THEN or ELSE keywords. There must be at least one *result-expression* in the CASE expression (NULL cannot be specified for every case). All *result-expressions* must have compatible data types, where the attributes of the result are determined based on the "Rules for Result Data Types" on page 78.

There are two scalar functions, NULLIF and COALESCE, that are specialized to handle a subset of the functionality provided by CASE. The following table shows the equivalent expressions using CASE or these functions.

Table 18. Equivalent CASE Expressions

CASE Expression	**Equivalent Expression**
CASE WHEN e1=e2 THEN NULL ELSE e1 END	NULLIF(e1,e2)
CASE WHEN e1 IS NOT NULL THEN e1 ELSE e2 END	COALESCE(e1,e2)
CASE WHEN e1 IS NOT NULL THEN e1 ELSE COALESCE(e2,...,eN) END	COALESCE(e1,e2,...,eN)

Examples

- If the first character of a department number is a division in the organization, then a CASE expression can be used to list the full name of the division to which each employee belongs:

```
SELECT EMPNO, LASTNAME,
  CASE SUBSTR(WORKDEPT,1,1)
  WHEN 'A' THEN 'Administration'
  WHEN 'B' THEN 'Human Resources'
  WHEN 'C' THEN 'Accounting'
  WHEN 'D' THEN 'Design'
  WHEN 'E' THEN 'Operations'
  END
FROM EMPLOYEE
```

- The number of years of education are used in the EMPLOYEE table to give the education level. A CASE expression can be used to group these and to show the level of education.

```
SELECT EMPNO, FIRSTNME, MIDINIT, LASTNAME,
  CASE
  WHEN EDLEVEL < 15 THEN 'SECONDARY'
  WHEN EDLEVEL < 19 THEN 'COLLEGE'
  ELSE 'POST GRADUATE'
  END
FROM EMPLOYEE
```

- Another interesting example of CASE statement usage is in protecting from division by 0 errors. For example, the following code finds the employees who earn more than 25% of their income from commission, but who are not fully paid on commission:

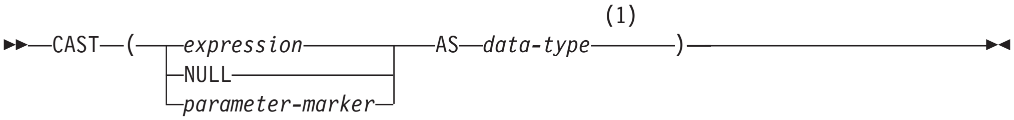
```
SELECT EMPNO, WORKDEPT, SALARY+COMM
FROM EMPLOYEE
WHERE (CASE WHEN SALARY=0 THEN NULL
            ELSE COMM/SALARY
       END) > 0.25
```

- The following CASE expressions are equivalent:

```
SELECT LASTNAME,
 CASE
 WHEN LASTNAME = 'Haas' THEN 'President'
 ...
```

```
SELECT LASTNAME,
 CASE LASTNAME
 WHEN 'Haas' THEN 'President'
 ...
```

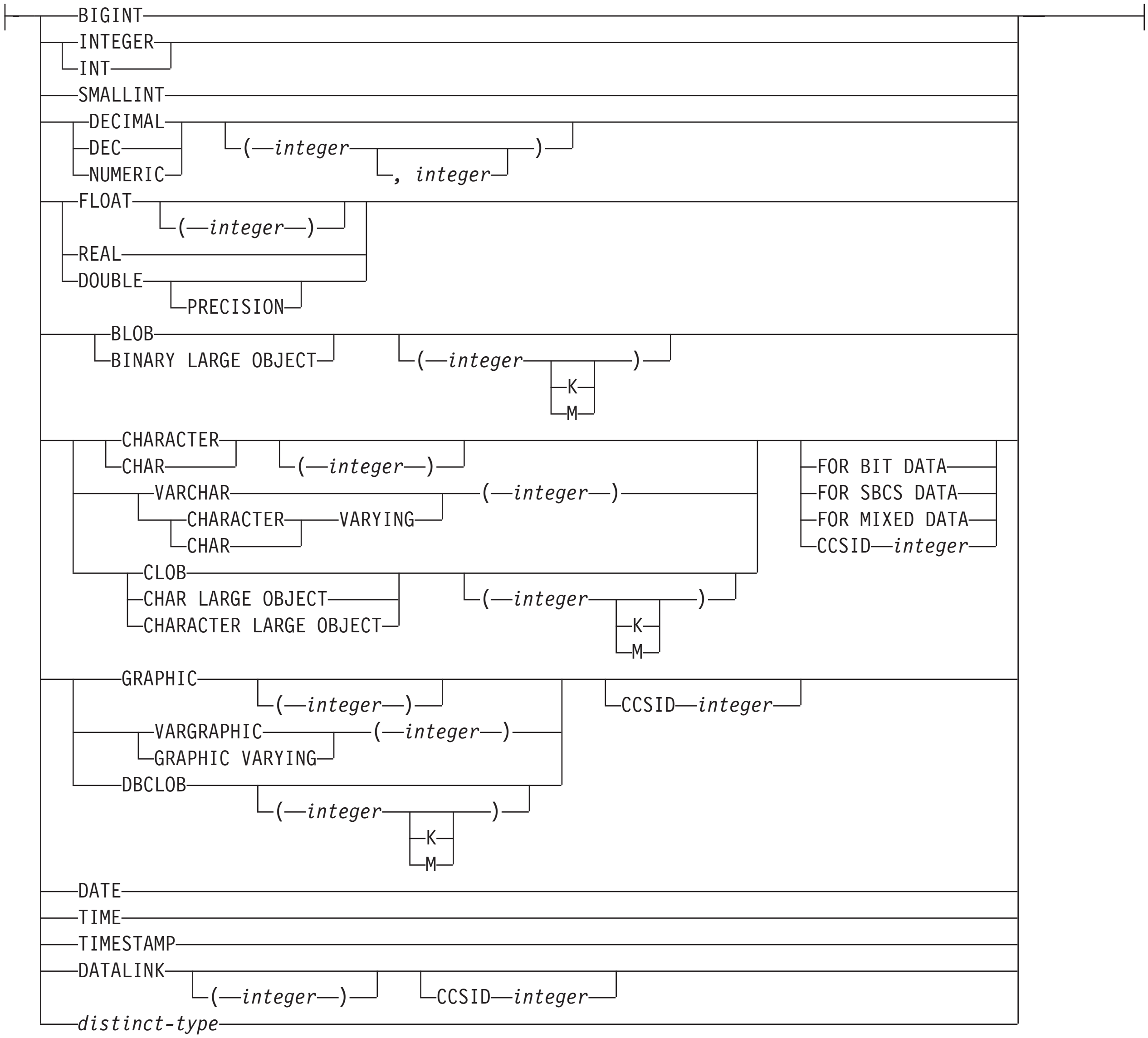
CAST Specification



Notes:

1 The data type names may be qualified. For more information see “Naming Conventions” on page 39.

data-type:



The CAST specification returns the cast operand (the first operand) cast to the type specified by the *data type*. If the data type of either operand is a distinct type, the privileges held by the authorization ID of the statement must include USAGE authority on the distinct type.

expression

If the cast operand is an expression (other than parameter marker or NULL), the result is the argument value converted to the specified target data type.

The supported casts are shown in Table 9 on page 65, where the first column represents the data type of the cast operand (source data type) and the data types across the top represent the target data type of the CAST specification. If the cast is not supported, an error will occur.

When casting character or graphic strings to a character or graphic string with a different length, a warning is returned if truncation of other than trailing blanks occurs.

NULL
If the cast operand is the keyword NULL, the result is a null value that has the specified *data type*.

parameter-marker
A parameter marker (specified as a question mark character) is normally considered an expression, but is documented separately in this case because it has a special meaning. If the cast operand is a *parameter-marker*, the specified *data type* is considered a promise that the replacement will be assignable to the specified data type (using the same rules as assignment to a column). Such a parameter marker is considered a *typed parameter marker*. Typed parameter markers will be treated like any other typed value for the purpose of DESCRIBE of a select list or for column assignment.

data-type
Specifies the data type of the result. If the data type is not qualified, the SQL path is used to find the appropriate data type. See "CREATE TABLE" on page 340 for a description of *data-type*.

If a data type has length, precision, scale, or CCSID attributes, specify the attributes. If the attributes are not specified, the default values are used. For example, the default for CHAR is a length of 1, and the default for DECIMAL is a precision of 5 and a scale of 0. For the default values of the other data types, see "CREATE TABLE" on page 340. (For portability across operating systems, when specifying a floating-point data type, use REAL or DOUBLE instead of FLOAT.)

- For a cast operand that is an *expression*, see Table 9 on page 65 for the target data types that are supported based on the data type of the cast operand.
- For a cast operand that is the keyword NULL, the target data type can be any data type.
- For a cast operand that is a parameter marker, the target data type can be any data type. If the data type is a distinct type, the application that uses the parameter marker will use the source data type of the distinct type.

For information on which casts between data types are supported and the rules for casting to a data type see "Casting Between Data Types" on page 63.

Examples

- An application is only interested in the integer portion of the SALARY column (defined as DECIMAL(9,2)) from the EMPLOYEE table. The following CAST specification will convert the SALARY column to INTEGER.

```
SELECT EMPNO, CAST(SALARY AS INTEGER)
  FROM EMPLOYEE
```

- Assume that two distinct types exist. T_AGE was sourced on SMALLINT and is the data type for the AGE column in the PERSONNEL table. R_YEAR was sourced on INTEGER and is the data type for the RETIRE_YEAR column in the same table. The following UPDATE statement could be prepared. An application is only interested in the integer portion of the SALARY column (defined as DECIMAL(9,2)) from the EMPLOYEE table. The following CAST specification will convert the SALARY column to INTEGER.

```
UPDATE PERSONNEL SET RETIRE_YEAR = ?
  WHERE AGE = CAST( ? AS T_AGE )
```

Predicates

A *predicate* specifies a condition that is true, false, or unknown about a given row or group. The following rules apply to all types of predicates:

- All values specified in a predicate must be compatible.
- The value of a host variable must not be a string longer than 32766 bytes.
- The CCSID conversion of operands of predicates involving two or more operands are done according to “Conversion Rules for Comparison” on page 76.
- Use of a DataLink value is limited to the NULL predicate.

Basic Predicate

```
►►──expression──┬─ =  ─┬──┬─expression───┬──────────────────────────────────►◄
                ├─ <> ─┤  └─(subselect)──┘
                ├─ ¬= ─┤
                ├─ <  ─┤
                ├─ >  ─┤
                ├─ <= ─┤
                ├─ ¬> ─┤
                ├─ >= ─┤
                └─ ¬< ─┘
```

Notes:

1. Some keyboards must use the hex values for the not (¬) symbol. The hex value varies and is dependent on the keyboard that is used. For this reason the <>, <=, and >= symbols are preferred.
2. You can use the exclamation point (!) in place of the not (¬) symbol.

A *basic predicate* compares two values. If the operands of the predicate contain SBCS data or mixed data, and if the sort sequence in effect at the time the statement is executed is not *HEX, then the comparison of the operands is performed using weighted values for the operands. The weighted values are based on the sort sequence.

A subselect in a basic predicate must specify a single result column and must not return more than one value.

If the value of either operand is null or the result of the subselect is empty, the result of the predicate is unknown. Otherwise the result is either true or false.

For values *x* and *y*:

Predicate	**Is True If and Only If...**
x **=** *y*	*x* is equal to *y*
*x***<>** *y*	*x* is not equal to *y*
*x***¬=** *y*	*x* is not equal to *y*
x **<** *y*	*x* is less than *y*
x **>** *y*	*x* is greater than *y*
*x***>=** *y*	*x* is greater than or equal to *y*
*x***<=** *y*	*x* is less than or equal to *y*

x¬< *y*	*x* is not less than *y*
x¬> *y*	*x* is not greater than *y*

Examples

```
EMPNO = '528671'
PRTSTAFF <> :VAR1
SALARY + BONUS + COMM < 20000
SALARY > (SELECT AVG(SALARY) FROM EMPLOYEE)
```

Quantified Predicate

```
►►──expression──┬─ = ──┬──┬─SOME─┬──(subselect)──────────────────────────►◄
                ├─ <> ─┤  ├─ANY──┤
                ├─ ¬= ─┤  └─ALL──┘
                ├─ < ──┤
                ├─ > ──┤
                ├─ <= ─┤
                ├─ ¬> ─┤
                ├─ >= ─┤
                └─ ¬< ─┘
```

Note: You can use the exclamation point (!) in place of the not (¬) symbol.

A *quantified predicate* compares a value with a set of values.

The subselect must specify a single result column and can return any number of values, whether null or not null. If the operands of the predicate contain SBCS data or mixed data, and if the sort sequence in effect at the time the statement is executed is not *HEX, then the comparison is performed using weighted values for the operands. The weighted values are based on the sort sequence.

When ALL is specified, the result of the predicate is:

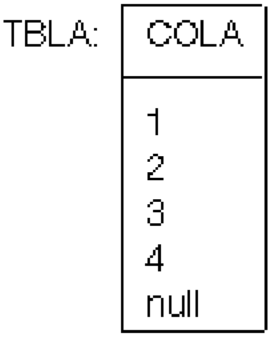
- True if the result of the subselect is empty, or if the specified relationship is true for every value returned by the subselect.
- False if the specified relationship is false for at least one value returned by the subselect.
- Unknown if the specified relationship is not false for any values returned by the subselect and at least one comparison is unknown because of a null value.

When SOME or ANY is specified, the result of the predicate is:

- True if the specified relationship is true for at least one value returned by the subselect.
- False if the result of the subselect is empty, or if the specified relationship is false for every value returned by the subselect.
- Unknown if the specified relationship is not true for any of the values returned by the subselect and at least one comparison is unknown because of a null value.

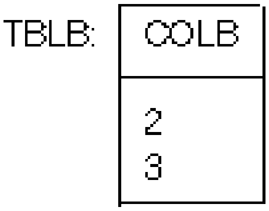
Examples

Use the tables below when referring to the following examples.



TBLA:

COLA
1
2
3
4
null



TBLB:

COLB
2
3

- The following select statement results in 2,3. The subselect returns (2,3). COLA in rows 2 and 3 equals at least one of these values.
  ```
  SELECT * FROM TBLA WHERE COLA = ANY(SELECT COLB FROM TBLB)
  ```
- The following select statement results in 3,4. The subselect returns (2,3). COLA in rows 3 and 4 is greater than at least one of these values.
  ```
  SELECT * FROM TBLA WHERE COLA > ANY(SELECT COLB FROM TBLB)
  ```
- The following select statement results in 4. The subselect returns (2,3). COLA in row 4 is the only one that is greater than both these values.
  ```
  SELECT * FROM TBLA WHERE COLA > ALL(SELECT COLB FROM TBLB)
  ```
- The following select statement results in 1,2,3,4, and null. The result of the subselect is empty. Thus, the predicate is true for all rows in TBLA.
  ```
  SELECT * FROM TBLA WHERE COLA > ALL(SELECT COLB FROM TBLB WHERE COLB<0)
  ```
- The following select statement results in the empty set. The result of the subselect is empty. Thus, the predicate is false for all rows in TBLA.
  ```
  SELECT * FROM TBLA WHERE COLA > ANY(SELECT COLB FROM TBLB WHERE COLB<0)
  ```

BETWEEN Predicate

```
►►—expression——————————BETWEEN—expression—AND—expression———————————————————►◄
                └─NOT─┘
```

The BETWEEN predicate compares a value with a range of values. If a sort sequence other than *HEX is in effect when the statement is executed and the BETWEEN predicate involves SBCS data or mixed data, the weighted values of the strings are compared instead of the values. The weighted value is based on the sort sequence.

The BETWEEN predicate:

```
value1 BETWEEN value2 AND value3
```

is logically equivalent to the search condition:

```
value1 >= value2 AND value1 <= value3
```

The BETWEEN predicate:

```
value1 NOT BETWEEN value2 AND value3
```

is equivalent to the search condition:

```
NOT(value1 BETWEEN value2 AND value3);that is,
value1 < value2 OR value1 > value3.
```

If the operands of the BETWEEN predicate are strings with different CCSIDs, operands are converted as if the above logically-equivalent search conditions were specified.

Given a mixture of datetime values and string representations of datetime values, all values are converted to the data type of the datetime operand.

Examples

```
EMPLOYEE.SALARY BETWEEN 20000 AND 40000

SALARY NOT BETWEEN 20000 + :HV1 AND 40000
```

EXISTS Predicate

```
►►──EXISTS──(subselect)──────────────────────────────────────────────►◄
```

The EXISTS predicate tests for the existence of certain rows. The subselect may specify any number of columns, and

- The result is true only if the number of rows specified by the subselect is not zero.
- The result is false only if the number of rows specified by the subselect is zero.
- The result cannot be unknown.

The values returned by the subselect are ignored.

Example

```
EXISTS (SELECT * FROM EMPLOYEE WHERE SALARY > 60000)
```

IN Predicate

The IN predicate compares a value with a set of values. If a sort sequence other than *HEX is in effect when the statement is executed and the IN predicate involves SBCS data or mixed data, the weighted values of the strings are compared instead of the actual values. The weighted values are based on the sort sequence.

```
►►──expression──┬─────┬──IN──┬─(subselect)───────────────────────┬──────►◄
                └─NOT─┘      │     ┌─,────────────────────┐      │
                             │     ▼                      │      │
                             ├─(───┬─host-variable────────┴───)──┤
                             │     ├─constant─────────┤          │
                             │     └─special-register─┘          │
                             └─────expression────────────────────┘
```

In the subselect form, the subselect must identify a single result column and may return any number of values, whether null or not null.

An IN predicate of the form:

expression **IN** (*subselect*)

is equivalent to a quantified predicate of the form:

expression = **ANY** (*subselect*)

An IN predicate of the form:

expression **NOT IN** (*subselect*)

is equivalent to a quantified predicate of the form:

expression <> **ALL** (*subselect*)

An IN predicate of the form:

expression **IN** *expression*

is equivalent to a basic predicate of the form:

expression = *expression*

An IN predicate of the form:

expression **IN** (*value1, value2, ..., valueN*)

is logically equivalent to:

expression **IN** (**SELECT** * **FROM** R)

Assume T is a table with a single row. R is a temporary table formed by the following fullselect:

```
SELECT value1 FROM T
  UNION
SELECT value2 FROM T
  UNION
    .
    .
    .
  UNION
SELECT valueN FROM T
```

Each host variable must identify a structure or variable that is described in accordance with the rule for declaring host structures or variables.

If the operands of the IN predicate have different data types or attributes, the rules used to determine the data type for evaluation of the IN predicate are those for UNION and UNION ALL. For a description, see “Rules for Result Data Types” on page 78.

If the operands of the IN predicate are strings with different CCSIDs, the rules used to determine which operands are converted are those for operations that combine strings. For a description, see “Conversion Rules for Operations That Combine Strings” on page 81.

Examples

```
DEPTNO IN ('D01', 'B01', 'C01')
```

```
EMPNO IN(SELECT EMPNO FROM EMPLOYEE WHERE WORKDEPT = 'E11')
```

LIKE Predicate

```
►►──expression──┬───────┬──LIKE──┬─USER────────────┬──────────────────────────►
                └──NOT──┘        ├─CURRENT_SERVER──┤
                                 ├─host-variable───┤
                                 └─string-constant─┘

►──┬──────────────────────────────────┬─────────────────────────────────────►◄
   └──ESCAPE──┬─host-variable───┬─────┘
              └─string-constant─┘
```

The LIKE predicate searches for strings that have a certain pattern. The pattern is specified by a string in which the underscore and percent sign have special meanings. If a sort sequence other than *HEX is in effect when the statement is executed and the LIKE predicate involves SBCS data or mixed data, the weighted values of the strings are compared instead of the actual values. The weighted values are based on the sort sequence.

The *expression* must identify a string. If a host variable is specified, it must identify a string variable (not a structure) that is described in the program under the rules for declaring string host variables. With character strings, the terms **character**, **percent sign**, and **underscore** in the following discussion refer to single-byte characters. With graphic strings, the terms refer to double-byte or UCS-2 characters. Trailing blanks in a pattern are a part of the pattern.

Simple Description

For character and graphic expressions, a simple description of the LIKE pattern is as follows:

- The underscore sign (_) represents any single character.
- The percent sign (%) represents a string of zero or more characters.
- Any other character represents itself.

Rigorous Description

Let *x* denote a value of an expression and *y* denote the string specified by the second operand.

The string *y* is interpreted as a sequence of the minimum number of substring specifiers, so each character of *y* is part of exactly one substring specifier. A substring specifier is an underscore, a percent sign, or any nonempty sequence of characters other than an underscore or a percent sign.

The result of the predicate is unknown if *x* or *y* is the null value; otherwise, the result of the predicate is either true or false. The result is true either if both *x* and *y* are empty strings, or a partitioning of *x* into substrings exists such that:

- A substring of *x* is a sequence of zero or more contiguous characters and each character of *x* is part of exactly one substring.
- If the *n*th substring specifier is an underscore, the *n*th substring of *x* is any single character.
- If the *n*th substring specifier is a percent sign, the *n*th substring of *x* is any sequence of zero or more characters.
- If the *n*th substring specifier is neither an underscore nor a percent sign, the *n*th substring of *x* is equal to that substring specifier and has the same length as that substring specifier.
- The number of substrings of *x* is the same as the number of substring specifiers.

It follows that if *y* is an empty string and *x* is not an empty string; the result is false.

The predicate *x* NOT LIKE *y* is equivalent to the search condition NOT(*x* LIKE *y*).

If the CCSID of the escape character is different than the CCSID of the pattern, it is converted to the CCSID of the pattern before the predicate is applied. If the CCSID of the pattern is different than the CCSID of the expression, each substring specifier of the pattern is converted to the CCSID of the expression before the predicate is applied.

Mixed Data

If the expression is mixed data, the expression might contain double-byte characters, and the pattern can include both SBCS and DBCS characters. In that case the special characters in *y* are interpreted as follows:

- An SBCS underscore refers to one SBCS character.
- A DBCS underscore refers to one DBCS character.
- A percent sign (either SBCS or DBCS) refers to any number of characters of any type, either SBCS or DBCS.
- Redundant shifts are not ignored.

UCS-2 Graphic Data

If the expression is UCS-2 graphic data, the pattern can include either or both of the supported code points for the UCS-2 underscore and percent sign. The supported code points for the UCS-2 underscore are X’005F’ and X’FF3F’. The supported code points for the UCS-2 percent sign are X’0025’ and X’FF05’.

ESCAPE clause

The ESCAPE clause allows the definition of patterns intended to match values that contain the actual percent and underscore characters. The following rules govern the use of the ESCAPE clause:

- If a character-string expression is identified, the escape character must be a character-string constant or variable of length 1.
- If a graphic-string expression is identified, the escape character must be a graphic-string constant or variable of length 1.
- If the ESCAPE *host-variable* has a negative indicator variable, the result of the predicate is unknown.
- The *host-variable* or *string-constant* forming the pattern must not contain the escape character except when followed by the escape character, percent, or underscore.

  For example, if '+' is the escape character, any occurrences of '+' other than '++', '+_', or '+%' in the pattern is an error.
- The escape character can be a parameter marker.

Examples

Example 1: Search for the string ‘SYSTEMS’ appearing anywhere within the PROJNAME column in the PROJECT table.

```
PROJECT.PROJNAME LIKE '%SYSTEMS%'
```

Example 2: Search for a string with a first character of ‘J’ that is exactly two characters long in the FIRSTNME column of the EMPLOYEE table.

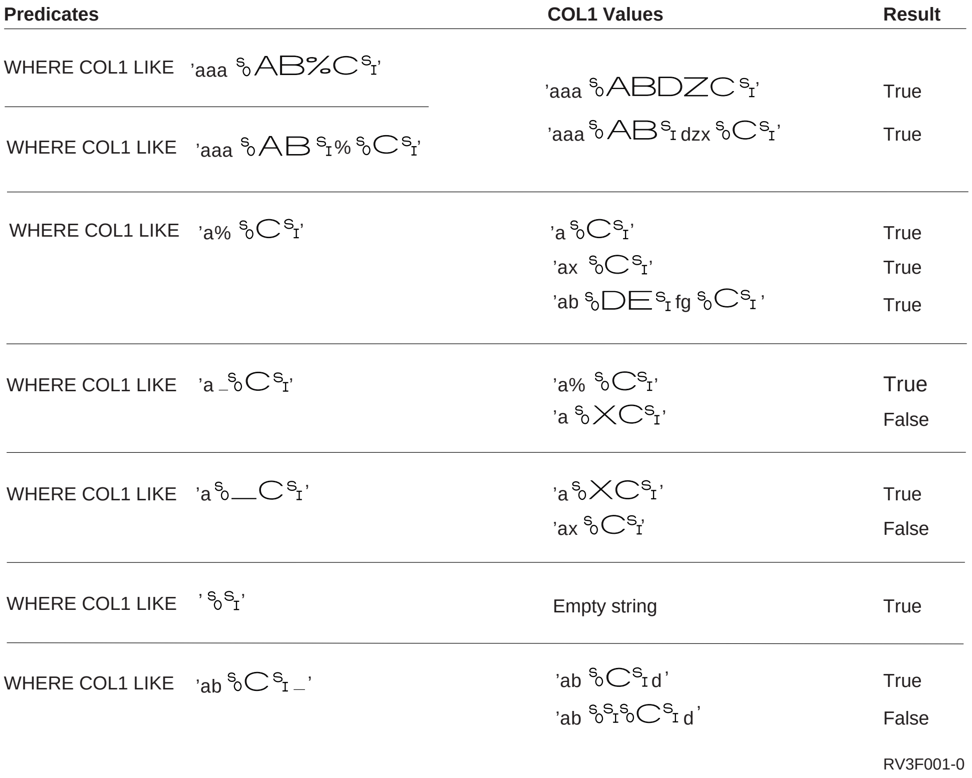
```
EMPLOYEE.FIRSTNME LIKE 'J_'
```

Example 3: In this example:

```
C1 LIKE 'AAAA+%BBB%' ESCAPE '+'
```

'+' is the escape character and indicates that the search is for a string that starts with 'AAAA%BBB'. The '+%' is interpreted as a single occurrence of '%' in the pattern.

Example 4: In the following table of EBCDIC examples, assume COL1 is mixed data. The table shows the results when the predicates in the first column are evaluated using the COL1 values from the second column:



Predicates	COL1 Values	Result
WHERE COL1 LIKE 'aaa $^{S}_{O}$ＡＢ％Ｃ$^{S}_{I}$'	'aaa $^{S}_{O}$ＡＢＤＺＣ$^{S}_{I}$'	True
WHERE COL1 LIKE 'aaa $^{S}_{O}$ＡＢ$^{S}_{I}$% $^{S}_{O}$Ｃ$^{S}_{I}$'	'aaa $^{S}_{O}$ＡＢ$^{S}_{I}$ dzx $^{S}_{O}$Ｃ$^{S}_{I}$'	True
WHERE COL1 LIKE 'a% $^{S}_{O}$Ｃ$^{S}_{I}$'	'a $^{S}_{O}$Ｃ$^{S}_{I}$'	True
	'ax $^{S}_{O}$Ｃ$^{S}_{I}$'	True
	'ab $^{S}_{O}$ＤＥ$^{S}_{I}$ fg $^{S}_{O}$Ｃ$^{S}_{I}$'	True
WHERE COL1 LIKE 'a _$^{S}_{O}$Ｃ$^{S}_{I}$'	'a% $^{S}_{O}$Ｃ$^{S}_{I}$'	True
	'a $^{S}_{O}$ＸＣ$^{S}_{I}$'	False
WHERE COL1 LIKE 'a $^{S}_{O}$＿Ｃ$^{S}_{I}$'	'a $^{S}_{O}$ＸＣ$^{S}_{I}$'	True
	'ax $^{S}_{O}$Ｃ$^{S}_{I}$'	False
WHERE COL1 LIKE ' $^{S}_{O}$$^{S}_{I}$'	Empty string	True
WHERE COL1 LIKE 'ab $^{S}_{O}$Ｃ$^{S}_{I}$ _'	'ab $^{S}_{O}$Ｃ$^{S}_{I}$ d'	True
	'ab $^{S}_{O}$$^{S}_{I}$$^{S}_{O}$Ｃ$^{S}_{I}$ d'	False

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NULL Predicate

```
►►—expression—IS——————————NULL————————————————————————————————————————►◄
                └─NOT─┘
```

The NULL predicate tests for null values.

The result of a NULL predicate cannot be unknown. If the value of the expression is null, the result is true. If the value is not null, the result is false. If NOT is specified, the result is reversed.

Examples

```
EMPLOYEE.PHONE IS NULL
```

```
SALARY IS NOT NULL
```

Search Conditions

```
►►──┬─────┬──┬─predicate──────────┬──────────────────────────────────────────────►
    └─NOT─┘  └─(search-condition)─┘

 ┌──────────────────────────────────────────────────────┐
 ▼                                                      │
►──┬─────────────────────────────────────────────────┬─┴─────────────────────────►◄
   └──┬─AND─┬────┬─────┬──┬─predicate──────────┬─────┘
      └─OR──┘    └─NOT─┘  └─(search-condition)─┘
```

A *search condition* specifies a condition that is true, false, or unknown about a given row or group.

The result of a search condition is derived by application of the specified *logical operators* (AND, OR, NOT) to the result of each specified predicate. If logical operators are not specified, the result of the search condition is the result of the specified predicate.

AND and OR are defined in the following table in which P and Q are any predicates:

Table 19. Truth Tables for AND and OR

P	**Q**	**P AND Q**	**P OR Q**
True	True	True	True
True	False	False	True
True	Unknown	Unknown	True
False	True	False	True
False	False	False	False
False	Unknown	False	Unknown
Unknown	True	Unknown	True
Unknown	False	False	Unknown
Unknown	Unknown	Unknown	Unknown

NOT(true) is false, NOT(false) is true, and NOT(unknown) is unknown.

Search conditions within parentheses are evaluated first. If the order of evaluation is not specified by parentheses, NOT is applied before AND, and AND is applied before OR. The order in which operators at the same precedence level are evaluated is undefined to allow for optimization of search conditions.

Examples

In the examples, the numbers on the second line indicate the order in which the operators are evaluated.

Example 1

```
MAJPROJ = 'MA2100' AND DEPTNO = 'D11'  OR  DEPTNO = 'B03' OR DEPTNO = 'E11'
                   1                   2 or 3             2 or 3
```

Example 2

```
MAJPROJ = 'MA2100'  AND  (DEPTNO = 'D11'  OR  DEPTNO = 'B03')  OR  DEPTNO = 'E11'
                    2                     1                    3
```

Chapter 3. Built-In Functions

A *built-in function* is a function that is supplied with DB2 UDB for AS/400. A built-in function is denoted by a function name followed by one or more operands which are enclosed in parentheses. The operands of functions are called *arguments*. Most functions have a single argument that is specified by an *expression*. The result of a function is a single value derived by applying the function to the result of the expression.

Functions are classified as *scalar functions* or *column functions*. The argument of a column function is a set of values. An argument of a scalar function is a single value.

In the syntax of SQL, the term *function* is used only in the definition of an expression. Thus a function can be used only where an expression can be used. Additional restrictions apply to the use of column functions as specified in the following section and in "Chapter 4. Queries" on page 219.

Column Functions

The following information applies to all column functions other than COUNT(*).

The argument of a column function is a set of values derived from one or more columns. The scope of the set is a group or an intermediate result table as explained in Chapter 4, ″Queries″.

If a GROUP BY clause is specified in a query and the intermediate result of the FROM, WHERE, GROUP BY, and HAVING clauses is the empty set, then the column functions are not applied, the result of the query is the empty set, the SQLCODE is set to +100, and the SQLSTATE is set to ’02000’.

If a GROUP BY clause is not specified in a query and the intermediate result of the FROM, WHERE, and HAVING clauses is the empty set, then the column functions are applied to the empty set.

For example, the result of the following SELECT statement is the number of distinct values of JOB for employees in department D01:

```
SELECT COUNT(DISTINCT JOB)
  FROM CORPDATA.EMPLOYEE
  WHERE WORKDEPT = 'D01'
```

The keyword DISTINCT is not considered an argument of the function, but rather a specification of an operation that is performed before the function is applied. If DISTINCT is specified, duplicate values are eliminated. If ALL is implicitly or explicitly specified, duplicate values are not eliminated.

The values of the argument are specified by an expression.

If a *column-name* is a correlated reference (which is allowed in a subquery of a HAVING clause), the expression must not include operators.

Following in alphabetical order is a definition of each of the column functions.

AVG

```
          ┌─ALL──────┐
►►──AVG──(─┼──────────┼──expression───)──────────────────────────────►◄
          └─DISTINCT─┘
```

The AVG function returns the average of a set of numbers.

The argument values must be any built-in numeric data type and their sum must be within the range of the data type of the result.

The data type of the result is the same as the data type of the argument values, except that:

- The result is double-precision floating point if the argument values are single-precision floating point.
- The result is large integer if the argument values are small integers.
- The result is decimal if the argument values are nonzero scale binary.

The result can be null.

If the data type of the argument values is decimal or nonzero scale binary with precision *p* and scale *s*, the precision of the result is 31 and the scale is 31-*p*+*s*.

The function is applied to the set of values derived from the argument values by the elimination of null values. If DISTINCT is used, duplicate values are eliminated.

If the function is applied to the empty set, the result is a null value. Otherwise, the result is the average value of the set.

The order in which the values are added is undefined, but every intermediate result must be within the range of the result data type.

If the type of the result is integer, the fractional part of the average is lost.

Example

Example 1: Using the PROJECT table, set the host variable AVERAGE (decimal(5,2)) to the average staffing level (PRSTAFF) of projects in department (DEPTNO) ‘D11’.

```
SELECT AVG(PRSTAFF)
  INTO :AVERAGE
  FROM PROJECT
  WHERE DEPTNO = 'D11'
```

Results in AVERAGE being set to 4.25 (that is, 17/4) when using the sample table.

Example 2: Using the PROJECT table, set the host variable ANY_CALC to the average of each unique staffing value (PRSTAFF) of projects in department (DEPTNO) ’D11’.

```
SELECT AVG(DISTINCT PRSTAFF)
  INTO :ANY_CALC
  FROM PROJECT
  WHERE DEPTNO = 'D11'
```

Results in ANY_CALC being set to 4.66 (that is, 14/3) when using the sample table.

COUNT

```
               ┌─ALL──────┐
►►──COUNT──(──┬┼──────────┼──expression─┬──)──────────────────────────────►◄
              │└─DISTINCT─┘             │
              └─*───────────────────────┘
```

The COUNT function returns the number of rows or values in a set of rows or values.

The result of the function is a large integer and it must be within the range of large integers. The result cannot be null. If the table is a distributed table, then the result is DECIMAL(15,0). For more information about distributed tables, see the DB2 Multisystem book.

The argument of COUNT(*) is a set of rows. The result is the number of rows in the set. A row that includes only null values is included in the count.

The argument of COUNT(*expression*) is a set of values. The function is applied to the set derived from the argument values by the elimination of null values. The result is the number of values in the set.

The argument of COUNT(DISTINCT *expression*) is a set of values. The argument values can be any values except character strings with a length attribute greater than 2000, graphic strings with a length attribute greater than 1000 DBCS or UCS-2 characters, LOBs, or DataLinks. The function is applied to the set of values derived from the argument values by the elimination of null values and duplicate values. The result is the number of values in the set.

If a sort sequence other than *HEX is in effect when the statement that contains the COUNT(DISTINCT *expression*) is executed and the arguments contain SBCS, UCS-2, or mixed data, then the result is obtained by comparing weighted values for each value in the set. The weighted values are based on the sort sequence.

Example

Example 1: Using the EMPLOYEE table, set the host variable FEMALE (int) to the number of rows where the value of the SEX column is ‘F’.

```
SELECT COUNT(*)
  INTO :FEMALE
  FROM EMPLOYEE
  WHERE SEX = 'F'
```

Results in FEMALE being set to 13 when using the sample table.

Example 2: Using the EMPLOYEE table, set the host variable FEMALE_IN_DEPT (int) to the number of departments (WORKDEPT) that have at least one female as a member.

```
SELECT COUNT(DISTINCT WORKDEPT)
  INTO :FEMALE_IN_DEPT
  FROM EMPLOYEE
  WHERE SEX='F'
```

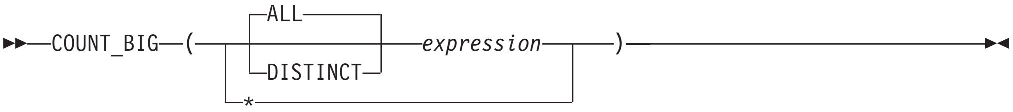
Results in FEMALE_IN_DEPT being set to 5 when using the sample table. (There is at least one female in departments A00, C01, D11, D21, and E11.)

Example 3: Using the PROJECT table, set the host variable SUB_PROJECT_COUNT (int) to the number of projects that are sub-projects of a major project.

```
SELECT COUNT(MAJPROJ)
  INTO :SUB_PROJECT_COUNT
  FROM PROJECT
```

Results in SUB_PROJECT_COUNT being set to 14 when using the sample tables.

COUNT_BIG



The COUNT_BIG function returns the number of rows or values in a set of rows or values. It is similar to COUNT except that the result can be greater than the maximum value of integer.

The result of the function is a decimal with precision 31 and scale 0. The result cannot be null.

The argument of COUNT_BIG(*) is a set of rows. The result is the number of rows in the set. A row that includes only null values is included in the count.

The argument of COUNT_BIG(*expression*) is a set of values. The function is applied to the set derived from the argument values by the elimination of null values. The result is the number of values in the set.

The argument of COUNT_BIG(DISTINCT *expression*) is a set of values. The argument values can be any values except character strings with a length attribute greater than 2000, graphic strings with a length attribute greater than 1000 DBCS or UCS-2 characters, LOBs, or DataLinks. The function is applied to the set of values derived from the argument values by the elimination of null values and duplicate values. The result is the number of values in the set.

If a sort sequence other than *HEX is in effect when the statement that contains the COUNT(DISTINCT *expression*) is executed and the arguments contain SBCS, UCS-2, or mixed data, then the result is obtained by comparing weighted values for each value in the set. The weighted values are based on the sort sequence.

Example

Example 1: Refer to COUNT examples and substitute COUNT_BIG for occurrences of COUNT. The results are the same except for the data type of the result.

Example 2: To count on a specific column, a sourced function must specify the type of the column. In this example, the CREATE FUNCTION statement creates a sourced function that takes any column defined as CHAR, uses COUNT_BIG to perform the counting, and returns the result as a double precision floating-point number. The query shown counts the number of unique departments in the sample employee table.

```
CREATE FUNCTION RICK.COUNT(CHAR()) RETURNS DOUBLE
  SOURCE QSYS2.COUNT_BIG(CHAR());
SELECT COUNT(DISTINCT WORKDEPT FROM CORPDATA.EMPLOYEE;
```

Note that the input parameter for the sourced function is defined with empty parentheses to indicate that the input parameter inherits the attributes of the parameter of the source function.

MAX

```
                .-ALL------.
>>--MAX--(------+----------+--expression----)-----------------------------------><
                '-DISTINCT-'
```

The MAX column function returns the maximum value in a set of values in a group.

The argument values can be any built-in data types except LOB and DataLink values.

The data type and length attribute of the result are the same as the data type and length attribute of the argument values. When the argument is a string, the result has the same CCSID as the argument. The result can be null.

If a sort sequence other than *HEX is in effect when the statement that contains the MAX function is executed and the arguments contain SBCS, UCS-2, or mixed data, then the result is obtained by comparing weighted values for each value in the set. The weighted values are based on the sort sequence.

The function is applied to the set of values derived from the argument values by the elimination of null values.

If the function is applied to the empty set, the result is a null value. Otherwise, the result is the maximum value in the set.

The specification of DISTINCT has no effect on the result and is not advised.

Examples

Example 1: Using the EMPLOYEE table, set the host variable MAX_SALARY (decimal(7,2)) to the maximum monthly salary (SALARY / 12) value.

```
SELECT MAX(SALARY) /12
  INTO:MAX_SALARY
  FROM EMPLOYEE
```

Results in MAX_SALARY being set to 4395.83 when using the sample table.

Example 2: Using the PROJECT table, set the host variable LAST_PROJ (char(24)) to the project name (PROJNAME) that comes last in the collating sequence.

```
SELECT MAX(PROJNAME)
  INTO :LAST_PROJ
  FROM PROJECT
```

Results in LAST_PROJ being set to 'WELD LINE PLANNING' when using the sample table.

MIN

```
              ┌─ALL──────┐
►►──MIN──(────┼──────────┼──expression────)────────────────────────────────►◄
              └─DISTINCT─┘
```

The MIN column function returns the minimum value in a set of values in a group.

The argument values can be any built-in data types except LOB and DataLink values.

The data type and length attribute of the result are the same as the data type and length attribute of the argument values. When the argument is a string, the result has the same CCSID as the argument. The result can be null.

If a sort sequence other than *HEX is in effect when the statement that contains the MIN function is executed and the arguments contain SBCS, UCS-2, or mixed data, then the result is obtained by comparing weighted values for each value in the set.

The function is applied to the set of values derived from the argument values by the elimination of null values.

If the function is applied to the empty set, the result is a null value. Otherwise, the result is the minimum value in the set.

The specification of DISTINCT has no effect on the result and is not advised.

Examples

Example 1: Using the EMPLOYEE table, set the host variable COMM_SPREAD (decimal(7,2)) to the difference between the maximum and minimum commission (COMM) for the members of department (WORKDEPT) ‘D11’.

```
SELECT MAX(COMM) - MIN(COMM)
  INTO :COMM_SPREAD
  FROM EMPLOYEE
  WHERE WORKDEPT  = 'D11'
```

Results in COMM_SPREAD being set to 1118 (that is, 2580 - 1462) when using the sample table.

Example 2: Using the PROJECT table, set the host variable FIRST_FINISHED (char(10)) to the estimated ending date (PRENDATE) of the first project scheduled to be completed.

```
SELECT MIN(PRENDATE)
  INTO :FIRST_FINISHED
  FROM PROJECT
```

Results in FIRST_FINISHED being set to ‘1982-09-15’ when using the sample table.

STDDEV

```
           ┌─ALL──────┐
►►──STDDEV──(──┼──────────┼──expression───)──────────────────────────────►◄
           └─DISTINCT─┘
```

The STDDEV function returns the biased standard deviation (/n) of a set of numbers. The formula used to calculate STDDEV is:

```
STDDEV = SQRT(VAR)
```

where SQRT(VAR) is the square root of the variance.

The argument values must be any built-in numeric data type and the sum must be within the range of the data type of the result.

The data type of the result is double-precision floating point. The result can be null.

The function is applied to the set of values derived from the argument values by the elimination of null values. If DISTINCT is specified, duplicate values are eliminated.

If the function is applied to the empty set, the result is a null value. Otherwise, the result is the standard deviation of the values in the set.

The order in which the values are added is undefined, but every intermediate result must be within the range of the result data type.

Example

Using the EMPLOYEE table, set the host variable DEV (FLOAT double precision) to the standard deviation of the salaries for those employees in department A00.

```
SELECT STDDEV(SALARY)
  INTO :DEV
  FROM EMPLOYEE
  WHERE WORKDEPT = 'A00';
```

Results in DEV being set to approximately 9938.00 when using the sample table.

SUM

```
        ┌─ALL──────┐
►►──SUM──(──┼──────────┼──expression───)─────────────────────────────────►◄
        └─DISTINCT─┘
```

The SUM function returns the sum of a set of numbers.

The argument values must be any built-in numeric data type and their sum must be within the range of the data type of the result.

The data type of the result is the same as the data type of the argument values except that the result is:

- Double-precision floating point if the argument values are single-precision floating point

- Large integer if the argument values are small integers
- Decimal if the argument values are nonzero scale binary

The result can be null.

If the data type of the argument values is decimal or nonzero scale binary, the precision of the result is 31 and the scale is the same as the scale of the argument values.

The function is applied to the set of values derived from the argument values by the elimination of null values. If DISTINCT is specified, duplicate values are eliminated.

If the function is applied to the empty set, the result is a null value. Otherwise, the result is the sum of the values in the set.

The order in which the values are added is undefined, but every intermediate result must be within the range of the result data type.

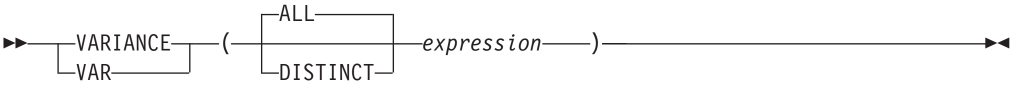
Example

Using the EMPLOYEE table, set the host variable JOB_BONUS (decimal(9,2)) to the total bonus (BONUS) paid to clerks (JOB='CLERK').

```
SELECT SUM(BONUS)
  INTO :JOB_BONUS
  FROM EMPLOYEE
  WHERE JOB = 'CLERK'
```

Results in JOB_BONUS being set to 2800 when using the sample table.

VARIANCE or VAR



The VAR and VARIANCE functions return the biased variance (/n) of a set of numbers. The formula used to calculate VAR is:

```
VAR = SUM(X**2)/COUNT(X) - (SUM(X)/COUNT(X))**2
```

The argument values must be any built-in numeric data type and the sum must be within the range of the data type of the result.

The data type of the result is double-precision floating point. The result can be null.

The function is applied to the set of values derived from the argument values by the elimination of null values. If DISTINCT is specified, duplicate values are eliminated.

If the function is applied to the empty set, the result is a null value. Otherwise, the result is the variance of the values in the set.

The order in which the values are added is undefined, but every intermediate result must be within the range of the result data type.

Example

Using the EMPLOYEE table, set the host variable VARNCE (FLOAT double precision) to the variance of the salaries for those employees in department A00.

```
SELECT VAR(SALARY)
  INTO :VARNCE
  FROM EMPLOYEE
  WHERE WORKDEPT = 'A00';
```

Results in VARNCE being set to approximately 98763888.88 when using the sample table.

Scalar Functions

A scalar function can be used wherever an expression can be used. The restrictions on the use of column functions do not apply to scalar functions because a scalar function is applied to a single value rather than a set of values. For example, the argument of a scalar function can be a function. However, the restrictions that apply to the use of expressions and column functions also apply when an expression or column function is used within a scalar function. For example, the argument of a scalar function can be a column function only if a column function is allowed in the context in which the scalar function is used.

For example, the result of the following SELECT statement has as many rows as there are employees in department D01:

```
SELECT EMPNO, LASTNAME, YYEAR(CURRENT DATE - BIRTHDATE)
  FROM CORPDATA.EMPLOYEE
  WHERE WORKDEPT = 'D01'
```

ABS or ABSVAL

```
►►──┬─ABS────┬──(──expression──)───────────────────────────────►◄
    └─ABSVAL─┘
```

The ABS and ABSVAL functions return the absolute value of a number.

The argument must be a number.

The data type and length attribute of the result are the same as the data type and length attribute of the argument value, except that the result is a large integer if the argument value is a small integer, and the result is double-precision floating point if the argument value is single-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable PROFIT is a large integer with a value of -50000.

```
ABSVAL(:PROFIT)
```

Returns the value 50000.

ACOS

```
►►──ACOS──(──expression──)─────────────────────────────────────►◄
```

The ACOS function returns the arc cosine of a number, in radians. The ACOS and COS functions are inverse operations.

The argument must be a number whose value is greater than or equal to -1 and less than or equal to 1.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is in the range (0, π).

Example

Assume the host variable ACOSINE is a decimal (10,9) host variable with a value of 0.070737202.

```
ACOS(:ACOSINE)
```

Returns the approximate value 1.49.

ANTILOG

```
►►──ANTILOG──(──expression──)────────────────────────────────────────►◄
```

The ANTILOG function returns the anti-logarithm (base 10) of a number. The ANTILOG and LOG functions are inverse operations.

The argument must be a number.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable ALOG is a decimal (10,9) host variable with a value of 1.499961866.

```
ANTILOG(:ALOG)
```

Returns the approximate value 31.62.

ASIN

```
►►──ASIN──(──expression──)───────────────────────────────────────────►◄
```

The ASIN function returns the arc sine of a number, in radians. The ASIN and SIN functions are inverse operations.

The argument must be a number whose value is greater than or equal to -1 and less than or equal to 1.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is in the range (-π/2, π/2).

Example

Assume the host variable ASINE is a decimal (10,9) host variable with a value of 0.997494987.

```
ASIN(:ASINE)
```

Returns the approximate value 1.50.

ATAN

```
►►──ATAN──(──expression──)─────────────────────────────────────────►◄
```

The ATAN function returns the arc tangent of a number, in radians. The ATAN and TAN functions are inverse operations.

The argument must be a number.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is in the range ($-\pi/2$, $\pi/2$).

Example

Assume the host variable ATANGENT is a decimal (10,8) host variable with a value of 14.10141995.

```
ATAN(:ATANGENT)
```

Returns the approximate value 1.50.

ATANH

```
►►──ATANH──(──expression──)────────────────────────────────────────►◄
```

The ATANH function returns the hyperbolic arc tangent of a number, in radians. The ATANH and TANH functions are inverse operations.

The argument must be a number whose value is greater than -1 and less than 1.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable HATAN is a decimal (10,9) host variable with a value of 0.905148254.

```
ATANH(:HATAN)
```

Returns the approximate value 1.50.

ATAN2

```
►►──ATAN2──(──expression1──,──expression2──)───────────────────────►◄
```

The ATAN2 function returns the the arctangent of x and y coordinates as an angle expressed in radians. The first and second arguments specify the x and y coordinates, respectively.

Each argument is an expression that returns the value of any built-in numeric data type. Both arguments must not be 0. Any argument that is not a double precision floating-point number is converted to one for processing by the function.

The data type of the result is double-precision floating point. If any argument can be null, the result can be null; if any argument is null, the result is the null value.

Example

Assume that host variables HATAN2A and HATAN2B are DOUBLE host variables with values of 1 and 2, respectively. The following statement:

```
SELECT ATAN2(:HATAN2A,:HATAN2B)
  FROM QSYS2.QSQPTABL
```

Returns a double precision floating-point number with an approximate value of 1.1071487.

BIGINT

```
►►──BIGINT──(──┬─numeric-expression───┬──)─────────────────────────────────►◄
               └─character-expression─┘
```

The BIGINT function returns a big integer representation of:

- A number
- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

numeric-expression
An expression that returns a numeric value of any numeric data type.

If the argument is a *numeric-expression*, the result is the same number that would occur if the argument were assigned to a big integer column or variable. If the whole part of the argument is not within the range of integers, an error occurs. The fractional part of the argument is truncated.

character-expression
An expression that returns a character string value.

If the argument is a *character-expression*, the result is the same number that would result from CAST(*character-expression* AS BIGINT). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming a floating-point, integer, or decimal constant. If the whole part of the argument is not within the range of integers, an error occurs. Any fractional part of the argument is truncated.

The result of the function is a big integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Using the EMPLOYEE table, select the EMPNO column in big integer form for further processing in the application..

```
SELECT BIGINT(SALARY)
  FROM EMPLOYEE
```

BLOB

```
►►──BLOB──(──string-expression──┬─────────────┬──)──────────────────────►◄
                                └─,──integer──┘
```

The BLOB function returns a BLOB representation of a string of any type.

The result of the function is a BLOB. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

string-expression
A *string-expression* whose value can be a character string, graphic string, or binary string.

integer
Specifies the length attribute for the resulting binary string. The value must be between 1 and 15 728 640.

If the second argument is not specified:

- If the *string-expression* is the empty string constant, the length attribute of the result is 1.
- Otherwise, the length attribute of the result is the same as the length attribute of the first argument, unless the argument is a graphic string. In this case, the length attribute of the result is twice the length attribute of the argument.

The actual length of the result is the minimum of the length attribute of the result and the actual length of the expression (or twice the length of the expression when the input is graphic data). If the length of the *string-expression* is greater than the length attribute of the result, truncation is performed and a warning is returned.

Example

Example 1: The following function returns a BLOB for the string 'This is a BLOB'.

```
SELECT BLOB('This is a BLOB') FROM T1
```

Example 2: The following function returns a BLOB for the large object that is identified by locator myclob_locator.

```
SELECT BLOB(:myclob_locator) FROM T1
```

Example 3: Assume that a table has a BLOB column named TOPOGRAPHIC_MAP and a VARCHAR column named MAP_NAME. Locate any maps that contain the string 'Pellow Island' and return a single binary string with the map name concatenated in front of the actual map. The following function returns a BLOB for the large object that is identified by locator myclob_locator.

```
SELECT BLOB( MAP_NAME CONCAT  ':  ' CONCAT  TOPOGRAPHIC_MAP )
  FROM ONTARIO_SERIES_4
  WHERE TOPOGRAPHIC_MAP LIKE '%Pellow Island%'
```

CEILING

```
►►──┬─CEILING─┬──(──numeric-expression──)──────────────────────────────►◄
    └─CEIL────┘
```

The CEIL or CEILING function returns the smallest integer value that is greater than or equal to *numeric-expression*.

The argument is an expression that returns a value of any built-in numeric data type.

The result of the function has the same data type and length attribute of the argument except that:

- The scale is 0 if the argument is DECIMAL or NUMERIC. For example, an argument with a data type of DECIMAL(5,5) will result in DECIMAL(5,0).

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Examples

- Find the highest monthly salary for all the employees. Round the result up to the next integer. The SALARY column has a decimal data type

  ```
  SELECT CEIL(MAX(SALARY)/12
    FROM CORPDATA.EMPLOYEE
  ```

  This example returns 4396.00 because the highest paid employee is Christine Haas who earns $52750.00 per year. Her average monthly salary before applying the CEIL function is 4395.83.

- Use CEILING on both positive and negative numbers.

  ```
  SELECT CEILING( 3.5),
         CEILING( 3.1),
         CEILING(-3.1),
         CEILING(-3.5),
    FROM TABLEX
  ```

  This example returns:

  ```
  4.0   4.0  -3.0  -3.0
  ```

  respectively.

CHAR

Datetime to Character

```
►►──CHAR──(──datetime-expression──┬─────────────────┬──)────────────────────►◄
                                  └─,──┬─ISO─┬──────┘
                                       ├─USA─┤
                                       ├─EUR─┤
                                       └─JIS─┘
```

Character to Character

```
►►──CHAR──(──character-expression──┬─────────────┬──)───────────────────────►◄
                                   └─,──integer──┘
```

Integer to Character

```
►►──CHAR──(──integer-expression──)──────────────────────────────────────────►◄
```

Decimal to Character

```
►►──CHAR──(──decimal-expression──┬───────────────────────┬──)───────────────►◄
                                 └─,──decimal-character──┘
```

Floating-point to Character

```
►►──CHAR──(──floating-point-expression──┬───────────────────────┬──)────────►◄
                                        └─,──decimal-character──┘
```

The CHAR function returns a string representation of:

- A datetime value if the first argument is a date, time, or timestamp.
- A character string if the first argument is any type of character string.
- An integer number if the first argument is a SMALLINT, INTEGER, or BIGINT.
- A decimal number if the first argument is a packed or zoned decimal number.
- A double-precision floating-point number if the first argument is a DOUBLE or REAL.

Note: The CAST expression can also be used to return a string expression. For more information, see ″CAST Specification″ under “Expressions” on page 105.

The result of the function is a fixed-length character string. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Datetime to Character

datetime-expression

An expression that is one of the following three data types

date The result is the character-string representation of the date in the format specified by the second argument. If the second argument is not specified, the format used is from the date format (DATFMT) and the date separator (DATSEP) parameters. If the format is ISO, USA, EUR, or JIS, the length of the result is 10. If the format is YMD, MDY, or DMY, the result is 8. If the format is JUL, the length of the result is 6.

The DATFMT and DATSEP parameters are specified on the Create SQL Program (CRTSQLxxx), Run SQL Statements (RUNSQLSTM), and Start SQL (STRSQL) commands. The SET OPTION statement can be used to specify the DATFMT and DATSEP parameters within the source of a program containing embedded SQL.

time The result is the character-string representation of the time in the format specified by the second argument. If the second argument is not specified, the format used is from the time format (TIMFMT) and the time separator (TIMSEP) parameters. The length of the result is 8.

The TIMFMT and TIMSEP parameters are specified on the Create SQL Program (CRTSQLxxx), Run SQL Statements (RUNSQLSTM), and Start SQL (STRSQL) commands. The SET OPTION statement can be used to specify the TIMFMT and TIMSEP parameters within the source of a program containing embedded SQL.

timestamp
The second argument is not applicable and must not be specified.

The result is the character-string representation of the timestamp. The length of the result is 26.

The CCSID of the string is the default SBCS CCSID at the current server.

Character to Character

character-expression
An expression that returns a value that is a CHAR or VARCHAR data type.

integer
Specifies the length attribute for the resulting fixed length character string. The value must be between 1 and 32766 (32765 if nullable). If the first argument is mixed data, the second argument cannot be less than 4.

If the second argument is not specified:

- If the *character-expression* is the empty string constant, the length attribute of the result is 1.
- Otherwise, the length attribute of the result is the same as the length attribute of the first argument.

The actual length is the same as the length attribute of the result. If the length of the *character-expression* is less than the length of the result, the result is padded with blanks up to the length of the result. If the length of the *character-expression* is greater than the length attribute of the result, truncation is performed. A warning is returned unless the truncated characters were all blanks.

The CCSID of the string is the CCSID of the *character-expression*.

Integer to Character

integer-expression
An expression that returns a value that is an integer data type (either SMALLINT, INTEGER, or BIGINT).

The result is the character string representation of the argument in the form of an SQL integer constant. The result consists of n characters that are the significant digits that represent the value of the argument with a preceding minus sign if the argument is negative. It is left justified.

- If the argument is a small integer:

  The length of the result is 6. If the number of characters in the result is less than 6, then the result is padded on the right with blanks.
- If the argument is a large integer:

  The length of the result is 11. If the number of characters in the result is less than 11, then the result is padded on the right with blanks.
- If the argument is a big integer:

  The length of the result is 20. If the number of characters in the result is less than 20, then the result is padded on the right with blanks.

The CCSID of the string is the default SBCS CCSID at the current server.

Decimal to Character

decimal-expression
An expression that returns a value that is a packed or zoned decimal data type (either DECIMAL or NUMERIC). If a different precision and scale is desired, the DECIMAL scalar function can be used to make the change.

decimal-character
Specifies the single-byte character constant that is used to delimit the decimal digits in the result character string. The character must be a period or comma.

The result is a fixed-length character string representation of the argument. The result includes a decimal character and up to *p* digits, where *p* is the precision of the *decimal-expression* with a preceding minus sign if the argument is negative. Leading zeros are not returned. Trailing zeros are returned. The length of the result is 2+*p* where *p* is the precision of the *decimal-expression*. This means that a positive value will always include one trailing blank.

The CCSID of the string is the default SBCS CCSID at the current server.

Floating-point to Character

floating-point expression
An expression that returns a value that is a floating-point data type (DOUBLE or REAL).

decimal-character
Specifies the single-byte character constant that is used to delimit the decimal digits in the result character string. The character must be a period or comma.

The result is a fixed-length character string representation of the argument in the form of a floating-point constant. The length of the result is 24. If the argument is negative, the first character of the result is a minus sign. Otherwise, the first character is a digit. If the argument is zero, the result is 0E0. Otherwise, the result includes the smallest number of characters that can be used to represent the value of the argument such that the mantissa consists of a single digit other than zero followed by a period and a sequence of digits. If the number of characters in the result is less than 24, then the result is padded on the right with blanks.

The CCSID of the string is the default SBCS CCSID at the current server.

Examples

Example 1: Assume the column PRSTDATE has an internal value equivalent to 1988-12-25. The date format is *MDY and the date separator is a slash (/).

```
CHAR(PRSTDATE, USA)
```

Results in the value ‘12/25/1988’.

```
CHAR(PRSTDATE)
```

Results in the value ‘12/25/88’.

Example 2: Assume the column STARTING has an internal value equivalent to 17.12.30, the host variable HOUR_DUR (decimal(6,0)) is a time duration with a value of 050000 (that is, 5 hours).

```
CHAR(STARTING, USA)
```

Results in the value ‘5:12 PM’.

```
CHAR(STARTING + :HOUR_DUR, USA)
```

Results in the value ‘10:12 PM’.

Example 3: Assume the column RECEIVED (timestamp) has an internal value equivalent to the combination of the PRSTDATE and STARTING columns.

```
CHAR(RECEIVED)
```

Results in the value ‘1988-12-25-17.12.30.000000’.

Example 4: Use the CHAR function to make the type fixed length character and reduce the length of the displayed results to 10 characters for the LASTNAME column (defined as VARCHAR(15)) of the EMPLOYEE table.

```
CHAR(LASTNAME,10)
```

For rows having a LASTNAME with a length greater than 10 characters (excluding trailing blanks), a warning that the value is truncated is returned.

Example 5: Use the CHAR function to return the values for EDLEVEL (defined as SMALLINT) as a fixed length string.

```
CHAR(EDLEVEL)
```

An EDLEVEL of 18 would be returned as the CHAR(6) value ’18’ (18 followed by 4 blanks).

Example 6: Assume that the STAFF table has a SALARY column defined as decimal with precision of 9 and scale of 2. The current value is 18357.50 and it is to be returned with a comma as the decimal character (18357,50).

```
CHAR(SALARY, ',')
```

returns the value ’18357,50’ followed by 3 blanks.

Example 7: Assume the same SALARY column subtracted from 20000.25 is to be returned with the default decimal character, and the default is period.

```
CHAR(20000.25 - SALARY)
```

returns the value ’-1642.75’ followed by 3 blanks.

Example 8: Assume a host variable, SEASONS_TICKETS, has an integer data type and a value of 10000.

```
CHAR(DECIMAL(:SEASONS_TICKETS,7,2))
```

Results in the character value ’10000.00’.

Example 9: Assume a host variable, DOUBLE_NUM, has a double precision floating-point data type and a value of -987.654321E-35.

```
CHAR(:DOUBLE_NUM)
```

Results in the character value ’-9.8765432100000002E-33 ’.

CHARACTER_LENGTH or CHAR_LENGTH

```
►►──┬─CHARACTER_LENGTH─┬──(──expression──)─────────────────────────────►◄
    └─CHAR_LENGTH──────┘
```

The CHARACTER_LENGTH or CHAR_LENGTH function returns the length of a string expression. See “LENGTH” on page 177 for a similar function.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is the number of characters in the argument (not the number of bytes). A single character is either an SBCS or DBCS character. The length of strings includes trailing blanks. The length of a varying-length string is the actual length, not the maximum length.

Example

Assume the host variable ADDRESS is a varying-length character string with a value of ‘895 Don Mills Road’.

```
CHARACTER_LENGTH(:ADDRESS)
```

Returns the value 18.

CLOB

Character to CLOB

```
►►──CLOB (──character-expression──┬──────────────────────────────────┬──)──────────────────►◄
                                  └─,──┬─length──┬──┬─────────────┬──┘
                                       └─DEFAULT─┘  └─,──integer──┘
```

Graphic to CLOB

```
►►──CLOB (──graphic-expression──┬──────────────────────────────────┬──)────────────────────►◄
                                └─,──┬─length──┬──┬─────────────┬──┘
                                     └─DEFAULT─┘  └─,──integer──┘
```

Integer to CLOB

```
►►──CLOB──(──integer-expression──)─────────────────────────────────────────────────────────►◄
```

Decimal to CLOB

```
►►──CLOB──(──decimal-expression──┬─────────────────────────┬──)────────────────────────────►◄
                                 └─,──decimal-character────┘
```

Floating-point to CLOB

```
►►──CLOB──(──floating-point-expression──┬─────────────────────────┬──)─────────────────────►◄
                                        └─,──decimal-character────┘
```

The CLOB function returns a character-string representation of:

- A character string if the first argument is any type of character string
- A graphic string if the first argument is an UCS-2 graphic string
- An integer number if the first argument is a SMALLINT, INTEGER, or BIGINT
- A decimal number if the first argument is a packed or zoned decimal number
- A double-precision floating-point number if the first argument is a DOUBLE or REAL

The result of the function is a varying-length string. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Character to CLOB

character-expression

An expression that returns a value that is a CHAR or VARCHAR or CLOB data type.

length

Specifies the length attribute for the resulting varying length character string. The value must be between 1 and 15 728 640. If the first argument is mixed data, the second argument cannot be less than 4.

If the second argument is not specified or DEFAULT is specified:

- If the *character-expression* is the empty string constant, the length attribute of the result is 1.
- Otherwise, the length attribute of the result is the same as the length attribute of the first argument.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *character-expression*. If the length of the *character-expression* is greater than the length attribute of the result, truncation is performed. A warning is returned unless the truncated characters were all blanks.

integer

Specifies the CCSID of the result. It must be a valid SBCS CCSID or mixed data CCSID. If the third argument is an SBCS CCSID, then the result is SBCS data. If the third argument is a mixed CCSID, then the result is mixed data. If the third argument is a SBCS CCSID, then the first argument cannot be a DBCS-either or DBCS-only string. The third argument cannot be 65535.

If the third argument is not specified, the first argument must not have a CCSID of 65535:

- If the first argument is bit data, an error occurs.
- If the first argument is SBCS data, then the result is SBCS data. The CCSID of the result is the same as the CCSID of the first argument.
- If the first argument is mixed data (DBCS-open, DBCS-only, or DBCS-either), then the result is mixed data. The CCSID of the result is the same as the CCSID of the first argument.

Graphic to CLOB

graphic-expression

An expression that returns a value that is a GRAPHIC or VARGRAPHIC or DBCLOB data type. It must not be DBCS-graphic data.

length

Specifies the length attribute for the resulting varying length character string. The value must be between 1 and 15 728 640. If the result is mixed data, the second argument cannot be less than 4.

If the second argument is not specified or DEFAULT is specified, the length attribute of the result is determined as follows (where *n* is the length attribute of the first argument):

- If the *graphic-expression* is the empty graphic string constant, the length attribute of the result is 1.
- If the result is SBCS data, the result length is *n*.
- If the result is mixed data, the result length is (2.5*(*n*-1)) + 4.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *graphic-expression*. If the length of the *graphic-expression* is greater than the length attribute of the result, truncation is performed. A warning is returned unless the truncated characters were all blanks.

integer

Specifies the CCSID of the result. It must be a valid SBCS CCSID or mixed data CCSID. If the third argument is an SBCS CCSID, then the result is SBCS data. If the third argument is a mixed CCSID, then the result is mixed data. The third argument cannot be 65535.

If the third argument is not specified, the CCSID of the result is the default CCSID at the current server. If the default CCSID is mixed data, then the result is mixed data. If the default CCSID is SBCS data, then the result is SBCS data.

Integer to CLOB

integer-expression
An expression that returns a value that is an integer data type (either SMALLINT or INTEGER).

The result is a varying-length character string of the argument in the form of an SQL integer constant. The result consists of n characters that are the significant digits that represent the value of the argument with a preceding minus sign if the argument is negative. It is left justified.

- If the argument is a small integer, the length attribute of the result is 6.
- If the argument is a large integer, the length attribute of the result is 11.
- If the argument is a big integer, the length attribute of the result is 20.

The actual length of the result is the smallest number of characters that can be used to represent the value of the argument. Leading zeroes are not included. If the argument is negative, the first character of the result is a minus sign. Otherwise, the first character is a digit.

The CCSID of the result is the default SBCS CCSID at the current server.

Decimal to CLOB

decimal-expression
An expression that returns a value that is a packed or zoned decimal data type (either DECIMAL or NUMERIC). If a different precision and scale is desired, the DECIMAL scalar function can be used to make the change.

decimal-character
Specifies the single-byte character constant that is used to delimit the decimal digits in the result character string. The character must be a period or comma.

The result is a varying-length character string representation of the argument. The result includes a decimal character and up to *p* digits, where *p* is the precision of the *decimal-expression* with a preceding minus sign if the argument is negative. Leading zeros are not returned. Trailing zeros are returned.

The length attribute of the result is 2+*p* where *p* is the precision of the *decimal-expression*. The actual length of the result is the smallest number of characters that can be used to represent the result, except that trailing characters are included. Leading zeros are not included. If the argument is negative, the result begins with a minus sign. Otherwise, the result begins with a digit.

The CCSID of the result is the default SBCS CCSID at the current server.

Floating-point to CLOB

floating-point expression
An expression that returns a value that is a floating-point data type (DOUBLE or REAL).

decimal-character
Specifies the single-byte character constant that is used to delimit the decimal digits in the result character string. The character must be a period or comma.

The result is a varying-length character string representation of the argument in the form of a floating-point constant.

The length attribute of the result is 24. The actual length of the result is the smallest number of characters that can represent the value of the argument such that the mantissa consists of a single digit other than zero followed by the *decimal-character* and a sequence of digits. If the argument is negative, the first character of the result is a minus sign; otherwise, the first character is a digit. If the argument is zero, the result is 0E0.

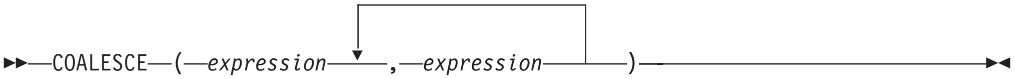
The CCSID of the result is the default SBCS CCSID at the current server.

Example

The following function returns a CLOB for the string 'This is a CLOB'.

```
SELECT CLOB('This is a CLOB') FROM T1
```

COALESCE



The COALESCE function returns the first argument that is not null.

The arguments must be compatible. Character-string arguments are compatible with datetime values. For more information on data type compatibility, see “Assignments and Comparisons” on page 66.

The arguments are evaluated in the order in which they are specified, and the result of the function is the first argument that is not null. The result can be null only if all arguments can be null, and the result is null only if all arguments are null. The selected argument is converted, if necessary, to the attributes of the result. There must be two or more arguments. Arguments other than the first argument may be parameter markers.

The attributes of the result are derived from all the operands as explained in “Rules for Result Data Types” on page 78.

Examples

Example 1: When selecting all the values from all the rows in the DEPARTMENT table, if the department manager (MGRNO) is missing (that is, null), then return a value of 'ABSENT'.

```
SELECT DEPTNO, DEPTNAME, COALESCE(MGRNO, 'ABSENT'), ADMRDEPT
  FROM DEPARTMENT
```

Example 2: When selecting the employee number (EMPNO) and salary (SALARY) from all the rows in the EMPLOYEE table, if the salary is missing (that is null), then return a value of zero.

```
SELECT EMPNO, COALESCE(SALARY,0)
  FROM EMPLOYEE
```

CONCAT

```
►►──CONCAT──(──expression──,──expression──)──────────────────────────────►◄
```

The CONCAT function is identical to the CONCAT operator. For more information, see “With the Concatenation Operator” on page 106.

Example

Concatenate the column FIRSTNME with the column LASTNAME.

```
CONCAT(FIRSTNME, LASTNAME)
```

COS

```
►►──COS──(──expression──)──────────────────────────────────────────────►◄
```

The COS function returns the cosine of a number. The COS and ACOS functions are inverse operations.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable COSINE is a decimal (2,1) host variable with a value of 1.5.

```
COS(:COSINE)
```

Returns the approximate value 0.07.

COSH

```
►►──COSH──(──expression──)─────────────────────────────────────────────►◄
```

The COSH function returns the hyperbolic cosine of a number.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable HCOS is a decimal (2,1) host variable with a value of 1.5.

```
COSH(:HCOS)
```

Returns the approximate value 2.35.

COT

```
►►──COT──(──expression──)──────────────────────────────────────────────►◄
```

The COT function returns the cotangent of a number.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable COTAN is a decimal (2,1) host variable with a value of 1.5.

```
COT(:COTAN)
```

Returns the approximate value 0.07.

CURDATE

```
►►──CURDATE──(──)──────────────────────────────────────────────►◄
```

The CURDATE function returns a date based on a reading of the time-of-day clock when the SQL statement is executed at the current server. The value returned by the CURDATE function is the same as the value returned by the CURRENT DATE special register. If this function is used more than once within a single SQL statement, or used with the CURTIME or NOW scalar functions or the CURRENT DATE, CURRENT TIME, or CURRENT TIMESTAMP special registers within a single statement, all values are based on a single clock reading.

The data type of the result is a date.

Example

Return the current date based on the time-of-day clock.

```
CURDATE()
```

CURTIME

```
►►──CURTIME──(──)──────────────────────────────────────────────►◄
```

The CURTIME function returns a time based on a reading of the time-of-day clock when the SQL statement is executed at the current server. The value returned by the CURTIME function is the same as the value returned by the CURRENT TIME special register. If this function is used more than once within a single SQL statement, or used with the CURDATE or NOW scalar functions or the CURRENT DATE, CURRENT TIME, or CURRENT TIMESTAMP special registers within a single statement, all values are based on a single clock reading.

The data type of the result is a time.

Example

Return the current time based on the time-of-day clock.

```
CURTIME()
```

DATE

```
►►──DATE──(──expression──)─────────────────────────────────────────►◄
```

The DATE function returns a date from a value.

The argument must be a timestamp, a date, a positive number less than or equal to 3652059, a valid string representation of a date, or a character string of length 7.

If the argument is a character string of length 7, it must represent a valid date in the form *yyyynnn*, where *yyyy* are digits denoting a year, and *nnn* are digits between 001 and 366 denoting a day of that year.

The result of the function is a date. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a timestamp:

  The result is the date part of the timestamp.
- If the argument is a date:

  The result is that date.
- If the argument is a number:

  The result is the date that is *n*-1 days after January 1, 0001, where *n* is the integral part of the number.
- If the argument is a character string:

  When a string representation of a date is SBCS data with a CCSID that is not the same as the default CCSID for SBCS data, that value is converted to adhere to the default CCSID for SBCS data before it is interpreted and converted to a date value.

  When a string representation of a date is mixed data with a CCSID that is not the same as the default CCSID for mixed data, that value is converted to adhere to the default CCSID for mixed data before it is interpreted and converted to a date value.

Examples

- Assume that the column RECEIVED (timestamp) has an internal value equivalent to '1988-12-25-17.12.30.000000'.

  ```
  DATE(RECEIVED)
  ```

  Results in an internal representation of '1988-12-25'.
- The following DATE scalar function applied to an ISO string representation of a date:

  ```
  DATE('1988-12-25')
  ```

  Results in an internal representation of '1988-12-25'.
- The following DATE scalar function applied to an EUR string representation of a date:

  ```
  DATE('25.12.1988')
  ```

  Results in an internal representation of '1988-12-25'.
- The following DATE scalar function applied to a positive number:

```
DATE(35)
```

Results in an internal representation of ‘0001-02-04’.

DAY

```
►►──DAY──(──expression──)──────────────────────────────────────────►◄
```

The DAY function returns the day part of a value.

The argument must be a date, timestamp, date duration, or timestamp duration.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:
- If the argument is a date or a timestamp:

  The result is the day part of the value, which is an integer between 1 and 31.
- If the argument is a date duration or timestamp duration:

  The result is the day part of the value, which is an integer between –99 and 99. A nonzero result has the same sign as the argument.

Examples

- Using the PROJECT table, set the host variable END_DAY (smallint) to the day that the WELD LINE PLANNING project (PROJNAME) is scheduled to stop (PRENDATE).

  ```
  SELECT DAY(PRENDATE)
    INTO :END_DAY   FROM PROJECT
    WHERE PROJNAME = 'WELD LINE PLANNING'
  ```

  Results in END_DAY being set to 15 when using the sample table.
- Assume that the column DATE1 (date) has an internal value equivalent to 2000-03-15 and the column DATE2 (date) has an internal value equivalent to 1999-12-31.

  ```
    DAY(DATE1 - DATE2)
  ```

  Results in the value 15.

DAYOFMONTH

```
►►──DAYOFMONTH──(──expression──)───────────────────────────────────►◄
```

The DAYOFMONTH function returns the day part of a value.

The argument must be a date or timestamp.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is the day part of the value, which is an integer between 1 and 31.

Examples

- Using the PROJECT table, set the host variable END_DAY (smallint) to the day that the WELD LINE PLANNING project (PROJNAME) is scheduled to stop (PRENDATE).

  ```
  SELECT DAYOFMONTH(PRENDATE)
    INTO :END_DAY   FROM PROJECT
    WHERE PROJNAME = 'WELD LINE PLANNING'
  ```

  Results in END_DAY being set to 15 when using the sample table.

DAYOFWEEK

```
►►──DAYOFWEEK──(──expression──)──────────────────────────────────────────────►◄
```

The DAYOFWEEK function returns an integer between 1 and 7 which represents the day of the week, where 1 is Sunday and 7 is Saturday.

The argument must be a date or a timestamp.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Using the EMPLOYEE table, set the host variable DAY_OF_WEEK (int) to the day of the week that Christine Haas (EMPNO='000010') started (HIREDATE).

```
SELECT DAYOFWEEK(HIREDATE)
  INTO :DAY_OF_WEEK
  FROM EMPLOYEE
  WHERE EMPNO = '000010'
```

Results in DAY_OF_WEEK being set to 6 when using the sample table.

DAYOFYEAR

```
►►──DAYOFYEAR──(──expression──)──────────────────────────────────────────────►◄
```

The DAYOFYEAR function returns an integer between 1 and 366 which represents the day of the year where 1 is January 1.

The argument must be a date or a timestamp.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Using the EMPLOYEE table, set the host variable AVG_DAY_OF_YEAR (int) to the average of the day of the year that employees started on (HIREDATE).

```
SELECT AVG(DAYOFYEAR(HIREDATE))
  INTO :AVG_DAY_OF_YEAR
  FROM EMPLOYEE
```

Results in AVG_DAY_OF_YEAR being set to 202 when using the sample table.

DAYS

```
►►──DAYS──(──expression──)────────────────────────────────────────────►◄
```

The DAYS function returns an integer representation of a date.

The argument must be a date, a timestamp, or a valid string representation of a date.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is 1 more than the number of days from January 1, 0001 to *D*, where *D* is the date that would occur if the DATE function were applied to the argument.

Examples

- Using the PROJECT table, set the host variable EDUCATION_DAYS (int) to the number of elapsed days (PRENDATE - PRSTDATE) estimated for the project (PROJNO) 'IF2000'.

  ```
    SELECT DAYS(PRENDATE) - DAYS(PRSTDATE)
      INTO :EDUCATION_DAYS
      FROM PROJECT
      WHERE PROJNO = 'IF2000'
  ```

  Results in EDUCATION_DAYS being set to 396 when using the sample table.
- Using the PROJECT table, set the host variable TOTAL_DAYS (int) to the sum of elapsed days (PRENDATE - PRSTDATE) estimated for all projects in department (DEPTNO) 'E21'.

  ```
  SELECT SUM(DAYS(PRENDATE) - DAYS(PRSTDATE))
    INTO :TOTAL_DAYS
    FROM PROJECT
    WHERE DEPTNO = 'E21'
  ```

  Results in TOTAL_DAYS being set to 1484 when using the sample table.

DBCLOB

```
►►──DBCLOB──(──expression──┬──────────────────────────────────────┬──)──────────►◄
                           └─,──┬─length──┬──┬─────────────────┬─┘
                                └─DEFAULT─┘  └─,──integer──────┘
```

The DBCLOB function returns a DBCLOB representation of a string expression.

The first argument must be a string expression. It cannot be a BLOB. It cannot be CHAR or VARCHAR bit data. It cannot be GRAPHIC or VARGRAPHIC with a CCSID of 65535 unless a third argument is specified.

The second argument, if specified as *length*, is the length attribute of the result and must be an integer constant between 1 and 7 864 320.

If the second argument is not specified or DEFAULT is specified:

- If the *expression* is an empty string constant, the length attribute of the result is 1.

- Otherwise, the length attribute of the result is the same as the length attribute of the first argument.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *expression*. If the length attribute of the resulting DBCLOB is less than the actual length of the first argument, truncation is performed and no warning is returned.

In the following rules, S denotes one of the following:

- If the string expression is a host variable containing data in a foreign encoding scheme, S is the result of the expression after converting the data to a CCSID in a native encoding scheme. (See “Character Conversion” on page 27 for more information.)
- If the string expression is data in a native encoding scheme, S is that string expression.

If the third argument is specified, the CCSID of the result is the third argument. It must be a DBCS or UCS-2 CCSID. The CCSID cannot be 65535.

If the third argument is not specified and the first argument is character, then the CCSID of the result is determined by a mixed CCSID. Let M denote that mixed CCSID. M is determined as follows:

- If the CCSID of S is a mixed CCSID, M is that CCSID.
- If the CCSID of S is an SBCS CCSID:
  - If the CCSID of S has an associated mixed CCSID, M is that CCSID.
  - Otherwise the operation is not allowed.

The following table summarizes the result CCSID based on M.

M	Result CCSID	Description	DBCS Substitution Character
930	300	Japanese EBCDIC	X’FEFE’
933	834	Korean EBCDIC	X’FEFE’
935	837	S-Chinese EBCDIC	X’FEFE’
937	835	T-Chinese EBCDIC	X’FEFE’
939	300	Japanese EBCDIC	X’FEFE’
5026	4396	Japanese EBCDIC	X’FEFE’
5035	4396	Japanese EBCDIC	X’FEFE’

If the third argument is not specified and the first argument is not character, then the CCSID of the result is the same as the CCSID of the first argument.

The result of the function is a DBCLOB string. If the expression can be null, the result can be null. If the expression is null, the result is the null value. If the expression is an empty string or the EBCDIC string `X'0E0F'`, the result is an empty string.

If the result is DBCS-graphic data, the equivalence of SBCS and DBCS characters depends on M. Regardless of the CCSID, every double-byte code point in the argument is considered a DBCS character, and every single-byte code point in the argument is considered an SBCS character with the exception of the EBCDIC mixed data shift codes `X'0E'` and `X'0F'`.

- If the nth character of the argument is a DBCS character, the nth character of the result is that DBCS character.
- If the nth character of the argument is an SBCS character that has an equivalent DBCS character, the nth character of the result is that equivalent DBCS character.
- If the nth character of the argument is an SBCS character that does not have an equivalent DBCS character, the nth character of the result is the DBCS substitution character.

If the result is UCS-2 graphic data, each character of the argument determines a character of the result. The nth character of the result is the UCS-2 equivalent of the nth character of the argument.

Example

Using the EMPLOYEE table, set the host variable VAR_DESC (vargraphic(24)) to the DBCLOB equivalent of the first name (FIRSTNME) for employee number (EMPNO) ’000050’.

```
SELECT DBCLOB(FIRSTNME)
  INTO :VAR_DESC
  FROM EMPLOYEE
  WHERE EMPNO = '000050'
```

DECIMAL

Numeric to Decimal

```
►►──┬─DECIMAL─┬──(──numeric-expression──┬──────────────────────────────────────────────┬──)──────►◄
    └─DEC─────┘                         └─,──precision-integer──┬───────────────────┬─┘
                                                                └─,──scale-integer──┘
```

Character to Decimal

```
►►──┬─DECIMAL─┬──────────────────────────────────────────────────────────────────────────────────►
    └─DEC─────┘

►──(──character-expression──┬────────────────────────────────────────────────────────────────────┬──)──►◄
                            └─,──precision-integer──┬────────────────────────────────────────────┬─┘
                                                    └─,──scale-integer──┬──────────────────────┬─┘
                                                                        └─,──decimal-character─┘
```

The DECIMAL function returns a packed decimal representation of:

- A number
- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

The result of the function is a decimal number with precision of *p* and scale of *s*, where *p* and *s* are the second and third arguments. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Numeric to Decimal

numeric-expression
  An expression that returns a value of any numeric data type.

precision-integer
An integer constant with a value in the range of 1 to 31.

The default for *precision-integer* depends on the data type of the *numeric-expression*:

- 15 for floating point, decimal, numeric, or nonzero scale binary
- 19 for big integer
- 11 for large integer
- 5 for small integer

scale-integer
An integer constant in the range of 0 to the *precision-integer* value. If not specified, the default is 0.

The result is the same number that would occur if the first argument were assigned to a decimal column or variable with a precision of *p* and a scale of *s*. An error occurs if the number of significant decimal digits required to represent the whole part of the number is greater than *p-s*.

Character to Decimal

character-expression
An expression that returns a value that is:

- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

precision-integer
An integer constant with a value in the range of 1 to 31. If not specified, the default is 15.

scale-integer
An integer constant in the range of 0 to the *precision-integer* value. If not specified, the default is 0.

decimal-character
Specifies the single-byte character constant that was used to delimit the decimal digits in *character-expression* from the whole part of the number. The character must be a period or comma.

The result is the same number that would result from CAST(*character-expression* AS DECIMAL(*p*,*s*)). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming a floating-point, integer, or decimal constant. Digits are truncated from the end if the number of digits to the right of the decimal character is greater than the scale *s*. An error occurs if the number of significant digits to the left of the decimal character (the whole part of the number) in *character-expression* is greater than *p-s*. The default decimal character is not valid in the substring if the *decimal-character* argument is specified.

Examples

- Use the DECIMAL function in order to force a DECIMAL data type (with a precision of 5 and a scale of 2) to be returned in a select-list for the EDLEVEL column (data type = SMALLINT) in the EMPLOYEE table. The EMPNO column should also appear in the select list.

```
SELECT EMPNO, DECIMAL(EDLEVEL,5,2)
  FROM EMPLOYEE
```

- Using the PROJECT table, select all of the starting dates (PRSTDATE) that have been incremented by a duration that is specified in a host variable. Assume the host variable PERIOD is of type INTEGER. Then, in order to use its value as a date duration it must be “cast” as decimal(8,0).

```
SELECT PRSTDATE + DECIMAL(:PERIOD,8)
  FROM PROJECT
```

- Assume that updates to the SALARY column are input through a window as a character string using comma as a decimal character (for example, the user inputs 21400,50). Once validated by the application, it is assigned to the host variable newsalary which is defined as CHAR(10).

```
UPDATE STAFF
  SET SALARY = DECIMAL(:newsalary, 9, 2, ',')
  WHERE ID = :empid
```

  The value of SALARY becomes 21400.50.

DEGREES

```
►►──DEGREES──(──expression──)──────────────────────────────────────────►◄
```

The DEGREES function returns the number of degrees of an angle.

The argument is an expression that returns the value of any built-in numeric data type. The value represents a number of radians. If the argument that is not a double precision floating-point number is converted to one for processing by the function.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable RAD is a decimal (4,3) host variable with a value of 3.142.

```
SELECT DEGREES(:RAD)
  FROM QSYS2.QSQPTABL
```

Returns the approximate value 180.0.

DIFFERENCE

```
►►──DIFFERENCE──(──expression──,──expression──)────────────────────────►◄
```

The DIFFERENCE function returns a value from 0 to 4 representing the difference between the sounds of two strings based on applying the SOUNDEX function to the strings. A value of 4 is the best possible sound match.

The arguments can be strings, but not BLOBS.

The data type of the result is INTEGER. If any argument can be null, the result can be null; if any argument is null, the result is the null value.

Example

Assume the following statement:

```
SELECT DIFFERENCE('CONSTRAINT','CONSTANT'),
       SOUNDEX('CONSTRAINT'),
       SOUNDEX('CONSTANT')
  FROM QSYS2.QSQPTABL
```

Returns 4, C523, and C523. Since the two strings return the same SOUNDEX value, the difference is 4 (the highest value possible).

Assume the following statement:

```
SELECT DIFFERENCE('CONSTRAINT','CONTRITE'),
       SOUNDEX('CONSTRAINT'),
       SOUNDEX('CONTRITE')
  FROM QSYS2.QSQPTABL
```

Returns 2, C523, and C536. In this case, the two strings return different SOUNDEX values, and hence, a lower difference value.

DIGITS

```
►►──DIGITS──(──expression──)──────────────────────────────────────►◄
```

The DIGITS function returns a character-string representation of the absolute value of a number.

The argument must be an integer or decimal value.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is a fixed-length character string representing the absolute value of the argument without regard to its scale. The result does not include a sign or a decimal point. Instead, it consists exclusively of digits, including, if necessary, leading zeros to fill out the string. The length of the string is:

- 5, if the argument is a small zero scale integer
- 10, if the argument is a large zero scale integer
- 19, if the argument is a big integer
- *p*, if the argument is a decimal or nonzero scale integer with a precision of *p*

The CCSID of the character string is the default SBCS CCSID at the current server.

Examples

- Assume that a table called TABLEX contains an INTEGER column called INTCOL containing 10-digit numbers. List all combinations of the first four digits contained in column INTCOL.

  ```
  SELECT DISTINCT SUBSTR(DIGITS(INTCOL),1,4)
    FROM TABLEX
  ```

- Assume that COLUMNX has the DECIMAL(6,2) data type, and that one of its values is -6.28. Then, for this value:

  ```
  DIGITS(COLUMNX)
  ```

  returns the value '000628'.

The result is a string of length six (the precision of the column) with leading zeros padding the string out to this length. Neither sign nor decimal point appear in the result.

DLCOMMENT

```
►►──DLCOMMENT──(──DataLink-expression──)──────────────────────────────────►◄
```

The DLCOMMENT function returns the comment value, if it exists, from a DataLink value.

The argument must be an expression that results in a value with data type of DataLink.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is VARCHAR(254).

The CCSID of the character string is the same as that of *DataLink-expression*.

Examples

- Prepare a statement to select the date, the description and the comment from the link to the ARTICLES column from the HOCKEY_GOALS table. The rows to be selected are those for goals scored by either of the Richard brothers (Maurice or Henri).

  ```
  stmtvar = "SELECT DATE_OF_GOAL, DESCRIPTION, DLCOMMENT(ARTICLES)
                    FROM HOCKEY_GOALS
                    WHERE BY_PLAYER = 'Maurice Richard' OR BY_PLAYER = 'Henri Richard' ";
  EXEC SQL PREPARE HOCKEY_STMT FROM :stmtvar;
  ```

- Given a DataLink value that was inserted into column COLA of a row in table TBLA using the scalar function:

  ```
  DLVALUE('http://dlfs.almaden.ibm.com/x/y/a.b','URL','A comment')
  ```

  then the following function operating on that value:

  ```
  DLCOMMENT(COLA)
  ```

  will return the value:

  A comment

DLLINKTYPE

```
►►──DLLINKTYPE──(──DataLink-expression──)─────────────────────────────────►◄
```

The DLLINKTYPE function returns the link type value from a DataLink value.

The argument must be an expression that results in a value with data type of DataLink.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is VARCHAR(4).

The CCSID of the character string is the same as that of *DataLink-expression*.

Examples

- Given a DataLink value that was inserted into column COLA of a row in table TBLA using the scalar function:

  ```
  DLVALUE('http://dlfs.almaden.ibm.com/x/y/a.b','URL','A comment')
  ```

  then the following function operating on that value:

  ```
  DLLINKTYPE(COLA)
  ```

  will return the value:

  URL

DLURLCOMPLETE

```
►►──DLURLCOMPLETE──(──DataLink-expression──)──────────────────────────────►◄
```

The DLURLCOMPLETE function returns the complete URL value from a DataLink value with a link type of URL. The value is the same as what would be returned by the concatenation of DLURLSCHEME with ’://’, then DLURLSERVER, then ’/’ and then DLURLPATH. If the DataLink has an attribute of FILE LINK CONTROL and READ PERMISSION DB, the value includes a file access token.

The argument must be an expression that results in a value with data type of DataLink.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is a varying-length string. The length attribute depends on the attributes of the DataLink:

- If the DataLink has an attribute of FILE LINK CONTROL and READ PERMISSION DB, the length attribute of the result is the length attribute of the argument plus 19.
- Otherwise, the length attribute of the result is the length attribute of the argument.

If the DataLink value only includes the comment, the result returned is a zero length string.

The CCSID of the character string is the same as that of *DataLink-expression*.

Examples

- Given a DataLink value that was inserted into column COLA of a row in table TBLA using the scalar function:

  ```
  DLVALUE('http://dlfs.almaden.ibm.com/x/y/a.b','URL','A comment')
  ```

  then the following function operating on that value:

  ```
  DLURLCOMPLETE(COLA)
  ```

  will return the value:

HTTP://DLFS.ALMADEN.IBM.COM/x/y/****************;a.b

(where **************** represents the access token)

DLURLPATH

```
►►──DLURLPATH──(──DataLink-expression──)──────────────────────────────►◄
```

The DLURLPATH function returns the path and file name necessary to access a file within a given server from a DataLink value with a linktype of URL. When appropriate, the value includes a file access token.

The argument must be an expression that results in a value with data type of DataLink.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is a varying-length string. The length attribute depends on the attributes of the DataLink:

- If the DataLink has an attribute of FILE LINK CONTROL and READ PERMISSION DB, the length attribute of the result is the length attribute of the argument plus 19.
- Otherwise, the length attribute of the result is the length attribute of the argument.

If the DataLink value only includes the comment, the result returned is a zero length string.

The CCSID of the character string is the same as that of *DataLink-expression*.

Examples

- Given a DataLink value that was inserted into column COLA of a row in table TBLA using the scalar function:

  ```
  DLVALUE('http://dlfs.almaden.ibm.com/x/y/a.b','URL','A comment')
  ```

  then the following function operating on that value:

  ```
  DLURLPATH(COLA)
  ```

  will return the value:

  /x/y/****************;a.b

  (where **************** represents the access token)

DLURLPATHONLY

```
►►──DLURLPATHONLY──(──DataLink-expression──)──────────────────────────►◄
```

The DLURLPATHONLY function returns the path and file name necessary to access a file within a given server from a DataLink value with a linktype of URL. The value returned NEVER includes a file access token.

The argument must be an expression that results in a value with data type of DataLink.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is a varying-length string with a length attribute of that is equal to the length attribute of the argument.

If the DataLink value only includes the comment, the result returned is a zero length string.

The CCSID of the character string is the same as that of *DataLink-expression*.

Examples

- Given a DataLink value that was inserted into column COLA of a row in table TBLA using the scalar function:

  ```
  DLVALUE('http://dlfs.almaden.ibm.com/x/y/a.b','URL','A comment')
  ```

  then the following function operating on that value:

  ```
  DLURLPATHONLY(COLA)
  ```

  will return the value:

  /x/y/a.b

DLURLSCHEME

```
►►──DLURLSCHEME──(──DataLink-expression──)─────────────────────────────►◄
```

The DLURLSCHEME function returns the scheme from a DataLink value with a linktype of URL. The value will always be in upper case.

The argument must be an expression that results in a value with data type of DataLink.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is VARCHAR(20).

If the DataLink value only includes the comment, the result returned is a zero length string.

The CCSID of the character string is the same as that of *DataLink-expression*.

Examples

- Given a DataLink value that was inserted into column COLA of a row in table TBLA using the scalar function:

  ```
  DLVALUE('http://dlfs.almaden.ibm.com/x/y/a.b','URL','A comment')
  ```

  then the following function operating on that value:

  ```
  DLURLSCHEME(COLA)
  ```

will return the value:

HTTP

DLURLSERVER

```
►►──DLURLSERVER──(──DataLink-expression──)─────────────────────────────────►◄
```

The DLURLSERVER function returns the file server from a DataLink value with a linktype of URL. The value will always be in upper case.

The argument must be an expression that results in a value with data type of DataLink.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is a varying-length string with a length attribute of that is equal to the length attribute of the argument.

If the DataLink value only includes the comment, the result returned is a zero length string.

The CCSID of the character string is the same as that of *DataLink-expression*.

Examples

- Given a DataLink value that was inserted into column COLA of a row in table TBLA using the scalar function:

  ```
  DLVALUE('http://dlfs.almaden.ibm.com/x/y/a.b','URL','A comment')
  ```

  then the following function operating on that value:

  ```
  DLURLSERVER(COLA)
  ```

  will return the value:

  DLFS.ALMADEN.IBM.COM

DLVALUE

```
►►──DLVALUE──(──data-location──┬─────────────────────────────────────────────┬──)──────────────►◄
                               └─,──linktype-string──┬────────────────────┬──┘
                                                     └─,──comment-string──┘
```

The DLVALUE function returns a DataLink value. When the function is on the right hand side of a SET clause in an UPDATE statement or is in a VALUES clause in an INSERT statement, it usually also creates a link to a file. However, if only a comment is specified (in which case the *data-location* is a zero-length string), the DataLink value is created with empty linkage attributes so there is no file link.

data-location
: If the link type is URL, then this is a character string expression that contains a complete URL value. If the expression is not an empty string, it must include

the URL scheme and URL server. The actual length of the character string expression must be less than or equal to 32718 characters.

linktype-string
An optional character string expression that specifies the link type of the DataLink value. The only valid value is 'URL'.

comment-string
An optional character string expression that provides a comment or additional location information. The actual length of the character string expression must be less than or equal to 254 characters.

The *comment-string* cannot be the null value. If a *comment-string* is not specified, the *comment-string* is the empty string.

If any of the arguments can be null, the result can be null; if any of the arguments is null, the result is the null value.

The result of the function is a DataLink value.

The CCSID of the DataLink is the same as that of *data-location* except in the following cases:

- If the *comment string* is mixed data and *data-location* is not mixed data, the CCSID of the result will be the CCSID of the *comment string*.[23]
- If the *data-location* has a CCSID of bit data (65535), UCS-2 graphic data (13488), Turkish data (905 or 1026), or Japanese data (290, 930, or 5026); the CCSID of the result is described in the following table:

CCSID of *data-location*	**CCSID of** *comment-string*	**Result CCSID**
65535	65535	Job Default CCSID
65535	non-65535	*comment-string* CCSID (unless the CCSID is 290, 930, 5026, 905, 1026, or 13488 where the CCSID will then be further modified as described in the following rows.)
290	any	4396
930 or 5026	any	939
905 or 1026	any	500
13488	any	500

When defining a DataLink value using this function, consider the maximum length of the target of the value. For example, if a column is defined as DataLink(200), then the maximum length of the *data-location* plus the comment is 200 bytes.

Examples

- Insert a row into the table. The URL values for the first two links are contained in the variables named url_article and url_snapshot. The variable named url_snapshot_comment contains a comment to accompany the snapshot link. There is, as yet, no link for the movie, only a comment in the variable named url_movie_comment.

---

[23] If the CCSID of *comment string* is 5026 or 930, the CCSID of the results will be 939.

```
INSERT INTO HOCKEY_GOALS
  VALUES('Maurice Richard',
         'Montreal canadian',
         '?',
         'Boston Bruins,
         '1952-04-24',
         'Winning goal in game 7 of Stanley Cup final',
         DLVALUE(:url_article),
         DLVALUE(:url_snapshot, 'URL', :url_snapshot_comment),
         DLVALUE('', 'URL', :url_movie_comment) )
```

DOUBLE_PRECISION or DOUBLE

```
►►──┬─DOUBLE_PRECISION─┬──(──┬─numeric-expression───┬──)──────────────────────►◄
    └─DOUBLE───────────┘     └─character-expression─┘
```

The DOUBLE_PRECISION and DOUBLE functions return a floating-point representation of:

- A number
- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

numeric-expression

An expression that returns a numeric value of any numeric data type.

If the argument is a *numeric-expression*, the result is the same number that would occur if the argument were assigned to a double-precision floating-point column or variable.

character-expression

An expression that returns a character string value.

If the argument is a *character-expression*, the result is the same number that would result from CAST(*character-expression* AS DOUBLE PRECISION). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming an floating-point, integer, or decimal constant.

The result of the function is a double-precision floating-point number. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Using the EMPLOYEE table, find the ratio of salary to commission for employees whose commission is not zero. The columns involved (SALARY and COMM) have DECIMAL data types. To eliminate the possibility of out-of-range results, DOUBLE_PRECISION is applied to SALARY so that the division is carried out in floating point:

```
SELECT EMPNO, DOUBLE_PRECISION(SALARY)/COMM
  FROM EMPLOYEE
  WHERE COMM > 0
```

EXP

```
►►──EXP──(──expression──)──────────────────────────────────────────►◄
```

The EXP function returns a value that is the base of the natural logarithm (e) raised to a power specified by the argument. The EXP and LN functions are inverse operations.

The argument must be a number.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable E is a decimal (10,9) host variable with a value of 3.453789832.

```
EXP(:E)
```

Returns the approximate value 31.62.

FLOAT

```
►►──FLOAT──(──┬─numeric-expression───┬──)──────────────────────────►◄
              └─character-expression─┘
```

The FLOAT function is identical to the DOUBLE_PRECISION and DOUBLE scalar functions. For more information, see “DOUBLE_PRECISION or DOUBLE” on page 171.

FLOOR

```
►►──FLOOR──(──numeric-expression──)────────────────────────────────►◄
```

The FLOOR function is returns the largest integer value less than or equal to *numeric-expression*.

The argument is an expression that returns a value of any built-in numeric data type.

The result of the function has the same data type and length attribute of the argument except that:

- The scale is 0 if the argument is DECIMAL or NUMERIC. For example, an argument with a data type of DECIMAL(5,5) will result in DECIMAL(5,0).

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Use the FLOOR function to truncate any digits to the right of the decimal point.

```
SELECT FLOOR(SALARY)
  FROM CORPDATA.EMPLOYEE
```

HASH

```
                ┌─,──────────┐
                ↓            │
►►──HASH──(─────expression───┴──)─────────────────────────────────►◄
```

The HASH function returns the partition number of a set of values. Also see the PARTITION function. For more information about partition numbers, see the DB2 Multisystem book.

The arguments cannot be datetime, floating-point, or DataLink values. The arguments must not be parameter markers.

The result of the function is a large integer with a value between 0 and 1023.

If any of the arguments are null, the result is zero. The result cannot be null.

Example

Use the HASH function to determine what the partitions would be if the partitioning key was composed of EMPNO and LASTNAME. This query returns the partition number for every row in EMPLOYEE.

```
SELECT HASH(EMPNO, LASTNAME)
  FROM CORPDATA.EMPLOYEE
```

HEX

```
►►──HEX──(──expression──)─────────────────────────────────────────►◄
```

The HEX function returns a hexadecimal representation of a value.

The argument can be any value.

The result of the function is a character string. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is a string of hexadecimal digits, the first two digits represent the first byte of the argument, the next two digits represent the second byte of the argument, and so forth. If the argument is a date or time value, the result is the hexadecimal representation of the internal form of the argument. This hexadecimal representation for DATE, TIMESTAMP, and NUMERIC data types is different from other database products because the internal form for these data types is different.

If the argument is not a graphic string, the length of the result is twice the length of the argument. If the argument is a graphic string, the length of the result is four times the length of the argument.

If the argument is a varying-length string, the result is a varying-length string. Otherwise, the result is a fixed-length string. The length attribute of the result is twice the storage length attribute of the argument. For information on the storage length attribute see “CREATE TABLE” on page 340.

The length attribute of the result cannot be greater than 32766 for fixed-length results or greater than 32740 for varying-length results. The CCSID of the string is the default SBCS CCSID at the current server.

Example

Use the HEX function to return a hexadecimal representation of the education level for each employee.

```
SELECT FIRSTNME, MIDINIT, LASTNAME, HEX(EDLEVEL)
  FROM EMPLOYEE
```

HOUR

```
►►──HOUR──(──expression──)─────────────────────────────────────────►◄
```

The HOUR function returns the hour part of a value.

The argument must be a time, timestamp, time duration, or timestamp duration.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a time or timestamp:

  The result is the hour part of the value, which is an integer between 0 and 24.
- If the argument is a time duration or timestamp duration:

  The result is the hour part of the value, which is an integer between −99 and 99. A nonzero result has the same sign as the argument.

Example

Using the CL_SCHED sample table, select all the classes that start in the afternoon.

```
SELECT * FROM CL_SCHED
  WHERE HOUR(STARTING) BETWEEN 12 AND 17
```

IFNULL

```
►►──IFNULL──(──expression──,──expression──)────────────────────────►◄
```

The IFNULL function is identical to the COALESCE scalar function with two arguments. For more information, see “COALESCE” on page 153.

Example

When selecting the employee number (EMPNO) and salary (SALARY) from all the rows in the EMPLOYEE table, if the salary is missing (that is, null), then return a value of zero.

```
SELECT EMPNO, IFNULL(SALARY,0)
  FROM EMPLOYEE
```

INTEGER or INT

```
►►──┬─INTEGER─┬──(──┬─numeric-expression───┬──)────────────────────►◄
    └─INT─────┘     └─character-expression─┘
```

The INTEGER function returns an integer representation of:

- A number

- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

numeric-expression

An expression that returns a numeric value of any numeric data type.

If the argument is a *numeric-expression*, the result is the same number that would occur if the argument were assigned to a large integer column or variable. If the whole part of the argument is not within the range of integers, an error occurs. The fractional part of the argument is truncated.

character-expression

An expression that returns a character string value.

If the argument is a *character-expression*, the result is the same number that would result from CAST(*character-expression* AS INTEGER). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming a floating-point, integer, or decimal constant. If the whole part of the argument is not within the range of integers, an error occurs. Any fractional part of the argument is truncated.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Using the EMPLOYEE table, select a list containing salary (SALARY) divided by education level (EDLEVEL). Truncate any decimal in the calculation. The list should also contain the values used in the calculation and the employee number (EMPNO).

```
SELECT INTEGER(SALARY / EDLEVEL), SALARY, EDLEVEL, EMPNO
  FROM EMPLOYEE
```

LAND

```
                          ┌────────────────┐
                          ▼                │
►►──LAND──(──expression────,──expression───┴──)──────────────────────────►◄
```

The LAND function returns a string that is the logical ’AND’ of the argument strings. This function takes the first argument string, does an AND comparison with the next string, and then continues to do AND comparisons with each successive argument using the previous result. If an argument is encountered that is shorter than the previous result, it is padded with blanks.

The arguments must be character strings but cannot be LOBs. The arguments cannot be mixed data character strings or graphic strings. There must be two or more arguments. Arguments other than the first argument may be parameter markers.

The arguments are converted, if necessary, to the attributes of the result. The attributes of the result are determined as follows:

- If all the arguments are fixed-length strings, the result is a fixed-length string of length *n*, where *n* is the length of the longest argument.

- If any argument is a varying-length string, the result is a varying-length string with length attribute *n*, where *n* is the length attribute of the argument with greatest length attribute. The actual length of the result is *m*, where *m* is the actual length of the longest argument.
- The CCSID of the result is 65535.

If an argument can be null, the result can be null; if an argument is null, the result is the null value.

Example

Assume the host variable L1 is a character(2) host variable with a value of X’A1B1’, host variable L2 is a character(3) host variable with a value of X’F0F040’, and host variable L3 is a character(4) host variable with a value of X’A1B10040’.

```
LAND(:L1,:L2,:L3)
```

Returns the value X’A0B00000’.

```
LAND(:L3,:L2,:L1)
```

Returns the value X’A0B00040’. In this case, the shorter arguments are padded with blanks (X’40’), so the logical AND result differs from the first example.

LEFT

```
►►──LEFT──(──string──,──length──)──────────────────────────────────────►◄
```

The LEFT function returns the leftmost specified number of characters from the string. [24]

If *string* is a character string, the result is a character string, and each character is one byte. If *string* is a graphic string, the result is a graphic string, and each character is a DBCS or UCS-2 character.

If any argument of the LEFT function can be null, the result can be null; if any argument is null, the result is the null value.

The CCSID of the result is the same as that of *string*.

string

Denotes an expression that specifies the string from which the result is derived. *String* must be a character string or a graphic string. A substring of *string* is zero or more contiguous bytes of *string*.

The LEFT function accepts mixed data. However, because LEFT operates on a strict byte-count basis, the result is not necessarily a properly formed mixed data character string.

length

Denotes an expression that specifies the length of the result. *length* must be a binary integer in the range 0 to *n*, where *n* is the length attribute of *string*. It must not, however, be the integer constant 0.

The *string* is effectively padded on the right with the necessary number of blank characters so that the specified substring of *string* always exists.

---

[24] The LEFT scalar function returns the same results as: SUBSTR(string, 1, length).

If *length* is specified by an integer constant, the result is a fixed-length string. In all other cases, the result is a varying-length string with a length attribute that is the same as the length attribute of *string*.

Example

Assume the host variable NAME (varchar(50)) has a value of 'KATIE AUSTIN' and the host variable FIRSTNAME_LEN (int) has a value of 5.

```
LEFT(:NAME, :FIRSTNAME_LEN)
```

Returns the value 'KATIE'

LENGTH

```
►►──LENGTH──(──expression──)─────────────────────────────────────────►◄
```

The LENGTH function returns the length of a value. See “CHARACTER_LENGTH or CHAR_LENGTH” on page 149 for a similar function.

The argument can be any value.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is the length of the argument. The length of strings includes blanks. The length of a varying-length string is the actual length, not the maximum length.

The length of a graphic string is the number of characters. The length of all other values is the number of bytes used to represent the value:

Numbers:
- 2 for small integer
- 4 for large integer
- 8 for big integer
- 4 for single-precision float
- 8 for double-precision float
- *p* for zoned decimal numbers with precision *p*
- The integral part of (*p*/2)+1 for packed decimal numbers with precision *p*

Character strings:
- The length of the string

Graphic strings:
- The number of DBCS or UCS-2 characters in the string

Datetime values:
- 3 for time
- 4 for date
- 10 for timestamp

DataLink values:
- The actual number of bytes used to store the DataLink value (plus 19 if the DataLink is FILE LINK CONTROL and READ PERMISSION DB).

Examples

- Assume the host variable ADDRESS is a varying-length character string with a value of ‘895 Don Mills Road’.

  ```
  LENGTH(:ADDRESS)
  ```

  Returns the value 18.
- Assume that START_DATE is a column of type DATE.

  ```
  LENGTH(START_DATE)
  ```

  Returns the value 4.
- Assume that START_DATE is a column of type DATE.

  ```
  LENGTH(CHAR(START_DATE, EUR))
  ```

  Returns the value 10.

LN

```
►►──LN──(──expression──)──────────────────────────────────────────►◄
```

The LN function returns the natural logarithm of a number. The LN and EXP functions are inverse operations.

The argument must be a number.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable NATLOG is a decimal (4,2) host variable with a value of 31.62.

```
LN(:NATLOG)
```

Returns the approximate value 3.45.

LNOT

```
►►──LNOT──(──expression──)────────────────────────────────────────►◄
```

The LNOT function returns a string that is the logical NOT of the argument string.

The argument must be a character string but cannot be a LOB. The argument cannot be a MIXED character string or a graphic string.

The data type and length attribute of the result is the same as the data type and length attribute of the argument value. If the argument is a varying-length string, the actual length of the result is the same as the actual length of the argument value. The CCSID of the result is 65535. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable L1 is a character(2) host variable with a value of X’F0F0’.

```
LNOT(:L1)
```

Returns the value X'0F0F'.

LOCATE

```
►►──LOCATE──(──search-string──,──source-string──┬────────────┬──)─────────────►◄
                                                └─,──start───┘
```

The LOCATE function returns the starting position of the first occurrence of one string (called the *search-string*) within another string (called the *source-string*). If the *search-string* is not found and neither argument is null, the result is zero. If the *search-string* is found, the result is a number from 1 to the actual length of the *source-string*.

The result of the function is a large integer. If any of the arguments can be null, the result can be null; if any of the arguments is null, the result is the null value.

search-string
: An expression that specifies the string that is to be searched for. *Search-string* may be a character-string or a graphic-string expression. It must be compatible with the *source-string*.

source-string
: An expression that specifies the source string in which the search is to take place. *Source-string* may be a character-string or a graphic-string expression.

start
: An expression that specifies the position within *source-string* at which the search is to start. It must be a positive integer.

If the CCSID of the *search-string* is different than the CCSID of the *source-string*, it is converted to the CCSID of the *source-string*.

If *start* is not specified, the function is equivalent to:

```
POSSTR( source-string , search-string )
```

If *start* is specified, the function is equivalent to:

```
POSSTR( SUBSTR(source-string,start) , search-string )
```

For more information, see "POSITION or POSSTR" on page 190.

Example

- Select RECEIVED and SUBJECT columns as well as the starting position of the words 'GOOD' within the NOTE_TEXT column for all entries in the IN_TRAY table that contain these words.

```
SELECT RECEIVED, SUBJECT, LOCATE('GOOD', NOTE_TEXT)
  FROM IN_TRAY
  WHERE LOCATE('GOOD', NOTE_TEXT) <> 0
```

LOG or LOG10

```
►►──┬─LOG───┬──(──expression──)──────────────────────────────────────────────►◄
    └─LOG10─┘
```

The LOG and LOG10 functions return the common logarithm (base 10) of a number. The LOG and ANTILOG functions are inverse operations.

The argument must be a number.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

LOG10 should be used instead of LOG because some database managers and applications implement LOG as the natural logarithm of a number instead of the common logarithm of a number.

Example

Assume the host variable L is a decimal (4,2) host variable with a value of 31.62.

```
LOG(:L)
```

Returns the approximate value 1.49.

LOR

```
                        ┌─────────────────────┐
                        ▼                     │
►►──LOR──(──expression────,──expression──────┴──)──────────────────────────►◄
```

The LOR function returns a string that is the logical OR of the argument strings. This function takes the first argument string, does an OR comparison with the next string, and then continues to do OR comparisons for each successive argument using the previous result. If an argument is encountered that is shorter than the previous result, it is padded with blanks.

The arguments must be character strings but cannot be LOBs. The arguments cannot be mixed data character strings or graphic strings. There must be two or more arguments. Arguments other than the first argument may be parameter markers.

The arguments are converted, if necessary, to the attributes of the result. The attributes of the result are determined as follows:

- If all the arguments are fixed-length strings, the result is a fixed-length string of length *n*, where *n* is the length of the longest argument.
- If any argument is a varying-length string, the result is a varying-length string with length attribute *n*, where *n* is the length attribute of the argument with greatest length attribute. The actual length of the result is *m*, where *m* is the actual length of the longest argument.
- The CCSID of the result is 65535.

If an argument can be null, the result can be null; if an argument is null, the result is the null value.

Example

Assume the host variable L1 is a character(2) host variable with a value of X'0101', host variable L2 is a character(3) host variable with a value of X'F0F000', and host variable L3 is a character(4) host variable with a value of X'0000000F'.

```
LOR(:L1,:L2,:L3)
```

Returns the value X'F1F1000F'.

```
LOR(:L3,:L2,:L1)
```

Returns the value X’F1F1404F’. In this case, the shorter arguments are padded with blanks (X’40’), so the logical OR result differs from the first example.

LOWER or LCASE

```
►►──┬─LCASE─┬──(──expression──)──────────────────────────────────────►◄
    └─LOWER─┘
```

The LCASE or LOWER function returns a string in which all the characters have been converted to lowercase characters, based on the CCSID of the argument. Only SBCS and UCS-2 graphic characters are converted. Refer to the *National Language Support Reference Volume 2* , SE09-8002, for a description of the monocasing tables that are used for this translation.

The argument must be an expression whose value is a character string or a graphic string.

The result of the function has the same data type, length attribute, actual length, and CCSID as the argument. If the argument can be null, the result can be null. If the argument is null, the result is the null value.

Examples

- Ensure that the characters in the value of host variable NAME are lowercase. NAME has a data type of VARCHAR(30) and a value of ’Christine Smith’.

  ```
  LCASE(:NAME)
  ```

  The result is the value ’christine smith’.

LTRIM

```
►►──LTRIM──(──expression──)──────────────────────────────────────────►◄
```

The LTRIM function removes blanks or hexadecimal zeros from the beginning of a string expression. [25]

The argument must be a string expression.

- If the argument is a binary string, then the leading hexadecimal zeros (X’00’) are removed.
- If the argument is a DBCS graphic string, then the leading DBCS blanks are removed.
- If the first argument is a UCS-2 graphic string, then the leading UCS-2 blanks are removed
- Otherwise, leading SBCS blanks are removed.

The data type of the result depends on the data type of *expression*:

Data type of *expression*	**Data type of the Result**
CHAR or VARCHAR	VARCHAR
GRAPHIC or VARGRAPHIC	VARGRAPHIC

---

[25] The LTRIM function returns the same results as: STRIP(expression,LEADING)

Data type of *expression*	**Data type of the Result**
BLOB	BLOB
CLOB	CLOB
DBCLOB	DBCLOB

The length attribute of the result is the same as the length attribute of *expression*. The actual length of the result is the length of the expression minus the number of bytes removed. If all characters are removed, the result is an empty string.

The CCSID of the result is the same as that of the string. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Example

Assume the host variable HELLO of type CHAR(9) has a value of ' Hello'.

```
LTRIM(:HELLO)
```

Results in: 'Hello'.

MAX

```
                          ┌────────────────────┐
                          ▼                    │
►►──MAX──(──expression──────,──expression──────┴──)────────────────────►◄
```

The MAX scalar function returns the maximum value in a set of values.

The arguments must be compatible. Character-string arguments are compatible with datetime values, but are not compatible with graphic strings. All but the first argument may be parameter markers. There must be two or more arguments. The arguments cannot be DataLink values.

The result of the function is the largest argument value. The result can be null if at least one argument can be null; the result is the null value if one of the arguments is null. The selected arguments are converted, if necessary, to the attributes of the result. The attributes of the result are determined as follows:

- If the arguments contain at least one date and the remaining arguments are dates or valid string representations of dates, the result is a date. If the arguments contain at least one time and the remaining arguments are times or valid string representations of times, the result is a time. If the arguments contain at least one timestamp and the remaining arguments are timestamps or valid string representations of timestamps, the result is a timestamp.
- If the arguments are strings, the CCSID of the result is the CCSID that would result if the arguments were concatenated. See “Conversion Rules for Operations That Combine Strings” on page 81.
- If all the arguments are fixed-length strings, the result is a fixed-length string of length *n*, where *n* is the length of the longest argument.
- If any argument is a varying-length string, the result is a varying-length string with length attribute *n*, where *n* is the length attribute of the argument with greatest length attribute. The actual length of the result is *m*, where *m* is the actual length of the longest argument.

- If the arguments are numbers, the result data type is the same as if the arguments were added. In the case of a decimal result:
  - The scale is *s*, where *s* is the scale of the argument with the greatest scale.
  - The precision is the minimum of 31 and *s*+*n*, where *n* is the number of digits in the argument with the largest difference between its precision and scale.
  - The number of digits required to represent the integral part of the largest argument must not be greater than 31−*s*.

If a sort sequence other than *HEX is in effect when the statement is executed and SBCS, UCS-2, or mixed data is involved, the weighted values of the strings are compared instead of the actual values. The weighted values are based on the sort sequence.

Examples

- Assume the host variable M1 is a decimal(2,1) host variable with a value of 5.5, host variable M2 is a decimal(3,1) host variable with a value of 4.5, and host variable M3 is a decimal(3,2) host variable with a value of 6.25.

  ```
  MAX(:M1,:M2,:M3)
  ```

  Returns the value 6.25.
- Assume the host variable M1 is a character(2) host variable with a value of ’AA’, host variable M2 is a character(3) host variable with a value of ’AA ’, and host variable M3 is a character(4) host variable with a value of ’AA A’.

  ```
  MAX(:M1,:M2,:M3)
  ```

  Returns the value ’AA A’.

MICROSECOND

```
►►──MICROSECOND──(──expression──)──────────────────────────────────────────►◄
```

The MICROSECOND function returns the microsecond part of a value.

The argument must be a timestamp, a string representation of a timestamp, or a timestamp duration.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a timestamp:

  The result is the microsecond part of the value, which is an integer between 0 and 999999.
- If the argument is a duration:

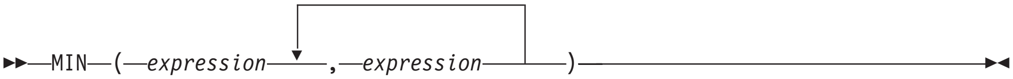
  The result is the microsecond part of the value, which is an integer between −999999 and 999999. A nonzero result has the same sign as the argument.

Example

Assume a table TABLEA contains two columns, TS1 and TS2, of type TIMESTAMP. Select all rows in which the microseconds portion of TS1 is not zero and the seconds portion of TS1 and TS2 are identical.

```
SELECT * FROM TABLEA
  WHERE MICROSECOND(TS1) <> 0 AND SECOND(TS1) = SECOND(TS2)
```

MIN



The MIN scalar function returns the minimum value in a set of values.

The arguments must be compatible. Character-string arguments are compatible with datetime values, but are not compatible with graphic strings. All but the first argument may be parameter markers. There must be two or more arguments. The arguments cannot be DataLink values.

The result of the function is the smallest argument value. The result can be null if at least one argument can be null; the result is the null value if one of the arguments is null. The selected arguments are converted, if necessary, to the attributes of the result. The attributes of the result are determined as follows:

- If the arguments contain at least one date and the remaining arguments are dates or valid string representations of dates, the result is a date. If the arguments contain at least one time and the remaining arguments are times or valid string representations of times, the result is a time. If the arguments contain at least one timestamp and the remaining arguments are timestamps or valid string representations of timestamps, the result is a timestamp.
- If the arguments are strings, the CCSID of the result is the CCSID that would result if the arguments were concatenated. See “Conversion Rules for Operations That Combine Strings” on page 81.
- If all the arguments are fixed-length strings, the result is a fixed-length string of length *n*, where *n* is the length of the longest argument.
- If any argument is a varying-length string, the result is a varying-length string with length attribute *n*, where *n* is the length attribute of the argument with greatest length attribute. The actual length of the result is *m*, where *m* is the actual length of the smallest argument.
- If the arguments are numbers, the data type of the result is the data type that would result if the arguments were added. In the case of a decimal result:
  - The scale is *s*, where *s* is the scale of the argument with the greatest scale.
  - The precision is the minimum of 31 and *s*+*n*, where *n* is the number of digits in the argument with the largest difference between its precision and scale.
  - The number of digits required to represent the integral part of the largest argument must not be greater than 31–*s*.

If a sort sequence other than *HEX is in effect when the statement is executed and SBCS, UCS-2, or mixed data is involved, the weighted values of the strings are compared instead of the actual values. The weighted values are based on the sort sequence.

Examples

- Assume the host variable M1 is a decimal(2,1) host variable with a value of 5.5, host variable M2 is a decimal(3,1) host variable with a value of 4.5, and host variable M3 is a decimal(3,2) host variable with a value of 6.25.

  ```
  MIN(:M1,:M2,:M3)
  ```

Returns the value 4.50.

- Assume the host variable M1 is a character(2) host variable with a value of ’AA’, host variable M2 is a character(3) host variable with a value of ’AAA’, and host variable M3 is a character(4) host variable with a value of ’AAAA’.

  ```
  MIN(:M1,:M2,:M3)
  ```

  Returns the value ’AA ’.

MINUTE

```
►►──MINUTE──(──expression──)───────────────────────────────────────────►◄
```

The MINUTE function returns the minute part of a value.

The argument must be a time, timestamp, time duration, or timestamp duration.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a time or a timestamp:

  The result is the minute part of the value, which is an integer between 0 and 59.
- If the argument is a time duration or timestamp duration:

  The result is the minute part of the value, which is an integer between −99 and 99. A nonzero result has the same sign as the argument.

Example

Using the CL_SCHED sample table, select all classes with a duration less than 50 minutes.

```
SELECT * FROM CL_SCHED
  WHERE HOUR(ENDING - STARTING) = 0 AND
      MINUTE(ENDING - STARTING) < 50
```

MOD

```
►►──MOD──(──expression──,──expression───)──────────────────────────────►◄
```

The MOD function divides the first argument by the second argument and returns the remainder.

The formula used to calculate the remainder is:

```
MOD(x,y) = x - (x/y) * y
```

where x/y is the truncated integer result of the division.

The arguments must be numbers. The second argument cannot be zero.

If an argument can be null, the result can be null; if an argument is null, the result is the null value.

The attributes of the result are determined as follows:

- If both arguments are large or small integers with zero scale, the data type of the result is large integer.
- If both arguments are integers with zero scale and at least one of the arguments is a big integer, the data type of the result is big integer.
- If one argument is an integer with zero scale and the other is decimal, the result is decimal with the same precision and scale as the decimal argument.
- If both arguments are decimal or integer with scale numbers, the result is decimal. The precision of the result is min (p-s,p’-s’) + max (s,s’), and the scale of the result is max (s,s’), where the symbols p and s denote the precision and scale of the first operand, and the symbols p’ and s’ denote the precision and scale of the second operand.
- If either argument is floating point, the data type of the result is double-precision floating point.

  The operation is performed in floating point; the operands having been first converted to double-precision floating-point numbers, if necessary.

  An operation involving a floating-point number and an integer is performed with a temporary copy of the integer that has been converted to double-precision floating point. An operation involving a floating-point number and a decimal number is performed with a temporary copy of the decimal number that has been converted to double-precision floating point. The result of a floating-point operation must be within the range of floating-point numbers.

Examples

- Assume the host variable M1 is an integer host variable with a value of 5, and host variable M2 is an integer host variable with a value of 2.

  ```
  MOD(:M1,:M2)
  ```

  Returns the value 1.
- Assume the host variable M1 is an integer host variable with a value of 5, and host variable M2 is a decimal(3,1) host variable with a value of 2.2.

  ```
  MOD(:M1,:M2)
  ```

  Returns the value 0.6.
- Assume the host variable M1 is an integer host variable with a value of 5, and host variable M2 is a decimal(3,2) host variable with a value of 2.20.

  ```
  MOD(:M1,:M2)
  ```

  Returns the value 0.60.
- Assume the host variable M1 is a decimal(4,2) host variable with a value of 5.50, and host variable M2 is a decimal(4,1) host variable with a value of 2.0.

  ```
  MOD(:M1,:M2)
  ```

  Returns the value 1.50.

MONTH

```
►►──MONTH──(──expression──)──────────────────────────────────────────►◄
```

The MONTH function returns the month part of a value.

The argument must be a date, timestamp, date duration, or timestamp duration.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a date or a timestamp:

  The result is the month part of the value, which is an integer between 1 and 12.
- If the argument is a date duration or timestamp duration:

  The result is the month part of the value, which is an integer between −99 and 99. A nonzero result has the same sign as the argument.

Example

- Select all rows from the EMPLOYEE table for people who were born (BIRTHDATE) in DECEMBER.

  ```
  SELECT * FROM EMPLOYEE
    WHERE MONTH(BIRTHDATE) = 12
  ```

NODENAME

```
►►──NODENAME──(──table-designator──)─────────────────────────────────────►◄
```

The NODENAME function returns the relational database name of where a row is located. If the argument identifies a non-distributed table, the value of the CURRENT SERVER special register is returned. For more information on nodes, see the DB2 Multisystem book.

The argument is a table designator of the subselect. For more information on table designators, see “Table Designators” on page 92.

In SQL naming, the table name may be qualified. In system naming, the table name cannot be qualified.

If the argument identifies a view, the function returns the relational database name of its base table. If the argument identifies a view derived from more than one base table, the function returns the relational database name of the first table in the outer subselect of the view.

The argument must not identify a view whose outer subselect includes a column function, a GROUP BY clause, or a HAVING clause. If the subselect contains a GROUP BY or HAVING clause, the NODENAME function can only be specified in the WHERE clause or as an operand of a column function. If the argument is a correlation name, the correlation name must not identify a correlated reference.

The data type of the result is VARCHAR(18). The result cannot be null.

Example

Join the EMPLOYEE and DEPARTMENT tables, select the employee number (EMPNO) and determine the node from which each row involved in the join originated.

```
SELECT EMPNO, NODENAME(X), NODENAME(Y)
  FROM CORPDATA.EMPLOYEE X, CORPDATA.DEPARTMENT Y
  WHERE X.DEPTNO=Y.DEPTNO
```

NODENUMBER

```
►►──NODENUMBER──(──table-designator──)──────────────────────────────────►◄
```

The NODENUMBER function returns the node number of a row. If the argument identifies a non-distributed table, the value 0 is returned.[26] For more information on nodes and node numbers, see the DB2 Multisystem book.

The argument is a table designator of the subselect. For more information on table designators, see "Table Designators" on page 92.

In SQL naming, the table name may be qualified. In system naming, the table name cannot be qualified.

If the argument identifies a view, the function returns the node number of its base table. If the argument identifies a view derived from more than one base table, the function returns the node number of the first table in the outer subselect of the view.

The argument must not identify a view whose outer subselect includes a column function, a GROUP BY clause, or a HAVING clause. If the subselect contains a GROUP BY or HAVING clause, the NODENUMBER function can only be specified in the WHERE clause or as an operand of a column function. If the argument is a correlation name, the correlation name must not identify a correlated reference.

The data type of the result is a large integer. The result cannot be null.

Example

Determine the node number and employee name for each row in the CORPDATA.EMPLOYEE table. If this is a distributed table, the number of the node where the row exists is returned.

```
SELECT NODENUMBER(CORPDATA.EMPLOYEE), LASTNAME
  FROM CORPDATA.EMPLOYEE
```

NOW

```
►►──NOW──(──)───────────────────────────────────────────────────────────►◄
```

The NOW function returns a timestamp based on a reading of the time-of-day clock when the SQL statement is executed at the current server. The value returned by the NOW function is the same as the value returned by the CURRENT TIMESTAMP special register. If this function is used more than once within a single SQL statement, or used with the CURDATE or CURTIME scalar functions or the CURRENT DATE, CURRENT TIME, or CURRENT TIMESTAMP special registers within a single statement, all values are based on a single clock reading.

The data type of the result is a timestamp.

---

[26] If the argument identifies a DDS created logical file that is based on more than one physical file member, NODENUMBER will not return 0, but instead will return the underlying physical file member number.

Example

Return the current timestamp based on the time-of-day clock.

```
NOW()
```

NULLIF

```
►►──NULLIF──(──expression──,──expression──)─────────────────────────────►◄
```

The NULLIF function returns a null value if the arguments are equal, otherwise it returns the value of the first argument.

The arguments must be compatible. Character-string arguments are compatible with datetime values. The arguments cannot be DataLink values.

The attributes of the result are the attributes of the first argument. The result can be null. The result is null if the first argument is null or if both arguments are equal.

The result of using NULLIF(e1,e2) is the same as using the expression

```
CASE WHEN e1=e2 THEN NULL ELSE e1 END
```

Note that when e1=e2 evaluates to unknown (because one or both arguments is NULL), CASE expressions consider this not true. Therefore, in this situation, NULLIF returns the value of the first operand, e1.

Example

Assume host variables PROFIT, CASH, and LOSSES have DECIMAL data types with the values 4500.00, 500.00, and 5000.00 respectively:

```
NULLIF (:PROFIT + :CASH, :LOSSES )
```

Returns the null value.

PARTITION

```
►►──PARTITION──(──table-designator──)───────────────────────────────────►◄
```

The PARTITION function returns the partition number of a row obtained by applying the hashing function on the partitioning key value of the row. Also see the HASH function. If the argument identifies a non-distributed table, the value 0 is returned. For more information on partition numbers and partitioning keys, see the DB2 Multisystem book.

The argument is a table designator of the subselect. For more information on table designators, see “Table Designators” on page 92.

In SQL naming, the table name may be qualified. In system naming, the table name cannot be qualified.

If the argument identifies an SQL view, the function returns the partition number of its base table. If the argument identifies an SQL View derived from more than one base table, the function returns the partition number of the first table in the outer subselect of the view.

The argument must not identify a view whose outer subselect includes a column function, a GROUP BY clause, or a HAVING clause. If the subselect contains a GROUP BY or HAVING clause, the PARTITION function can only be specified in the WHERE clause or as an operand of a column function. If the argument is a correlation name, the correlation name must not identify a correlated reference.

The data type of the result is a large integer with a value between 0 and 1023. The result cannot be null.

Example

Select the employee number (EMPNO) from the EMPLOYEE table for all rows where the partition number is equal to 100.

```
SELECT EMPNO
  FROM CORPDATA.EMPLOYEE
  WHERE PARTITION(CORPDATA.EMPLOYEE) = 100
```

POSITION or POSSTR

```
►►──┬─POSITION──(──search-string──IN──source-string──)──┬────────────────────►◄
    └─POSSTR──(──source-string──,──search-string──)─────┘
```

The POSITION and POSSTR functions return the starting position of the first occurrence of one string (called the *search-string*) within another string (called the *source-string*). If the *search-string* is not found and neither argument is null, the result is zero. If the *search-string* is found, the result is a number from 1 to the actual length of the *source-string*. See the related function, “LOCATE” on page 179.

The result of the function is a large integer. If either of the arguments can be null, the result can be null. If either of the arguments is null, the result is the null value.

source-string
: An expression that specifies the source string in which the search is to take place. *Source-string* may be a binary-string, character-string, or a graphic-string expression.

search-string
: An expression that specifies the string that is to be searched for. *Search-string* may be a binary-string, character-string, or a graphic-string expression.

If either argument is a binary string, both arguments must be binary strings.

If the CCSID of the *search-string* is different than the CCSID of the *source-string*, it is converted to the CCSID of the *source-string*.

The POSITION function operates on a character basis. The POSSTR function operates on a strict byte-count basis. It is recommended that if either the *search-string* or *source-string* contains mixed data, POSITION should be used instead of POSSTR. Because POSSTR operates on a strict byte-count basis, if the *search-string* or *source-string* contains mixed data, the *search-string* will only be found if any shift-in and shift-out characters are also found in the *source-string* in exactly the same positions. Because POSITION operates on a character-string basis, any shift-in and shift-out characters are not required to be in exactly the same position and their only significance is to indicate which characters are SBCS and which characters are DBCS.

If the *search-string* has a length of zero, the result returned by the function is 1. Otherwise:

- if the *source-string* has a length of zero, the result returned by the function is 0.
- Otherwise,
  - If the value of *search-string* is equal to an identical length of substring of contiguous positions within the value of *source-string*, then the result returned by the function is the starting position of the first such substring within the *source-string* value.
  - Otherwise, the result returned by the function is 0.[27]

Example

- Select RECEIVED and SUBJECT columns as well as the starting position of the words 'GOOD' within the NOTE_TEXT column for all entries in the IN_TRAY table that contain these words.

```
SELECT RECEIVED, SUBJECT, POSSTR(NOTE_TEXT, 'GOOD')
  FROM IN_TRAY
  WHERE POSSTR(NOTE_TEXT, 'GOOD') <> 0
```

POWER

```
►►──POWER──(──expression──,──expression──)──────────────────────────────►◄
```

The POWER function returns the result of raising the first argument to the power of the second argument. [28]

Both arguments must be numbers.

The result of the function is a double-precision floating-point number. If an argument can be null, the result can be null; if an argument is null, the result is the null value.

Example

Assume the host variable HPOWER is an integer with value 3.

```
POWER(2,:HPOWER)
```

Returns the value 8.

QUARTER

```
►►──QUARTER──(──expression──)───────────────────────────────────────────►◄
```

The QUARTER function returns an integer between 1 and 4 which represents the quarter of the year in which the date resides. For example, any dates in January, February, or March will return the integer 1.

The argument must be a date or a timestamp.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

---

[27] This includes the case where the *search-string* is longer than the *source-string*.

[28] The result of the POWER function is exactly the same as the result of exponentiation: *expression-1 ** expression-2*.

Example

Using the PROJECT table, set the host variable QUART (int) to the quarter in which project 'PL2100' ended (PRENDATE).

```
SELECT QUARTER(PRENDATE)
  INTO :QUART
  FROM PROJECT
  WHERE PROJNO = 'PL2100'
```

Results in QUART being set to 3 when using the sample table.

RADIANS

```
►►──RADIANS──(──numeric-expression──)──────────────────────────────────►◄
```

The RADIANS function returns the number of radians for an argument that is expressed in degrees.

The argument is an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume that host variable HDEG is an INTEGER with a value of 180. The following statement:

```
SELECT RADIANS(:HDEG)
  FROM T1
```

Returns a double precision floating-point number with an approximate value of 3.1415926536.

RAND

```
►►──RAND──(──┬────────────────────┬──)─────────────────────────────────►◄
             └─numeric-expression─┘
```

The RAND function returns a floating point value between 0 and 1.

If an expression is specified, it is used as the seed value. The expression must be a SMALLINT or INTEGER.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume that host variable HRAND is an INTEGER with a value of 100. The following statement:

```
SELECT RAND(:HRAND)
  FROM QSYS2.QSQPTABL
```

Returns a random floating-point number between 0 and 1, such as the approximate value .0121398.

To generate values in a numeric interval other than 0 to 1, multiply the RAND function by the size of the desired interval. For example, to get a random number between 0 and 10, such as the approximate value 5.8731398, multiply the function by 10:

```
SELECT RAND(:HRAND) * 10
  FROM QSYS2.QSQPTABL
```

REAL

```
►►──REAL──(──┬─numeric-expression───┬──)───────────────────────────────►◄
             └─character-expression─┘
```

The REAL function returns a single-precision floating-point representation of:

- A number
- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

numeric-expression
: An expression that returns a numeric value of any numeric data type.

  If the argument is a *numeric-expression*, the result is the same number that would occur if the argument were assigned to a single-precision floating-point column or variable.

character-expression
: An expression that returns a character string value.

  If the argument is a *character-expression*, the result is the same number that would result from CAST(*character-expression* AS REAL). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming an floating-point, integer, or decimal constant.

The result of the function is a single-precision floating-point number. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Using the EMPLOYEE table, find the ratio of salary to commission for employees whose commission is not zero. The columns involved (SALARY and COMM) have DECIMAL data types. To eliminate the possibility of out-of-range results, REAL is applied to SALARY so that the division is carried out in floating point:

```
SELECT EMPNO, REAL(SALARY)/COMM
  FROM EMPLOYEE
  WHERE COMM > 0
```

ROUND

```
►►──ROUND──(──expression1──,──expression2───)──────────────────────────►◄
```

The ROUND function returns *expression1* rounded to *expression2* places to the right of the decimal point if *expression2* is positive or to the left of the decimal point if *expression2* is zero or negative.

If *expression2* is positive, a value of 5 is rounded to the next higher positive number. For example, ROUND(3.5,0) = 4. If the argument is negative, a value of 5 is rounded to the next lower negative number. For example, ROUND(-3.5,0) = -4.

expression1
An expression that returns a value of any built-in numeric data type.

expression2
An expression that returns a small or large integer. The absolute value of integer specifies the number of places to the right of the decimal point for the result if *expression2* is not negative, or to left of the decimal point if *expression2* is negative.

If *expression2* is negative, *expression1* is rounded to the absolute value of *expression2*+1 number of places to the left of the decimal point.

If the absolute value of *expression2* is larger than the number of digits to the left of the decimal point, the result is 0. For example, ROUND(748.58,-4) = 0.

The data type and length attribute of the result are the same as the data type and length attribute of the first argument, except that:

- Precision is increased by one if *expression1* is DECIMAL or NUMERIC and the precision is less than 31. For example, an argument with a data type of DECIMAL(5,2) will result in DECIMAL(6,2). An argument with a data type of DECIMAL(31,2) will result in DECIMAL(31,2).

If either argument can be null, the result can be null. If either argument is null, the result is the null value.

Examples

- Calculate the number 873.726 rounded to 2, 1, 0, -1, -2, -3, and -4 decimal places respectively.

```
SELECT ROUND(873.726,  2),
       ROUND(873.726,  1),
       ROUND(873.726,  0),
       ROUND(873.726, -1),
       ROUND(873.726, -2),
       ROUND(873.726, -3),
       ROUND(873.726, -4)
  FROM TABLEX
```

  This example returns:

```
0873.730   0873.700  0874.000  0870.000  0900.000  1000.000  0000.000
```

  respectively.

- Calculate both positive and negative numbers.

```
SELECT ROUND( 3.5, 0),
       ROUND( 3.1, 0),
       ROUND(-3.1, 0),
       ROUND(-3.5, 0)
  FROM TABLEX
```

  This example returns:

```
4.0   3.0  -3.0  -4.0
```

  respectively.

RRN

```
►►──RRN──(──table-designator──)──────────────────────────────────────►◄
```

The RRN function returns the relative record number of a row.

The argument is a table designator of the subselect. For more information on table designators, see “Table Designators” on page 92.

In SQL naming, the table name may be qualified. In system naming, the table name can not be qualified.

If the argument identifies a view, the function returns the relative record number of its base table. If the argument identifies a view derived from more than one base table, the function returns the relative record number of the first table in the outer subselect of the view.

If the argument identifies a distributed table, the function returns the relative record number of the row on the node where the row is located. This means that RRN will not be unique for each row of a distributed table.

The argument must not identify a view whose outer subselect includes a column function, a GROUP BY clause, or a HAVING clause. The RRN function cannot be specified in a SELECT clause if the subselect contains a column function, a GROUP BY clause, or a HAVING clause. If the argument is a correlation name, the correlation name must not identify a correlated reference.

The data type of the result is a decimal with precision 15 and scale 0. The result can be null. The RRN value for a row that is from a table on the right side for left outer and exception joins will return 0 for a row that does not match.

Example

```
SELECT RRN(CORPDATA.EMPLOYEE), LASTNAME
  FROM CORPDATA.EMPLOYEE
  WHERE DEPTNO = 20
```

Returns the relative record number and employee name from table EMPLOYEE for those employees in department 20.

RTRIM

```
►►──RTRIM──(──expression──)──────────────────────────────────────────►◄
```

The RTRIM function removes blanks or hexadecimal zeroes from the end of a string expression. [29]

The argument must be a string expression.

- If the argument is a binary string, then the trailing hexadecimal zeros (X’00’) are removed.
- If the argument is a DBCS graphic string, then the trailing DBCS blanks are removed.

---

[29] The RTRIM function returns the same results as: STRIP(expression,TRAILING)

- If the first argument is a UCS-2 graphic string, then the trailing UCS-2 blanks are removed
- Otherwise, trailing SBCS blanks are removed.

The data type of the result depends on the data type of *expression*:

Data type of ***expression***	**Data type of the Result**
CHAR or VARCHAR	VARCHAR
GRAPHIC or VARGRAPHIC	VARGRAPHIC
BLOB	BLOB
CLOB	CLOB
DBCLOB	DBCLOB

The length attribute of the result is the same as the length attribute of *expression*. The actual length of the result is the length of the expression minus the number of bytes removed. If all characters are removed, the result is an empty string.

The CCSID of the result is the same as that of the string. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Example

Assume the host variable HELLO of type CHAR(9) has a value of ’Hello ’.

```
RTRIM(:HELLO)
```

Results in: ’Hello’.

SECOND

```
►►──SECOND──(──expression──)─────────────────────────────────────────────►◄
```

The SECOND function returns the seconds part of a value.

The argument must be a time, timestamp, time duration, or timestamp duration.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a time or timestamp:

  The result is the seconds part of the value, which is an integer between 0 and 59.
- If the argument is a time duration or timestamp duration:

  The result is the seconds part of the value, which is an integer between −99 and 99. A nonzero result has the same sign as the argument.

Examples

- Assume that the host variable TIME_DUR (decimal(6,0)) has the value 153045.

  ```
  SECOND(:TIME_DUR)
  ```

  Returns the value 45.

- Assume that the column RECEIVED (timestamp) has an internal value equivalent to 1988-12-25-17.12.30.000000.

  ```
  SECOND(RECEIVED)
  ```

  Returns the value 30.

SIGN

```
►►──SIGN──(──numeric-expression──)─────────────────────────────────────►◄
```

The SIGN function returns an indicator of the sign of expression. The returned value is:

–1	if the argument is less than zero
0	if the argument is zero
1	if the argument is greater than zero

The argument is an expression that returns a value of any built-in numeric data type.

The result has the same data type and length attribute as the argument, except that:

- Precision is increased by one if the argument is DECIMAL or NUMERIC and the scale of the argument is equal to its precision. For example, an argument with a data type of DECIMAL(5,5) will result in DECIMAL(6,5). If the precision is already 31, the scale will be decreased by one. For example, DECIMAL(31,31) will result in DECIMAL(31,30).

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume that host variable PROFIT is a large integer with a value of 50000.

```
SELECT SIGN(:PROFIT)
  FROM CORPDATA.EMPLOYEE
```

This example returns the value 1.

SIN

```
►►──SIN──(──expression──)──────────────────────────────────────────────►◄
```

The SIN function returns the sine of a number. The SIN and ASIN functions are inverse operations.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable SINE is a decimal (2,1) host variable with a value of 1.5.

```
SIN(:SINE)
```

Returns the approximate value 0.99.

SINH

```
►►──SINH──(──expression──)──────────────────────────────────────────────►◄
```

The SINH function returns the hyperbolic sine of a number.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable HSINE is a decimal (2,1) host variable with a value of 1.5.

```
SINH(:HSINE)
```

Returns the approximate value 2.12.

SMALLINT

```
►►──SMALLINT──(──┬─numeric-expression───┬──)──────────────────────────►◄
                 └─character-expression─┘
```

The SMALLINT function returns a small integer representation of

- A number
- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

numeric-expression
An expression that returns a numeric value of any numeric data type.

If the argument is a *numeric-expression*, the result is the same number that would occur if the argument were assigned to a small integer column or variable. If the whole part of the argument is not within the range of small integers, an error occurs. The fractional part of the argument is truncated.

character-expression
An expression that returns a character string value.

If the argument is a *character-expression*, the result is the same number that would result from CAST(*character-expression* AS SMALLINT). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming a floating-point, integer, or decimal constant. If the whole part of the argument is not within the range of small integers, an error occurs. Any fractional part of the argument is truncated.

The result of the function is a small integer. If the argument can be null, the result can be null. If the argument is null, the result is the null value.

Example

Using the EMPLOYEE table, select a list containing salary (SALARY) divided by education level (EDLEVEL). Truncate any decimal in the calculation. The list should also contain the values used in the calculation and the employee number (EMPNO).

```
SELECT SMALLINT(SALARY / EDLEVEL), SALARY, EDLEVEL, EMPNO
  FROM EMPLOYEE
```

SOUNDEX

```
►►──SOUNDEX──(──expression──)──────────────────────────────────────►◄
```

The SOUNDEX function returns a 4 character code representing the sound of the words in the argument. The result can be used to compare with the sound of other strings.

The argument can be any string, but not a BLOB.

The data type of the result is CHAR(4). If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The SOUNDEX function is useful for finding strings for which the sound is known but the precise spelling is not. It makes assumptions about the way that letters and combinations of letters sound that can help to search out words with similar sounds. The comparison can be done directly or by passing the strings as arguments to the DIFFERENCE function. For more information, see "DIFFERENCE" on page 163.

Example

Using the EMPLOYEE table, find the EMPNO and LASTNAME of the employee with a surname that sounds like 'Loucesy'.

```
SELECT EMPNO, LASTNAME
       FROM EMPLOYEE
       WHERE SOUNDEX(LASTNAME) = SOUNDEX('Loucesy')
```

Returns row:

```
000110 LUCCHESSI
```

SQRT

```
►►──SQRT──(──expression──)─────────────────────────────────────────►◄
```

The SQRT function returns the square root of a number.

The argument must be a number whose value is a positive numeric value.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable SQUARE is a decimal (2,1) host variable with a value of 9.0.

```
SQRT(:SQUARE)
```

Returns the approximate value 3.00.

STRIP

```
►►──STRIP──(──expression──┬──────────────────────────────────────────────┬──)──────────────►◄
                          └─┬─,──BOTH─────┬──┬────────────────────────┬──┘
                            ├─,──B────────┤  └─,──strip-character─────┘
                            ├─,──LEADING──┤
                            ├─,──L────────┤
                            ├─,──TRAILING─┤
                            └─,──T────────┘
```

The STRIP function is identical to the TRIM scalar function. For more information, see “TRIM” on page 206.

SUBSTRING or SUBSTR

```
►►──┬─┬─SUBSTR─────┬──(──string──,──start──┬──────────────┬──)─┬──────────►◄
    │ └─SUBSTRING──┘                       └─,──length────┘    │
    └─SUBSTRING──(──string──FROM──start────┬──────────────┬──)─┘
                                           └─FOR──length──┘
```

The SUBSTR and SUBSTRING functions are used to obtain a substring of a string.

If *string* is a character string, the result is a character string. If *string* is a graphic string, the result is a graphic string. If *string* is a binary string, the result is a binary string. If *string* is a binary or character string, a character is a byte. If *string* is a graphic string, a character is a DBCS or UCS-2 character. If any argument of the SUBSTR function can be null, the result can be null; if any argument is null, the result is the null value. The CCSID of the result is the same as that of *string*.

string
: Denotes an expression that specifies the string from which the result is derived.

  A substring of *string* is zero or more contiguous bytes of *string*. The SUBSTR function accepts mixed data. However, because SUBSTR operates on a strict byte-count basis, the result is not necessarily a properly formed mixed data character string. The SUBSTRING function accepts mixed data. Because SUBSTRING operates on a character-count basis, the result is a properly formed mixed data character string.

start
: Denotes an expression that specifies the position of the first character (or byte) of the result. It must be a positive binary integer that is not greater than the length attribute of *string*. (The length attribute of a varying-length string is its maximum length.)

length
: Denotes an expression that specifies the length of the result. If specified, *length* must be a binary integer in the range 0 to *n*, where *n* is the length attribute of *string* - *start* + 1. It must not, however, be the integer constant 0.

  If SUBSTR is specified, and *string* is a varying-length string and *length* is explicitly specified, *string* is effectively padded on the right with the necessary number of blank characters so that the specified substring of *string* always exists. If SUBSTRING is specified, padding is not performed.

If *string* is a fixed-length string, omission of *length* is an implicit specification of LENGTH(*string*) - *start* + 1, which is the number of characters (or bytes) from the *start* character (or byte) to the last character (or byte) of *string*. If *string* is a varying-length string, omission of *length* is an implicit specification of zero or LENGTH(*string*) - *start* + 1, whichever is greater. If the resulting length is zero, the result is the empty string.

The data type of the result depends on the data type of *string* and whether the function is a SUBSTR or SUBSTRING:

Data type of ***string***	**Data Type of the Result for SUBSTRING**	**Data Type of the Result for SUBSTR**
CHAR or VARCHAR	VARCHAR	CHAR, if *length* is explicitly specified by an integer constant or if *length* is not explicitly specified, but *string* is a fixed-length string and *start* is an integer constant. VARCHAR, in all other cases.
GRAPHIC or VARGRAPHIC	VARGRAPHIC	GRAPHIC, if *length* is explicitly specified by an integer constant or if *length* is not explicitly specified, but *string* is a fixed-length string and *start* is an integer constant. VARGRAPHIC, in all other cases.
BLOB	BLOB	BLOB
CLOB	CLOB	CLOB
DBCLOB	DBCLOB	DBCLOB

If the SUBSTRING function is specified, the length attribute of the result is equal to the length attribute of *string*.

If the SUBSTR function is specified and *string* is not a LOB, the length attribute of the result depends on *length*, *start*, and the attributes of *string*.

- If *length* is explicitly specified by an integer constant, the length attribute of the the result is *length*.
- If *length* is not explicitly specified, but *string* is a fixed-length string and *start* is an integer constant, the length attribute of the result is LENGTH(*string*) - *start* + 1.

In all other cases, the length attribute of the result is the same as the length attribute of *string*. (Remember that if the actual length of *string* is less than the value for *start*, the actual length of the substring is zero.)

Examples

- Assume the host variable NAME (varchar(50)) has a value of 'KATIE AUSTIN' and the host variable SURNAME_POS (int) has a value of 7.

  ```
  SUBSTR(:NAME, :SURNAME_POS)
  ```

  Returns the value 'AUSTIN'

  ```
  SUBSTR(:NAME, :SURNAME_POS, 1)
  ```

  Returns the value 'A'.

- Select all rows from the PROJECT table for which the project name (PROJNAME) starts with the word 'OPERATION '.

  ```
  SELECT * FROM PROJECT
    WHERE SUBSTR(PROJNAME,1,10) = 'OPERATION '
  ```

  The space at the end of the constant is necessary to preclude initial words such as 'OPERATIONS'.

TAN

```
►►──TAN──(──expression──)──────────────────────────────────────────►◄
```

The TAN function returns the tangent of a number. The TAN and ATAN functions are inverse operations.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable TANGENT is a decimal (2,1) host variable with a value of 1.5.

```
TAN(:TANGENT)
```

Returns the approximate value 14.10.

TANH

```
►►──TANH──(──expression──)─────────────────────────────────────────►◄
```

The TANH function returns the hyperbolic tangent of a number. The TANH and ATANH functions are inverse operations.

The argument must be a number whose value is specified in radians.

The data type of the result is double-precision floating point. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Assume the host variable HTANGENT is a decimal (2,1) host variable with a value of 1.5.

```
TANH(:HTANGENT)
```

Returns the approximate value 0.90.

TIME

```
►►──TIME──(──expression──)─────────────────────────────────────────►◄
```

The TIME function returns a time from a value.

The argument must be a timestamp, a time, or a valid string representation of a time.

The result of the function is a time. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a timestamp:

  The result is the time part of the timestamp.
- If the argument is a time:

  The result is that time.
- If the argument is a character string:

  When a string representation of a time is SBCS data with a CCSID that is not the same as the default CCSID for SBCS data, that value is converted to adhere to the default CCSID for SBCS data before it is interpreted and converted to a time value.

  When a string representation of a time is mixed data with a CCSID that is not the same as the default CCSID for mixed data, that value is converted to adhere to the default CCSID for mixed data before it is interpreted and converted to a time value.

Example

Select all notes from the IN_TRAY sample table that were received at least one hour later in the day (any day) than the current time.

```
SELECT * FROM IN_TRAY
  WHERE TIME(RECEIVED) >= CURRENT TIME + 1 HOUR
```

TIMESTAMP

```
►►──TIMESTAMP──(──expression──┬──────────────────┬──)──────────────────────►◄
                              └─,──expression────┘
```

The TIMESTAMP function returns a timestamp from a value or a pair of values.

The rules for the arguments depend on whether the second argument is specified.

- If only one argument is specified:

  It must be a timestamp, a valid string representation of a timestamp, or a character string of length 14.

  A character string of length 14 must be a string of digits that represents a valid date and time in the form yyyyxxddhhmmss, where yyyy is year, xx is month, dd is day, hh is hour, mm is minute, and ss is seconds.
- If both arguments are specified:

  The first argument must be a date or a valid string representation of a date; the second argument must be a time or a valid string representation of a time.

The result of the function is a timestamp. If either argument can be null, the result can be null; if either argument is null, the result is the null value.

The other rules depend on whether the second argument is specified:

- If both arguments are specified:

The result is a timestamp with the date specified by the first argument and the time specified by the second argument. The microsecond part of the timestamp is zero.

- If only one argument is specified and it is a timestamp:

  The result is that timestamp.
- If only one argument is specified and it is a character string:

  The result is the timestamp represented by that character string. If the argument is a character string of length 14, the timestamp has a microsecond part of zero.

When a string representation of a timestamp is SBCS data with a CCSID that is not the same as the default CCSID for SBCS data, that value is converted to adhere to the default CCSID for SBCS data before it is interpreted and converted to a timestamp value.

When a string representation of a timestamp is mixed data with a CCSID that is not the same as the default CCSID for mixed data, that value is converted to adhere to the default CCSID for mixed data before it is interpreted and converted to a timestamp value.

Example

- Assume the column START_DATE (date) has a value equivalent to 1988-12-25, and the column START_TIME (time) has a value equivalent to 17.12.30.

  ```
  TIMESTAMP(START_DATE, START_TIME)
  ```

  Returns the value ’1988-12-25-17.12.30.000000’.

TRANSLATE

```
►►──TRANSLATE──(──expression──┬──────────────────────────────────────────────────────┬──)──────────►◄
                              └─,──to-string──┬───────────────────────────────────┬──┘
                                              └─,──from-string──┬───────────────┬─┘
                                                                └─,──pad-character─┘
```

The TRANSLATE function translates one or more characters of the first argument.

The first argument must be a character string or a UCS-2 graphic string. The data type and length attribute of the result are the same as the first argument.

The second argument is a character string constant of no more than 256 characters. Note that this is sometimes called the *output translation table*. If the length attribute of the *to-string* is less than the length attribute of the *from-string*, then the *to-string* is padded to the longer length using either the *pad-character* or a blank. If the length attribute of the *to-string* is greater than the length attribute of the *from-string*, the extra characters in *to-string* are ignored without warning.

The third argument is a character string constant of no more than 256 characters. Note that this is sometimes called the *input translation table*. If there are duplicate characters in *from-string*, the first one scanning from the left is used and no warning is issued. The default value for *from-string* is a string starting with the character X’00’ and ending with the character X’FF’ (decimal 255).

The fourth argument is a character constant of length 1 that is used to pad the *to-string* if it is shorter than the *from-string*. The default value for the *pad-character* is an SBCS space.

If the first argument is a UCS-2 graphic string, no other arguments may be specified.

If only the first argument is specified, the SBCS characters of the argument are translated to uppercase, based on the CCSID of the argument. If the first argument is UCS-2 graphic, the alphabetic UCS-2 characters are translated to uppercase. Refer to the *National Language Support Reference Volume 2* , SE09-8002, for a description of the monocasing tables that are used for this translation.

Otherwise, the result string is built character by character from *expression*, translating characters in *from-string* to the corresponding character in *to-string*. For each character in *expression*, the same character is searched for in *from-string*. If the character is found to be the *n*th character in *from-string*, the resulting string will contain the *n*th character from *to-string*. If *to-string* is less than *n* characters long, the resulting string will contain the pad character. If the character is not found in *from-string*, it is moved to the result string untranslated.

Translation is done on a byte basis and, if used improperly, may result in an invalid mixed string.

If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Examples

- Monocase the string ′abcdef′.

  ```
  TRANSLATE('abcdef')
  ```

  Returns the value ′ABCDEF′.
- Monocase the mixed character string.

  TRANSLATE(′ab $^{S}_{O}$⊂$^{S}_{I}$def′)

  Returns the value ′AB $^{S}_{O}$⊂$^{S}_{I}$DEF′
- Given that the host variable SITE is a varying-length character string with a value of ′Pivabiska Lake Place′.

  ```
  TRANSLATE(:SITE, '$', 'L')
  ```

  Returns the value ′Pivabiska $ake Place′.

  ```
  TRANSLATE(:SITE, '$$', 'Ll')
  ```

  Returns the value ′Pivabiska $ake P$ace′.

  ```
  TRANSLATE(:SITE, 'pLA', 'Place', '.')
  ```

  Returns the value ′pivAbiskA LAk. pLA..′.

TRIM

```
►►──TRIM──(──┬──────────────────────────────────────────┬──expression──)──────────────►◄
             │ ┌─BOTH─────┐                              │
             └─┴──────────┴──┬─────────────────┬──FROM──┘
               ├─B────────┤  └─strip-character─┘
               ├─LEADING──┤
               ├─L────────┤
               ├─TRAILING─┤
               └─T────────┘
```

The TRIM function removes blanks or another specified character from the end or beginning of a string expression.

The *expression* must be a string expression.

The first argument, if specified, indicates whether characters are removed from the end or beginning of the string. If the first argument is not specified, then the characters are removed from both the end and the beginning of the string.

The second argument, if specified, is a single-character constant that indicates the binary, SBCS, or DBCS character that is to be removed. If *expression* is a binary string, the second argument must be a binary string constant. If *expression* is a DBCS graphic or DBCS-only string, the second argument must be a graphic constant consisting of a single DBCS character. If the second argument is not specified then:

- If *expression* is a binary string, then the default strip character is a hexadecimal zero (X'00').
- If *expression* is a DBCS graphic string, then the default strip character is a DBCS blank.
- If *expression* is a UCS-2 graphic string, then the default strip character is a UCS-2 blank.
- Otherwise, the default strip character is an SBCS blank.

The data type of the result depends on the data type of *expression*:

Data type of *expression*	**Data type of the Result**
CHAR or VARCHAR	VARCHAR
GRAPHIC or VARGRAPHIC	VARGRAPHIC
BLOB	BLOB
CLOB	CLOB
DBCLOB	DBCLOB

The length attribute of the result is the same as the length attribute of *expression*. The actual length of the result is the length of the expression minus the number of bytes removed. If all characters are removed, the result is an empty string.

The CCSID of the result is the same as that of the string. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Examples

- Assume the host variable HELLO of type CHAR(9) has a value of ' Hello'.

```
  TRIM(:HELLO)
Results in: 'Hello'.

  TRIM( TRAILING FROM :HELLO)
Results in: '  Hello'.
```

- Assume the host variable BALANCE of type CHAR(9) has a value of '000345.50'.

```
  TRIM( L '0' FROM :BALANCE )
Results in: '345.50'
```

- Assume the string to be stripped contains mixed data.

  TRIM(BOTH '$^{S}_{O}$ $^{S}_{I}$' **FROM**'$^{S}_{O}$ ＡＢ Ｃ $^{S}_{I}$' **)**

  Results in: '$^{S}_{O}$ＡＢ Ｃ$^{S}_{I}$'

TRUNCATE

```
►►──┬─TRUNCATE─┬──(──expression1──,──expression2───)──────────────────────►◄
    └─TRUNC────┘
```

The TRUNCATE function returns *expression1* truncated to *expression2* places to the right of the decimal point if *expression2* is positive or to the left of the decimal point if *expression2* is zero or negative.

expression1
: An expression that returns a value of any built-in numeric data type.

expression2
: An expression that returns a small or large integer. The absolute value of integer specifies the number of places to the right of the decimal point for the result if *expression2* is not negative, or to left of the decimal point if *expression2* is negative.

  If *expression2* is negative, *expression1* is truncated to the absolute value of *expression2*+1 number of places to the left of the decimal point.

  If the absolute value of *expression2* is larger than the number of digits to the left of the decimal point, the result is 0. For example, TRUNCATE(748.58,-4) = 0.

The data type and length attribute of the result are the same as the data type and length attribute of the first argument.

If either argument can be null, the result can be null. If either argument is null, the result is the null value.

Examples

- Calculate the average monthly salary for the highest paid employee. Truncate the result to two places to the right of the decimal point.

```
  SELECT TRUNCATE(MAX(SALARY/12, 2)
    FROM EMP
```

  Because the highest paid employee in the sample employee table earns $52750.00 per year, the example returns the value 4395.83.

- Calculate the number 873.726 truncated to 2, 1, 0, -1, -2, and -3 decimal places respectively.

```
SELECT TRUNCATE(873.726,  2),
       TRUNCATE(873.726,  1),
       TRUNCATE(873.726,  0),
       TRUNCATE(873.726, -1),
       TRUNCATE(873.726, -2),
       TRUNCATE(873.726, -3)
  FROM TABLEX
```

  This example returns:

```
0873.720   0873.700  0873.000  0870.000  0800.000  0000.000
```

  respectively.

- Calculate both positive and negative numbers.

```
SELECT TRUNCATE( 3.5, 0),
       TRUNCATE( 3.1, 0),
       TRUNCATE(-3.1, 0),
       TRUNCATE(-3.5, 0)
  FROM TABLEX
```

  This example returns:

```
3.0   3.0  -3.0  -3.0
```

  respectively.

UCASE or UPPER

```
►►──┬─UCASE─┬──(──expression──)──────────────────────────────────────►◄
    └─UPPER─┘
```

The UCASE or UPPER function returns a string in which all the characters have been converted to uppercase characters, based on the CCSID of the argument. Only SBCS and UCS-2 graphic characters are converted. Refer to the *National Language Support Reference Volume 2* , SE09-8002, for a description of the monocasing tables that are used for this translation.

The argument must be an expression whose value is a character string or a graphic string.

The result of the function has the same data type, length attribute, actual length, and CCSID as the argument. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Examples

- Uppercase the string ’abcdef’ using the UCASE scalar function.

  `UCASE('abcdef')`

  Returns the value ’ABCDEF’.

- Uppercase the mixed character string using the UPPER scalar function.

  UPPER(’ab$^{S}_{O}$⊂$^{S}_{I}$def’)

  Returns the value: ’AB$^{S}_{O}$⊂$^{S}_{I}$DEF’

VALUE

```
                             ┌──────────────────┐
                             ▼                  │
►►──VALUE──(──expression─────┴──,──expression───┴──)──────────────────────►◄
```

The VALUE function is identical to the COALESCE scalar function. For more information, see "COALESCE" on page 153.

VARCHAR

Character to Varchar

```
►►──VARCHAR (──character-expression──┬──────────────────────────────────┬──)────────────►◄
                                     └─,──┬─length──┬──┬─────────────┬──┘
                                          └─DEFAULT─┘  └─,──integer──┘
```

Graphic to Varchar

```
►►──VARCHAR (──graphic-expression──┬──────────────────────────────────┬──)──────────────►◄
                                   └─,──┬─length──┬──┬─────────────┬──┘
                                        └─DEFAULT─┘  └─,──integer──┘
```

Integer to Varchar

```
►►──VARCHAR──(──integer-expression──)─────────────────────────────────────────────────►◄
```

Decimal to Varchar

```
►►──VARCHAR──(──decimal-expression──┬──────────────────────────┬──)──────────────────►◄
                                    └─,──decimal-character─────┘
```

Floating-point to Varchar

```
►►──VARCHAR──(──floating-point-expression──┬──────────────────────────┬──)───────────►◄
                                           └─,──decimal-character─────┘
```

The VARCHAR function returns a character-string representation of:

- A character string if the first argument is any type of character string
- A graphic string if the first argument is a UCS-2 graphic string
- An integer number if the first argument is a SMALLINT, INTEGER, or BIGINT
- A decimal number if the first argument is a packed or zoned decimal number
- A double-precision floating-point number if the first argument is a DOUBLE or REAL

The result of the function is a varying-length string. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Character to Varchar

character-expression
An expression that returns a value that is a CHAR or VARCHAR data type.

length
Specifies the length attribute for the resulting varying length character string. The value must be between 1 and 32740 (32739 if nullable). If the first argument is mixed data, the second argument cannot be less than 4.

If the second argument is not specified or DEFAULT is specified:

- If the *character-expression* is an empty string constant, the length attribute of the result is 1.
- Otherwise, the length attribute of the result is the same as the length attribute of the first argument.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *character-expression*. If the length of the character-expression is greater than the length attribute of the result, truncation is performed. A warning is returned unless the truncated characters were all blanks.

integer
Specifies the CCSID of the result. It must be a valid SBCS CCSID, mixed data CCSID, or 65535 (bit data). If the third argument is an SBCS CCSID, then the result is SBCS data. If the third argument is a mixed CCSID, then the result is mixed data. If the third argument is 65535, then the result is bit data. If the third argument is a SBCS CCSID, then the first argument cannot be a DBCS-either or DBCS-only string.

If the third argument is not specified then:

- If the first argument is SBCS data, then the result is SBCS data. The CCSID of the result is the same as the CCSID of the first argument.
- If the first argument is mixed data (DBCS-open, DBCS-only, or DBCS-either), then the result is mixed data. The CCSID of the result is the same as the CCSID of the first argument.

Graphic to Varchar

graphic-expression
An expression that returns a value that is a GRAPHIC or VARGRAPHIC data type. It must not be DBCS-graphic data.

length
Specifies the length attribute for the resulting varying length character string. The value must be between 1 and 32740 (32739 if nullable). If the first argument is mixed data, the second argument cannot be less than 4.

If the second argument is not specified or DEFAULT is specified, the length attribute of the result is determined as follows (where *n* is the length attribute of the first argument):

- If the *graphic-expression* is the empty graphic string constant, the length attribute of the result is 1.
- If the result is SBCS data, the result length is *n*.
- If the result is mixed data, the result length is (2.5*(*n*-1)) + 4.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *graphic-expression*. If the length of the character-expression is greater than the length attribute of the result, truncation is performed. A warning is returned unless the truncated characters were all blanks.

integer

Specifies the CCSID of the result. It must be a valid SBCS CCSID or mixed data CCSID. If the third argument is an SBCS CCSID, then the result is SBCS data. If the third argument is a mixed CCSID, then the result is mixed data. The third argument cannot be 65535.

If the third argument is not specified, the CCSID of the result is the default CCSID at the current server. If the default CCSID is mixed data, then the result is mixed data. If the default CCSID is SBCS data, then the result is SBCS data.

Integer to Varchar

integer-expression

An expression that returns a value that is an integer data type (either SMALLINT or INTEGER).

The result is a varying-length character string of the argument in the form of an SQL integer constant. The result consists of n characters that are the significant digits that represent the value of the argument with a preceding minus sign if the argument is negative. It is left justified.

- If the argument is a small integer, the length attribute of the result is 6.
- If the argument is a large integer, the length attribute of the result is 11.
- If the argument is a big integer, the length attribute of the result is 20.

The actual length of the result is the smallest number of characters that can be used to represent the value of the argument. Leading zeroes are not included. If the argument is negative, the first character of the result is a minus sign. Otherwise, the first character is a digit.

The CCSID of the result is the default SBCS CCSID at the current server.

Decimal to Varchar

decimal-expression

An expression that returns a value that is a packed or zoned decimal data type (either DECIMAL or NUMERIC). If a different precision and scale is desired, the DECIMAL scalar function can be used to make the change.

decimal-character

Specifies the single-byte character constant that is used to delimit the decimal digits in the result character string. The character must be a period or comma.

The result is a varying-length character string representation of the argument. The result includes a decimal character and up to *p* digits, where *p* is the precision of the *decimal-expression* with a preceding minus sign if the argument is negative. Leading zeros are not returned. Trailing zeros are returned.

The length attribute of the result is 2+*p* where *p* is the precision of the *decimal-expression*. The actual length of the result is the smallest number of characters that can be used to represent the result, except that trailing characters are included. Leading zeros are not included. If the argument is negative, the result begins with a minus sign. Otherwise, the result begins with a digit.

The CCSID of the result is the default SBCS CCSID at the current server.

Floating-point to Varchar

floating-point expression
An expression that returns a value that is a floating-point data type (DOUBLE or REAL).

decimal-character
Specifies the single-byte character constant that is used to delimit the decimal digits in the result character string. The character must be a period or comma.

The result is a varying-length character string representation of the argument in the form of a floating-point constant.

The length attribute of the result is 24. The actual length of the result is the smallest number of characters that can represent the value of the argument such that the mantissa consists of a single digit other than zero followed by the *decimal-character* and a sequence of digits. If the argument is negative, the first character of the result is a minus sign; otherwise, the first character is a digit. If the argument is zero, the result is 0E0.

The CCSID of the result is the default SBCS CCSID at the current server.

Example

Make EMPNO varying-length with a length of 10.

```
SELECT VARCHAR(EMPNO,10) INTO :VARHV FROM EMPLOYEE
```

VARGRAPHIC

```
>>──VARGRAPHIC──(──expression──┬──────────────────────────────────┬──)──────────><
                               └─,──┬─length──┬──┬──────────────┬─┘
                                    └─DEFAULT─┘  └─,──integer───┘
```

The VARGRAPHIC function returns a graphic string representation of a string expression.

The first argument must be a string expression. It cannot be a BLOB. Additionally it cannot be CHAR or VARCHAR bit data.

The second argument, if specified as *length*, is the length attribute of the result and must be an integer constant between 1 and 16370 if the first argument is not nullable or between 1 and 16369 if the first argument is nullable.

If the second argument is not specified, or if DEFAULT is specified, the length attribute of the result is the same as the length attribute of the first argument.

In the following rules, S denotes one of the following:

- If the string expression is a host variable containing data in a foreign encoding scheme, S is the result of the expression after converting the data to a CCSID in a native encoding scheme. (See “Character Conversion” on page 27 for more information.)
- If the string expression is data in a native encoding scheme, S is that string expression.

If the third argument is specified, the CCSID of the result is the third argument. It must be a DBCS or UCS-2 CCSID. The CCSID cannot be 65535.

If the third argument is not specified, and the first argument is character, then the CCSID of the result is determined by a mixed CCSID. Let M denote that mixed CCSID. M is determined as follows:

- If the CCSID of S is a mixed CCSID, M is that CCSID.
- If the CCSID of S is an SBCS CCSID:
  - If the CCSID of S has an associated mixed CCSID, M is that CCSID.
  - Otherwise the operation is not allowed.

The following table summarizes the result CCSID based on M.

M	Result CCSID	Description	DBCS Substitution Character
930	300	Japanese EBCDIC	X’FEFE’
933	834	Korean EBCDIC	X’FEFE’
935	837	S-Chinese EBCDIC	X’FEFE’
937	835	T-Chinese EBCDIC	X’FEFE’
939	300	Japanese EBCDIC	X’FEFE’
5026	4396	Japanese EBCDIC	X’FEFE’
5035	4396	Japanese EBCDIC	X’FEFE’

If the third argument is not specified, and the first argument is not a character string, then the CCSID of the result is the same as the CCSID of the first argument.

The result of the function is a varying-length graphic string. If the expression can be null, the result can be null. If the expression is null, the result is the null value. If the expression is an empty string or the EBCDIC string `X'0E0F'`, the result is an empty string.

The actual length of the result depends on the number of characters in the argument. Each character of the argument determines a character of the result. If the length attribute of the resulting varying-length string is less than the actual length of the first argument, truncation is performed and no warning is returned.

If the result is DBCS-graphic data, the equivalence of SBCS and DBCS characters depends on M. Regardless of the CCSID, every double-byte code point in the argument is considered a DBCS character, and every single-byte code point in the argument is considered an SBCS character with the exception of the EBCDIC mixed data shift codes `X'0E'` and `X'0F'`.

- If the nth character of the argument is a DBCS character, the nth character of the result is that DBCS character.
- If the nth character of the argument is an SBCS character that has an equivalent DBCS character, the nth character of the result is that equivalent DBCS character.
- If the nth character of the argument is an SBCS character that does not have an equivalent DBCS character, the nth character of the result is the DBCS substitution character.

If the result is UCS-2 graphic data, each character of the argument determines a character of the result. The nth character of the result is the UCS-2 equivalent of the nth character of the argument.

Example

Using the EMPLOYEE table, set the host variable VAR_DESC (vargraphic(24)) to the VARGRAPHIC equivalent of the first name (FIRSTNME) for employee number (EMPNO) ’000050’.

```
SELECT VARGRAPHIC(FIRSTNME)
  INTO :VAR_DESC
  FROM EMPLOYEE
  WHERE EMPNO = '000050'
```

WEEK

```
►►──WEEK──(──expression──)─────────────────────────────────────────►◄
```

The WEEK function returns an integer between 1 and 54 which represents the week of the year. The basic accounting calendar is used. The week starts with Sunday, and January 1 is always in the first week.

The argument must be a date or a timestamp.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example

Using the PROJECT table, set the host variable WEEK (int) to the week that project (‘PL2100’) ended.

```
SELECT WEEK(PRENDATE)
  INTO :WEEK
  FROM PROJECT
  WHERE PROJNO = 'PL2100'
```

Results in WEEK being set to 38 when using the sample table.

XOR

```
                           ┌───────────────────┐
                           ▼                   │
►►──XOR──(──expression──────,──expression──────┴──)─────────────────►◄
```

The XOR function returns a string that is the logical XOR of the argument strings. This function takes the first argument string, does an XOR comparison with the next string, and then continues to do XOR comparisons for each successive argument using the previous result. If an argument is encountered that is shorter than the previous result, it is padded with blanks.

The arguments must be character strings but cannot be LOBs. The arguments cannot be mixed data character strings or graphic strings. There must be two or more arguments. Arguments other than the first may be parameter markers.

The arguments are converted, if necessary, to the attributes of the result. The attributes of the result are determined as follows:

- If all the arguments are fixed-length strings, the result is a fixed-length string of length *n*, where *n* is the length of the longest argument.

- If any argument is a varying-length string, the result is a varying-length string with length attribute *n*, where *n* is the length attribute of the argument with greatest length attribute. The actual length of the result is *m*, where *m* is the actual length of the longest argument.
- The CCSID of the result is 65535.

If an argument can be null, the result can be null; if an argument is null, the result is the null value.

Example

Assume the host variable L1 is a character(2) host variable with a value of X'E1E1', host variable L2 is a character(3) host variable with a value of X'F0F000', and host variable L3 is a character(4) host variable with a value of X'0000000F'.

```
XOR(:L1,:L2,:L3)
```

Returns the value X'1111404F'. In this case, the shorter results are padded with blanks (X'40'), so the logical XOR result differs from the result in the following example.

```
XOR(:L3,:L2,:L1)
```

Returns the value X'1111400F'.

YEAR

```
►►──YEAR──(──expression──)─────────────────────────────────────────►◄
```

The YEAR function returns the year part of a value.

The argument must be a date, timestamp, date duration, or timestamp duration.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

- If the argument is a date or a timestamp:

  The result is the year part of the value, which is an integer between 1 and 9999.
- If the argument is a date duration or timestamp duration:

  The result is the year part of the value, which is an integer between –9999 and 9999. A nonzero result has the same sign as the argument.

Examples

- Select all the projects in the PROJECT table that are scheduled to start (PRSTDATE) and end (PRENDATE) in the same calendar year.

  ```
  SELECT * FROM PROJECT
    WHERE YEAR(PRSTDATE) = YEAR(PRENDATE)
  ```
- Select all the projects in the PROJECT table that are scheduled to take less than one year to complete.

  ```
  SELECT * FROM PROJECT
    WHERE YEAR(PRENDATE - PRSTDATE) < 1
  ```

ZONED

Numeric to Zoned Decimal

```
►►──ZONED──(──numeric-expression──┬─────────────────────────────────────────────┬──)──────────►◄
                                  └─,──precision-integer──┬──────────────────┬──┘
                                                          └─,──scale-integer─┘
```

Character to Zoned Decimal

```
►►──ZONED──────────────────────────────────────────────────────────────────────────────────►

►──(──character-expression──┬─────────────────────────────────────────────────────────────────┬──)──►◄
                            └─,──precision-integer──┬─────────────────────────────────────────┬─┘
                                                    └─,──scale-integer──┬───────────────────────┬┘
                                                                        └─,──decimal-character──┘
```

The ZONED function returns a zoned decimal representation of:

- A number
- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

The result of the function is a zoned decimal number with precision of *p* and scale of *s*, where *p* and *s* are the second and third arguments. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Numeric to Zoned Decimal

numeric-expression
An expression that returns a value of any numeric data type.

precision-integer
An integer constant with a value in the range of 1 to 31.

The default for *precision-integer* depends on the data type of the *numeric-expression*:

- 15 for floating point, decimal, numeric, or nonzero scale binary
- 19 for big integer
- 11 for large integer
- 5 for small integer

scale-integer
An integer constant in the range of 0 to the *precision-integer* value. If not specified, the default is 0.

The result is the same number that would occur if the first argument were assigned to a NUMERIC column or variable with a precision of *p* and a scale of *s*. An error occurs if the number of significant decimal digits required to represent the whole part of the number is greater than *p-s*.

Character to Zoned Decimal

character-expression
An expression that returns a value that is:

- A character string representation of a decimal number
- A character string representation of an integer
- A character string representation of a floating-point number

precision-integer
An integer constant with a value in the range of 1 to 31. If not specified, the default is 15.

scale-integer
An integer constant in the range of 0 to the *precision-integer* value. If not specified, the default is 0.

decimal-character
Specifies the single-byte character constant that was used to delimit the decimal digits in *character-expression* from the whole part of the number. The character must be a period or comma.

The result is the same number that would result from CAST(*character-expression* AS NUMERIC(*p*,*s*)). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming a floating-point, integer, or decimal constant. Digits are truncated from the end if the number of digits right of the decimal character is greater than the scale *s*. An error occurs if the number of significant digits to the left of the decimal character (the whole part of the number) in *character-expression*is greater than *p-s*. The default decimal character is not valid in the substring if the *decimal-character* argument is specified.

Examples

- Assume the host variable Z1 is a decimal host variable with a value of 1.123.

  ```
  ZONED(:Z1,15,14)
  ```

  Returns the value 1.12300000000000.
- Assume the host variable Z1 is a decimal host variable with a value of 1123.

  ```
  ZONED(:Z1,11,2)
  ```

  Returns the value 1123.00.

  ```
  ZONED(:Z1,4)
  ```

  Returns the value 1123.

Chapter 4. Queries

An SQL *query* specifies a result table or an intermediate result table.

A query is a component of certain SQL statements. There are three forms of a query:

- The *subselect*
- The *fullselect*
- The *select-statement*

Another form of select is described under "SELECT INTO" on page 476.

Authorization

For any form of a query, the privileges held by the authorization ID of the statement must include at least one of the following:

- For each table or view identified in the statement,
  - The SELECT privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the SELECT privilege on a table when:

- It is the owner of the table,
- It has been granted the SELECT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *READ on the table

The authorization ID of the statement has the SELECT privilege on a view when:

- It is the owner of the view,
- It has been granted the SELECT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *READ on the view and the system authority *READ on all tables and views on which this view is directly or indirectly dependent. That is, all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth.

If an *expression* includes a function, the authorization ID of the statement must include at least one of the following for each user-defined function:

- The EXECUTE privilege on the function
- Administrative authority

The authorization ID of the statement has the EXECUTE privilege on a function when:

- It is the owner of the function,
- It has been granted the EXECUTE privilege on the function, or
- It has been granted the system authorities of *OBJOPR and *EXECUTE on the function.

subselect

```
►►──select-clause──from-clause──┬──────────────┬──┬──────────────────┬──────────►
                                └─where-clause─┘  └─group-by-clause─┘

►──┬───────────────┬────────────────────────────────────────────────────────────►◄
   └─having-clause─┘
```

The *subselect* is a component of the fullselect, the CREATE VIEW statement, and the INSERT statement. It is also a component of certain predicates, which in turn, are components of a subselect. A subselect that is a component of a predicate is called a *subquery*.

A subselect specifies a result table derived from the tables or views identified in the FROM clause. The derivation can be described as a sequence of operations in which the result of each operation is input for the next. (This is only a way of describing the subselect. The method used to perform the derivation may be quite different from this description.)

The sequence of the (hypothetical) operations is:

1. FROM clause
2. WHERE clause
3. GROUP BY clause
4. HAVING clause
5. SELECT clause

select-clause

The SELECT clause specifies the columns of the final result table. The column values are produced by the application of the *select list* to R. The select list is the names or expressions specified in the SELECT clause, and R is the result of the previous operation of the subselect. For example, if the only clauses specified are SELECT, FROM, and WHERE, R is the result of that WHERE clause.

```
         ┌─ALL──────┐
►►──SELECT─┼──────────┼──┬─*─────────────────────────────────────────┬──────►◄
         └─DISTINCT─┘  │  ┌─,──────────────────────────────────────┐ │
                       │  ▼                                        │ │
                       └────┬─expression──┬──────────────────────┬─┴─┘
                            │             └─┬────┬──column-name─┘  │
                            │               └─AS─┘                 │
                            ├─table-name.*──────────────────────────┤
                            ├─view-name.*───────────────────────────┤
                            └─correlation-name.*────────────────────┘
```

ALL
Selects all rows of the final result table and does not eliminate duplicates. This is the default.

DISTINCT
Eliminates all but one of each set of duplicate rows of the final result table.

Two rows are duplicates of one another only if each value in the first row is equal to the corresponding value in the second row. (For determining duplicate rows, two null values are considered equal.) Sort sequence is also used for determining distinct values.

DISTINCT is not allowed if the *select list* contains a LOB or DATALINK column.

Select List Notation

*
Represents a list of names that identify the columns of table R. The first name in the list identifies the first column of R, the second name identifies the second column of R, and so on.

The list of names is established when the statement containing the SELECT clause is prepared. Hence, * does not identify any columns that have been added to a table after the statement has been prepared.

expression
Specifies the values of a result column. Each *column-name* in the *expression* must unambiguously identify a column of R.

column-name or **AS** *column-name*
Names or renames the result column. The name must not be qualified and does not have to be unique.

*name.**
Represents a list of names that identify the columns of *name*. The *name* can be a table name, view name, or correlation name, and must designate a table or view named in the FROM clause. The first name in the list identifies the first column of the table or view, the second name in the list identifies the second column of the table or view, and so on.

The list of names is established when the statement containing the SELECT clause is prepared. Hence, * does not identify any columns that have been added to a table after the statement has been prepared.

Normally, when SQL statements are implicitly rebound, the list of names is not re-established. Therefore, the number of columns returned by the statement does not change. However, there are four cases where the list of names is established again and the number of columns can change:

- When an SQL program or SQL package is saved and then restored on an AS/400 system that is not the same release as the system from which it was saved.
- When SQL naming is specified for an SQL program or package and the owner of the program has changed since the SQL program or package was created.
- When an SQL statement is executed for the first time after the install of a more recent release of OS/400.
- When the SELECT * occurs in the subselect of an INSERT statement or in a subselect within a predicate, and a table or view referenced in the subselect has been deleted and recreated with additional columns.

The number of columns in the result of SELECT is the same as the number of expressions in the operational form of the select list (that is, the list established at prepare time), and cannot exceed 8000. The result of a subquery must be a single expression, unless the subquery is used in the EXISTS predicate.

Applying the Select List

Some of the results of applying the select list to R depend on whether or not GROUP BY or HAVING is used. Those results are described separately.

If GROUP BY or HAVING is used:

- Each expression that contains a *column-name* in the select list must identify a grouping expression or be specified within a column function.
- The RRN, PARTITION, NODENAME, and NODENUMBER functions cannot be specified in the select list.
- The select list is applied to each group of R, and the result contains as many rows as there are groups in R. When the select list is applied to a group of R, that group is the source of the arguments of the column functions in the select list.

If neither GROUP BY nor HAVING is used:

- The select list must not include any column functions, or it must be entirely a list of column functions.
- If the select list does not include column functions, the select list is applied to each row of R and the result contains as many rows as there are rows in R.
- If the select list is a list of column functions, R is the source of the arguments of the functions and the result of applying the select list is one row.

In either case the *n*th column of the result contains the values specified by applying the *n*th expression in the operational form of the select list.

Null attributes of result columns

Result columns allow null values if they are derived from:

- Any column function but COUNT
- Any column that allows null values
- A scalar function or expression with an operand that allows null values
- A host variable that has an indicator variable
- A result of a UNION if at least one of the corresponding items in the select list is nullable
- An arithmetic expression

Names of result columns

- If the AS clause is specified, the name of the result column is the name specified on the AS clause.
- If a column list is specified in the correlation clause, the name of the result column is the corresponding name in the correlation column list.
- If neither an AS clause nor a column list in the correlation clause is specified and the result column is derived only from a single column (without any functions or operators), then the result column name is the unqualified name of that column.
- All other result columns are unnamed.

Data types of result columns

Each column of the result of SELECT acquires a data type from the expression from which it is derived.

When the expression is:	The data type of the result column is:
The name of any numeric column	The same as the data type of the column, with the same precision and scale for decimal columns.
An integer constant	INTEGER or BIGINT (if the value of the constant is outside the range of INTEGER, but within the range of BIGINT).
A decimal or floating-point constant	The same as the data type of the constant, with the same precision and scale for decimal constants.
The name of any numeric host variable	The same as the data type of the variable, with the same precision and scale for decimal variables. If the data type of the variable is not identical to an SQL data type (for example, DISPLAY SIGN LEADING SEPARATE in COBOL), the result column is decimal.
An arithmetic expression	The same as the data type of the result, with the same precision and scale for decimal results as described under "Expressions" on page 105.
Any function	See Chapter 3 to determine the data type of the result.
The name of any string column	The same as the data type of the column, with the same length attribute.
The name of any string host variable	The same as the data type of the variable, with a length attribute equal to the length of the variable. If the data type of the variable is not identical to an SQL data type (for example, a NUL-terminated string in C), the result column is a varying-length string.
A character-string constant of length *n*	VARCHAR(*n*)
A graphic-string constant of length *n*	VARGRAPHIC(*n*)
The name of a datetime column, or an ILE RPG for AS/400 or ILE COBOL for AS/400 datetime host variable	The same as the data type of the column or host variable.

from-clause

The FROM clause specifies an intermediate result table.

```
              ┌─,───────────────┐
              ▼                 │
►►──FROM──────table-reference───┴──────────────────────────────────►◄
```

If only one *table-reference* is specified, the intermediate result table is simply the result of that *table-reference*. If more than one *table-reference* is specified in the FROM clause, the intermediate result table consists of all possible combinations of the rows of the specified table-references (the Cartesian product). Each row of the result is a row from the first *table-reference* concatenated with a row from the second *table-reference*, concatenated in turn with a row from the third, and so on. The number of rows in the result is the product of the number of rows in all the individual *table-references*. For a description of *table-reference*, see "table-reference" on page 224.

table-reference

A *table-reference* specifies an intermediate result table.

```
►►──┬─single-table────────────┬───────────────────────────────────►◄
    ├─nested-table-expression─┤
    └─joined-table────────────┘
```

single-table:

```
├──┬─table-name─┬──┬────────────────────┬─────────────────────────────┤
   └─view-name──┘  └─correlation-clause─┘
```

nested-table-expression:

```
├──(──subselect──)──correlation-clause───────────────────────────────┤
```

correlation-clause:

```
   ┌─AS─┐
├──┴────┴──correlation-name──┬───────────────────────────┬───────────┤
                             │      ┌─,───────────┐      │
                             └─(────▼─column-name─┴──)───┘
```

- If a single table or view is identified, the intermediate result table is simply that table or view.
- A subselect in parentheses is called a *nested table expression*.[30] If a nested table expression is specified, the result table is the result of that nested table expression. The columns of the result do not need unique names, but a column with a non-unique name cannot be referenced.
- If a *joined-table* is specified, the intermediate result table is the result of one or more join operations. For more information, see "joined-table" on page 226.

The list of names in the FROM clause must conform to these rules:

- Each *table-name* and *view-name* must name an existing table or view at the current server or the table-name of a *common-table expression* (see "common-table-expression" on page 233) defined preceding the subselect containing the table-reference.
- The exposed names must be unique. An exposed name is a correlation-name, a table-name that is not followed by a correlation-name, or a view-name that is not followed by a correlation-name.

Each *correlation-name* is defined as a designator of the intermediate result table specified by the immediately preceding table-reference. A correlation name must be specified for a nested table expression.

The exposed names of all table references should be unique. An exposed name is:

- A *correlation-name*
- A *table-name* or *view-name* that is not followed by a *correlation-name*

---

[30] A *nested table expression* is also called a *derived table*.

Any qualified reference to a column for a table, view, or nested table expression must use the exposed name. If the same table name or view name is specified twice, at least one specification should be followed by a *correlation-name*. The *correlation-name* is used to qualify references to the columns of the table or view. When a *correlation-name* is specified, column-names can also be specified to give names to the columns of the *table-name*, *view-name*, or *nested-table-expression*. If a column list is specified, there must be a name in the column list for each column in the table or view and for each result column in the *nested-table-expression*. For more information, see "Correlation Names" on page 90.

In general, *nested-table-expressions* can be specified in any from-clause. Columns from the nested table expressions can be referenced in the select list and in the rest of the subselect using the correlation name which must be specified. The scope of this correlation name is the same as correlation names for other table or view names in the FROM clause. A nested table expression can be used:

- in place of a view to avoid creating the view (when general use of the view is not required)
- when the desired result table is based on host variables.

Correlated References in table-references: Correlated references can be used in nested table expressions. The basic rule that applies is that the correlated reference must be from a *table-reference* at a higher level in the hierarchy of subqueries. This hierarchy includes the *table-references* that have already been resolved in the left-to-right processing of the FROM clause. So the following examples are valid syntax:

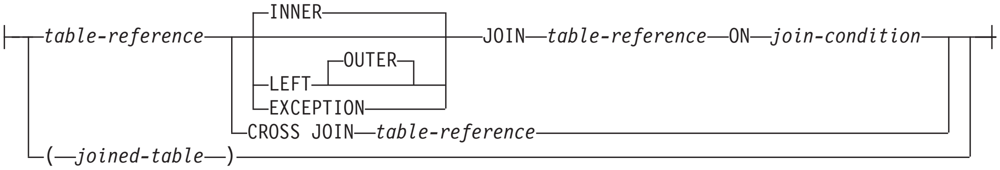
Example 1: The following example is valid:

```
SELECT D.DEPTNO, D.DEPTNAME, EMPINFO.AVGSAL, EMPINFO.EMPCOUNT
FROM DEPARTMENT D,
  (SELECT AVG(E.SALARY) AS AVGSAL,COUNT (*) AS EMPCOUNT
     FROM EMPLOYEE E
     WHERE E.WORKDEPT =
       (SELECT X.DEPTNO
         FROM DEPARTMENT X
         WHERE X.DEPTNO = E.WORKDEPT ) ) AS EMPINFO
```

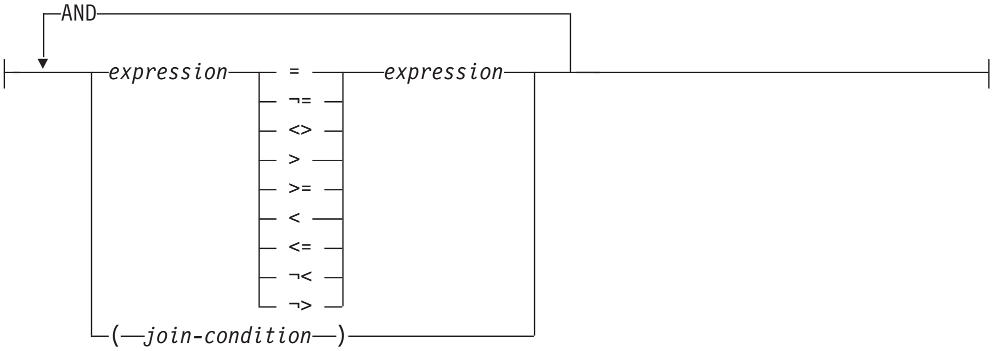
The following example is not valid because the reference to D.DEPTNO in the WHERE clause of the *nested-table-expression* attempts to reference a table that is outside the hierarchy of subqueries:

```
SELECT D.DEPTNO, D.DEPTNAME, EMPINFO.AVGSAL, EMPINFO.EMPCOUNT
FROM DEPARTMENT D,
  (SELECT AVG(E.SALARY) AS AVGSAL,COUNT (*) AS EMPCOUNT
     FROM EMPLOYEE E
     WHERE E.WORKDEPT = D.DEPTNO ) AS EMPINFO
```

joined-table



join-condition:



Note: In the join-condition, you can use the exclamation point (!) in place of the not (¬) symbol.

A *joined-table* specifies an intermediate result table that is the result of either an inner join, outer, cross or exception join. The table is derived by applying one of the join operators: INNER, LEFT OUTER, EXCEPTION, or CROSS to its operands.

If a join-operator is not specified, INNER is implicit. The order in which multiple joins are performed can affect the result. Joins can be nested within other joins. The order of processing for joins is generally from left to right, but based on the position of the required join-condition. Parentheses are recommended to make the order of nested joins more readable. For example:

```
TB1 LEFT JOIN TB2 ON TB1.C1=TB2.C1
    LEFT JOIN TB3 LEFT JOIN TB4 ON TB3.C1=TB4.C1
            ON TB1.C1=TB3.C1
```

is the same as

```
(TB1 LEFT JOIN TB2 ON TB1.C1=TB2.C1)
     LEFT JOIN (TB3 LEFT JOIN TB4 ON TB3.C1=TB4.C1)
           ON TB1.C1=TB3.C1
```

A joined table can be used in any context in which any form of the SELECT statement is used. A view or a cursor is read-only if its SELECT statement includes a joined table.

JOIN or **INNER JOIN**
Specifies that each row in the table to the left will be joined with one or more rows in the table to the right using the *join-condition*. Any rows in the table to the left that do not have a corresponding row in the table to the right will not be included in the result table.

LEFT JOIN or **LEFT OUTER JOIN**
Specifies that each row in the table to the left will be joined with one or more rows in the table to the right using the *join-condition*. Any row in the table to

the left that does not have a corresponding row in the table to the right will return the null value for each column in the table to the right.

EXCEPTION JOIN

Specifies that only the rows in the table to the left that have no corresponding rows in the table to the right using the *join-condition* will be returned. The null value will be returned for each column in every row for the table to the right.

CROSS JOIN

Specifies that the result table will contain a row for each row from the table to the left concatenated with each row from the table to the right.

ON *join-condition*

Specifies the condition to apply to each combination of rows from the two tables being joined in determining which rows are to be added to the intermediate result table. The following rules apply to the expression:

- One *expression* in each predicate can either use a column from the table specified to the right of the JOIN keyword, or can contain no columns.
- The other *expression* can use columns from any of the tables specified in the current *from-clause* prior to the JOIN keyword, or can contain no columns.
- Each column name must unambiguously identify a column in one of the tables in the *from-clause*.
- Column functions cannot be used in the *expression*.

Notes

Using the INNER JOIN syntax with a *join-condition* will produce the same result as specifying the join by listing two tables in the FROM clause separated by commas and using the *where-clause* to provide the condition.

where-clause

```
►►──WHERE──search-condition────────────────────────────────────────────►◄
```

The WHERE clause specifies an intermediate result table that consists of those rows of R for which the *search-condition* is true. R is the result of the FROM clause of the statement.

The *search-condition* must conform to the following rules:

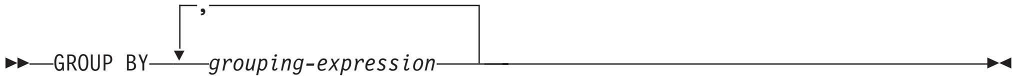
- Each *column-name* must unambiguously identify a column of R or be a correlated reference. A *column-name* is a correlated reference if it identifies a column of a table or view identified in an outer subselect.
- A column function must not be specified unless the WHERE clause is specified in a subquery of a HAVING clause and the argument of the function is a correlated reference to a group.

If a sort sequence other than *HEX is in effect when the statement that contains the WHERE clause is executed and if the search-condition contains predicates that have SBCS, mixed, or UCS-2 data, then the comparison for those predicates is done using weighted values. The weighted values are derived by applying the sort sequence to the operands of the predicate.

Any subquery in the *search-condition* is effectively executed for each row of R and the results are used in the application of the *search-condition* to the given row of R. A subquery is actually executed for each row of R only if it includes a correlated reference to a column of R. In fact, a subquery with no correlated reference is executed just once, whereas a subquery with a correlated reference may have to be executed once for each row.

group-by-clause

The GROUP BY clause specifies an intermediate result table that consists of a grouping of the rows of R. R is the result of the previous clause of the subselect.



In its simplest form, a GROUP BY clause contains a *grouping-expression*. A *grouping-expression* is an *expression* used in defining the grouping of R. Each column-name included in a *grouping-expression* must unambiguously identify a column of R. LOB and DataLink columns cannot be used in a *grouping-expression*. The length attribute of each *grouping-expression* must not be more than 2000, or 1999 if the column is nullable. A *grouping-expression* cannot include a function that is variant, or the RRN, PARTITION, NODENAME, or NODENUMBER functions.

The result of the GROUP BY clause is a set of groups of rows. In each group of more than one row, all values of each *grouping-expression* are equal, and all rows with the same set of values of the *grouping-expressions* are in the same group. For grouping, all null values for a *grouping-expression* are considered equal.

If a sort sequence other than *HEX is in effect when the statement that contains the GROUP BY clause is executed, the rows are placed into groups using the weighted values. The weighted values are derived by applying the sort sequence to the SBCS data *grouping-expressions*, to the SBCS data of mixed data *grouping-expressions*, and to UCS-2 data *grouping-expressions*.

Grouping-expressions can be used in a search condition in a HAVING clause, in the SELECT clause, or in a *sort-key-expression* of an ORDER BY clause (see order-by-clause for details). In each case, the reference specifies only one value for each group. The *grouping-expression* specified in these clauses must exactly match the *grouping-expression* in the GROUP BY clause, except that blanks are not significant. For example, a *grouping-expression* of

```
SALARY*.10
```

will match the expression in a *having-clause* of

```
HAVING SALARY*.10
```

but will not match

```
HAVING .10 *SALARY
 or
HAVING (SALARY*.10)+100
```

If the *grouping-expression* contains varying-length strings with trailing blanks, the values in the group can differ in the number of trailing blanks and may not all have the same length. In that case, a reference to the *grouping-expression* still specifies only one value for each group, but the value for a group is chosen arbitrarily from the available set of values. Thus, the actual length of the result value is unpredictable.

The GROUP BY clause can contain up to 120 *grouping-expressions* or 2000 − n bytes, where n is the number of *grouping-expressions* specified that allow nulls.

having-clause

```
►►──HAVING──search-condition──────────────────────────────────────────►◄
```

The HAVING clause specifies an intermediate result table that consists of those groups of R for which the *search-condition* is true. R is the result of the previous clause of the subselect. If this clause is not GROUP BY, R is considered a single group with no grouping expressions.

Each expression that contains a *column-name* in the search condition must do one of the following:

- Unambiguously identify a grouping expression of R.
- Be specified within a column function.
- Be a correlated reference. A *column-name* is a correlated reference if it identifies a column of a table or view identified in an outer subselect.

The RRN, PARTITION, NODENAME, and NODENUMBER functions cannot be specified in the HAVING clause unless it is within a column function. See ″Functions″ in Chapter 3 for restrictions that apply to the use of column functions.

If a sort sequence other than *HEX is in effect when the statement that contains the HAVING clause is executed and if the search-condition contains predicates that have SBCS, mixed, or UCS-2 data, the comparison for those predicates is done using weighted values. The weighted values are derived by applying the sort sequence to the operands in the predicate.

A group of R to which the search condition is applied supplies the argument for each column function in the search condition, except for any function whose argument is a correlated reference.

If the search condition contains a subquery, the subquery can be thought of as being executed each time the search condition is applied to a group of R, and the results used in applying the search condition. In actuality, the subquery is executed for each group only if it contains a correlated reference. For an illustration of the difference, see examples 6 and 7 under “Examples of a subselect”.

A correlated reference to a group of R must either identify a grouping column or be contained within a column function.

When HAVING is used without GROUP BY, any column name in the select list must appear within a column function.

Examples of a subselect

Example 1

Select all columns and rows from the EMPLOYEE table.

```
SELECT * FROM EMPLOYEE
```

Example 2

Join the EMP_ACT and EMPLOYEE tables, select all the columns from the EMP_ACT table and add the employee’s surname (LASTNAME) from the EMPLOYEE table to each row of the result.

```
SELECT EMP_ACT.*, LASTNAME
  FROM EMP_ACT, EMPLOYEE
  WHERE EMP_ACT.EMPNO = EMPLOYEE.EMPNO
```

Example 3

Join the EMPLOYEE and DEPARTMENT tables, select the employee number (EMPNO), employee surname (LASTNAME), department number (WORKDEPT in the EMPLOYEE table and DEPTNO in the DEPARTMENT table) and department name (DEPTNAME) of all employees who were born (BIRTHDATE) earlier than 1930.

```
SELECT EMPNO, LASTNAME, WORKDEPT, DEPTNAME
  FROM EMPLOYEE, DEPARTMENT
  WHERE WORKDEPT = DEPTNO
  AND YEAR(BIRTHDATE) < 1930
```

This subselect could also be written as follows:

```
SELECT EMPNO, LASTNAME, WORKDEPT, DEPTNAME
  FROM EMPLOYEE INNER JOIN DEPARTMENT
  ON WORKDEPT = DEPTNO
  WHERE YEAR(BIRTHDATE) < 1930
```

Example 4

Select the job (JOB) and the minimum and maximum salaries (SALARY) for each group of rows with the same job code in the EMPLOYEE table, but only for groups with more than one row and with a maximum salary greater than or equal to 27000.

```
SELECT JOB, MIN(SALARY), MAX(SALARY)
  FROM EMPLOYEE
  GROUP BY JOB
  HAVING COUNT(*) > 1 AND MAX(SALARY) >= 27000
```

Example 5

Select all the rows of EMP_ACT table for employees (EMPNO) in department (WORKDEPT) ‘E11’. (Employee department numbers are shown in the EMPLOYEE table.)

```
SELECT * FROM EMP_ACT
  WHERE EMPNO IN (SELECT EMPNO
                  FROM EMPLOYEE
                  WHERE WORKDEPT = 'E11')
```

Example 6

From the EMPLOYEE table, select the department number (WORKDEPT) and maximum departmental salary (SALARY) for all departments whose maximum salary is less than the average salary for all employees.

```
SELECT WORKDEPT, MAX(SALARY)
  FROM EMPLOYEE
  GROUP BY WORKDEPT
  HAVING MAX(SALARY) < (SELECT AVG(SALARY)
       FROM EMPLOYEE)
```

The subquery in the HAVING clause would only be executed once in this example.

Example 7

Using the EMPLOYEE table, select the department number (WORKDEPT) and maximum departmental salary (SALARY) for all departments whose maximum salary is less than the average salary in all other departments.

```
SELECT WORKDEPT, MAX(SALARY)
  FROM EMPLOYEE EMP_COR
  GROUP BY WORKDEPT
```

```
HAVING MAX(SALARY) < (SELECT AVG(SALARY)
     FROM EMPLOYEE
     WHERE NOT WORKDEPT = EMP_COR.WORKDEPT)
```

In contrast to example 6, the subquery in the HAVING clause would need to be executed for each group.

Example 8

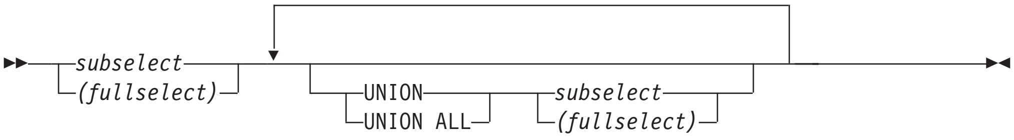
Join the EMPLOYEE and EMP_ACT tables, select all of the employees and their project numbers. Return even those employees that do not have a project number currently assigned.

```
SELECT EMPLOYEE.EMPNO, PROJNO
  FROM EMPLOYEE LEFT OUTER JOIN EMP_ACT
  ON EMPLOYEE.EMPNO = EMP_ACT.EMPNO
```

Any employee in the EMPLOYEE table that does not have a project number in the EMP_ACT table will return one row in the result table containing the EMPNO value and the null value in the PROJNO column.

fullselect

A *fullselect* specifies a result table. If UNION is not used, the result of the fullselect is the result of the specified subselect.



UNION or **UNION ALL**

Derives a result table by combining two other result tables (R1 and R2). If UNION ALL is specified, the result consists of all rows in R1 and R2. If UNION is specified without the ALL option, the result is the set of all rows in either R1 or R2, with duplicate rows eliminated. In either case, however, each row of the UNION table is either a row from R1 or a row from R2.

If the nth column of R1 and the nth column of R2 have the same result column name, then the nth column of the result table has that column name. If the nth column of R1 and the nth column of R2 do not have the same name, then the nth column of the result table is unnamed.

Two rows are duplicates if each value in the first is equal to the corresponding value of the second. If a sort sequence other than *HEX is in effect when the statement that contains the UNION keyword is executed and if the result tables contain columns that have SBCS, UCS-2, or mixed data, the comparison for those columns is done using weighted values. The weighted values are derived by applying the sort sequence to each value. (For determining duplicates, two null values are considered equal.)

Both UNION and UNION ALL are associative operations. When you include the UNION ALL operator in the same SQL statement as a UNION operator, the result of the operation depends on the order of evaluation. Where there are no parentheses, evaluation is from left to right. Where parentheses are included, the parenthesized subselect is evaluated first, followed, from left to right, by the other components of the statement.

Rules for columns: R1 and R2 must have the same number of columns, and the data type of the nth column of R1 must be compatible with the data type of the nth column of R2. Character-string values are not compatible with datetime values.

The nth column of the result of UNION and UNION ALL is derived from the nth columns of R1 and R2. The attributes of the result columns are determined using the rules for result columns. For more information see “Rules for Result Data Types” on page 78.

If UNION is specified, no column can be a LOB or DATALINK column.

Examples of a fullselect

Example 1

Select all columns and rows from the EMPLOYEE table.

```
SELECT * FROM EMPLOYEE
```

Example 2

List the employee numbers (EMPNO) of all employees in the EMPLOYEE table whose department number (WORKDEPT) either begins with 'E' **or** who are assigned to projects in the EMP_ACT table whose project number (PROJNO) equals 'MA2100', 'MA2110', or 'MA2112'.

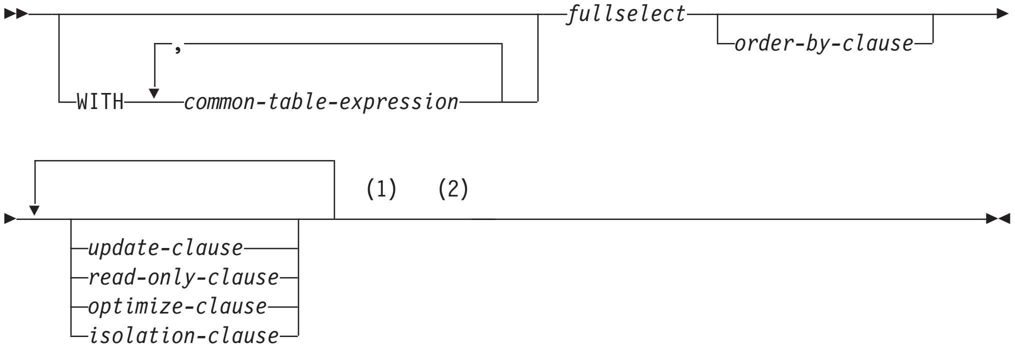
```
SELECT EMPNO FROM EMPLOYEE
  WHERE WORKDEPT LIKE 'E%'
UNION
SELECT EMPNO FROM EMP_ACT
  WHERE PROJNO IN('MA2100', 'MA2110', 'MA2112')
```

Example 3

Make the same query as in example 2, only use UNION ALL so that no duplicate rows are eliminated.

```
SELECT EMPNO FROM EMPLOYEE
  WHERE WORKDEPT LIKE 'E%'
UNION ALL
SELECT EMPNO FROM EMP_ACT
  WHERE PROJNO IN('MA2100', 'MA2110', 'MA2112')
```

select-statement



Notes:

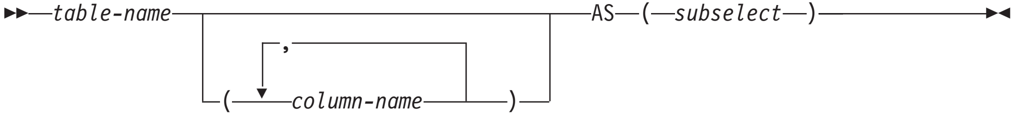
1 The update-clause and read-only-clause cannot both be specified in the same select-statement.

2 Each clause may be specified only once.

The *select-statement* is the form of a query that can be directly specified in a DECLARE CURSOR statement, or prepared and then referenced in a DECLARE CURSOR statement. It can also be issued interactively, using the interactive facility (STRSQL command), causing a result table to be displayed at your work station. In either case, the table specified by a *select-statement* is the result of the fullselect.

common-table-expression

A *common-table-expression* permits defining a result table with a *table-name* that can be specified as a table name in any FROM clause of the fullselect that follows. The *table-name* must be unqualified. Multiple common table expressions can be specified following the single WITH keyword. Each common table expression specified can also be referenced by name in the FROM clause of subsequent common table expressions.



If a list of columns is specified, it must consist of as many names as there are columns in the result table of the fullselect. Each *column-name* must be unique and unqualified. If these column names are not specified, the names are derived from the select list of the fullselect used to define the common table expression.

The *table-name* of a common table expression must be different from any other common table expression table-name in the same statement. A common table expression *table-name* can be specified as a table name in any FROM clause throughout the fullselect. A *table-name* of a common table expression overrides any existing table, view, or alias (in the catalog) with the same qualified name.

If more than one common table expression is defined in the same statement, cyclic references between the common table expressions are not permitted. A *cyclic reference* occurs when two common table expressions *dt1* and *dt2* are created such that *dt1* refers to *dt2* and *dt2* refers to *dt1*.

common-table-expression

A *common-table-expression* is also optional prior to the fullselect in the CREATE VIEW and INSERT statements.

A *common-table-expression* can be used:

- In place of a view to avoid creating the view (when general use of the view is not required and positioned updates or deletes are not used
- When the desired result table is based on host variables
- When the same result table needs to be shared in a *fullselect*

If a *subselect* of a common table expression contains a reference to itself in a FROM clause, the common table expression is a *recursive table expression*. Recursive common table expressions are not supported in DB2 UDB for AS/400.

order-by-clause

The ORDER BY clause specifies an ordering of the rows of the result table. If a single *sort-key* is identified, the rows are ordered by the values of that *sort-key*. If more than one *sort-key* is identified, the rows are ordered by the values of the first identified *sort-key*, then by the values of the second identified *sort-key*, and so on.

```
              ┌─,──────────────────────┐
              │               ┌─ASC──┐ │
►►──ORDER BY──▼──sort-key─────┼──────┼─┴───────────────────────────►◄
                              └─DESC─┘
```

sort-key:

```
├──┬─simple-column-name──┬──────────────────────────────────────────┤
   ├─simple-integer──────┤
   └─sort-key-expression─┘
```

If a sort sequence other than *HEX is in effect when the statement that contains the ORDER BY clause is executed and if the ORDER BY clause involves *sort-keys* that have SBCS, UCS-2, or mixed data, the comparison for those *sort-keys* is done using weighted values. The weighted values are derived by applying the sort sequence to the values of the *sort-keys*.

A named column in the select list may be identified by a *sort-key* that is a *simple-integer* or a *simple-column-name*. An unnamed column in the select list may be identified by a *simple-integer* or by a *sort-key-expression*. A column is unnamed if the AS clause is not specified in the select-list and if it is derived from a constant, an expression with operators, or a function. If the fullselect includes a UNION operator, see “fullselect” on page 231 for the rules on named columns in a fullselect.

simple-column-name

Must unambiguously identify a column of the result table. The column must not be a LOB or DATALINK column. Although columns not included in the result table cannot be referenced in the ORDER BY clause, the rules for unambiguous column references are the same as in the other clauses of the fullselect. See “Column Name Qualifiers to Avoid Ambiguity” on page 92 for more information.

If the fullselect includes a UNION or UNION ALL, the column name cannot be qualified.

The *simple-column-name* may also identify a column name of a table, view or nested table identified in the FROM clause if the query is a subselect. An error occurs if the subselect produces a grouped result and the *simple-column-name* is not a *grouping-expression*.

integer
Must be greater than 0 and not greater than the number of columns in the result table. The integer *n* identifies the *n*th column of the result table. The identified column must not be a LOB or DATALINK column.

sort-key-expression
An expression that is not simply a column name or an unsigned integer constant. The query to which ordering is applied must be a subselect to use this form of *sort-key*.

The *sort-key-expression* specified in these clauses must exactly match an expression in the select list; except that blanks are not significant. The *sort-key-expression* cannot contain RRN, PARTITION, NODENAME, or NODENUMBER if the *fullselect* includes a UNION or UNION ALL. The result of the *sort-key-expression* must not be a LOB or DATALINK.

If the subselect is grouped, the *sort-key-expression* can:

- be an expression in the select list of the subselect,
- include a *grouping-expression* from the GROUP BY clause of the subselect

ASC
Uses the values of the column in ascending order. This is the default.

DESC
Uses the values of the column in descending order.

Ordering is performed in accordance with the comparison rules described in Chapter 2. The null value is higher than all other values. If your ordering specification does not determine a complete ordering, rows with duplicate values of the last identified *sort-key* have an arbitrary order. If the ORDER BY clause is not specified, the rows of the result table have an arbitrary order.

The ORDER BY clause can contain up to 10000-n *sort-keys* or 10000-n bytes (where n is the number of *sort-keys* specified that allow nulls).

update-clause

The UPDATE clause identifies the columns that can be updated in a subsequent Positioned UPDATE statement. Each *column-name* must be unqualified and must identify a column of the table or view identified in the first FROM clause of the fullselect. If the UPDATE clause is specified without column names, all updateable columns of the table or view identified in the first FROM clause of the fullselect are included. The clause can appear either before or after an accompanying optimize-clause.

```
►►──FOR UPDATE──┬─────────────────────────┬──────────────────────────────►◄
                │        ┌─,───────────┐  │
                │        ▼             │  │
                └─OF─────column-name───┴──┘
```

The FOR UPDATE OF clause must not be specified if the result table of the fullselect is read-only (for more information see “DECLARE CURSOR” on page 368 page 368), if the FOR READ ONLY clause is used, or if the SCROLL keyword is specified without the DYNAMIC keyword on the DECLARE CURSOR statement.

Positioned UPDATE statements identifying the cursor associated with a select-statement can update all updateable columns, if:

- The select-statement does not contain one of the following:
  - An UPDATE clause
  - A FOR READ ONLY clause
  - An ORDER BY clause
- The DECLARE CURSOR statement does not contain a SCROLL keyword without the DYNAMIC keyword.

The UPDATE clause is a performance option that is not part of ISO/ANSI SQL.

read-only-clause

```
►►──FOR──┬─READ──┬──ONLY──────────────────────────────────────────►◄
         └─FETCH─┘
```

The FOR READ ONLY or FOR FETCH ONLY clause indicates that the result table is read-only. For example, its cursor is not used for Positioned DELETE or UPDATE statements.

Some result tables are read-only by nature (for example, a table based on a read-only view). FOR READ ONLY can still be specified for such tables, but the specification has no effect.

For result tables in which updates and deletes are allowed, specifying FOR READ ONLY can possibly improve the performance of FETCH operations by allowing the database manager to do blocking and avoid exclusive locks. For example, in programs that contain dynamic SQL statements without the FOR READ ONLY or ORDER BY clause, the database manager might open cursors that have not specified SCROLL without the DYNAMIC keyword as if the FOR UPDATE OF clause was specified.

A read-only result table must not be referred to in an UPDATE or DELETE statement, whether it is read-only by nature or specified as FOR READ ONLY.

The FOR READ ONLY clause cannot appear in a statement containing an UPDATE clause. The clause can appear either before or after an accompanying optimize-clause.

optimize-clause

```
►►──OPTIMIZE FOR──┬─integer─┬──┬─ROW──┬──────────────────────────►◄
                  └─ALL─────┘  └─ROWS─┘
```

The optimize-clause tells the database manager to assume that the program does not intend to retrieve more than *integer* rows from the result table. Without this clause, or with the keyword ALL, the database manager assumes that all rows of the result table are to be retrieved, and it optimizes accordingly. Optimizing for *integer* rows, or at a minimum, the number of rows that are fetched, could improve performance. The clause does not change the result table or the order in which the rows are fetched. Any number of rows can be fetched, but performance can possibly degrade after *integer* fetches. The clause can appear either before or after an accompanying update-clause or read-only-clause.

isolation-clause

```
                (1)
►►──WITH──┬─NC──────────────────────────┬──────────────────────────────────────►◄
          │     (2)                     │
          ├─UR──────────────────────────┤
          ├─CS──┬─────────────────────┬─┤
          │     │               (3)   │ │
          │     └─KEEP LOCKS──────────┘ │
          │     (4)                     │
          ├─RS──────────────────────────┤
          └─RR──────────────────────────┘
```

Notes:

1 The keyword NONE can be used as a synonym for NC.

2 The keyword CHG can be used as a synonym for UR.

3 The KEEP LOCKS clause can only be used on a DECLARE CURSOR, SELECT INTO, and a fullselect statement.

4 The keyword ALL can be used as a synonym for RS.

The isolation-clause specifies an isolation level on the SELECT, SELECT INTO, INSERT, UPDATE, DELETE, and DECLARE CURSOR statements. This isolation level is in effect only for the execution of the statement containing the isolation clause. For more information on isolation level see Isolation Level.

The KEEP LOCKS clausespecifies that any read locks acquired will be held for a longer duration. Normally, read locks are released when the next row is read. If the isolation clause is associated with a cursor, the locks will be held until the cursor is closed or until a COMMIT or ROLLBACK statement is executed. Otherwise, the locks will be held until the completion of the SQL statement. The KEEP LOCKS clause is allowed on an SQL SELECT, SELECT INTO, or DECLARE CURSOR statement. It is not allowed on updateable cursors.

Examples of a select-statement

Example 1

Select all columns and rows from the EMPLOYEE table.

```
SELECT * FROM EMPLOYEE
```

Example 2

Select the project name (PROJNAME), start date (PRSTDATE), and end date (PRENDATE) from the PROJECT table. Order the result table by the end date with the most recent dates appearing first.

```
SELECT PROJNAME, PRSTDATE, PRENDATE
  FROM PROJECT
  ORDER BY PRENDATE DESC
```

Example 3

Select the department number (WORKDEPT) and average departmental salary (SALARY) for all departments in the EMPLOYEE table. Arrange the result table in ascending order by average departmental salary.

```
SELECT WORKDEPT, AVG(SALARY)
  FROM EMPLOYEE
  GROUP BY WORKDEPT
  ORDER BY 2
```

Example 4

Declare a cursor named UP_CUR, to be used in a PL/I program, that updates the start date (PRSTDATE) and the end date (PRENDATE) columns in the PROJECT table. The program must receive both of these values together with the project number (PROJNO) value for each row. The declaration specifies that the access path for the query be optimized for the retrieval of a maximum of 2 rows. Even so, the program can retrieve more than 2 rows from the result table. However, when more than 2 rows are retrieved, performance could possibly degrade.

```
EXEC SQL  DECLARE UP_CUR CURSOR FOR
            SELECT PROJNO, PRSTDATE, PRENDATE
              FROM PROJECT
              FOR UPDATE OF PRSTDATE, PRENDATE
              OPTIMIZE FOR 2 ROWS ;
```

Example 5

Select items from a table with an isolation level of Repeatable Read (RS, ALL).

```
SELECT NAME, SALARY FROM PAYROLL WHERE DEPT = 704  WITH RS
```

Chapter 5. Statements

This chapter contains syntax diagrams, semantic descriptions, rules, and examples of the use of the SQL statements listed in the following table.

Table 20. SQL Statements

SQL Statement	**Function**
"ALTER TABLE" on page 246	Alters the description of a table
"BEGIN DECLARE SECTION" on page 265	Marks the beginning of an SQL declare section
"CALL" on page 266	Calls a procedure
"CLOSE" on page 271	Closes a cursor
"COMMENT ON" on page 273	Replaces or adds a comment to the description of an alias, column, function, index, package, parameter, procedure, table, type or view
"COMMIT" on page 280	Ends a unit of work and commits the database changes made by that unit of work
"CONNECT (Type 1)" on page 283	Connects to an application server and establishes the rules for remote unit of work
"CONNECT (Type 2)" on page 287	Connects to an application server and establishes the rules for application-directed distributed unit of work
"CREATE ALIAS" on page 291	Creates an alias
"CREATE COLLECTION" on page 294	Creates a collection
"CREATE DISTINCT TYPE" on page 295	Creates a distinct type (user-defined type)
"CREATE FUNCTION" on page 301	Creates a user-defined function
"CREATE FUNCTION (Scalar)" on page 303	Creates either an external function or an SQL scalar function
"CREATE FUNCTION (Sourced)" on page 318	Creates a user-defined function based on another existing scalar or column function
"CREATE INDEX" on page 324	Creates an index on a table
"CREATE PROCEDURE" on page 327	Creates an external procedure or an SQL procedure.
"CREATE SCHEMA" on page 337	Creates a collection and a set of objects in that collection
"CREATE TABLE" on page 340	Creates a table
"CREATE VIEW" on page 362	Creates a view of one or more tables or views
"DECLARE CURSOR" on page 368	Defines an SQL cursor
"DECLARE PROCEDURE" on page 375	Defines an external procedure
"DECLARE STATEMENT" on page 382	Declares the names used to identify prepared SQL statements

Table 20. SQL Statements (continued)

SQL Statement	Function
"DECLARE VARIABLE" on page 383	Declares a subtype or CCSID other than the default for a host variable
"DELETE" on page 385	Deletes one or more rows from a table
"DESCRIBE" on page 389	Describes the result columns of a prepared statement
"DESCRIBE TABLE" on page 393	Obtains information about a table or view
"DISCONNECT" on page 396	Immediately ends one or more connections
"DROP" on page 398	Deletes a collection, index, package, procedure, table, or view
"END DECLARE SECTION" on page 406	Marks the end of an SQL declare section
"EXECUTE" on page 407	Executes a prepared SQL statement
"EXECUTE IMMEDIATE" on page 410	Prepares and executes an SQL statement
"FETCH" on page 412	Positions a cursor on a row of the result table; can also assign values from one or more rows of the result table to host variables
"FREE LOCATOR" on page 419	Removes the association between a LOB locator variable and its value
"GET DIAGNOSTICS" on page 420	Returns information about the previous SQL statement that was executed.
"GRANT (Function or Procedure Privileges)" on page 422	Grants privileges on a function or procedure
"GRANT (Package Privileges)" on page 427	Grants privileges on a package
"GRANT (Table Privileges)" on page 429	Grants privileges on a table or view
"GRANT (User-Defined Type Privileges)" on page 434	Grants privileges on a user-defined type
"INCLUDE" on page 436	Inserts declarations into a source program
"INSERT" on page 437	Inserts one or more rows into a table
"LABEL ON" on page 443	Replaces or adds a label on the description of an alias, column, package, table, or view
"LOCK TABLE" on page 446	Either prevents concurrent processes from changing a table or prevents concurrent processes from using a table
"OPEN" on page 447	Opens a cursor
"PREPARE" on page 453	Prepares an SQL statement for execution
"RELEASE" on page 459	Places one or more connections in the release-pending state
"RENAME" on page 461	Renames a table, view, or index.
"REVOKE (Function or Procedure Privileges)" on page 463	Revokes privileges on a function or procedure
"REVOKE (Package Privileges)" on page 468	Revokes the privilege to execute statements in a package

Table 20. SQL Statements (continued)

SQL Statement	Function
"REVOKE (Table Privileges)" on page 470	Revokes privileges on a table or view
"REVOKE (User-Defined Type Privileges)" on page 472	Revokes the privilege to use a user-defined type
"ROLLBACK" on page 474	Ends a unit of work and backs out the database changes made by that unit of work
"SELECT INTO" on page 476	Assigns values to host variables
"SET CONNECTION" on page 478	Establishes the application server of the process by identifying one of its existing connections
"SET OPTION" on page 480	Establishes the options for processing SQL statements
"SET PATH" on page 493	Assigns a value to the CURRENT PATH special register
"SET RESULT SETS" on page 495	Identifies the result sets in a procedure
"SET TRANSACTION" on page 497	Changes the isolation level for the current unit of work
"SET variable" on page 499	Specifies a result table of no more than one row and assigns the values to host variables.
"UPDATE" on page 501	Updates the values of one or more columns in one or more rows of a table
"VALUES INTO" on page 508	Specifies a result table of no more than one row and assigns the values to host variables.
"WHENEVER" on page 510	Defines actions to be taken on the basis of SQL return codes

How SQL Statements Are Invoked

The SQL statements described in this chapter are classified as *executable* or *nonexecutable*. The *Invocation* section in the description of each statement indicates whether or not the statement is executable.

An *executable statement* can be invoked in any of the following ways:

- Embedded in an application program
- Dynamically prepared and executed
- Issued interactively

Note: Statements embedded in REXX or processed using RUNSQLSTM are prepared and executed dynamically.

Depending on the statement, you can use some or all of these methods. The *Invocation* section in the description of each statement tells you which methods can be used.

A *nonexecutable statement* can only be embedded in an application program.

In addition to the statements described in this chapter, there is one more SQL statement construct: the *select-statement*. See "select-statement" on page 233. It is not included in this chapter because it is used in a different way from other statements.

A *select-statement* can be invoked in one of the following ways:
- Included in DECLARE CURSOR and implicitly executed by OPEN
- Dynamically prepared, referenced in DECLARE CURSOR, and implicitly executed by OPEN
- Issued interactively

The first two methods are called, respectively, the *static* and the *dynamic* invocation of *select-statement*.

Embedding a Statement in an Application Program

SQL statements can be included in a source program that will be submitted to the precompiler by using the CRTSQLCBL, CRTSQLCBLI, CRTSQLCI, CRTSQLFTN, CRTSQLCPPI, CRTSQLPLI, CRTSQLRPG, CRTSQLRPGI, or CVTSQLCPP commands. Such statements are said to be *embedded* in the program. An embedded statement can be placed anywhere in the program where a host language statement is allowed. Each embedded statement must be preceded by the keywords EXEC and SQL.

Executable statements

An executable statement embedded in an application program is executed every time a statement of the host language would be executed if specified in the same place. This means that a statement within a loop is executed every time the loop is executed, and a statement within a conditional construct is executed only when the condition is satisfied.

An embedded statement can contain references to host variables. A host variable referenced in this way can be used in two ways:
- As input (the current value of the host variable is used in the execution of the statement)
- As output (the variable is assigned a new value as a result of executing the statement)

In particular, all references to host variables in expressions and predicates are effectively replaced by current values of the variables; that is, the variables are used as input. The treatment of other references is described individually for each statement.

All executable statements should be followed by a test of an SQL return code. Alternatively, the WHENEVER statement (which is itself nonexecutable) can be used to change the flow of control immediately after the execution of an embedded statement.

Objects referenced in SQL statements need not exist when the statements are prepared.

Nonexecutable statements

An embedded nonexecutable statement is processed only by the precompiler. The precompiler reports any errors encountered in such a statement. The statement is *never* executed, and acts as a no-operation if placed among executable statements of the application program. Therefore, such statements should not be followed by a test of an SQL return code.

Dynamic Preparation and Execution

An application program can dynamically build an SQL statement in the form of a character string placed in a host variable. In general, the statement is built from some data available to the program (for example, input from a work station). The statement can be prepared for execution using the (embedded) statement PREPARE and executed by the (embedded) statement EXECUTE. Alternatively, the (embedded) statement EXECUTE IMMEDIATE can be used to prepare and execute a statement in one step.

A statement that is dynamically prepared must not contain references to host variables. It can contain parameter markers instead. See "PREPARE" on page 453 for rules concerning the parameter markers. When the prepared statement is executed, the parameter markers are effectively replaced by the current values of the host variables specified in the EXECUTE statement. See "EXECUTE" on page 407 for rules concerning this replacement. After a statement is prepared, it can be executed several times with different values of host variables. Parameter markers are not allowed in EXECUTE IMMEDIATE.

The successful or unsuccessful execution of the statement is indicated by the setting of an SQL return code in the SQLCA after the EXECUTE (or EXECUTE IMMEDIATE) statement. You should check the SQL return code as described above for embedded statements. See the topic "SQL Return Codes" on page 244 for more information.

Static Invocation of a select-statement

A select-statement can be included as a part of the (nonexecutable) statement DECLARE CURSOR. Such a statement is executed every time the cursor is opened by means of the (embedded) statement OPEN. After the cursor is open, the result table can be retrieved one row at a time by successive executions of the FETCH statement or multiple rows at a time by using the multiple-row FETCH statement.

Used in this way, the *select-statement* can contain references to host variables. These references are effectively replaced by the values that the variables have at the moment of executing OPEN.

Dynamic Invocation of a select-statement

An application program can dynamically build a *select-statement* in the form of a character string placed in a host variable. In general, the statement is built from some data available to the program (for example, a query obtained from a work station). The statement is then executed every time the cursor is opened by means of the (embedded) statement OPEN. After the cursor is open, the result table can be retrieved one row at a time by successive executions of the FETCH statement or multiple rows at a time by using the multiple-row FETCH statement.

Used in this way, the *select-statement* must not contain references to host variables. It can instead contain parameter markers. See "PREPARE" on page 453 for rules concerning the parameter markers. The parameter markers are effectively replaced by the values of the host variables specified in the OPEN statement. See "OPEN" on page 447 for rules concerning this replacement.

Interactive Invocation

A capability for entering SQL statements from a work station is part of the architecture of the database manager. The DB2 UDB for AS/400 licensed program provides the Start Structured Query Language (STRSQL) command, the Start Query Manager (STRQM) command, and the SQL Script support of Operations Navigator for this facility. Other products are also available. A statement entered in this way is said to be issued interactively. A statement that cannot be dynamically prepared cannot be issued interactively, with the exception of connection management statements (CONNECT, DISCONNECT, RELEASE, and SET CONNECTION).

A statement issued interactively must be an executable statement that does not contain parameter markers or references to host variables, because these make sense only in the context of an application program.

SQL Return Codes

An application program containing executable SQL statements must provide at least one of the following:

- A structure named SQLCA
- A stand-alone integer variable named SQLCODE
- A stand-alone CHAR(5) (CHAR(6) in C) variable named SQLSTATE

Both a stand-alone SQLCODE and SQLSTATE may be provided. If an SQLCA is provided, neither a stand-alone SQLCODE or SQLSTATE can be provided. A stand-alone SQLCODE or SQLSTATE must not be declared in a host structure.

An SQLCA is provided automatically in REXX and RPG. In other languages, an SQLCA can be obtained by using the INCLUDE SQLCA statement. INCLUDE SQLCA must not be used if a stand-alone SQLCODE or SQLSTATE is provided. The SQLCA includes an integer variable named SQLCODE (SQLCOD in RPG) and a character-string variable named SQLSTATE (SQLSTT in RPG).

The option of providing a stand-alone SQLSTATE instead of an SQLCA allows for conformance with the ISO/ANSI SQL standard. The option of providing a stand-alone SQLCODE instead of a stand-alone SQLSTATE is a deprecated feature in the ISO/ANSI SQL standard. If conformance with the ISO/ANSI SQL standard is desired, the stand-alone SQLSTATE should be used.

SQLCODE

Regardless of whether the application program provides an SQLCA or a stand-alone variable, SQLCODE is set by the database manager after each SQL statement is executed. DB2 UDB for AS/400 conforms to the ISO/ANSI SQL standard as follows:

- If SQLCODE = 0 and SQLWARN0 is blank, execution was successful.
- If SQLCODE = 100, no data was found. For example, a FETCH statement returned no data, because the cursor was positioned after the last row of the result table.
- If SQLCODE > 0 and not = 100, execution was successful with a warning.
- If SQLCODE = 0 and SQLWARN0 = 'W', execution was successful with a warning.
- If SQLCODE < 0, execution was not successful.

A complete listing of DB2 UDB for AS/400 SQLCODEs and their corresponding SQLSTATEs is provided in Appendix B of the SQL Programming Concepts book.

SQLSTATE

Regardless of whether the application program provides an SQLCA or a standalone variable, SQLSTATE is also set by the database manager after execution of each SQL statement. Thus, application programs can check the execution of SQL statements by testing SQLSTATE instead of SQLCODE.

SQLSTATE provides application programs with common codes for common error conditions. Furthermore, SQLSTATE is designed so that application programs can test for specific errors or classes of errors. The scheme is the same for all database managers and is based on the proposed ISO/ANSI standard. A complete list of SQLSTATE classes and SQLSTATEs associated with each SQLCODE is supplied in Appendix B of the SQL Programming Concepts book.

SQL Comments

Static SQL statements can include host language or SQL comments. Dynamic SQL statements can include SQL comments. There are two types of SQL comments:

simple comments
Simple comments are introduced by two consecutive hyphens.

bracketed comments
Bracketed comments are introduced by /* and end with */.

These rules apply to the use of simple comments:

- The two hyphens must be on the same line and must not be separated by a space.
- Simple comments can be started wherever a space is valid (except within a delimiter token or between 'EXEC' and 'SQL').
- Simple comments cannot be continued to the next line.
- The hyphens must be preceded by a space in COBOL.

These rules apply to the use of bracketed comments:

- The /* must be on the same line and not separated by a space.
- The */ must be on the same line and not separated by a space.
- Bracketed comments can be started wherever a space is valid (except within a delimiter token or between 'EXEC' and 'SQL').
- Bracketed comments can be continued to the next line.
- You can nest a bracketed comment within another bracketed comment.

Example

This example shows how to include simple comments in a statement:

```
CREATE VIEW PRJ_MAXPER        -- PROJECTS WITH MOST SUPPORT PERSONNEL
   AS SELECT PROJNO, PROJNAME  -- NUMBER AND NAME OF PROJECT
      FROM PROJECT
      WHERE DEPTNO = 'E21'     -- SYSTEMS SUPPORT DEPT CODE
      AND PRSTAFF > 1
```

This example shows how to include bracketed comments in a statement:

```
CREATE VIEW PRJ_MAXPER        /* PROJECTS WITH MOST SUPPORT
                                     PERSONNEL               */
   AS SELECT PROJNO, PROJNAME  /* NUMBER AND NAME OF PROJECT   */
      FROM PROJECT
      WHERE DEPTNO = 'E21'     /* SYSTEMS SUPPORT DEPT CODE    */
      AND PRSTAFF > 1
```

ALTER TABLE

The ALTER TABLE statement adds, drops, or alters a column from an existing table; adds unique, referential, or check constraints; and adds or drops a primary, unique, or foreign key.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the table identified in the statement,
  - The ALTER privilege on the table, and
  - The system authority *EXECUTE on the library containing the table
- Administrative authority

The authorization ID of the statement has the ALTER privilege on the table when one of the following is true:

- It is the owner of the table.
- It was granted the ALTER privilege to the table.
- It was granted the system authorities of either *OBJALTER or *OBJMGT to the table.

To define a foreign key, the privileges held by the authorization ID of the statement must include at least one of the following on the parent table:

- The REFERENCES privilege or object management authority for the table
- The REFERENCES privilege on each column of the specified parent key
- Ownership of the table
- Administrative authority

The authorization ID of the statement has the REFERENCES privilege on a table when one of the following is true:

- It is the owner of the table.
- It was granted the REFERENCES privilege to the table.
- It was granted the system authorities of either *OBJREF or *OBJMGT to the table.

If a user-defined type is referenced, the privileges held by the authorization ID of the statement must include at least one of the following:

- For each user-defined type identified in the statement:
  - The USAGE privilege on the user-defined type, and
  - The system authority *EXECUTE on the library containing the user-defined type
- Administrative authority

The authorization ID of the statement has the USAGE privilege on a user-defined type when one of the following is true:

- It is the owner of the user-defined type.

- It was granted the USAGE privilege to the user-defined type.
- It was granted the system authorities of *OBJOPR and *EXECUTE to the user-defined type.

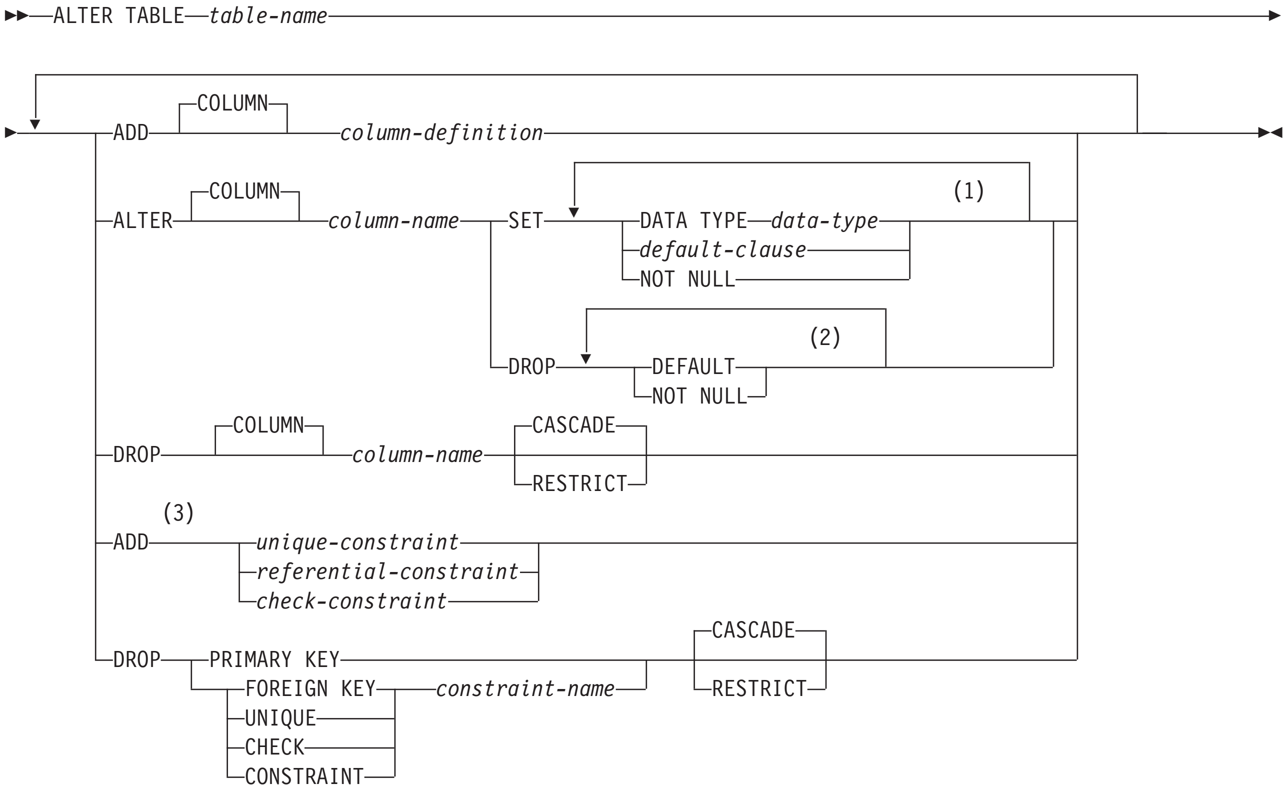
If a user-defined cast function is referenced, the privileges held by the authorization ID of the statement must include at least one of the following:

- For each user-defined function identified in the statement:
  - The EXECUTE privilege on the user-defined function, and
  - The system authority *EXECUTE on the library containing the user-defined function
- Administrative authority

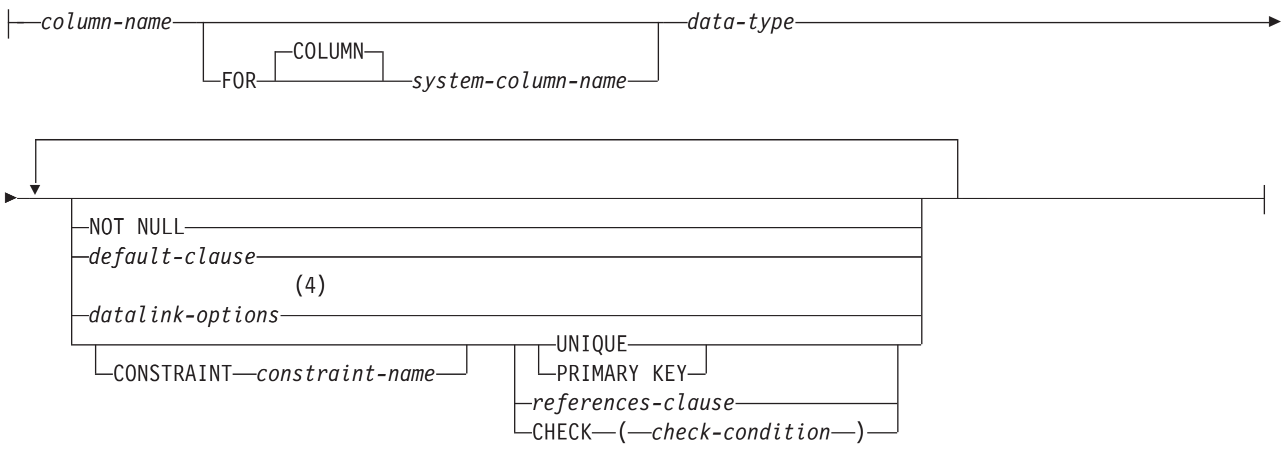
The authorization ID of the statement has the EXECUTE privilege on a user-defined function when one of the following is true:

- It is the owner of the user-defined function.
- It was granted the EXECUTE privilege to the user-defined function.
- It was granted the system authorities of *OBJOPR and *EXECUTE to the user-defined function.

Syntax



column-definition:



Notes:

1 Each clause may be specified only once. If DATA TYPE is specified, it must be specified first.

2 Each clause may be specified only once.

3 If this is the first clause of the ALTER TABLE statement, the ADD keyword is optional, but strongly recommended. Otherwise, it is required.

4 The datalink-options can only be specified for DATALINKs and distinct-types sourced on DATALINKs.

data-type:

```
├──┬─BIGINT───────────────────────────────────────────────────────────────────────────────────────────────────┬──┤
   ├─┬─INTEGER─┬──────────────────────────────────────────────────────────────────────────────────────────────┤
   │ └─INT─────┘                                                                                              │
   ├─SMALLINT─────────────────────────────────────────────────────────────────────────────────────────────────┤
   ├─┬─DECIMAL─┬──┬───────────────────────────────┬───────────────────────────────────────────────────────────┤
   │ ├─DEC─────┤  └─(──integer──┬────────────┬──)─┘                                                           │
   │ └─NUMERIC─┘                └─, integer──┘                                                                │
   ├─┬─FLOAT──┬────────────────┬─┬────────────────────────────────────────────────────────────────────────────┤
   │ │        └─(──integer──)──┘ │                                                                            │
   │ ├─REAL──────────────────────┤                                                                            │
   │ │         ┌─PRECISION─┐     │                                                                            │
   │ └─DOUBLE──┴───────────┴─────┘                                                                            │
   ├─┬─BLOB────────────────┬──┬──────────────────────┬──┬─────────────────┬───────────────────────────────────┤
   │ └─BINARY LARGE OBJECT─┘  └─(──integer──┬───┬──)─┘  └─allocate-clause─┘                                   │
   │                                        ├─K─┤                                                             │
   │                                        └─M─┘                                                             │
   ├─┬─┬─CHARACTER─┬──┬───────────────┬───────────────────────────────────────────┬───┬────────────────┬──────┤
   │ │ └─CHAR──────┘  └─(──integer──)─┘                                           │   ├─FOR BIT DATA───┤      │
   │ ├─┬─┬─VARCHAR────────────────┬──(──integer──)──┬──┬─────────────────┬────────┤   ├─FOR SBCS DATA──┤      │
   │ │ │ └─┬─CHARACTER─┬──VARYING─┘                 │  └─allocate-clause─┘        │   ├─FOR MIXED DATA─┤      │
   │ │ │   └─CHAR──────┘                            │                             │   └─CCSID──integer─┘      │
   │ │ └─LONG VARCHAR───────────────────────────────┘                             │                           │
   │ └─┬─CLOB───────────────────┬──┬──────────────────────┬──┬─────────────────┬──┘                           │
   │   ├─CHAR LARGE OBJECT──────┤  └─(──integer──┬───┬──)─┘  └─allocate-clause─┘                              │
   │   └─CHARACTER LARGE OBJECT─┘                ├─K─┤                                                        │
   │                                             └─M─┘                                                        │
   ├─┬─GRAPHIC───┬───────────────┬────────────────────────────────────┬──┬────────────────┬───────────────────┤
   │ │           └─(──integer──)─┘                                    │  └─CCSID──integer─┘                   │
   │ ├─┬─┬─VARGRAPHIC──────┬──(──integer──)──┬──┬─────────────────┬───┤                                       │
   │ │ │ └─GRAPHIC VARYING─┘                 │  └─allocate-clause─┘   │                                       │
   │ │ └─LONG VARGRAPHIC─────────────────────┘                        │                                       │
   │ └─DBCLOB────┬──────────────────────┬──┬─────────────────┬────────┘                                       │
   │             └─(──integer──┬───┬──)─┘  └─allocate-clause─┘                                                │
   │                           ├─K─┤                                                                          │
   │                           └─M─┘                                                                          │
   ├─DATE─────────────────────────────────────────────────────────────────────────────────────────────────────┤
   ├─TIME─────────────────────────────────────────────────────────────────────────────────────────────────────┤
   ├─TIMESTAMP────────────────────────────────────────────────────────────────────────────────────────────────┤
   ├─DATALINK──┬───────────────┬──┬─────────────────┬──┬────────────────┬─────────────────────────────────────┤
   │           └─(──integer──)─┘  └─allocate-clause─┘  └─CCSID──integer─┘                                     │
   └─distinct-type────────────────────────────────────────────────────────────────────────────────────────────┘
```

allocate-clause:

```
├──ALLOCATE──(integer)──────────────────────────────────────────────────────────────────────────┤
```

default-clause:

```
   ┌─WITH─┐
├──┴──────┴─DEFAULT─┬──────────────────────────────────────────────────────────┬──────────────────────────┤
                    ├─constant─────────────────────────────────────────────────┤
                    ├─NULL─────────────────────────────────────────────────────┤
                    ├─USER─────────────────────────────────────────────────────┤
                    ├─CURRENT_DATE─────────────────────────────────────────────┤
                    ├─CURRENT_TIME─────────────────────────────────────────────┤
                    ├─CURRENT_TIMESTAMP────────────────────────────────────────┤
                    └─cast-function-name──(──┬─constant──────────┬──)──────────┘
                                             ├─USER──────────────┤
                                             ├─CURRENT_DATE──────┤
                                             ├─CURRENT_TIME──────┤
                                             └─CURRENT_TIMESTAMP─┘
```

datalink-options:

```
├──LINKTYPE URL──┬─NO LINK CONTROL──────────────────────────────────────┬──────────────────────────────┤
                 └─FILE LINK CONTROL──┬─file-link-options─┬─────────────┘
                                      └─MODE DB2OPTIONS───┘
```

file-link-options:

```
   ┌──────────────────────────────────┐
   │    (1)                           │
├──▼─┬─INTEGRITY ALL─────────────────┬┴────────────────────────────────────────────────────────────────┤
     ├─┬─READ PERMISSION FS─┬────────┤
     │ └─READ PERMISSION DB─┘        │
     ├─┬─WRITE PERMISSION FS──────┬──┤
     │ └─WRITE PERMISSION BLOCKED─┘  │
     ├─RECOVERY NO───────────────────┤
     └─┬─ON UNLINK RESTORE─┬─────────┘
       └─ON UNLINK DELETE──┘
```

Notes:

1 The file-link-options can be specified in any order.

unique-constraint:

```
                                                    ┌─,───────────┐
├──┬─────────────────────────────┬──┬─UNIQUE──────┬──(───▼─column-name─┴──)──────────────────┤
   └─CONSTRAINT──constraint-name─┘  └─PRIMARY KEY─┘
```

referential-constraint:

```
                                          (1)         ┌─,───────────┐
├──┬─────────────────────────────┬──FOREIGN KEY──────(───▼─column-name─┴──)──references-clause──┤
   └─CONSTRAINT──constraint-name─┘
```

references-clause:

```
                                                                       (2)
                                                ┌─ON DELETE NO ACTION────────────┐
├──REFERENCES──table-name──┬─────────────────────────┬──┼────────────────────────────────┼──────►
                           │     ┌─,───────────┐     │  └─ON DELETE──┬─RESTRICT────┬──┘
                           └─(───▼─column-name─┴──)─┘               ├─CASCADE─────┤
                                                                    ├─SET NULL────┤
                                                                    └─SET DEFAULT─┘

   ┌─ON UPDATE NO ACTION─┐
►──┼─────────────────────┼─────────────────────────────────────────────────────────────────────┤
   └─ON UPDATE RESTRICT──┘
```

check-constraint:

```
├──┬─────────────────────────────┬──CHECK──(──check-condition──)────────────────────────────┤
   └─CONSTRAINT──constraint-name─┘
```

Notes:

1 For compatibility with other products, constraint-name (without the CONSTRAINT keyword) may be specified following FOREIGN KEY.

2 The ON DELETE and ON UPDATE clauses may be specified in either order.

Description

table-name
Identifies the table you want to be altered. The *table-name* must identify a table that exists at the current server. It must not be a view or a catalog table.

ADD COLUMN

column-definition
Adds a column to the table. If the table has rows, every value of the column is set to its default value. If the table previously had *n* columns, the ordinality of the new column is *n*+1. The value of *n* must not exceed 8000.

Adding a new column must not make the total byte count of all columns exceed 32766 or, if a VARCHAR or VARGRAPHIC column is specified, 32740.

column-name
Names the column you want to add to the table. Do not use the same name for more than one column of the table or for a system-column-name of the table. Do not qualify *column-name*.

FOR COLUMN *system-column-name*
Provides an OS/400 name for the column. Do not use the same name for more than one column-name or system-column-name of the table.

If the system-column-name is not specified, and the column-name is not a valid system-column-name, a system column name is generated. For more information on how system column names are generated, see "Rules for Column Name Generation" on page 360.

data-type
Specifies the data type of the column. See "CREATE TABLE" on page 340 for a description of *data-type*.

A DataLink column with FILE LINK CONTROL cannot be added to a table that is a dependent in a referential constraint with a delete rule of CASCADE.

NOT NULL
Prevents the column from containing null values. Omission of NOT NULL implies that the column can contain null values. If NOT NULL is specified, DEFAULT must also be specified.

DEFAULT
Specifies a default value for the column. This clause cannot be specified more than once in the *column-definition*. If a value is not specified and the column is nullable, the default value is the null value. If a value is not specified and the column is not nullable, the default depends on the data type of the column:

Data type	**Default value**
Numeric	0
Fixed-length string	Blanks
Varying-length string	A string length of 0
Date	For existing rows, a date corresponding to 1 January 0001. For added rows, the current date.
Time	For existing rows, a time corresponding to 0 hours, 0 minutes, and 0 seconds. For added rows, the current time.
Timestamp	For existing rows, a date corresponding to 1 January 0001 and a time corresponding to 0 hours, 0 minutes, 0 seconds, and 0 microseconds. For added rows, the current timestamp.
Datalink	A value corresponding to DLVALUE('','URL','').
distinct-type	The default value of the corresponding source type of the distinct type.

Omission of NOT NULL and DEFAULT from a *column-definition* is an implicit specification of DEFAULT NULL.

constant
Specifies the constant as the default for the column. The specified constant must represent a value that could be assigned to the column in accordance with the rules of assignment as described in "Assignments and Comparisons" on page 66. A floating-point constant must not be used for a SMALLINT, INTEGER, BIGINT, DECIMAL, or NUMERIC column. A decimal constant must not contain more digits to the right of the decimal point than the specified scale of the column.

NULL
Specifies null as the default for the column. If NOT NULL is specified, DEFAULT NULL must not be specified within the same *column-definition*.

USER
Specifies the value of the USER special register at the time of INSERT or UPDATE as the default value for the column. The data type of the column must be CHAR or VARCHAR with a length attribute greater than or equal to 18.

CURRENT_DATE
Specifies the current date as the default for the column. If CURRENT_DATE is specified, the data type of the column must be DATE.

CURRENT_TIME
Specifies the current time as the default for the column. If CURRENT_TIME is specified, the data type of the column must be TIME.

CURRENT_TIMESTAMP
Specifies the current timestamp as the default for the column. If CURRENT_TIMESTAMP is specified, the data type of the column must be TIMESTAMP.

cast-function-name
This form of a default value can only be used with columns defined as a distinct type, BLOB, CLOB, DBCLOB, DATE, TIME, or TIMESTAMP data types. The following table describes the allowed uses of these *cast-functions*.

Data Type	Cast Function Name
Distinct type N based on a BLOB, CLOB, or DBCLOB	BLOB, CLOB, or DBCLOB *
Distinct type N based on a DATE, TIME, or TIMESTAMP	N (the user-defined cast function that was generated when N was created) ** or DATE, TIME, or TIMESTAMP *
Distinct type N based on other data types	N (the user-defined cast function that was generated when N was created) **
BLOB, CLOB, or DBCLOB	BLOB, CLOB, or DBCLOB *
DATE, TIME, or TIMESTAMP	DATE, TIME, or TIMESTAMP *

Notes:

* The name of the function must match the name of the data type (or the source type of the distinct type) with an implicit or explicit schema name of QSYS2

** The name of the function must match the name of the distinct type for the column. If qualified with a collection name, it must be the same as the collection name for the distinct type. If not qualified, the collection name from function resolution must be the same as the collection name for the distinct type.

constant

Specifies a constant as the argument. The constant must conform to the rules of a constant for the source type of the distinct type or for the data type if not a distinct type. For BLOB, CLOB, DBCLOB, DATE, TIME, and TIMESTAMP functions, the constant must be a string constant.

USER

Specifies the value of the USER special register at the time of INSERT or UPDATE as the default value for the column. The data type of the source type of the distinct type of the column must be CHAR or VARCHAR with a length attribute greater than or equal to 18.

CURRENT_DATE

Specifies the current date as the default for the column. If CURRENT_DATE is specified, the data type of the source type of the distinct type of the column must be DATE.

CURRENT_TIME

Specifies the current time as the default for the column. If CURRENT_TIME is specified, the data type of the source type of the distinct type of the column must be TIME.

CURRENT_TIMESTAMP

Specifies the current timestamp as the default for the column. If CURRENT_TIMESTAMP is specified, the data type of the source type of the distinct type of the column must be TIMESTAMP.

datalink-options

Specifies the options associated with a DATALINK column. See "CREATE TABLE" on page 340 for a description of *datalink-options*.

CONSTRAINT *constraint-name*

Names the constraint. A constraint-name must not identify a constraint that already exists at the current server.

If the clause is not specified, a unique constraint name is generated by the database manager.

PRIMARY KEY
Provides a shorthand method of defining a primary key composed of a single column. Thus, if PRIMARY KEY is specified in the definition of column C, the effect is the same as if the PRIMARY KEY(C) clause is specified as a separate clause.

This clause must not be specified in more than one *column-definition* and must not be specified at all if the UNIQUE clause is specified in the column definition. When a primary key is added, a CHECK constraint is implicitly added to enforce the rule that the NULL value is not allowed in the column that makes up the primary key.

UNIQUE
Provides a shorthand method of defining a unique key composed of a single column. Thus, if UNIQUE is specified in the definition of column C, the effect is the same as if the UNIQUE(C) clause is specified as a separate clause.

This clause cannot be specified more than once in a column definition and must not be specified if PRIMARY KEY is specified in the *column-definition*.

references-clause
The *references-clause* of a column-definition provides a shorthand method of defining a foreign key composed of a single column. Thus, if a references-clause is specified in the definition of column C, the effect is the same as if that references-clause were specified as part of a FOREIGN KEY clause in which C is the only identified column.

CHECK(*check-condition***)**
Provides a shorthand method of defining a check constraint whose *check-condition* only references a single column. Thus, if CHECK is specified in the column definition of column C, no columns other than C can be referenced in the *check-condition* of the check constraint. The effect is the same as if the check constraint were specified as a separate clause.

ALTER COLUMN

Alters the definition of an existing column. Only the attributes specified will be altered. Others will remain unchanged.

column-name
Identifies the column to be altered. The column name must not be qualified. The name must identify a column of the specified table. The name must not identify a column that was already added or dropped in this ALTER TABLE statement.

SET DATA TYPE *data-type*
Specifies the new data type of the column to be altered. The new data type must be compatible with the existing data type of the column. For more information on the compatibility of data types see “Assignments and Comparisons” on page 66. However, there are two exceptions to the general rules:

- Changing data types between character and UCS-2 graphic is allowed.
- Changing data types from datetime data types to character is not allowed.

The specified length, precision, and scale may be larger, smaller, or the same as the existing length, precision, and scale. However, if the new length, precision, or scale is smaller, truncation or numeric conversion errors may occur.

If the specified column has a default value and a new default value is not specified, the existing default value must represent a value that could be assigned to the column in accordance with the rules for assignment as described in "Assignments and Comparisons" on page 66.

If the column is specified in a unique, primary, or foreign key, the new sum of the lengths of the columns of the keys must not exceed 2000-n, where n is the number of columns specified that allow nulls.

Changing the attributes will cause any existing values in the column to be converted to the new column attributes according to the rules for assignment to a column, except that string values will be truncated.

SET *default-clause*

Specifies the new default value of the column to be altered. The specified default value must represent a value that could be assigned to the column in accordance with the rules for assignment as described in "Assignments and Comparisons" on page 66.

SET NOT NULL

Specifies that the column cannot contain null values. All values for this column in existing rows of the table must be not null. If the specified column has a default value and a new default value is not specified, the existing default value must not be NULL. SET NOT NULL is not allowed if the column is identified in the foreign key of a referential constraint with a DELETE rule of SET NULL and no other nullable columns exist in the foreign key.

DROP DEFAULT

Drops the current default for the column. The specified column must have a default value and must not have NOT NULL as the null attribute. The new default value is the null value.

DROP NOT NULL

Drops the NOT NULL attribute of the column, allowing the column to have the null value. If a default value is not specified or does not already exist, the new default value is the null value. DROP NOT NULL is not allowed if the column is specified in the primary key of the table.

DROP COLUMN

Drops the identified column from the table.

column-name

Identifies the column to be dropped. The column name must not be qualified. The name must identify a column of the specified table. The name must not identify a column that was already added or altered in this ALTER TABLE statement. The name must not identify the only column of a table.

CASCADE

Specifies that any views, indexes, or constraints that are dependent on the column being dropped are also dropped.

RESTRICT

Specifies that the column cannot be dropped if any views, indexes, or constraints are dependent on the column.

If all the columns referenced in a constraint are dropped in the same ALTER TABLE statement, RESTRICT does not prevent the drop.

ADD unique-constraint

CONSTRAINT *constraint-name*
Names the constraint. A constraint-name must not identify a constraint that already exists at the current server. The constraint-name must be unique within a collection.

If not specified, a unique constraint name is generated by the database manager.

UNIQUE(*column-name***,...)**
Defines a unique key composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of the table. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of identified columns must not exceed 120, and the sum of their lengths must not exceed 2000-n, where n is the number of columns specified that allow nulls. The identified columns cannot be the same as the columns specified in another UNIQUE constraint or PRIMARY KEY on the table. For example, UNIQUE(A,B) is not allowed if UNIQUE(B,A) or PRIMARY KEY(A,B) already exists on the table. Any existing nonnull values in the set of columns must be unique. Multiple null values are allowed.

If a unique index already exists on the identified columns, that index is designated as a unique index. Otherwise, a unique index is created to support the uniqueness of the unique key. The unique index is created as part of the AS/400 physical file, not as a separate AS/400 logical file.

PRIMARY KEY(*column-name***,...)**
Defines a primary key composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of the table. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of identified columns must not exceed 120, and the sum of their lengths must not exceed 2000. The table must not already have a primary key. The identified columns cannot be the same as the columns specified in another UNIQUE constraint on the table. For example, PRIMARY KEY(A,B) is not allowed if UNIQUE(B,A) already exists on the table. Any existing values in the set of columns must be unique. When a primary key is added, a CHECK constraint is implicitly added to enforce the rule that the NULL value is not allowed in any of the columns that make up the primary key.

If a unique index already exists on the identified columns, that index is designated as a primary index. Otherwise, a primary index is created to support the uniqueness of the primary key. The unique index is created as part of the AS/400 physical file, not a separate AS/400 logical file.

ADD referential-constraint

CONSTRAINT *constraint-name*
Names the constraint. A constraint-name must not identify a constraint that already exists at the current server.

If not specified, a unique constraint name is generated by the database manager.

FOREIGN KEY

Defines a referential constraint.

Let T1 denote the table being altered.

(*column-name***,...)**

The foreign key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of T1. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of the identified columns must not exceed 120, and the sum of their lengths must not exceed 2000-n, where n is the number of columns specified that allows nulls.

REFERENCES *table-name*

The *table-name* specified in a REFERENCES clause must identify a base table that exists at the current server, but it must not identify a catalog table. This table is referred to as the parent table in the constraint relationship.

A referential constraint is a *duplicate* if its foreign key, parent key, and parent table are the same as the foreign key, parent key, and parent table of an existing referential constraint. Duplicate referential constraints are allowed, but not recommended.

Let T2 denote the identified parent table.

(*column-name***,...)**

The parent key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of T2. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of identified columns must not exceed 120, and the sum of their lengths must not exceed 2000-n, where n is the number of columns specified that allow nulls.

The list of column names must be identical to the list of column names in the primary key of T2 or a UNIQUE constraint that exists on T2. The names may be specified in any order. For example, if (A,B) is specified, a unique constraint defined as UNIQUE(B,A) would satisfy the requirement. If a column name list is not specified then T2 must have a primary key. Omission of the column name list is an implicit specification of the columns of that primary key.

The specified foreign key must have the same number of columns as the parent key of T2. The description of the *n*th column of the foreign key and the *n*th column of the parent key must have identical data types and lengths.

Unless the table is empty, the values of the foreign key must be validated before the table can be used. Values of the foreign key are validated during the execution of the ALTER TABLE statement. Therefore, every nonnull value of the foreign key must match some value of the parent key of T2.

The referential constraint specified by the FOREIGN KEY clause defines a relationship in which T2 is the parent and T1 is the dependent.

ON DELETE

Specifies what action is to take place on the dependent tables when a row of the parent table is deleted.

SET NULL must not be specified unless some column of the foreign key allows null values.

CASCADE must not be specified if T1 has a delete trigger. SET NULL and SET DEFAULT must not be specified if T1 has an update trigger.

CASCADE must not be specified if T1 contains a DataLink column with FILE LINK CONTROL.

The delete rule applies when a row of T2 is the object of a DELETE or propagated delete operation and that row has dependents in T1. Let *p* denote such a row of T2.

- If RESTRICT or NO ACTION is specified, an error occurs and no rows are deleted.
- If CASCADE is specified, the delete operation is propagated to the dependents of *p* in T1.
- If SET NULL is specified, each nullable column of the foreign key of each dependent of *p* in T1 is set to null.
- If SET DEFAULT is specified, each column of the foreign key of each dependent of *p* in T1 is set to its default value.

ON UPDATE

Specifies what action is to take place on the dependent tables when a row of the parent table is updated.

The update rule applies when a row of T2 is the object of an UPDATE or propagated update operation and that row has dependents in T1. Let *p* denote such a row of T2.

- If RESTRICT or NO ACTION is specified, an error occurs and no rows are updated.

ADD check-constraint

CONSTRAINT *constraint-name*

Names the constraint. A constraint-name must not identify a constraint that already exists at the current server. The constraint-name must be unique within a collection.

If not specified, a unique constraint name is generated by the database manager.

CHECK(*check-condition***)**

Defines a check constraint. At any time, the *check-condition* must be true or unknown for every row of the table.

The *check-condition* is a *search-condition*, except:

- It can only refer to columns of the table
- It must not contain any of the following:
  - Subqueries

- Column functions
- Host variables
- Parameter markers
- CURRENT TIMEZONE, CURRENT SERVER, CURRENT PATH, and USER special registers
- NODENAME scalar function
- User-defined functions
- Functions that were implicitly generated with the creation of a distinct type
- ATAN2, DIFFERENCE, RAND, RADIANS, and SOUNDEX scalar functions
- DLVALUE, DLURLPATH, DLURLPATHONLY, DLURLSERVER, or DLURLSCHEME scalar functions
- DLURLCOMPLETE scalar function (for DataLinks with an attribute of FILE LINK CONTROL and READ PERMISSION DB)

For more information on search-condition, see “Search Conditions” on page 128.

DROP

PRIMARY KEY
Drops the definition of the primary key and all referential constraints in which the primary key is a parent key. The table must have a primary key.

FOREIGN KEY *constraint-name*
Drops the referential constraint *constraint-name*. The *constraint-name* must identify a referential constraint in which the table is a dependent.

UNIQUE *constraint-name*
Drops the unique constraint *constraint-name* and all referential constraints in which the unique key is a parent key. The *constraint-name* must identify a unique constraint on the table. DROP UNIQUE will not drop a PRIMARY KEY unique constraint.

CHECK *constraint-name*
Drops the check constraint constraint-name. The *constraint-name* must identify a check constraint on the table.

CONSTRAINT *constraint-name*
Drops the constraint *constraint-name*. If the constraint is a PRIMARY KEY or UNIQUE constraint, all referential constraints in which the primary key or unique key is a parent are also dropped. The constraint-name must identify a check, unique, or referential constraint on the table.

CASCADE
Specifies for unique constraints that any referential constraints that are dependent on the constraint being dropped are also dropped.

RESTRICT
Specifies for unique constraints that the constraint cannot be dropped if any referential constraints are dependent on the constraint.

Notes

A column can only be referenced *once* in an ADD, ALTER, or DROP COLUMN clause in a single ALTER TABLE statement. However, that same column can be referenced multiple times for adding or dropping constraints in the same ALTER TABLE statement.

The order of operations within an ALTER TABLE statement is:
- drop constraints
- drop columns for which the RESTRICT option was specified
- alter all other column definitions (this includes adding columns and dropping columns for which the CASCADE option was specified)
- add constraints

Within each of these stages, the order in which the user specifies the clauses is the order in which they are performed, with one exception. If any columns are being dropped, that operation is logically done before any column definitions are added or altered, in case record length is increased as a result of the ALTER TABLE statement.

Any views or logical files in another job's QTEMP that are dependent on the table being altered will be dropped as a result of an ALTER TABLE statement.

Authority checking is performed only on the table being altered. Other objects may be accessed by the ALTER TABLE statement, but no authority to those objects is required. For example, no authority is required on views that exist on the table being altered, nor on dependent tables that reference the table being altered through a referential constraint.

It is strongly recommended that a current backup of the table and dependent views and logical files exist prior to altering a table.

The following performance considerations apply to an ALTER TABLE statement when adding, altering, or dropping columns from a table:
- The data in the table may be copied.[31]

  Adding and dropping columns require the data to be copied.

  Altering a column usually requires the data to be copied. The data does not need to be copied, however, if the alter only includes the following changes:
  - The length attribute of a VARCHAR column is increasing and the current length attribute is greater than 20.
  - The length attribute of a VARGRAPHIC column is increasing and the current length attribute is greater than 10.
  - The allocated length of a VARCHAR column is changing and the current and new allocated lengths are both less than or equal to 20.
  - The allocated length of a VARGRAPHIC column is changing and the current and new allocated lengths are both less than or equal to 10.
  - The CCSID of a column is changing but no conversion is necessary between the old and new CCSID. For example, if one CCSID is 65535, no data conversion is necessary.

---

[31] In cases where enough storage does not exist to make a complete copy, a special copy that only requires approximately 16-32 megabytes of free storage is performed.

  - The default value is changing, and the length of the default value is not greater than the current allocated length.
  - DROP DEFAULT is specified.
  - DROP NOT NULL is specified, but at least one nullable column will still exist in the table after the alter table is complete.
- Indexes may need to be rebuilt.[32]

  An index does not need to be rebuilt when columns are added to a table or when columns are dropped or altered and those columns are not referenced in the index key.

  Altering a column that is used in the key of an index or constraint usually requires the index to be rebuilt. The index does not need to be rebuilt, however, in the following cases:
  - The length attribute of a VARCHAR or VARGRAPHIC key is increasing.
  - The CCSID of a column is changing but no conversion is necessary between the old and new CCSID. For example, if one CCSID is 65535.

Cascaded Effects

Adding a column has no cascaded effects to SQL views or most logical files.[33] For example, adding a column to a table does not cause the column to be added to any dependent views, even if those views were created with a SELECT * clause.

Dropping or altering a column may cause several cascaded effects. Table 21 lists the cascaded effects of dropping a column.

Table 21. Cascaded effects of dropping a column

Operation	RESTRICT Effect	CASCADE Effect
Drop of a column referenced by a view	The drop of the column is not allowed.	The view and all views dependent on that view are dropped.
Drop of a column referenced by a non-view logical file	The drop is allowed, and the column is dropped from the logical file if: • The logical file shares a format with the file being altered, and • The dropped column is not used as a key field or in select/omit specifications, and • That format is not used again in the logical file with another based-on file. Otherwise, the drop of the column is not allowed.	The drop is allowed, and the column is dropped from the logical file if: • The logical file shares a format with the file being altered, and • The dropped column is not used as a key field or in select or omit specifications, and • That format is not used again in the logical file with another based-on file. Otherwise, the logical file is dropped.
Drop of a column referenced in the key of an index	The drop of the index is not allowed.	The index is dropped.

---

[32] Any indexes that need to be rebuilt are rebuilt asynchronously by database server jobs.

[33] A column will also be added to a logical file that shares its physical file’s format when a column is added to that physical file (unless that format is used again in the logical file with another based-on file).

Table 21. Cascaded effects of dropping a column (continued)

Operation	RESTRICT Effect	CASCADE Effect
Drop of a column referenced in a unique constraint	If all the columns referenced in the unique constraint are dropped in the same ALTER COLUMN statement and the unique constraint is not referenced by a referential constraint, the columns and the constraint are dropped. (Hence, the index used to satisfy the constraint is also dropped.) For example, if column A is dropped, and a unique constraint of UNIQUE(A) or PRIMARY KEY(A) exists and no referential constraints reference the unique constraint, the operation is allowed. Otherwise, the drop of the column is not allowed.	The unique constraint is dropped as are any referential constraints that refer to that unique constraint. (Hence, any indexes used by those constraints are also dropped).
Drop of a column referenced in a referential constraint	If all the columns referenced in the referential constraint are dropped at the same time, the columns and the constraint are dropped. (Hence, the index used by the foreign key is also dropped). For example, if column B is dropped and a referential constraint of FOREIGN KEY (A) exists, the operation is allowed. Otherwise, the drop of the column is not allowed.	The referential constraint is dropped. (Hence, the index used by the foreign key is also dropped).

Table 22 lists the cascaded effects of altering a column. (Alter of a column in the following chart means altering a data type, precision, scale, length, or nullability characteristic.)

Table 22. Cascaded effects of altering a column

Operation	Effect
Alter of a column referenced by a view	The alter is allowed. The views that are dependent on the table will be recreated. The new column attributes will be used when recreating the views.
Alter of a column referenced by a non-view logical file	The alter is allowed. The non-view logical files that are dependent on the table will be recreated. If the logical file shares a format with the file being altered, and that format is not used again in the logical file with another based-on file, the new column attributes will be used when recreating the logical file. Otherwise, the new column attributes will not be used when recreating the logical file. Instead, the current logical file attributes are used.
Alter of a column referenced in the key of an index.	The alter is allowed. (Hence, the index will usually be rebuilt.)

Table 22. Cascaded effects of altering a column (continued)

Operation	**Effect**
Alter of a column referenced in a unique constraint	The alter is allowed. (Hence, the index will usually be rebuilt.) If the unique constraint is referenced by a referential constraint, the attributes of the foreign keys no longer match the attributes of the unique constraint. The constraint will be placed in a defined and check-pending state.
Alter of a column referenced in a referential constraint	The alter is allowed. • If the referential constraint is in the defined but check-pending state, the alter is allowed and an attempt is made to put the constraint in the enabled state. (Hence, the index used to satisfy the unique constraint will usually to be rebuilt.) • If the referential constraint is in the enabled state, the constraint is placed in the defined and check-pending state.

Examples

Example 1

Assume a new table EQUIPMENT has been created with the following columns:

Column Name	**Data Type**
EQUIP_NO	INT
EQUIP_DESC	VARCHAR(50)
LOCATION	VARCHAR(50)
EQUIP_OWNER	CHAR(3)

Add a referential constraint to the EQUIPMENT table so that the owner (EQUIP_OWNER) must be a department number (DEPTNO) that is present in the DEPARTMENT table. If a department is removed from the DEPARTMENT table, the owner (EQUIP_OWNER) values for all equipment owned by that department should become unassigned (or set to null). Give the constraint the name, DEPTQUIP. Assume the DEPARTMENT table has a primary key defined as (DEPTNO).

```
ALTER TABLE EQUIPMENT
  ADD CONSTRAINT DEPTQUIP
   FOREIGN KEY (EQUIP_OWNER)
   REFERENCES DEPARTMENT
   ON DELETE SET NULL
```

Example 2

Assume the same table EQUIPMENT exists as in the first example.

- Add a column to table EQUIPMENT containing the quantity in stock of each equipment number. Call the column QUANTITY.

```
ALTER TABLE EQUIPMENT
  ADD COLUMN QUANTITY INT
```

- Change the default value for the EQUIP_OWNER column to ’ABC’.

```
ALTER TABLE EQUIPMENT
  ALTER COLUMN EQUIP_OWNER
  SET DEFAULT 'ABC'
```

- Drop the LOCATION column. Also drop any views, indexes, or constraints that are built on that column.

```
ALTER TABLE EQUIPMENT
  DROP COLUMN LOCATION CASCADE
```

- Alter the table so that a new column called SUPPLIER is added, the existing column called LOCATION is dropped, a unique constraint over the new column SUPPLIER is added, and a primary key is built over the existing column EQUIP_NO.

```
ALTER TABLE EQUIPMENT
  ADD COLUMN SUPPLIER INT
  DROP COLUMN LOCATION
  ADD UNIQUE SUPPLIER
  ADD PRIMARY KEY EQUIP_NO
```

- Notice that the column EQUIP_DESC is a variable length column. If an allocated length of 25 was specified, the following ALTER TABLE statement would not change that allocated length.

```
ALTER TABLE EQUIPMENT
  ALTER COLUMN EQUIP_DESC
  SET DATA TYPE VARCHAR(60)
```

BEGIN DECLARE SECTION

The BEGIN DECLARE SECTION statement marks the beginning of an SQL declare section.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in RPG or REXX.

Authorization

None required.

Syntax

```
►►──BEGIN DECLARE SECTION─────────────────────────────────────────────────────►◄
```

Description

The BEGIN DECLARE SECTION statement can be coded in the application program wherever variable declarations can appear in accordance with the rules of the host language. It cannot be coded in the middle of a host structure declaration. The statement is used to indicate the beginning of an SQL declare section. An SQL declare section ends with an END DECLARE SECTION statement, described on page 406.

The BEGIN DECLARE SECTION and the END DECLARE SECTION statements must be paired and cannot be nested.

SQL statements should not be included within a declare section, with the exception of the DECLARE VARIABLE and INCLUDE statements.

If SQL declare sections are specified in the program, only the variables declared within the SQL declare sections can be used as host variables. If SQL declare sections are not specified in the program, all variables in the program are eligible for use as host variables.

SQL declare sections should be specified for host languages, other than RPG and REXX, so that the source program conforms to the IBM SQL standard of SQL. SQL declare sections are required for all host variables in C++. The SQL declare section should appear before the first reference to the variable. Host variables are declared without the use of these statements in RPG, and they are not declared at all in REXX.

Variables declared outside an SQL declare section should not have the same name as variables declared within an SQL declare section.

More than one SQL declare section can be specified in the program.

Examples

Example 1

Define the host variables hv_smint (smallint), hv_vchar24 (varchar(24)), and hv_double (float) in a C program.

```
EXEC SQL  BEGIN DECLARE SECTION;
  static short                        hv_smint;
  static struct {
           short hv_vchar24_len;
           char  hv_vchar24_value[24];
         }                            hv_vchar24;
  static double                       hv_double;
EXEC SQL  END DECLARE SECTION;
```

Example 2

Define the host variables HV-SMINT (smallint), HV-VCHAR24 (varchar(24)), and HV-DEC72 (dec(7,2)) in a COBOL program.

```
WORKING-STORAGE SECTION.
EXEC SQL BEGIN DECLARE SECTION  END-EXEC.
  01  HV-SMINT             PIC S9(4)       BINARY.
  01  HV-VCHAR24.
      49 HV-VCHAR24-LENGTH  PIC S9(4)       BINARY.
      49 HV-VCHAR24-VALUE   PIC X(24).
  01  HV-DEC72             PIC S9(5)V9(2)  COMP-3.
EXEC SQL END DECLARE SECTION  END-EXEC.
```

Example 3

Define the host variables HV_SMINT (smallint), HV_VCHAR24 (varchar(24)), and HV_DEC72 (dec(7,2)) in a PL/I program.

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  HV_SMINT     BINARY    FIXED(15);
  DCL  HV_VCHAR24   CHAR(24)  VARYING;
  DCL  HV_DEC72     FIXED     DECIMAL(7,2);
EXEC SQL  END DECLARE SECTION;
```

CALL

The CALL statement calls an external procedure.

Invocation

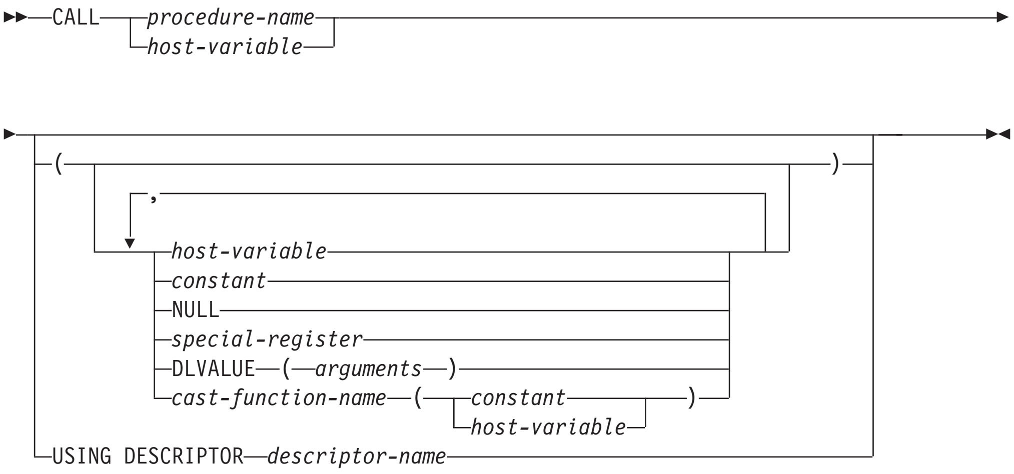
This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- If the external procedure is a REXX procedure:
  - The system authorities *OBJOPR, *READ, and *EXECUTE on the source file associated with the procedure,
  - The system authority *EXECUTE on the library containing the source file, and
  - The system authority *USE to the CL command,
- If the external procedure is not a REXX procedure:
  - The system authority *EXECUTE on the program associated with the procedure, and
  - The system authority *EXECUTE on the library containing the program associated with the procedure
- If the external procedure is a Java procedure:
  - Read authority (*R) to the integrated file system file that contains the Java class.
  - Read and execute authority (*RX) to all directories that must be accessed in order to find the integrated file system file.
- Administrative authority

Syntax



Description

procedure-name or *host-variable*
Identifies the procedure to call by the specified procedure name or the procedure name contained in the host variable. The procedure-name must identify a procedure that exists at the current server. If a host variable is specified:

- It must be a character-string variable or UCS-2 graphic-string and must not include an indicator variable.
- The procedure name that is contained within the host variable must be left-justified and must be padded on the right with blanks if its length is less than that of the host variable.
- The name of the procedure must be in uppercase unless it is a delimited name.

If the procedure name is unqualified, it is implicitly qualified based on the path and number of parameter. For more information see "Qualification of Unqualified Object Names" on page 45.

If the procedure-name identifies a procedure that was defined by a CREATE PROCEDURE or DECLARE PROCEDURE statement, and the current server is a DB2 UDB for AS/400 server, then:

- The CREATE PROCEDURE or DECLARE PROCEDURE statement determines the name of the external program, language, and calling convention.
- The attributes of the parameters of the procedure are defined by the CREATE PROCEDURE or DECLARE PROCEDURE statement.

Otherwise:

- The current server determines the name of the external program, language, and calling convention.
- If the current server is DB2 UDB for AS/400:
  - The external program name is assumed to be the same as the external procedure name.
  - If the program attribute information associated with the program identifies a recognizable language, then that language is used. Otherwise, the language is assumed to be C.
  - The calling convention is assumed to be GENERAL.
- The application requester assumes all parameters that are host variables or parameter markers are INOUT. All parameters that are not host variables are assumed to be IN.
- The actual attributes of the parameters are determined by the current server.

  If the current server is a DB2 UDB for AS/400, the attributes of the parameters will be the same as the attributes of the arguments specified on the CALL statement. [34]

host-variable or *constant* or **NULL** or *special-register*

Identifies a list of values to be passed as parameters to the procedure. The `n`th value corresponds to the `n`th parameter in the procedure.

When the CALL statement is executed, the value of each of its parameters is assigned to the corresponding parameter of the stored procedure. Control is passed to the stored procedure according to the calling conventions of the host language. When execution of the stored procedure is complete, the value of each parameter of the stored procedure is assigned to the corresponding parameter of the CALL statement defined as OUT or INOUT. For details on the rules used to assign parameters, see"String Assignments" on page 69.[35]

DLVALUE(*arguments***)**

Specifies the value for the column is the value resulting from a DLVALUE scalar function. A DLVALUE scalar function can only be specified for a DataLink column.The DLVALUE function requires a link value on insert (scheme, server, and path/file). The first argument of DLVALUE must be a

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[34] Note that in the case of decimal constants, leading zeroes are significant when determining the attributes of the argument. Normally, leading zeroes are not significant.

[35] If the CALL statement is prepared and then executed by an embedded SQL EXECUTE statement, the OUT and INOUT parameters are not assigned.

constant, host variable, or a typed parameter marker (CAST(? AS data-type)). The second and third arguments of DLVALUE must be constants or host-variables.

cast-function-name
This form of an argument can only be used with parameters defined as a distinct type, BLOB, CLOB, DBCLOB, DATE, TIME or TIMESTAMP data types. The following table describes the allowed uses of these *cast-functions*.

Parameter Type	**Cast Function Name**
Distinct type N based on a BLOB, CLOB, or DBCLOB	BLOB, CLOB, or DBCLOB *
Distinct type N based on a DATE, TIME, or TIMESTAMP	DATE, TIME, or TIMESTAMP *
BLOB, CLOB, or DBCLOB	BLOB, CLOB, or DBCLOB *
DATE, TIME, or TIMESTAMP	DATE, TIME, or TIMESTAMP *
Notes:	
* The name of the function must match the name of the data type (or the source type of the distinct type) with an implicit or explicit schema name of QSYS2	

constant
Specifies a constant as the argument. The constant must conform to the rules of a constant for the source type of the distinct type or for the data type if not a distinct type. For BLOB, CLOB, DBCLOB, DATE, TIME, and TIMESTAMP functions, the constant must be a string constant.

host-variable
Specifies a host variable as the argument. The host variable must conform to the rules of a constant for the source type of the distinct type or for the data type if not a distinct type.

USING DESCRIPTOR *descriptor-name*
Identifies an SQLDA that must contain a valid description of host variables.

Before the CALL statement is processed, you must set the following fields in the SQLDA. (The rules for REXX are different. For more information, see the SQL Programming Concepts book.)

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA
- SQLDABC to indicate the number of bytes of storage allocated for the SQLDA
- SQLD to indicate the number of variables used in the SQLDA when processing the statement
- SQLVAR occurrences to indicate the attributes of the variables.

The SQLDA must have enough storage to contain all SQLVAR occurrences. Therefore, the value in SQLDABC must be greater than or equal to 16 + SQLN*(80), where 80 is the length of an SQLVAR occurrence. If LOBs or distinct types are specified, there must be two SQLVAR entries for each parameter marker and SQLN must be set to two times the number of parameter markers.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN. It must be the same as the number of parameter markers in the CALL statement. The *n*th variable described by the SQLDA corresponds to the `n`th parameter marker in the prepared statement. (For a description of an SQLDA, see “Appendix C. SQL Descriptor Area (SQLDA)” on page 551.)

Note that RPG/400 does not provide the function for setting pointers. Because the SQLDA uses pointers to locate the appropriate host variables, you have to set these pointers outside your RPG/400 application.

Notes

If the *procedure-name* identifies a procedure that was defined by a CREATE PROCEDURE or DECLARE PROCEDURE statement, each OUT or INOUT parameter must be specified as a host variable.

If the *procedure-name* identifies a procedure that was defined by a CREATE PROCEDURE or DECLARE PROCEDURE statement, the number of arguments specified must be the same as the number of parameters defined by that CREATE PROCEDURE or DECLARE PROCEDURE statement.

For an explanation of *constant* and *host-variable*, see “Constants” on page 82 and “References to Host Variables” on page 94. For a description of *special-register*, see “Special Registers” on page 87. NULL specifies the null value.

The maximum number of parameters allowed on a CALL statement is dependent on the type of call being performed. If the procedure was defined with GENERAL, then 255 parameters are allowed. If the procedure was defined with GENERAL WITH NULLS, then 254 parameters are allowed. If the procedure is an SQL procedure, 253 parameters are allowed.

If the external procedure to be called is a REXX procedure, then the procedure must be declared using the CREATE PROCEDURE or DECLARE PROCEDURE statement.

Host variables cannot be used in the CALL statement within a REXX procedure. Instead, the CALL must be the object of a PREPARE and EXECUTE using parameter markers.

When an SQL or an external procedure is called, an attribute is set for SQL data-access that was defined when the procedure was created. The possible values for the attribute are:

```
NONE
CONTAINS
READS
MODIFIES
```

If a second procedure is invoked within the execution of the current procedure, an error is issued if:

- The invoked procedure possibly contains SQL and the invoking procedure does not allow SQL
- The invoked procedure reads SQL data and the invoking procedure does not allow reading SQL data
- The invoked procedure modifies SQL data and the invoking procedure does not allow modifying SQL data

| Result sets are only returned from a procedure when the procedure is called from a
| client using the Client Access Open Database Connectivity (ODBC) driver, a client

using the Client Access Optimized SQL API, from the SQL Call Level Interface, or from JDBC. There are three ways to return result sets from a procedure:

- If a SET RESULT SETS statement is executed in the procedure, the SET RESULT SETS statement identifies the result sets. The result sets are returned in the order specified on the SET RESULT SETS statement.
- If a SET RESULT SETS statement is not executed in the procedure,
  - If no cursors have specified a WITH RETURN clause, each cursor that the procedure opens and leaves open when it returns identifies a result set. The result sets are returned in the order in which the cursors are opened.
  - If any cursors have specified a WITH RETURN clause, each cursor that is defined with WITH RETURN CLAUSE that the procedure opens and leaves open when it returns identifies a result set. The result sets are returned in the order in which the cursors are opened.

When a result set is returned using an open cursor, the rows are returned starting with the current cursor position.

Nesting CALL Statements

A program that is executing as a procedure, a user-defined function, or a trigger can issue a CALL statement. When a procedure, user-defined function, or trigger calls a procedure, user-defined function, or trigger, the call is considered to be nested. There is no limit on how many levels procedures and functions can be nested, but triggers can only be nested up to 300 levels deep.

If a procedure returns any query result sets, the result sets are returned to the caller of the procedure. If the SQL CALL statement is nested, the result sets are visible only to the program that is at the previous nesting level. For example, if a client program calls procedure PROCA, which in turn calls stored procedure PROCB. Only PROCA can access any result sets that PROCB returns; the client program has no access to the query result sets.

Example

Call procedure PGM1 and pass two parameters.

```
CALL PGM1 (:hv1,:hv2)
```

CLOSE

The CLOSE statement closes a cursor. If a result table was created when the cursor was opened, that table is destroyed.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required. See “DECLARE CURSOR” on page 368 for the authorization required to use a cursor.

Syntax

```
►►──CLOSE──cursor-name──────────────────────────────────────────────►◄
```

Description

cursor-name
Identifies the cursor to be closed. The *cursor-name* must identify a declared cursor as explained in the DECLARE CURSOR statement. When the CLOSE statement is executed, the cursor must be in the open state.

Notes

All cursors in a program are in the closed state when:

- The program is called.
  - If CLOSQLCSR(*ENDPGM) is specified, all cursors are in the closed state each time the program is called.
  - If CLOSQLCSR(*ENDSQL) is specified, all cursors are in the closed state only the first time the program is called as long as one SQL program remains on the call stack.
  - If CLOSQLCSR(*ENDJOB) is specified, all cursors are in the closed state only the first time the program is called in the job.
  - If CLOSQLCSR(*ENDMOD) is specified, all cursors are in the closed state each time the module is initiated.
  - If CLOSQLCSR(*ENDACTGRP) is specified, all cursors are in the closed state the first time the module in the program is initiated within the activation group.
- A program starts a new unit of work by executing a COMMIT or ROLLBACK statement without a HOLD option. Cursors declared with the HOLD option are not closed by a COMMIT statement.

Note: The DB2 UDB for AS/400 database manager will open files in order to implement queries. The closing of the files can be separate from the SQL CLOSE statement. For more information, see the SQL Programming Concepts book.

Explicitly closing cursors as soon as possible can improve performance.

Example

In a COBOL program, use the cursor C1 to fetch the values from the first four columns of the EMP_ACT table a row at a time and put them in the following host variables:

- EMP (char(6))
- PRJ (char(6))
- ACT (smallint)
- TIM (dec(5,2))

Finally, close the cursor.

```
EXEC SQL  BEGIN DECLARE SECTION  END-EXEC.
  77  EMP             PIC X(6).
  77  PRJ             PIC X(6).
  77  ACT             PIC S9(4) BINARY.
  77  TIM             PIC S9(3)V9(2) COMP-3.
EXEC SQL  END DECLARE SECTION  END-EXEC.
.
.
.

EXEC SQL  DECLARE C1 CURSOR FOR
            SELECT EMPNO, PROJNO, ACTNO, EMPTIME
```

```
              FROM EMP_ACT                        END-EXEC.

EXEC SQL  OPEN C1  END-EXEC.

EXEC SQL  FETCH C1 INTO :EMP, :PRJ, :ACT, :TIM  END-EXEC.

IF SQLSTATE = '02000'
  PERFORM DATA-NOT-FOUND
ELSE
  PERFORM GET-REST UNTIL SQLSTATE IS NOT EQUAL TO '00000'.

EXEC SQL  CLOSE C1  END-EXEC.

GET-REST
EXEC SQL  FETCH C1 INTO :EMP, :PRJ, :ACT, :TIM  END-EXEC.
.
.
.
```

COMMENT ON

The COMMENT ON statement adds or replaces comments in the catalog descriptions of tables, views, aliases, user-defined types, functions, packages, parameters, procedures, indexes, or columns.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

To comment on a table, view, alias, index, column, user-defined type, or package, the privileges held by the authorization ID of the statement must include at least one of the following:

- For the table, view, alias, index, user-defined type, or package in the statement,
  - The ALTER privilege on the table, view, alias, index, user-defined type, or package, and
  - The system authority *EXECUTE on the library that contains the table, view, alias, index, user-defined type, or package
- Administrative authority

The authorization ID of the statement has the ALTER privilege on the table, view, alias, index, user-defined type, or package when:

- It is the owner of the table, view, alias, index, user-defined type, or package
- It has been granted the ALTER privilege to the table, view, alias, user-defined type, or package, or
- It has been granted the system authorities of either *OBJALTER or *OBJMGT to the table, view, alias, index, user-defined type, or package

To comment on a function, the privileges held by the authorization ID of the statement must include at least one of the following:

- For the SYSFUNCS catalog view:
  - The UPDATE privilege on the view, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

To comment on a procedure, the privileges held by the authorization ID of the statement must include at least one of the following:

- For the SYSPROCS catalog view:
  - The UPDATE privilege on the view, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

To comment on a parameter, the privileges held by the authorization ID of the statement must include at least one of the following:

- For the SYSPARMS catalog table:
  - The UPDATE privilege on the table, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

The authorization ID of the statement has the UPDATE privilege on a table when:

- It is the owner of the table,
- It has been granted the UPDATE privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *UPD on the table.

Syntax

```
>>-COMMENT ON--------------------------------------------------------------------------------------->

>--+-+-ALIAS--alias-name--------------------------------------------------------+--IS--string-constant-+-><
   | +-COLUMN--+-table-name.column-name-+---------------------------------------+                      |
   | |         '-view-name.column-name--'                                       |                      |
   | +-+--------------+--TYPE--type-name----------------------------------------+                      |
   | | |          (1) |                                                         |                      |
   | | '-DISTINCT-----'                                                         |                      |
   | +-+-FUNCTION-+--function-name--+-------------------------------+-----------+                      |
   | | '-ROUTINE--'                 '-(--+---------------------+--)-'           |                      |
   | |                                   |  .-,--------------. |                |                      |
   | |                                   |  V                | |                |                      |
   | |                                   '---parameter-type--+-'                |                      |
   | +-INDEX--index-name--------------------------------------------------------+                      |
   | |        (2)                                                               |                      |
   | +-PACKAGE------package-name------------------------------------------------+                      |
   | +-PARAMETER--+-routine-name.parameter-name---------------------------+-----+                      |
   | |            '-SPECIFIC--+-FUNCTION--+--specific-name.parameter-name-'     |                      |
   | |                        +-PROCEDURE-+                                     |                      |
   | |                        '-ROUTINE---'                                     |                      |
   | +-+-PROCEDURE-+--procedure-name--+-------------------------------+---------+                      |
   | | '-ROUTINE---'                  '-(--+---------------------+--)-'         |                      |
   | |                                     |  .-,--------------. |              |                      |
   | |                                     |  V                | |              |                      |
   | |                                     '---parameter-type--+-'              |                      |
   | +-SPECIFIC--+-FUNCTION--+--specific-name-----------------------------------+                      |
   | |           +-PROCEDURE-+                                                  |                      |
   | |           '-ROUTINE---'                                                  |                      |
   | '-TABLE--+-table-name-+----------------------------------------------------'                      |
   |          '-view-name--'                                                                           |
   +-multiple-columns----------------------------------------------------------------------------------+
   '-multiple-parameters-------------------------------------------------------------------------------'
```

multiple-columns:

```
                                  .-,-------------------------------.
   .-COLUMN-.                     V                                 |
|--+--------+--+-table-name-+--(----column-name--IS--string-constant-+--)--------------------------|
               '-view-name--'
```

multiple-parameters:

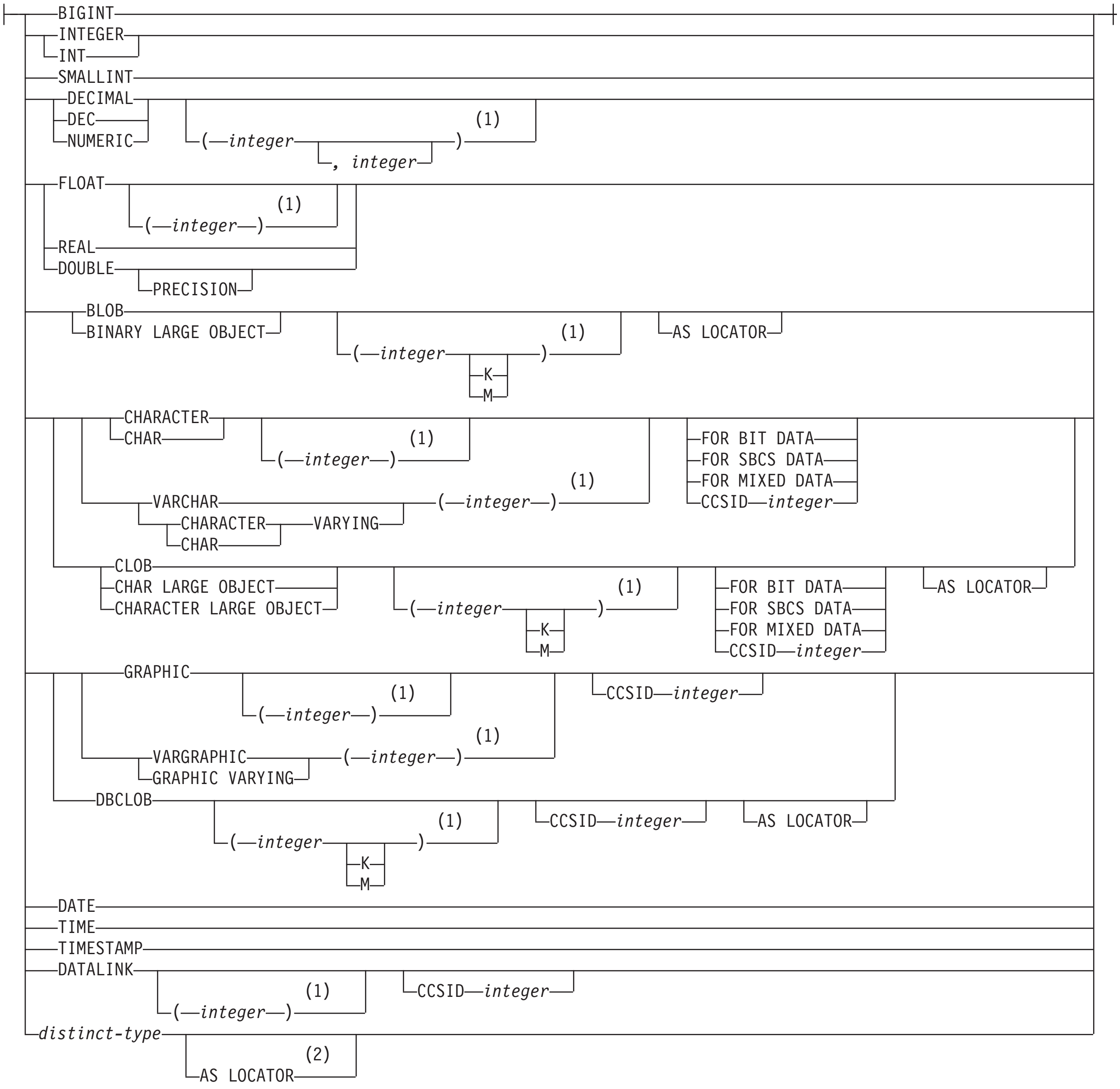
```
|--PARAMETER--+-SPECIFIC--+-FUNCTION--+--specific-name------------------------------------------+-->
              |           +-PROCEDURE-+                                                         |
              |           '-ROUTINE---'                                                         |
              |  .-ROUTINE---.                                                                  |
              '--+-----------+--routine-name--+-------------------------------+-----------------'
                 +-FUNCTION--+                '-(--+---------------------+--)-'
                 '-PROCEDURE-'                     |  .-,--------------. |
                                                   |  V                | |
                                                   '---parameter-type--+-'

      .-,----------------------------------.
      V                                    |
>--(----parameter-name--IS--string-constant-+--)---------------------------------------------------|
```

Notes:

1 The keyword DATA can be used when commenting on any user-defined type.

2 The keyword PROGRAM can be used as a synonym for PACKAGE.

parameter-type:



Notes:

1 The values that are specified for length, precision, or scale attributes must match the values that were specified when the function or procedure was created. Coding specific values is optional. Empty parentheses, (), can be used instead to indicate that DB2 ignores the attributes when determining whether data types match.

2 AS LOCATOR can be specified only for distinct type based on a LOB data type.

Description

ALIAS
Indicates that a comment will be added to or replaced for an alias.

alias-name
Identifies the alias to which the comment applies. The name must identify an alias that exists at the current server.

COLUMN
Indicates that a comment will be added to or replaced for a column.

table-name.column-name or *view-name.column-name*
Identifies the column to which the comment applies. The *table-name* or *view-name* must identify a table or view that exists at the current server, and the *column-name* must identify a column of that table or view.

TYPE
Indicates that a comment will be added to or replaced for a user-defined type.

type-name
Identifies the user-defined type to which the comment applies. The name must identify a user-defined type that exists at the current server.

FUNCTION
Indicates that a comment will be added to or replaced for a function. Identifies the function to which the comment applies. You can identify the particular function by its name, function signature, or specific name. The rules for function resolution (and the SQL path) are not used.

FUNCTION *function-name*
The *function-name* must identify exactly one function that exists at the current server. The function may have any number of parameters defined for it. If there is more than one function of the specified name in the specified or implicit collection, an error is returned.

FUNCTION *function-name (parameter-type, ...)*
The *function-name (parameter-type, ...)* must identify a function with the specified function signature that exists at the current server. The specified parameters must match the data types, that were specified on the CREATE FUNCTION statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance to which the comment is applied. If *function-name ()* is specified, the function identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. For more information on the default attributes see “CREATE TABLE” on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

SPECIFIC FUNCTION *specific-name*

The *specific-name* must identify a specific function that exists at the current server.

INDEX

Indicates that a comment will be added to or replaced for an index.

index-name

Identifies the index to which the comment applies. The name must identify an index that exists at the current server.

PACKAGE

Indicates that a comment will be added to or replaced for a package.

package-name

Identifies the package to which the comment applies. The name must identify a package that exists at the current server.

PARAMETER

Indicates that a comment will be added to or replaced for a parameter.

routine-name.parameter-name

Identifies the parameter to which the comment applies. The parameter could be for a procedure or a function. The *routine-name* must identify a procedure or function that exists at the current server, and the *parameter-name* must identify a parameter of that procedure or function.

specific-name.parameter-name

Identifies the parameter to which the comment applies. The parameter could be for a procedure or a function. The *specific-name* must identify a procedure or function that exists at the current server, and the *parameter-name* must identify a parameter of that procedure or function.

PROCEDURE

Indicates that a comment will be added to or replaced for a procedure. Identifies the procedure to which the comment applies. You can identify the particular procedure by its name, procedure signature, or specific name. The rules for procedure resolution (and the SQL path) are not used.

PROCEDURE *procedure-name*

The *procedure-name* must identify exactly one procedure that exists at the current server. The procedure may have any number of parameters defined for it. If there is more than one procedure of the specified name in the specified or implicit collection, an error is returned.

PROCEDURE *procedure-name (parameter-type, ...)*

The *procedure-name (parameter-type, ...)* must identify a procedure with the specified procedure signature that exists at the current server. The specified parameters must match the data types that were specified on the CREATE PROCEDURE statement in the corresponding position. The number of data types and the logical concatenation of the data types is used to identify the specific procedure instance which is to be commented on. If *procedure-name ()* is specified, the procedure identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE PROCEDURE statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type is implied. For more information on the default attributes see "CREATE TABLE" on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE PROCEDURE statement.

SPECIFIC PROCEDURE *specific-name*

The *specific-name* must identify a specific procedure that exists at the current server.

TABLE

Indicates that a comment will be added to or replaced for a table or view.

table-name or *view-name*

Identifies the table or view to which the comment applies. The name must identify a table or view that exists at the current server.

IS

Introduces the comment that you want to make.

string-constant

Can be any character-string constant of up to 2000 characters. The constant may contain SBCS or DBCS characters.

multiple-columns

To comment on more than one column in a table or view, specify the table or view name and then, in parenthesis, a list of the form:

```
column-name IS string-constant,
column-name IS string-constant, ...
```

The column name must not be qualified, each name must identify a column of the specified table or view, and that table or view must exist at the current server.

multiple-parameters

To comment on more than one parameter in a procedure or function, specify the procedure name, function name, or specific name, and then, in parenthesis, a list of the form:

```
parameter-name IS string-constant,
parameter-name IS string-constant, ...
```

The parameter name must not be qualified, each name must identify a parameter of the specified procedure or function, and that procedure or function must exist at the current server.

Examples

Example 1

Insert a comment for the EMPLOYEE table.

```
COMMENT ON TABLE EMPLOYEE
  IS 'Reflects first quarter 1981 reorganization'
```

Example 2

Insert a comment for the EMP_VIEW1 view.

```
COMMENT ON TABLE EMP_VIEW1
  IS 'View of the EMPLOYEE table without salary information'
```

Example 3

Insert a comment for the EMPNO column of the EMPLOYEE table.

```
COMMENT ON COLUMN EMPLOYEE.EMPN
  IS 'Highest grade level passed in school'
```

Example 4

Enter comments on two columns in the CORPDATA.DEPARTMENT table.

```
COMMENT ON CORPDATA.DEPARTMENT
  (MGRNO IS 'EMPLOYEE NUMBER OF DEPARTMENT MANAGER',
   ADMRDEPT IS 'DEPARTMENT NUMBER OF ADMINISTERING DEPARTMENT')
```

Example 5

Insert a comment for the CORPDATA.PAYROLL package.

```
COMMENT ON PACKAGE CORPDATA.PAYROLL
  IS 'This package is used for distributed payroll processing.'
```

COMMIT

The COMMIT statement ends a unit of work and commits the database changes that were made by that unit of work.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

COMMIT is not allowed in a trigger program if the trigger program and the triggering program run under the same commitment definition. COMMIT is not allowed in a procedure if the procedure is called on a remote application server.

Authorization

None required.

Syntax

```
           ┌─WORK─┐
►►──COMMIT─┴──────┴─┬──────┬──────────────────────────────────────────►◄
                    └─HOLD─┘
```

Description

The COMMIT statement ends the unit of work in which it is executed and starts a new unit of work. It commits all changes made by ALTER, CALL, CREATE, COMMENT ON, DELETE, DROP (except DROP COLLECTION), GRANT, INSERT, LABEL ON, RENAME, REVOKE, and UPDATE statements executed during the unit of work.

Connections in the release-pending state are ended.

WORK
COMMIT WORK has the same effect as COMMIT.

HOLD
Indicates a hold on resources. If specified, currently open cursors are not closed and all resources acquired during the unit of work are held. Locks on specific rows and objects implicitly acquired during the unit of work are released.

If HOLD is omitted:

- Cursors opened under this unit of work's commitment definition are closed unless the cursors were declared with the WITH HOLD clause.
- Table locks acquired by the LOCK TABLE statement under this unit of work's commitment definition are released.

All implicitly acquired locks are released; except for object level locks required for the cursors that are not closed.

Notes

An implicit COMMIT may be performed under some circumstances. However, it is recommended that an explicit COMMIT or ROLLBACK be issued before the application ends.

- For the default activation group:
  - An implicit COMMIT is not performed when applications that run in the default activation group end. Interactive SQL, Query Manager, and non-ILE programs are examples of programs that run in the default activation group.
  - In order to commit work, you must issue a COMMIT.
- For nondefault activation groups when the scope of the commitment definition is to the activation group:
  - If the activation group ends normally, the commitment definition is implicitly committed.
  - If the activation group ends abnormally, the commitment definition is implicitly rolled back.
- Regardless of the type of activation group, if the scope of the commitment definition is the job, an implicit commit is never performed.

A unit of work can include the processing of up to 4 million rows, including rows retrieved during a SELECT or FETCH statement[36], and rows inserted, deleted, or updated as part of INSERT, DELETE, and UPDATE statements.[37]

---

[36] This limit also includes:

- Any records accessed or changed through files opened under commitment control through high-level language file processing
- Any rows deleted, updated, or inserted as a result of a trigger or CASCADE, SET NULL, or SET DEFAULT referential integrity delete rule.

[37] Unless you specified COMMIT(*CHG) or COMMIT(*CS), in which case these rows are not included in this total.

The commit and rollback operations do not affect the DROP COLLECTION statement, and this statement is not, therefore, allowed in an application program that also specifies COMMIT(*CHG), COMMIT(*CS), COMMIT(*ALL), or COMMIT(*RR).

The commitment definition used by SQL is determined as follows:

- If the activation group of the program calling SQL is already using an activation group level commitment definition, then SQL uses that commitment definition.
- If the activation group of the program calling SQL is using the job level commitment definition, then SQL uses the job level commitment definition.
- If the activation group of the program calling SQL is not currently using a commitment definition but the job commitment definition is started, then SQL uses the job commitment definition.
- If the activation group of the program calling SQL is not currently using a commitment definition and the job commitment definition is not started, then SQL implicitly starts a commitment definition. SQL uses the Start Commitment Control (STRCMTCTL) command with:
  - A CMTSCOPE(*ACTGRP) parameter
  - A LCKLVL parameter based on the COMMIT option specified on either the CRTSQLxxx, STRSQL, or RUNSQLSTM commands. In REXX, the LCKLVL parameter is based on the commit option in the SET OPTION statement.

Example

In a PL/I program, compiled with COMMIT (*CHG), transfer a certain amount of commission (COMM) from one employee (EMPNO) to another in the EMPLOYEE table. Subtract the amount from one row and add it to the other. Use the COMMIT WORK statement to ensure that no permanent changes are made to the database until both operations are completed successfully.

```
XFRCOMM:  PROC OPTIONS(MAIN);
  EXEC SQL  BEGIN DECLARE SECTION;
    DCL  AMOUNT       FIXED DECIMAL(5,2);
    DCL  FROM_EMPNO   CHAR(6);
    DCL  TO_EMPNO     CHAR(6);
  EXEC SQL  END DECLARE SECTION;
  EXEC SQL  INCLUDE SQLCA;
  EXEC SQL  WHENEVER SQLERROR GOTO SQLERR;
  GET ...
  EXEC SQL  UPDATE EMPLOYEE
              SET COMM = COMM - :AMOUNT
              WHERE EMPNO = :FROM_EMPNO;
  EXEC SQL  UPDATE EMPLOYEE
              SET COMM = COMM + :AMOUNT
              WHERE EMPNO = :TO_EMPNO;
FINISHED:
  EXEC SQL  COMMIT WORK;
  RETURN;
SQLERR:
  PUT ...
  EXEC SQL  WHENEVER SQLERROR CONTINUE;    /* continue if error on rollback    */
  EXEC SQL  ROLLBACK WORK;
  RETURN;
END XFRCOMM;
```

CONNECT (Type 1)

The CONNECT (TYPE 1) statement connects an activation group within an application process to the identified application server using the rules for remote unit of work. This server is then the current server for the activation group. This type of CONNECT statement is used if RDBCNNMTH(*RUW) was specified on the CRTSQLxxx command. Differences between the two types of statements are described in "CONNECT (Type 1) and CONNECT (Type 2) Differences" on page 588. Refer to "Application-Directed Distributed Unit of Work" on page 24 for more information about connection states.

Invocation

This statement can only be embedded within an application program or issued interactively. It is an executable statement that cannot be dynamically prepared. It must not be specified in REXX.

CONNECT is not allowed in a trigger program. CONNECT is not allowed in an external procedure if the external procedure is called on a remote application server.

Authorization

The privileges held by the authorization ID of the statement must include communications-level security. (See the section about security in the Distributed Database Programming book.)

If the application server is DB2 UDB for AS/400, the user profile of the person issuing the statement must also be a valid user profile on the application server system, UNLESS:

- User is specified. In this case, the USER clause must specify a valid user profile on the application server system.
- TCP/IP is used with a server authorization entry for the application server. In this case, the server authorization entry must specify a valid user profile on the application server system.

Syntax

```
►►──CONNECT──┬───────────────┬────────────────────────────────►◄
             ├─RESET─────────┤
             └─┤ to-clause ├─┘
```

to-clause:

```
├──TO──┬─server-name───┬──────────────────────────────────────►
       └─host-variable─┘

►──┬──────────────────────────────────────────────────────────┬──┤
   └─USER──┬─authorization-name─┬──USING──┬─password──────┬─┘
           └─host-variable──────┘         └─host variable─┘
```

Description

TO *server-name* or *host-variable*
Identifies the application server by the specified server name or the server name contained in the host variable. If a host variable is specified:

- It must be a character-string variable.
- It must not be followed by an indicator variable.
- The server name must be left-justified within the host variable and must conform to the rules for forming an ordinary identifier.
- If the length of the server name is less than the length of the host variable, it must be padded on the right with blanks.

If the server-name is the local relational database and an authorization-name is specified, it must be the authorization-name of the job. If the specified authorization-name is different than the authorization-name of the job, an error occurs and the application is left in the unconnected state.

USER *authorization-name or host-variable*
Identifies the authorization-name by the specified *authorization-name* or a *host-variable* which contains the authorization name that will be used to start the remote job.

If a *host-variable* is specified,

- It must be a character string variable.
- It must not be followed by an indicator variable.
- The authorization name must be left-justified within the host variable and must conform to the rules of forming an authorization name.
- If the length of the authorization name is less than the length of the host variable, it must be padded on the right with blanks.

USING *password or host-variable*
Identifies the password by the specified *password* or a *host-variable*, which contains the password for the authorization-name that will be used to start the remote job.

If a *host-variable* is specified,

- It must be a character-string variable.
- It must not be followed by an indicator variable.
- The password must be left-justified within the host variable.
- If the length of the password is less than that of the host variable, it must be padded on the right with blanks.

When the CONNECT statement is executed, the specified server name or the server name contained in the host variable must identify an application server described in the local directory and the activation group must be in the connectable state.

If the CONNECT statement is successful:

- All open cursors are closed, all prepared statements are destroyed, and all locks are released from all current and dormant connections.
- The activation group is disconnected from all current and dormant connections, if any, and connected to the identified application server.
- The name of the application server is placed in the CURRENT SERVER special register.

- Information about the application server is placed in the SQLERRP and SQLERRD(4) fields of the SQLCA. If the application server is an IBM relational database product, the information in the SQLERRP field has the form *pppvvrrm*, where:
  - *ppp* identifies the product as follows:

    ARI for DB2 for VM and VSE
    DSN for DB2 UDB for OS/390
    QSQ for DB2 UDB for AS/400
    SQL for all other DB2 products
  - *vv* is a two-digit version identifier such as '04'
  - *rr* is a two-digit release identifier such as '01'
  - *m* is a one-digit modification level such as '0'

  For example, if the application server is Version 4 of DB2 UDB for OS/390, the value of SQLERRP is 'DSN04010'.

  The SQLERRD(4) field of the SQLCA contains values indicating whether the application server allows commitable updates to be performed. For a CONNECT (Type 1) statement SQLERRD(4) will always contain the value 1. The value 1 indicates that commitable updates can be performed, and the connection:
  - Uses an unprotected conversation,[38] or
  - Is a connection to an application requester driver program using the *RUW connection method, or
  - Is a local connection using the *RUW connection method.
- Additional information about the connection is placed in the SQLERRMC field of the SQLCA. Refer to “Appendix B. SQL Communication Area” on page 541

If the CONNECT statement is unsuccessful, the SQLERRP field of the SQLCA is set to the name of the module at the application requester that detected the error. Note that the first three characters of the module name identify the product. For example, if the application requester is DB2 UDB for NT the first three characters are ’SQL’.

If the CONNECT statement is unsuccessful because the activation group is not in the connectable state, the connection state of the activation group is unchanged. If the CONNECT statement is unsuccessful for any other reason:

- The activation group remains in a connectable, but unconnected state
- All open cursors are closed, all prepared statements are destroyed, and all locks are released from all current and dormant connections.

An application in a connectable but unconnected state can only execute the CONNECT or SET CONNECTION statements.

RESET
CONNECT RESET is equivalent to CONNECT TO x where x is the local server name.

CONNECT with no operand
This form of the CONNECT statement returns information about the current

---

[38] To reduce the possibility of confusion between network connections and SQL connections, in this book the term ’conversation’ will be used to apply to network connections over TCP/IP as well as over APPC, even though it formally applies only to APPC connections.

server and has no effect on connection states, open cursors, prepared statements, or locks. The information is returned in the SQLCA as described above.

Notes

For a description of connection states, see "Remote Unit of Work Connection Management" on page 22.

- When running in the default activation group, the SQL program implicitly connects to a remote relational database when:
  - The activation group is in a connectable state.
  - The first SQL statement in the first SQL program on the program stack is executed.
- When running in a nondefault activation group, the SQL program implicitly connects to a remote relational database when the first SQL statement in the first SQL program for that activation group is executed.

Note: It is a good practice for the first SQL statement executed by an activation group to be the CONNECT statement.

When APPC is used for connecting to an RDB, implicit connect always sends the authorization-name of the application requester job and does not send passwords. If the authorization-name of the application server job is different, or if a password must be sent, an explicit connect statement must be used.

When TCP/IP is used for connecting to an RDB, an implicit connect is not bound by the above restrictions. Use of the ADDSVRAUTE and other -SVRAUTE commands allows one to specify, for a given user under which the implicit (or explicit) CONNECT is done, the remote authorization-name and password to be used in connecting to a given RDB.

In order for the password to be stored with the ADDSVRAUTE or CHGSVRAUTE command, the QRETSVRSEC system value must be set to '1' rather than the default of '0'. When using these commands for DRDA connection, it is very important to realize that the value of the RDB name entered into the SERVER parameter must be in UPPER CASE. For more information, see Example 2 under Type 2 CONNECT.

For more information on implicit connect, refer to the SQL Programming Concepts book. Once a connection to a relational database for a user profile is established, the password, if specified, may not be validated again on subsequent connections to the same relational database with the same user profile. Revalidation of the password depends on if the conversation is still active. See the Distributed Database Programming book for more details.

Consecutive CONNECT statements can be executed successfully because CONNECT does not remove the activation group from the connectable state.

A CONNECT to either a current or dormant connection in the application group is executed as follows:

- If the connection identified by the server-name was established using a CONNECT (Type 1) statement, then no action is taken. Cursors are not closed, prepared statements are not destroyed, and locks are not released.

- If the connection identified by the server-name was established using a CONNECT (Type 2) statement, then the CONNECT statement is executed like any other CONNECT statement.

CONNECT cannot execute successfully when it is preceded by any SQL statement other than CONNECT, COMMIT, DISCONNECT, SET CONNECTION, RELEASE, or ROLLBACK. To avoid an error, execute a commit or rollback operation before a CONNECT statement is executed.

If any previous current or dormant connections were established using protected conversations, then the CONNECT (Type 1) statement will fail. Either, a CONNECT (Type 2) statement must be used, or the connections using protected conversations must be ended by releasing the connections and successfully committing.

For more information about connecting to a remote relational database and the local directory, see the SQL Programming Concepts book and the Distributed Database Programming book.

Examples

For an example of the additional flexibility available in doing connects using the TCP/IP protocol with DRDA, see Example 2 under the discussion of CONNECT Type 2. This example applies also to CONNECT Type 1.

Example 1

In a PL/I program, user JOE will connect to the application server TOROLAB3. JOE’s password is XYZ1.

```
USERNAME='JOE';
USERPASS='XYZ1';
EXEC SQL CONNECT TO  TOROLAB3
           USER :USERNAME  USING :USERPASS;
```

Example 2

In a PL/I program, connect to an application server whose name is stored in the host variable APP_SERVER (varchar(18)). Following a successful connection, copy the 3 character product identifier of the application server to the host variable PRODUCT (char(3)).

```
EXEC SQL  CONNECT TO :APP_SERVER;
IF SQLSTATE = '00000' THEN
   PRODUCT = SUBSTR(SQLERRP,1,3);
```

CONNECT (Type 2)

The CONNECT (Type 2) statement connects an activation group within an application process to the identified application server using the rules for application directed distributed unit of work. This server is then the current server for the activation group. This type of CONNECT statement is used if RDBCNNMTH(*DUW) was specified on the CRTSQLxxx command. Differences between the two types of statements are described in “CONNECT (Type 1) and CONNECT (Type 2) Differences” on page 588. Refer to “Application-Directed Distributed Unit of Work” on page 24 for more information about connection states.

Invocation

This statement can only be embedded in an application program or issued interactively. It is an executable statement that cannot be dynamically prepared. It must not be specified in REXX.

CONNECT is not allowed in a trigger program. CONNECT is not allowed in an external procedure if the external procedure is called on a remote application server.

Authorization

The privileges held by the authorization ID of the statement must include communications-level security. (See the section about security in the Distributed Database Programming book.)

If the application server is DB2 UDB for AS/400, the profile ID of the person issuing the statement must also be a valid user profile on the application server system, UNLESS:

- USER is specified. If USER is specified, the USER clause must specify a valid user profile on the application server system.
- TCP/IP is used with a server authorization entry for the application server. If this is the case, the server authorization entry must specify a valid user profile on the application server system.

Syntax

```
►►──CONNECT──┬───────────────┬────────────────────────────────────────►◄
             ├─RESET─────────┤
             └─┤ to-clause ├─┘
```

to-clause:

```
├──TO──┬─server-name───┬──────────────────────────────────────────────►
       └─host-variable─┘

►──┬────────────────────────────────────────────────────────────┬─────┤
   └─USER──┬─authorization-name─┬──USING──┬─password──────┬─┘
           └─host-variable──────┘         └─host variable─┘
```

Description

TO *server-name* or *host-variable*

Identifies the application server by the specified server name or the server name contained in the host variable. If a host variable is specified:

- It must be a character-string variable.
- It must not be followed by an indicator variable
- The server name must be left-justified within the host variable and must conform to the rules for forming an ordinary identifier
- If the length of the server name is less than the length of the host variable, it must be padded on the right with blanks.

USER *authorization-name or host-variable*
Identifies the authorization-name by the specified *authorization-name* or a *host-variable*, which contains the authorization name that will be used to start the remote job.

If a *host-variable* is specified,
- It must be a character string variable.
- It must not be followed by an indicator variable. The authorization name must be left-justified within the host variable and must conform to the rules of forming an authorization name.
- If the length of the authorization name is less than the length of the host variable, it must be padded on the right with blanks.

USING *password or host-variable*
Identifies the password by the specified *password* or a *host-variable*, which contains the password for the authorization-name that will be used to start the remote job.

If password is specified as a literal, it must be a character string. The maximum length is 10 characters. It must be left justified.

If a *host-variable* is specified,
- It must be a character-string variable.
- It must not be followed by an indicator variable.
- The password must be left-justified within the host variable.
- If the length of the password is less than that of the host variable, it must be padded on the right with blanks.

When the CONNECT statement is executed, the specified server name or the server name contained in the host variable must identify an application server described in the local directory.

Let S denote the specified server name or the server name contained in the host variable. S must not identify an existing connection of the application process.

If the CONNECT statement is successful:
- A connection to application server S is created and placed in the current and held states. The previous connection, if any, is placed in the dormant state.
- S is placed in the CURRENT SERVER special register.
- Information about application server S is placed in the SQLERRP and SQLERRD(4) fields of the SQLCA. If the application server is an IBM relational database product, the information in the SQLERRP field has the form *pppvvrrm*, where:
  - *ppp* identifies the product as follows:
    ARI for DB2 for VM and VSE
    DSN for DB2 UDB for OS/390
    QSQ for DB2 UDB for AS/400
    SQL for all other DB2 products
  - *vv* is a two-digit version identifier such as '04'
  - *rr* is a two-digit release identifier such as '01'
  - *m* is a one-digit modification level such as '0'

For example, if the application server is Version 4 of DB2 UDB for OS/390, the value of SQLERRP is 'DSN04010'.

The SQLERRD(4) field of the SQLCA contains values indicating whether application server S allows commitable updates to be performed. Following is a list of values and their meanings for the SQLERRD(4) field of the SQLCA on the CONNECT:

- 1 - commitable updates can be performed. Conversation is unprotected. [38]
- 2 - No commitable updates can be performed. Conversation is unprotected.
- 3 - It is unknown if commitable updates can be performed. Conversation is protected.
- 4 - It is unknown if commitable updates can be performed. Conversation is unprotected.
- 5 - It is unknown if commitable updates can be performed. The connection is either a local connection or a connection to an application requester driver program.

- Additional information about the connection is placed in the SQLERRMC field of the SQLCA. Refer to "Appendix B. SQL Communication Area" on page 541.

If the CONNECT statement is unsuccessful, the connection state of the activation group and the states of its connections are unchanged.

CONNECT RESET
CONNECT RESET is equivalent to CONNECT TO *x* where *x* is the local server name.

CONNECT with no operand
This form of the CONNECT statement returns information about the current server and has no effect on connection states, open cursors, prepared statements, or locks. The information is returned in the fields of the SQLCA as described above.

In addition, the SQLERRD(3) field of the SQLCA will indicate the status of connection for this unit of work. It will have one of the following values:

- 1 - commitable updates can be performed on the connection for this unit of work.
- 2 - No commitable updates can be performed on the connection for this unit of work.

Notes

Implicit connect will always send the authorization-name of the application requester job and will not send passwords. If the authorization-name of the application server job is different or if a password must be sent, an explicit connect statement must be used.

When TCP/IP is used for connecting to an RDB, an implicit connect is not bound by the above restrictions. Use of the ADDSVRAUTE and other -SVRAUTE commands allows one to specify, for a given user under which the implicit (or explicit) CONNECT is done, the remote authorization-name and password to be used in connecting to a given RDB.

In order for the password to be stored with the ADDSVRAUTE or CHGSVRAUTE command, the QRETSVRSEC system value must be set to '1' rather than the default of '0'. When using these commands for DRDA connection, it is very important to realize that the value of the RDB name entered into the SERVER parameter must be in UPPER CASE. For more information, see Example 2 under Type 2 CONNECT.

For more information on implicit connect, refer to the SQL Programming Concepts book. Once a connection to a relational database for a user profile is established, the password, if specified, may not be validated again on subsequent connections to the same relational database with the same user profile. Revalidation of the password depends on if the conversation is still active. See the Distributed Database Programming book for more details.

Examples

Example 1

Execute SQL statements at TOROLAB1 and TOROLAB2. The first CONNECT statement creates the TOROLAB1 connection and the second CONNECT statement places it in the dormant state.

```
EXEC SQL  CONNECT TO TOROLAB1;

(execute statements referencing objects at TOROLAB1)

EXEC SQL  CONNECT TO TOROLAB2;

(execute statements referencing objects at TOROLAB2)
```

Example 2

User JOE wants to connect to TOROLAB3 and execute SQL statements under the user ID ANONYMOUS which has a password of SHIBBOLETH. The RDB directory entry for TOROLAB3 specifies *IP for the connection type.

Before running the application, some setup must be done.

This command will be required to allow server security information to be retained in OS/400, if it has not been previously run:

```
CHGSYSVAL SYSVAL(QRETSVRSEC) VALUE('1')
```

This command adds the required server authorization entry:

```
ADDSVRAUTE USRPRF(JOE) SERVER(TOROLAB3) USRID(ANONYMOUS) +
           PASSWORD(SHIBBOLETH)
```

This statement, run under JOE's user profile, will now make the desired connection:

```
EXEC SQL CONNECT TO TOROLAB3;
(execute statements referencing objects at TOROLAB3)
```

CREATE ALIAS

The CREATE ALIAS statement creates an alias on a table, view, or member of a database file.

Invocation

This statement can be embedded or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - *USE to the Create DDM File (CRTDDMF) command
  - *EXECUTE, *READ and *ADD to the library into which the alias is created
- Administrative authority

If SQL names are specified and a user profile exists that has the same name as the library into which the alias is created, and that name is different from the authorization ID of the statement, then the privileges held by the authorization ID of the statement must include at least one of the following:

- The system authority *ADD to the user profile with that name
- Administrative authority

Syntax

```
                    (1)
►►──CREATE──ALIAS──────alias-name─────────────────────────────────────►

►─FOR───┬─table-name─┬───┬───────────────────┬──────────────────────►◄
        └─view-name──┘   └─(──member-name──)─┘
```

Notes:

1 The keyword SYNONYM can be used as a synonym for ALIAS.

Description

alias-name

Names the alias. The name, including the implicit or explicit qualifier, must not be the same as an index, table, view, alias or file that already exists at the current server.

If SQL names were specified, the alias will be created in the collection or library specified by the implicit or explicit qualifier. The qualifier is the *owner* of the alias if a user profile with that name exists. Otherwise, the *owner* of the alias is the user profile or group user profile of the job invoking the statement.

If system names were specified, the alias will be created in the collection or library that is specified by the qualifier. If not qualified, the alias will be created in the same collection or library as the table or view for which the alias was created. If the table is not qualified and does not exist at the time the alias is created, the alias will be created in the current library (*CURLIB). The *owner* of the alias is the user profile or group user profile of the job invoking the statement.

If the owner of the alias is a member of a group profile (GRPPRF keyword) and group authority is specified (GRPAUT keyword), that group profile will also have authority to the alias.

If the alias name is not a valid system name, DB2 UDB for AS/400 will generate a system name. For information on the rules for generating a name, see “Rules for Table Name Generation” on page 361.

FOR *table-name* or *view-name*

Identifies the table or view at the current server for which the alias is to be created. An alias name cannot be specified (an alias cannot refer to another alias).

The *table-name* or *view-name* need not identify a table or view that exists at the time the alias is created. If the table or view does not exist when the alias is created, a warning is returned. If the table or view does not exist when the alias is used, an error is returned.

If SQL names were specified and the *table-name* or *view-name* was not qualified, then the qualifier is the implicit qualifier. For more information, see “Naming Conventions” on page 39.

If system names were specified and the *table-name* or *view-name* is not qualified and does not exist when the alias is created, the *table-name* or *view-name* is qualified by the library in which the alias is created.

member-name

Identifies a member of a database file.

If a member is specified, you can only use the alias in data manipulation (DML) SQL statements. If a member name is not specified, *FIRST is used.

Notes

An alias is created as a special form of a DDM file. If SQL names are used, aliases are created with the system authority of *EXCLUDE on *PUBLIC. If system names are used, aliases are created with the authority to *PUBLIC as determined by the create authority (CRTAUT) parameter of the collection or library.

The Override Database File (OVRDBF) CL command allows the database manager to process individual members of a database file. Creating an alias over a member of a database file, however, is easier and performs better by eliminating the need to perform the override.

An alias created over a distributed table is only created on the current server. For more information on distributed tables, see the DB2 Multisystem book.

Examples

Example 1

Create an alias named CURRENT_PROJECTS for the PROJECT table.

```
CREATE ALIAS CURRENT_PROJECTS
  FOR PROJECT
```

Example 2

Create an alias named SALES_JANUARY on the JANUARY member of the SALES table. The sales table has 12 members (one for each month of the year).

```
CREATE ALIAS SALES_JANUARY
  FOR SALES(JANUARY)
```

CREATE COLLECTION

The CREATE COLLECTION statement creates a collection in which tables, views, indexes, aliases, procedures, and packages can be created.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The *USE system authority to the following CL commands:
  - Create Library (CRTLIB)
  - If WITH DATA DICTIONARY is specified, Create Data Dictionary (CRTDTADCT)
- Administrative authority

Syntax

```
                     (1)
►►──CREATE COLLECTION──────collection-name──┬────────────────┬──────────────►
                                            └─IN ASP──integer─┘

►──┬──────────────────────┬─────────────────────────────────────────────────►◄
   └─WITH DATA DICTIONARY─┘
```

Notes:

1 The keyword DATABASE can be used as a synonym for COLLECTION.

Description

collection-name
Names the collection. The name must not be the name of an existing SQL collection or a library at the current server. The *owner* of the collection is the user profile or group user profile of the job executing the statement.

If the owner of the collection is a member of a group profile (GRPPRF keyword) and group authority is specified (GRPAUT keyword), that group profile will also have authority to the collection.

IN ASP *integer*
Specifies the auxiliary storage pool (ASP) in which to create the collection. The integer must be between 1 and 16. If 1 is specified, the collection is created on the system ASP. If this clause is omitted, an ASP of 1 is assumed.

WITH DATA DICTIONARY
If this clause is specified, an IDDU data dictionary is created in the collection.

Notes

A collection is created as:

- A library: A library groups related objects, and allows you to find objects by name.
- A catalog: A catalog contains descriptions of the tables, views, indexes, and packages in the collection. A catalog consists of a set of views and if WITH DATA DICTIONARY is specified, an IDDU data dictionary. For more information, see the SQL Programming Concepts book.
- A journal and journal receiver: A journal QSQJRN and journal receiver QSQJRN0001 is created in the collection, and is used to record changes to all tables subsequently created in the collection. For more information, see the book *Backup and Recovery*, SC41-5304-04.

If SQL names have been specified, the owner of the collection is the authorization ID of the statement. If system names have been specified, the owner of the collection is the user profile (or the group user profile of the job) invoking the statement.

If SQL names were specified when the collection is created, the system authority *EXCLUDE is initially given to *PUBLIC, and the library is created with the create authority parameter CRTAUT(*EXCLUDE). The owner is the only user having any authority to the collection. If other users require authority to the collection, the owner can grant authority to the objects created; using the CL command Grant Object Authority (GRTOBJAUT).

If system names were specified when the collection is created, the system authority given to *PUBLIC is determined by the system value QCRTAUT, and the library is created with CRTAUT(*SYSVAL). For more information on AS/400 system security, see the books *Security - Reference*, SC41-5302-04, and the SQL Programming Concepts book.

Example

Create a collection called DBTEMP.

```
CREATE COLLECTION DBTEMP
```

CREATE DISTINCT TYPE

The CREATE DISTINCT TYPE statement creates a distinct type. The distinct type is always sourced on one of the built-in data types. Successful execution of the statement also generates functions to cast between the distinct type and its source type and generates support for the comparison operators (=, <>, <, <=, >, and >=) for use with the distinct type.

Invocation

This statement can be embedded or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The system authorities *EXECUTE, *READ and *ADD to the library into which the distinct type is created, and
- Administrative authority

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the SYSTYPES catalog table:
  - The INSERT privilege on the table, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

The authorization ID of the statement has the INSERT privilege on a table when:

- It is the owner of the table,
- It has been granted the INSERT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *ADD on the table.

If SQL names are specified and a user profile exists that has the same name as the library into which the distinct type is created, and that name is different from the authorization ID of the statement, then the privileges held by the authorization ID of the statement must include at least one of the following:

- The system authority *ADD to the user profile with that name
- Administrative authority

Syntax

```
             ┌─DISTINCT─┐                                                  ┌─WITH COMPARISONS─┐
►►──CREATE───┴──────────┴──TYPE──distinct-type-name──AS──source-data-type──┴──────────────────┴──────►◄
```

source-data-type:

```
├──┬─BIGINT──────────────────────────────────────────────────────────────────────────────────────┬──┤
   ├─┬─INTEGER─┬─────────────────────────────────────────────────────────────────────────────────┤
   │ └─INT─────┘                                                                                 │
   ├─SMALLINT────────────────────────────────────────────────────────────────────────────────────┤
   ├─┬─DECIMAL─┬──┬─────────────────────────────────┬────────────────────────────────────────────┤
   │ ├─DEC─────┤  └─(──integer──┬────────────┬──)───┘                                            │
   │ └─NUMERIC─┘                └─, integer──┘                                                   │
   ├─┬─FLOAT──┬─────────────────┬──┬─────────────────────────────────────────────────────────────┤
   │ │        └─(──integer──)───┘  │                                                             │
   │ ├─REAL────────────────────────┤                                                             │
   │ │        ┌─PRECISION─┐        │                                                             │
   │ └─DOUBLE─┴───────────┴────────┘                                                             │
   ├───┬─BLOB────────────────┬───┬─────────────────────────┬─────────────────────────────────────┤
   │   └─BINARY LARGE OBJECT─┘   └─(──integer──┬───┬──)────┘                                     │
   │                                           ├─K─┤                                             │
   │                                           └─M─┘                                             │
   │                                                                                             │
   ├──┬──┬─CHARACTER─┬──┬─────────────────┬───────────────────┬──┬────────────────────┬───────────┤
   │  │  └─CHAR──────┘  └─(──integer──)───┘                   │  ├─FOR BIT DATA───────┤           │
   │  ├────┬─VARCHAR──────────────────────┬──(──integer──)────┤  ├─FOR SBCS DATA──────┤           │
   │  │    └─┬─CHARACTER─┬──VARYING───────┘                   │  ├─FOR MIXED DATA─────┤           │
   │  │      └─CHAR──────┘                                    │  └─CCSID──integer─────┘           │
   │  └───┬─CLOB─────────────────────┬──┬─────────────────────────┬──┘                           │
   │      ├─CHAR LARGE OBJECT────────┤  └─(──integer──┬───┬──)────┘                              │
   │      └─CHARACTER LARGE OBJECT───┘                ├─K─┤                                      │
   │                                                  └─M─┘                                      │
   ├──┬───GRAPHIC──┬─────────────────┬─────────┬──┬──────────────────┬───────────────────────────┤
   │  │            └─(──integer──)───┘         │  └─CCSID──integer───┘                           │
   │  ├────┬─VARGRAPHIC──────┬──(──integer──)──┤                                                 │
   │  │    └─GRAPHIC VARYING─┘                 │                                                 │
   │  └───DBCLOB──┬──────────────────────────┬─┘                                                 │
   │              └─(──integer──┬───┬──)─────┘                                                   │
   │                            ├─K─┤                                                            │
   │                            └─M─┘                                                            │
   ├─DATE────────────────────────────────────────────────────────────────────────────────────────┤
   ├─TIME────────────────────────────────────────────────────────────────────────────────────────┤
   ├─TIMESTAMP───────────────────────────────────────────────────────────────────────────────────┤
   └─DATALINK──┬─────────────────┬───┬──────────────────┬────────────────────────────────────────┘
               └─(──integer──)───┘   └─CCSID──integer───┘
```

Description

distinct-type-name

Names the distinct type. The name, including the implicit or explicit qualifier, must not be the same as a distinct type that already exists at the current server.

If SQL names were specified, the distinct type will be created in the collection or library specified by the implicit or explicit qualifier. The qualifier is the *owner* of the distinct type if a user profile with that name exists. Otherwise, the *owner* of the distinct type is the user profile or group user profile of the job invoking the statement.

If system names were specified, the distinct type will be created in the collection or library that is specified by the qualifier. If not qualified, the distinct type will be created in the current library (*CURLIB). The *owner* of the distinct type is the user profile or group user profile of the job invoking the statement.

If the owner of the distinct type is a member of a group profile (GRPPRF keyword) and group authority is specified (GRPAUT keyword), that group profile will also have authority to the distinct type.

If the distinct type name is not a valid system name, DB2 UDB for AS/400 will generate a system name. For information on the rules for generating a name, see “Rules for Table Name Generation” on page 361.

distinct-type-name must not be the name of a built-in data type, or any of the following system-reserved keywords even if you specify them as delimited identifiers.

=	<	>	>=
<=	<>	¬=	¬<
¬<	!=	!<	!>
ALL	FALSE	ONLY	TABLE
AND	FOR	OR	THEN
ANY	FROM	OVERLAPS	TRIM
BETWEEN	IN	PARTITION	TRUE
BOOLEAN	IS	POSITION	TYPE
CASE	LIKE	RRN	UNIQUE
CAST	MATCH	SELECT	UNKNOWN
CHECK	NODENAME	SIMILAR	WHEN
DISTINCT	NODENUMBER	SOME	
EXCEPT	NOT	STRIP	
EXISTS	NULL	SUBSTRING	

If a qualified *distinct-type-name* is specified, the collection name cannot be QSYS, QSYS2, or QTEMP.

source-data-type
Specifies the data type that is used as the basis for the internal representation of the distinct type. The data type must be a built-in data type. You can use any of the built-in data types that are allowed for the CREATE TABLE statement except for LONG VARCHAR or LONG VARGRAPHIC. For more information about data types see “CREATE TABLE” on page 340.

WITH COMPARISONS
Specifies that system-generated comparison operators are to be created for comparing two instances of the distinct type. WITH COMPARISONS is the default. Comparisons will be generated for all source types with the exception of a DATALINK whether or not WITH COMPARISONS is specified. For compatibility with other DB2 products, WITH COMPARISONS should be specified.

Notes

A distinct type is created as a *SQLUDT object. If SQL names are used, distinct types are created with the system authority of *EXCLUDE to *PUBLIC. If system names are used, distinct types are created with the authority to *PUBLIC as determined by the create authority (CRTAUT) parameter of the collection or library.

The successful execution of the CREATE DISTINCT TYPE statement causes DB2 to generate the following cast functions:

- One function to convert from the distinct type to the source type
- One function to convert from the source type to the distinct type
- One function to convert from INTEGER to the distinct type if the source type is SMALLINT
- One function to convert from DOUBLE to the distinct type if the source type is REAL
- one function to convert from VARCHAR to the distinct type if the source type is CHAR
- one function to convert from VARGRAPHIC to the distinct type if the source type is GRAPHIC.

The cast functions are created as if the following statements were executed:

```
CREATE FUNCTION distinct-type-name (source-type-name)
  RETURNS distinct-type-name

CREATE FUNCTION source-type-name (distinct-type-name)
  RETURNS source-type-name
```

Even if you specified a length, precision, or scale for the source data type in the CREATE DISTINCT TYPE statement, the name of the cast function that converts from the distinct type to the source type is simply the name of the source data type. The data type of the value that the cast function returns includes any length, precision, or scale values that you specified for the source data type. (See Table 23 on page 300.)

The name of the cast function that converts from the source type to the distinct type is the name of the distinct type. The input parameter of the cast function has the same data type as the source data type, including the length, precision, and scale.

For example, assume that a distinct type named T_SHOESIZE is created with the following statement:

```
CREATE DISTINCT TYPE CLAIRE.T_SHOESIZE AS VARCHAR(2) WITH COMPARISONS
```

When the statement is executed, DB2 also generates the following cast functions. VARCHAR converts from the distinct type to the source type, and T_SHOESIZE converts from the source type to the distinct type.

```
FUNCTION CLAIRE.VARCHAR (CLAIRE.T_SHOESIZE) RETURNS VARCHAR(2)

FUNCTION CLAIRE.T_SHOESIZE (VARCHAR(2) RETURNS CLAIRE.T_SHOESIZE
```

Notice that function VARCHAR returns a value with a data type of VARCHAR(2) and that function T_SHOESIZE has an input parameter with a data type of VARCHAR(2).

The schema of the generated cast functions is the same as the collection of the distinct type. A function with the same name and function signature must not already exist in the collection.

You cannot explicitly drop a generated cast function. The cast functions that are generated for a distinct type are implicitly dropped when the distinct type is dropped with the DROP statement.

For each built-in data type that can be the source data type for a distinct type, the following table gives the names of the generated cast functions, the data types of the input parameters, and the data types of the values that the functions returns.

Table 23. CAST Functions on Distinct Types

Source Type Name	**Function Name**	**Parameter Type**	**Return Type**
BLOB	distinct	BLOB(n)	distinct
	BLOB	distinct	BLOB(n)
CHAR	distinct	CHAR(n)	distinct
	CHAR	distinct	CHAR(n)
	distinct	VARCHAR(n)	distinct
VARCHAR	distinct	VARCHAR(n)	distinct
	VARCHAR	distinct	VARCHAR(n)
CLOB	distinct	CLOB(n)	distinct
	CLOB	distinct	CLOB(n)
GRAPHIC	distinct	GRAPHIC(n)	distinct
	GRAPHIC	distinct	GRAPHIC(n)
	distinct	VARGRAPHIC(n)	distinct
VARGRAPHIC	distinct	VARGRAPHIC(n)	distinct
	VARGRAPHIC	distinct	VARGRAPHIC(n)
DBCLOB	distinct	DBCLOB(n)	distinct
	DBCLOB	distinct	DBCLOB(n)
SMALLINT	distinct	SMALLINT	distinct
	SMALLINT	distinct	SMALLINT
	distinct	INTEGER	distinct
INTEGER	distinct	INTEGER	distinct
	INTEGER	distinct	INTEGER
BIGINT	distinct	BIGINT	distinct
	BIGINT	distinct	BIGINT
DECIMAL	distinct	DECIMAL(p,s)	distinct
	DECIMAL	distinct	DECIMAL(p,s)
NUMERIC	distinct	NUMERIC(p,s)	distinct
	NUMERIC	distinct	NUMERIC(p,s)
REAL	distinct	REAL	distinct
	REAL	distinct	REAL
	distinct	DOUBLE	distinct
FLOAT(n) where n <= 24	distinct	REAL	distinct
	REAL	distinct	REAL
	distinct	DOUBLE	distinct

Table 23. CAST Functions on Distinct Types (continued)

Source Type Name	Function Name	Parameter Type	Return Type
FLOAT(n) where n > 24	distinct	DOUBLE	distinct
	DOUBLE	distinct	DOUBLE
DOUBLE or DOUBLE PRECISION	distinct	DOUBLE	distinct
	DOUBLE	distinct	DOUBLE
DATE	distinct	DATE	distinct
	DATE	distinct	DATE
TIME	distinct	TIME	distinct
	TIME	distinct	TIME
TIMESTAMP	distinct	TIMESTAMP	distinct
	TIMESTAMP	distinct	TIMESTAMP
DATALINK	distinct	DATALINK	distinct
	DATALINK	distinct	DATALINK
Notes: * Conversion is only supported for UCS-2 graphic. Only a DATALINK can be cast to a DATALINK type.			

NUMERIC and FLOAT are not recommended when creating a distinct type for a portable application. DECIMAL and DOUBLE should be used instead.

Examples

Example 1

Create a distinct type named SHOESIZE that is sourced on an INTEGER data type.

```
CREATE DISTINCT TYPE SHOESIZE AS INTEGER WITH COMPARISONS
```

The successful execution of this statement also generates two cast functions. Function INTEGER(SHOESIZE) returns a value with data type INTEGER, and function SHOESIZE(INTEGER) returns a value with distinct type SHOESIZE.

Example 2

Create a distinct type named MILES that is sourced on a DOUBLE data type.

```
CREATE DISTINCT TYPE MILES AS DOUBLE WITH COMPARISONS
```

The successful execution of this statement also generates two cast functions. Function DOUBLE(MILES) returns a value with data type DOUBLE, and function MILES(DOUBLE) returns a value with distinct type MILES.

CREATE FUNCTION

You can use the CREATE FUNCTION statement to create a user-defined function which is registered with the application server.

Invocation

You can embed this statement in an application program, or you can issue this statement interactively. It is an executable statement that can be dynamically prepared.

You can create two different types of functions when using this statement:

- External or SQL Scalar

  The function is written in a programming language and returns a scalar value. The external executable is registered in the database along with various attributes of the function.
- Sourced

  The function is implemented by invoking another function (either built-in, external, or sourced) that is already registered in the database.

Notes

Choosing data types for input parameters

When you choose the data types of the input parameters for your function, consider the rules of promotion that can affect the values of the input parameters (See “Promotion of Data Types” on page 62). For example, a constant that is one of the input arguments to the function might have a built-in data type that is different from the data type that the function expects, and more significantly, might not be promotable to that expected data type. Based on the rules of promotion, we recommend using the following data types for parameters:

- INTEGER instead of SMALLINT
- DOUBLE instead of REAL
- VARCHAR instead of CHAR
- VARGRAPHIC instead of GRAPHIC

For portability of functions across platforms that are not DB2 UDB for AS/400, do not use the following data types, which might have different representations on different platforms:

- FLOAT. Use DOUBLE or REAL instead.
- NUMERIC. Use DECIMAL instead.

Determining the uniqueness of functions in a collection

At the current server, each function signature must be unique. The signature of a function is the qualified function name combined with the number and data types of the input parameters. This means that two different collections can each contain a function with the same name that have the same data types for all of their corresponding data types. However, a collection must not contain two functions with the same name that have the same data types for all of their corresponding data types.

When determining whether corresponding data types match, DB2 does not consider any length, precision, scale, or CCSID attributes in the comparison. DB2 considers the synonyms of data types (REAL and FLOAT, and DOUBLE and FLOAT) a match. Therefore, CHAR(8) and CHAR(35) are considered to be the same, as are DECIMAL(11,2) and DECIMAL(4,3).

Assume that the following statements are executed to create four functions in the same collection. The second and fourth statements fail because they create functions that are duplicates of the functions that the first and third statements created.

```
CREATE FUNCTION PART (INT, CHAR(15) ...
CREATE FUNCTION PART (INTEGER, CHAR(40) ...

CREATE FUNCTION ANGLE (DECIMAL(12,2)) ...
CREATE FUNCTION ANGLE (DECIMAL(12,2)) ...
```

Overriding a built-in function

Giving a user-defined function the same name as a built-in function is not a recommended practice unless you are trying to override (change the functionality) of the built-in function.

If you do use a user-defined function to override a built-in function, be careful to maintain the uniqueness of its function signature. If your function has the same name and data types of the corresponding parameters of the built-in function but implements different logic, DB2 might choose the wrong function when the function is invoked with an unqualified function name. Thus, the application might fail, or perhaps even worse, run successfully but provide an inappropriate result.

CREATE FUNCTION (Scalar)

This CREATE FUNCTION statement creates either an external function or an SQL function. The function returns a single result.

Authorization

The privileges held by the authorization id of the statement must include at least one of the following:

- For the SYSFUNCS catalog view and SYSPARMS catalog table:
  - The INSERT privilege on the table, and
  - The system authority *EXECUTE on library QSYS2
- Administrative Authority

The authorization ID of the statement has the INSERT privilege on a table when:

- It is the owner of the table,
- It has been granted the INSERT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *ADD on the table.

For external functions, if the external program or service program exists, the privileges held by the authorization ID of the statement must include at least one of the following:

- For the external program or service program that is referenced in the SQL statement:
  - The system authority *EXECUTE on the library that contains the external program or service program.
  - The system authority *EXECUTE on the external program or service program, and
  - The system authority *CHANGE on the program or service program. The system needs this authority to update the program object to contain the

information necessary to save/restore the function to another system. If user does not have this authority, the function is still created, but the program object is not updated.

- Administrative Authority

To create an SQL function, the privileges held by the authorization ID of the statement must also include at least one of the following:

- The following system authorities:
  - *USE to the Create Structured Query Language ILE C (CRTSQLCI) command
  - *USE to the Create ILE C/400 Module (CRTCMOD) command
  - *USE to the Create Service Program (CRTSRVPGM) command or
  - *EXECUTE and *ADD to the library into which the function is created.
- Administrative authority

If SQL names are specified and a user profile exists that has the same name as the library into which the function is created, and that name is different from the authorization ID of the statement, then the privileges held by the authorization ID of the statement must include at least one of the following:

- The system authority *ADD to the user profile with that name
- Administrative authority

Syntax

```
►►──CREATE FUNCTION──function-name──────────────────────────────────────────────────►

►──(──┬───────────────────────────────────────────────────────────────┬──)──────────►
      │ ┌─,─────────────────────────────────────────────────────────┐ │
      │ ▼                                                           │ │
      └───┬────────────────┬──data-type1──┬─────────────────┬──┬────────┬─┴─┘
          └─parameter-name─┘              │            (2)  │  └─RESULT─┘
                                          └─AS LOCATOR──────┘

►──RETURNS──┬─data-type2──┬─────────────────┬──────────────┬────────────────────────►
            │             │            (2)  │              │
            │             └─AS LOCATOR──────┘              │
            └─data-type3──CAST FROM──data-type4──┬─────────────────┬──┘
                                                 │            (2)  │
                                                 └─AS LOCATOR──────┘

                                                                         (3)
                                                     ┌─NOT DETERMINISTIC──────┐
►──┬─────────────────────────┬──┬──────────────────────────┬──┼────────────────────────┼──►
   │           (1)           │  └─SPECIFIC──specific-name──┘  │ ┌─IS─┐                 │
   └─LANGUAGE────┬─C───────┬─┘                                └─┴────┴──DETERMINISTIC──┘
                 ├─C++─────┤
                 ├─CL──────┤
                 ├─COBOL───┤
                 ├─COBOLLE─┤
                 ├─PLI─────┤
                 ├─RPG─────┤
                 ├─RPGLE───┤
                 └─SQL─────┘
                                                      (4)
   ┌─READS SQL DATA─────┐  ┌─FENCED─────┐  ┌─CALLED ON NULL INPUT────────────┐  ┌─EXTERNAL ACTION────┐
►──┼────────────────────┼──┼────────────┼──┼─────────────────────────────────┼──┼────────────────────┼──►
   ├─NO SQL─────────────┤  └─NOT FENCED─┘  │                            (5)  │  └─NO EXTERNAL ACTION─┘
   ├─CONTAINS SQL───────┤                  └─RETURNS NULL ON NULL INPUT──────┘
   └─MODIFIES SQL DATA──┘
   ┌─NO SCRATCHPAD──────────┐  ┌─NO FINAL CALL─┐  ┌─DISALLOW PARALLEL─┐  ┌─NO DBINFO─┐
►──┼────────────────────────┼──┼───────────────┼──┼───────────────────┼──┼───────────┼──►
   └─SCRATCHPAD──┬─────────┬┘  └─FINAL CALL────┘  └─ALLOW PARALLEL────┘  └─DBINFO────┘
                 └─integer─┘

►──┬───────────────────┬──┬─external-function-body─┬────────────────────────────────►◄
   └─STATIC DISPATCH───┘  └─function-body──────────┘
```

Notes:

1 The optional clauses can be specified in a different order. If LANGUAGE SQL is specified, it must immediately follow the RETURNS clause.

2 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

3 The keywords VARIANT and NOT VARIANT can be used as a synonym for NOT DETERMINISTIC and DETERMINISTIC.

4 The keywords NULL CALL can be used as a synonym for CALLED ON NULL INPUT.

5 The keywords NOT NULL CALL can be used as a synonym for RETURNS NULL ON NULL INPUT.

external-function-body:

```
   ┌─EXTERNAL──────────────────────────────┐  ┌─PARAMETER STYLE─┐   ┌─SQL────────────────┐  (1)
├──┼───────────────────────────────────────┼──┴─────────────────┴───┼────────────────────┼────────────┤
   └─EXTERNAL NAME──external-program-name──┘                        ├─DB2SQL─────────────┤
                                                                    ├─GENERAL────────────┤
                                                                    └─GENERAL WITH NULLS─┘
```

function-body:

```
├──SQL-routine-body──────────────────────────────────────────────────────────────────────┤
```

Notes:

1 The keywords SIMPLE CALL can be used as a synonym for GENERAL.

data-type:

```
├──┬─BIGINT─────────────────────────────────────────────────────────────────────────────┬──┤
   ├─┬─INTEGER─┬────────────────────────────────────────────────────────────────────────┤
   │ └─INT─────┘                                                                        │
   ├─SMALLINT───────────────────────────────────────────────────────────────────────────┤
   ├─┬─DECIMAL─┬──┬──────────────────────────────────┬──────────────────────────────────┤
   │ ├─DEC─────┤  └─(──integer──┬──────────────┬──)──┘                                  │
   │ └─NUMERIC─┘                └─, integer────┘                                        │
   ├─┬─FLOAT──┬──────────────────┬─┬────────────────────────────────────────────────────┤
   │ │        └─(──integer──)────┘ │                                                    │
   │ ├─REAL────────────────────────┤                                                    │
   │ │        ┌─PRECISION─┐        │                                                    │
   │ └─DOUBLE─┴───────────┴────────┘                                                    │
   ├──┬─BLOB────────────────┬──┬─────────────────────────────┬──────────────────────────┤
   │  └─BINARY LARGE OBJECT─┘  └─(──integer──┬─────┬──)──────┘                          │
   │                                         ├─K───┤                                    │
   │                                         └─M───┘                                    │
   ├──┬──┬─CHARACTER─┬──┬──────────────────┬──────────────┬──┬───────────────────┬──────┤
   │  │  └─CHAR──────┘  └─(──integer──)────┘              │  ├─FOR BIT DATA──────┤      │
   │  ├────┬─VARCHAR─────────────────────┬─(──integer──)──┤  ├─FOR SBCS DATA─────┤      │
   │  │    └──┬─CHARACTER─┬──VARYING─────┘                │  ├─FOR MIXED DATA────┤      │
   │  │       └─CHAR──────┘                               │  └─CCSID──integer────┘      │
   │  └────┬─CLOB───────────────────┬──┬────────────────────────────┬──┘                │
   │       ├─CHAR LARGE OBJECT──────┤  └─(──integer──┬─────┬──)─────┘                   │
   │       └─CHARACTER LARGE OBJECT─┘                ├─K───┤                            │
   │                                                 └─M───┘                            │
   ├──┬──GRAPHIC──┬──────────────────┬────────┬──┬───────────────────┬──────────────────┤
   │  │           └─(──integer──)────┘        │  └─CCSID──integer────┘                  │
   │  ├────┬─VARGRAPHIC──────┬──(──integer──)─┤                                         │
   │  │    └─GRAPHIC VARYING─┘                │                                         │
   │  └──DBCLOB──┬─────────────────────────┬──┘                                         │
   │             └─(──integer──┬─────┬──)──┘                                            │
   │                           ├─K───┤                                                  │
   │                           └─M───┘                                                  │
   ├─DATE───────────────────────────────────────────────────────────────────────────────┤
   ├─TIME───────────────────────────────────────────────────────────────────────────────┤
   ├─TIMESTAMP──────────────────────────────────────────────────────────────────────────┤
   ├─DATALINK──┬──────────────────┬──┬───────────────────┬──────────────────────────────┤
   │           └─(──integer──)────┘  └─CCSID──integer────┘                              │
   └─distinct-type──────────────────────────────────────────────────────────────────────┘
```

Description

function-name

Names the user-defined function. The combination of name, collection name, the number of parameters, and the data type of each parameter (without regard for any length, precision, scale, or CCSID attributes of the data type) must not identify a user-defined function that exists at the current server. The specified function information is added to the catalog tables SYSROUTINES and SYSPARMS.

For SQL naming, the function will be created in the collection or library specified by the implicit or explicit qualifier. The qualifier is the *owner* of the function is a user profile with that name exists. Otherwise the *owner* is the user profile or group user profile of the job executing the statement.

For system naming, the function will be created in the collection or library that is specified by the qualifier. If no qualifier is specified, the function will be created in the current library (*CURLIB). If there is no current library, the function will be created in QGPL. The *owner* of the function is the user profile or group user profile of the job executing the statement.

In general, more than one function can have the same name if the function signature of each function is unique.

The collection name cannot be QSYS2, QSYS, or QTEMP. The name cannot be one of the following names reserved for system use:

=
<=
¬<
ALL
AND
ANY
BETWEEN
BOOLEAN
CASE
CAST
CHECK
DISTINCT
EXCEPT
EXISTS
<
<>
!=
FALSE
FOR
FROM
IN
IS
LIKE
MATCH
NODENAME
NODENUMBER
NOT
NULL
>
¬=
!>
ONLY
OR
OVERLAPS
PARTITION
POSITION
RRN
SELECT
SIMILAR
SOME
STRIP
SUBSTRING
>=
¬<
!<
TABLE
THEN
TRIM
TRUE
TYPE
UNIQUE
UNKNOWN
WHEN

(data-type1,...)
Specifies the number of input parameters of the function and the data type of each input parameter. All the parameters for a function are input parameters. There must be one entry in the list for each parameter that the function expects to receive. Although not required, you can give each parameter a name. DataLinks are not allowed for external functions.

A function can have no parameters. In this case, you must code an empty set of parentheses, for example:

```
CREATE FUNCTION WOOFER()
```

If a CCSID is specified, the parameter will be converted to that CCSID prior to passing it to the function.

parameter-name
Specifies the name of the input parameter. Do not specify the same name more than once. A parameter name must be specified for parameters in SQL functions.

AS LOCATOR
Specifies that the input parameter is a locator to the value rather than the actual value. You can specify AS LOCATOR only if the input parameter has a LOB data type or a distinct type based on a LOB data type. The AS LOCATOR clause is not allowed for SQL functions.

RESULT
RESULT may be specified for at most one parameter. The parameter type must be a user-defined-type, and the data type on the RETURNS clause must also specify the user-defined type.

RETURNS
Specifies the output of the function.

data-type2
Specifies the data type and attributes of the output.

You can specify any built-in data type (except LONG VARCHAR, LONG VARGRAPHIC, or DataLink) or a distinct type (that is not based on a DataLink).

If a CCSID is specified, the result returned is assumed to be encoded in that CCSID.

data-type3 **CAST FROM** *data-type4*
Specifies the data type and attributes of the output (*data-type4*) and the data type in which that output is returned to the invoking statement (*data-type3*). The two data types can be different. For example, for the following definition, the function returns a CHAR(10) value, which DB2 converts to a DATE value and then passes to the statement that invoked the function:

```
CREATE FUNCTION GET_HIRE_DATE (CHAR6)
  RETURNS DATE CAST FROM CHAR(10)
```

The value of *data-type4* must not be a distinct type and must be castable to *data-type3*. The value for *data-type3* can be any built-in data type or distinct type. (For information on casting data types, see "Casting Between Data Types" on page 63).

If a CCSID is specified, the result returned is assumed to be encoded in that CCSID.

This form is not valid for the RETURNS clause of SQL functions.

AS LOCATOR
Specifies that the function returns a locator to the value rather than the actual value. You can specify AS LOCATOR only if the output from the function has a LOB data type or a distinct type based on a LOB data type. The AS LOCATOR clause is not allowed for SQL functions.

SPECIFIC *specific-name*
Provides a unique name for the function. The name is implicitly or explicitly qualified with a collection name. The name, including the collection name, must not identify the specific name of another function that exists at the current server. If unqualified, the implicit qualifier is the same as the qualifier of the function name. If qualified, the qualifier must be the same as the qualifier of the function name.

If specific name is not specified, it is set to the function name. If a function or procedure with that specific name already exists, a unique name is generated similar to the rules used to generate unique table names.

LANGUAGE (language clause)
If a function body is specified, LANGUAGE SQL must be specified. If an external function body is specified, the language clause specifies the language of the external program.

If LANGUAGE is not specified, the LANGUAGE is determined from the program attribute information associated with the external program at the time the function is created. The language of the program is assumed to be C if:

- The program attribute information associated with the program does not identify a recognizable language
- The program cannot be found

C
The external program is written in C.

C++
The external program is written in C++.

CL
The external program is written in CL or ILE CL.

COBOL
The external program is written in COBOL.

COBOLLE
The external program is written in ILE COBOL/400.

FORTRAN
The external program is written in FORTRAN.

PLI
The external program is written in PL/I.

RPG
The external program is written in RPG.

RPGLE
The external program is written in ILE RPG/400.

SQL
An SQL function is being created or referenced. If SQL is specified, an SQL function body must be specified.

DETERMINISTIC or NOT DETERMINISTIC
Indicates whether the function is deterministic.

NOT DETERMINISTIC
Specifies that the function will not always return the same result from successive function invocations with identical input arguments.

DETERMINISTIC
Specifies that the function will always return the same result from successive invocations with identical input arguments.

CONTAINS SQL, READS SQL DATA, MODIFIES SQL DATA, or NO SQL
Indicates whether the function contains SQL, reads SQL data, or modifies SQL data.

CONTAINS SQL
Indicates that the function contains SQL. The function can only contain:

- Non-executable statements (such as DECLARE statements),
- CALL statements to procedures with a NO SQL or CONTAINS SQL attribute,
- FREE LOCATOR,
- SET RESULT SET, and
- SET assignment and VALUES INTO as long as a only variables or constants are referenced.

NO SQL
Indicates that the external function does not contain SQL data. NO SQL cannot be specified for an SQL function.

READS SQL DATA
Indicates that the function possibly reads data using SQL. The function can contain any SQL statement other than:

- COMMIT, ROLLBACK, or SET TRANSACTION
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION
- DELETE, INSERT, or UPDATE
- ALTER TABLE, COMMENT ON, any CREATE statement, DROP, any GRANT statement, LABEL ON, RENAME, or any REVOKE statement

MODIFIES SQL DATA
Indicates that the function possibly modifies data using SQL. The function can contain any SQL statement other than:

- COMMIT, ROLLBACK, or SET TRANSACTION
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION

FENCED or NOT FENCED
This parameter is allowed for compatibility with other products and is not used by DB2 UDB for AS/400.

NULL INPUT
Indicates whether the function needs to be called if an input parameter is NULL.

CALLED ON NULL INPUT
Always call the function.

RETURNS NULL ON NULL INPUT
The function need not be called if a null value is passed and the output of the function would be the NULL value.

EXTERNAL ACTION or NO EXTERNAL ACTION
This parameter implies that the function performs some external action (outside the scope of the function program). Thus, the function must be invoked with each successive function invocation.

SCRATCHPAD
Indicates whether the function requires a static memory area.

SCRATCHPAD *integer*
Indicates that the function requires a persistent memory area of length integer. The integer can range from 1 to 16,000,000. If the memory area is not specified, the size of the area is 100 bytes. If parameter style DB2SQL is specified, a pointer is passed following the required parameters that points to a static storage area. If PARALLEL is specified, a memory area is allocated for each user-defined function reference in the statement. If DISALLOW PARALLEL is specified, only 1 memory area will be allocated for the function.

The scope of a scratchpad is the SQL statement. For each reference to the function in an SQL statement, there is one scratchpad. For example, assuming that function UDFX was defined with the SCRATCHPAD keyword, three scratchpads are allocated for the three references to UDFX in the following SQL statement:

```
SELECT A, UDFX(A) FROM TABLEB
  WHERE UDFX(A) > 103 OR UDFX(A) < 19
```

If the function is run under parallel tasks, one scratchpad is allocated for each parallel task of each reference to the function in the SQL statement. This can lead to unpredictable results. For example, if a function uses the scratchpad to count the number of times that it is invoked, the count reflects the number of invocations done by the parallel task and not the SQL statement. Specify the DISALLOW PARALLEL clause for functions that will not work correctly with parallelism.

SCRATCHPAD is only allowed with PARAMETER STYLE DB2SQL.

NO SCRATCHPAD
Indicates that the function does not require a persistent memory area.

FINAL CALL
Indicates whether the function requires special call indication. If PARAMETER STYLE DB2SQL is specified, an additional parameter is passed to the function indicating first call, normal call, or final call.

FINAL CALL
Indicates that the function requires a parameter to be passed indicating whether the call is the first call, a normal call, or the final call. FINAL CALL is only allowed with PARAMETER STYLE DB2SQL.

NO FINAL CALL
Indicates that the function does not require the special call parameter.

PARALLEL
Indicates whether the function can be run in parallel.

DISALLOW PARALLEL
Indicates that the function cannot be run in parallel.

ALLOW PARALLEL
Indicates that the function can be run in parallel.

DBINFO
Indicates whether or not the function requires the database information be passed.

DBINFO
Indicates that the database manager should pass a structure to the function which contains the following information:

- Relational database name - the name of the current server.
- Authorization ID - the run-time authorization ID.
- CCSID - identifies the CCSID of the job. If a CCSID is not explicitly specified for a parameter on the CREATE FUNCTION statement, the input string is assumed to be encoded in this CCSID and the string is passed without conversion to the external program. If a CCSID is explicitly specified for a parameter on the CREATE FUNCTION statement, the input string passed to the external function will be converted to the explicitly specified CCSID before calling the external program.
- Target column - If a user-defined function is specified on the right-hand side of a SET clause in an UPDATE statement, the following information identifies the target column:
  - Collection name
  - Base table name
  - Column name

If the user-defined function is not on the right-hand side of a SET clause in an UPDATE statement, these fields are blank.

- Version and release - identifies the version, release, and modification level of the database manager.
- Platform - contains the server's platform type.

DBINFO is only allowed with PARAMETER STYLE DB2SQL.

NO DBINFO

Indicates that the function does not require the database information to be passed.

STATIC DISPATCH

Must be specified if a parameter is specified that is a user-defined type.

external-function-body

Specifies an external function

EXTERNAL NAME *external-program-name*

Specifies the program or service program that will be executed when the function is invoked in an SQL statement. The name must identify a program or service program that exists at the application server at the time the function is invoked. If the naming option is *SYS and the name is not qualified, the current path will be used to search for the program or service program at the time the function is invoked.

The validity of the name is checked at the application server. If the format of the name is not correct, an error is returned.

If external-program-name is not specified, the external program name is assumed to be the same as the function name.

The program or service program need not exist at the time the function is created, but it must exist at the time the function is invoked.

PARAMETER STYLE

Defines the parameter passing convention for function. If you specify the PARAMETER STYLE keywords, you must specify one of the following:

SQL

All applicable parameters are passed. The parameters are defined to be in the following order:

- The first N parameters are the input parameters that are specified on the CREATE FUNCTION statement.
- A parameter for the result of the function.
- N parameters for indicator variables for the input parameters.
- A parameter for the indicator variable for the result.
- A CHAR(5) output parameter for SQLSTATE. The SQLSTATE returned indicates the success or failure of the function. The SQLSTATE returned either be:
  - the SQLSTATE from the last SQL statement executed in the external program,
  - an SQLSTATE that is assigned by the external program.

    The user may set the SQLSTATE in the external program to return an error or warning from the function. In this case, the SQLSTATE must contain:
    - '00000' to indicate success;

    - ’01Hxx’, where xx is any two digits or uppercase letters, to indicate a warning; or
    - ’38yxx’, where y is an uppercase letter between ’I’ and ’Z’ and xx is any two digits or uppercase letters, to indicate an error.
- A VARCHAR(517) input parameter for the fully qualified function name.
- A VARCHAR(128) input parameter for the specific name.
- A VARCHAR(70) output parameter for the message text.

GENERAL

All applicable parameters are passed. The parameters are defined to be in the following order:

- The first N parameters are the input parameters that are specified on the CREATE FUNCTION statement.

Note that the result is returned through as a value of a value returning function. For example:

```
return_val func(parameter-1, parameter-2, ...)
```

GENERAL is only allowed when EXTERNAL NAME identifies a service program.

GENERAL WITH NULLS

All applicable parameters are passed. The parameters are defined to be in the following order:

- The first N parameters are the input parameters that are specified on the CREATE FUNCTION statement.
- An additional argument is passed for an indicator variable array.
- A parameter for the indicator variable for the result.

Note that the result is returned through as a value of a value returning function. For example:

```
return_val func(parameter-1, parameter-2, ...)
```

GENERAL WITH NULLS is only allowed when EXTERNAL NAME identifies a service program.

DB2SQL

All applicable parameters are passed. The parameters are defined to be in the following order:

- The first N parameters are the input parameters that are specified on the CREATE FUNCTION statement.
- A parameter for the result of the function.
- N parameters for indicator variables for the input parameters.
- A parameter for the indicator variable for the result.
- A CHAR(5) output parameter for SQLSTATE. The SQLSTATE returned indicates the success or failure of the function. The SQLSTATE returned either be:
    - the SQLSTATE from the last SQL statement executed in the external program,
    - an SQLSTATE that is assigned by the external program.

      The user may set the SQLSTATE in the external program to return an error or warning from the function. In this case, the SQLSTATE must contain:

        - ’00000’ to indicate success;
        - ’01Hxx’, where xx is any two digits or uppercase letters, to indicate a warning; or
        - ’38yxx’, where y is an uppercase letter between ’I’ and ’Z’ and xx is any two digits or uppercase letters, to indicate an error.
    - A VARCHAR(517) input parameter for the fully qualified function name.
    - A VARCHAR(128) input parameter for the specific name.
    - A VARCHAR(70) output parameter for the message text.
    - Zero to three optional parameters:
        - The scratchpad, if SCRATCH PAD was specified on the CREATE FUNCTION statement.
        - A parameter for the call type, if FINAL CALL was specified on the CREATE FUNCTION statement.
        - A parameter for the dbinfo structure, if DBINFO was specified on the CREATE FUNCTION statement.

SQL-routine-body
Specifies a single SQL statement, including a compound statement. See “Chapter 6. SQL Procedures and Functions” on page 513 for more information on defining SQL functions.

Notes

CONNECT, SET CONNECTION, RELEASE, DISCONNECT, COMMIT, ROLLBACK and SET TRANSACTION statements are not allowed in a function.

The maximum number of parameters allowed in CREATE FUNCTION is 90. For external functions created with PARAMETER STYLE SQL and for SQL functions, the input and result parameters specified and the implicit parameters for indicators, SQLSTATE, function name, specific name, and message text, as well as any optional parameters are included. The maximum number of parameters is also limited by the maximum number of parameters allowed by the licensed program that is used to compile the external program or service program.

When an SQL function or an external function associated with an ILE external program or service program is created, an attempt is made to save the function’s attributes in the associated program or service program object. If the *PGM or *SRVPGM object is saved and then restored to this or another system, the catalogs are automatically updated with those attributes.

The attributes can always be saved for SQL functions. The attributes can be saved for external functions subject to the following restrictions:
- The external program library must not be QSYS or QSYS2.
- The external program must exist when the CREATE FUNCTION statement is issued.
- The external program must be an ILE *PGM or *SRVPGM object.
- The external program or service program must contain at least one SQL statement.

During restore of the function:
- If the specific name was specified when the function was originally created and it is not unique, an error is issued.

- If the specific name was not specified, a unique name is generated if necessary.
- If the signature is not unique, the function cannot be registered, and an error is issued.

Notes for SQL Functions

When an SQL function is created, SQL creates a temporary source file that will contain C source code with embedded SQL statements. A *SRVPGM object is then created using the CRTSQLCI, CRTCMOD, and CRTSRVPGM commands. The options used to create the service program are the options that are in effect at the time the CREATE FUNCTION statement is executed. The DB2 UDB Query Manager and SQL Development Kit and ILE C products must be installed on the system when the SQL function is created. OS/400 Option 13, System Openness Includes must also be installed.

When an SQL function is invoked, it runs in the activation group of the calling program.

If a function is specified in the select-list of a select-statement and if the function specifies EXTERNAL ACTION or MODIFIES SQL DATA, the function will only be invoked for each row returned. Otherwise, the UDF may be invoked for rows that are not selected.

The specific name is used to determine the name of the source file member and *SRVPGM object. If the specific name is a valid system name, it will used as the name of member and program. If the member already exists, it will be overlaid. If a program already exists in the specified library, a unique name is generated using the rules for generating system table names. If the specific name is not a valid system name, a unique name is generated using the rules for generating system table names.

If the tables specified in a routine body exist, all references in the routine body of an SQL routine are resolved to identify a particular column, SQL parameter, or SQL variable at the time the SQL routine is created. If the tables do not exist, all names that exist as SQL variables or parameters are resolved to identify the variable or parameter when the function is created. The remaining names are assumed to be columns bound to the tables when the function is invoked.

If duplicate names are used for columns and SQL variables and parameters, qualify the duplicate names by using the table designator for columns, the function name for parameters, and the label name for SQL variables.

Notes for External Functions

When an external function is invoked, it runs in whatever activation group was specified when the external program or service program was created. However, ACTGRP(*CALLER) should normally be used so that the function runs in the same activation group as the calling program. ACTGRP(*NEW) is not allowed.

When creating an external function, if the external program exists and is an ILE *PGM or *SRVPGM object, an attempt is made to add the information specified on the CREATE FUNCTION statement to the actual program object. If the information is saved, when the object is saved and restored to another system, it will automatically be registered into the catalogs. If the object cannot be updated, the function will still be created.

Example 1

Assume that you want to write an external function service program in C that implements the following logic:

```
output = 2 * input - 4
```

The function should return a null value if and only if one of the input arguments is null. The simplest way to avoid a function call and get a null result when an input value is null is to specify RETURNS NULL ON NULL INPUT on the CREATE FUNCTION statement. The following example, however, includes the code to return null if the input parameter is null. Write the statement needed to create the function, using the specific name MINENULL1.

```
CREATE FUNCTION NTEST1 (INTEGER)
  RETURNS INTEGER
  EXTERNAL NAME 'MYLIB/NTESTMOD(nudft1)'
  SPECIFIC MINENULL1
  LANGUAGE C
  DETERMINISTIC
  NO SQL
  PARAMETER STYLE DB2SQL
  CALLED ON NULL INPUT
  NO EXTERNAL ACTION
```

The program code:

```
  void nudft1
    (int *input,               /* ptr to input arg             */
     int *output,              /* ptr to output arg            */
     short *input_ind,           /* ptr to input indicator       */
     short *output_ind,          /* ptr to output indicator      */
     char sqlstate[6], /* sqlstate                      */
     char fname[140],  /* fully qualified function name */
     char finst[129],  /* function specific name        */
     char msgtext[71]) /* msg text buffer               */
  {
    if (*input_ind == -1)
      *output_ind = -1;
    else
  {
      *output = 2*(*input)-4;
      *output_ind = 0;
    }
    return;
 }
```

Example 2

Create the SQL function NTEST1 to implement the rule:

```
output = 2 * input - 4
```

```
CREATE FUNCTION NTEST1 (p_input INTEGER)
  RETURNS INTEGER
  LANGUAGE SQL
  SPECIFIC MINENULL1
  func1_lab:
    BEGIN
      DECLARE p_output INT;
      IF p_input IS NULL THEN
        SET p_output = NULL;
      ELSE
        SET p_output = 2 * p_input - 4;
     END IF;
     RETURN p_output;
    END
```

Example 3

Assume that user McBride (who has administrative authority) wants to create an external function named CENTER in the SMITH schema. McBride plans to give the function specific name FOCUS98. The function program uses a scratchpad to perform some initialization and save the results. The function program returns a value with a FLOAT data type. Write the statement McBride needs to create the function and ensure that when the function is invoked, it returns a value with a data type of DECIMAL(8,4).

```
CREATE FUNCTION SMITH.CENTER (FLOAT, FLOAT, FLOAT)
  RETURNS DECIMAL(8,4) CAST FROM FLOAT
  EXTERNAL NAME CMOD
  SPECIFIC FOCUS98
  LANGUAGE C
  DETERMINISTIC
  NO SQL
  PARAMETER STYLE DB2SQL
  RETURNS NULL ON NULL INPUT
  NO EXTERNAL ACTION
  SCRATCHPAD
  NO FINAL CALL
```

CREATE FUNCTION (Sourced)

This CREATE FUNCTION statement is used to create a user-defined function, based on another existing scalar or column function, with an application server.

Authorization

The privileges held by the authorization id of the statement must include at least one of the following:

- For the SYSFUNCS catalog view and SYSPARMS catalog table:
  - The INSERT privilege on the table, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

The authorization ID of the statement has the INSERT privilege on a table when:

- It is the owner of the table,
- It has been granted the INSERT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *ADD on the table.

If the source function is a user-defined function, the authorization ID of the statement must include at least one of the following for the source function:

- The EXECUTE privilege on the function
- Administrative authority

The authorization ID of the statement has the EXECUTE privilege on a function when:

- It is the owner of the function,
- It has been granted the EXECUTE privilege on the function, or
- It has been granted the system authorities of *OBJOPR and *EXECUTE on the function.

To create a sourced function, the privileges held by the authorization ID of the statement must also include at least one of the following:

- The following system authorities:
  - *USE to the Create Structured Query Language ILE C (CRTSQLCI) command
  - *USE to the Create ILE C/400 Module (CRTCMOD) command
  - *USE to the Create Service Program (CRTSRVPGM) command or
  - *USE to the Create Program (CRTPGM) command
  - *EXECUTE and *ADD to the library into which the function is created.
- Administrative authority

If SQL names are specified and a user profile exists that has the same name as the library into which the function is created, and that name is different from the authorization ID of the statement, then the privileges held by the authorization ID of the statement must include at least one of the following:

- The system authority *ADD to the user profile with that name
- Administrative authority

Syntax

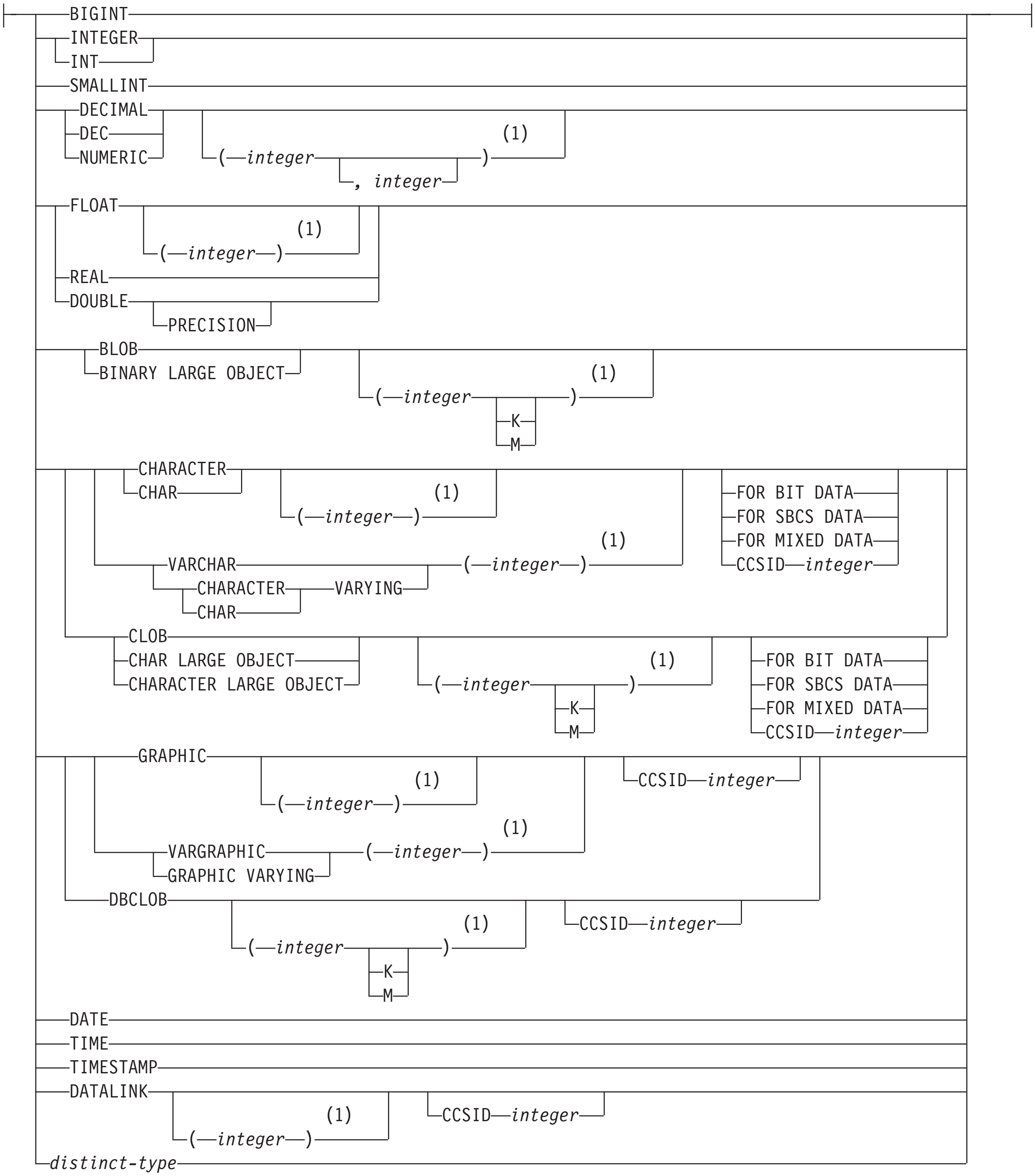
```
►►──CREATE──FUNCTION──function-name────────────────────────────────────────────────────►

►──(──┬───────────────────────────────────────────────────────────────────────────┬──)──►
      │ ┌─,─────────────────────────────────────────────────────────────────────┐ │
      │ ▼                                                                       │ │
      └───┬────────────────┬──parameter-type1──┬──────────────────┬──┬────────┬─┴─┘
          └─parameter-name─┘                   │              (1) │  └─RESULT─┘
                                               └─AS LOCATOR───────┘

                                            (2)
►──RETURNS──data-type──┬──────────────────┬──┬─────────────────────────┬────────────────►
                       │              (1) │  └─SPECIFIC──specific-name─┘
                       └─AS LOCATOR───────┘

►──SOURCE──┬─function-name──────────────────────────────────┬──────────────────────────►◄
           ├─SPECIFIC──specific-name────────────────────────┤
           └─function-name──(──┬──────────────────────┬──)──┘
                               │ ┌─,────────────────┐ │
                               │ ▼                  │ │
                               └───parameter-type2──┴─┘
```

Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

2 The RETURNS, SPECIFIC, and SOURCE clauses can be specified in any order.

parameter-type:



Notes:

1 The values that are specified for length, precision, or scale attributes must match the values that were specified when the function was created. Coding specific values is optional. Empty parentheses, (), can be used instead to indicate that DB2 ignores the attributes when determining whether data types match.

Description

function-name

Names the user-defined function. The combination of name, collection name, the number of parameters, and the data type of each parameter (without regard for any length, precision, scale, or CCSID attributes of the data type) must not identify a user-defined function that exists at the current server. The specified function information is added to the catalog tables SYSROUTINES and SYSPARMS.

For SQL naming, the function will be created in the collection or library specified by the implicit or explicit qualifier. The qualifier is the *owner* of the function is a user profile with that name exists. Otherwise the *owner* is the user profile or group user profile of the job executing the statement.

For system naming, the function will be created in collection or library that is specified by the qualifier. If no qualifier is specified, the function will be created in the current library (*CURLIB). If there is no current library, the function will be created in QGPL. The *owner* of the function is the user profile or group user profile of the job executing the statement.

If the function is sourced on an existing function to enable the use of the existing function with a distinct type, the name can be the same name as the existing function. In general, more than one function can have the same name if the function signature of each function is unique.

The collection name cannot be QSYS2, QSYS, or QTEMP. The name cannot be one of the following names reserved for system use:

=	<	>	>=
<=	<>	¬=	¬<
¬<	!=	!<	!>
ALL	FALSE	ONLY	TABLE
AND	FOR	OR	THEN
ANY	FROM	OVERLAPS	TRIM
BETWEEN	IN	PARTITION	TRUE
BOOLEAN	IS	POSITION	TYPE
CASE	LIKE	RRN	UNIQUE
CAST	MATCH	SELECT	UNKNOWN
CHECK	NODENAME	SIMILAR	WHEN
DISTINCT	NODENUMBER	SOME	
EXCEPT	NOT	STRIP	
EXISTS	NULL	SUBSTRING	

The name can be one of the following operators if at least one of the parameters is a distinct type: +, -, *, /, || , CONCAT.

(parameter-type1,...)

Specifies the number of input parameters of the function and the data type of each input parameter. All the parameters for a function are input parameters. There must be one entry in the list for each parameter that the function expects to receive. Although not required, you can give each parameter a name. DataLinks are not allowed for external functions.

If a CCSID is specified, the parameter will be converted to that CCSID prior to passing it to the function.

A function can have no parameters. In this case, you must code an empty set of parentheses, for example:

```
CREATE FUNCTION WOOFER()
```

parameter-name
Specifies the name of the input parameter. Do not specify the same name more than once.

AS LOCATOR
Specifies that the input parameter is a locator to the value rather than the actual value. You can specify AS LOCATOR only if the input parameter has a LOB data type or a distinct type based on a LOB data type. The AS LOCATOR clause is not allowed for SQL functions.

RETURNS
Specifies the output of the function.

data-type
Specifies the data type and attributes of the output.

You can specify any built-in data type (except LONG VARCHAR, LONG VARGRAPHIC, or a DataLink) or distinct type (that is not based on a DataLink), provided it is castable from the result type of the source function. (For information on casting data types, see “Casting Between Data Types” on page 63)

AS LOCATOR
Specifies that the function returns a locator to the value rather than the actual value. You can specify AS LOCATOR only if the output from the function has a LOB data type or a distinct type based on a LOB data type. The AS LOCATOR clause is not allowed for SQL functions.

SPECIFIC *specific-name*
Provides a unique name for the function. The name is implicitly or explicitly qualified with a collection name. The name, including the collection name, must not identify the specific name of another function that exists at the current server. If unqualified, the implicit qualifier is the same as the qualifier of the function name. If qualified, the qualifier must be the same as the qualifier of the function name.

If specific name is not specified, it is set to the function name. If a function or procedure with that specific name already exists, a unique name is generated similar to the rules used to generate unique table names.

SOURCE
Specifies that the function that you are creating is a sourced function. A sourced function is implemented by another function (the source function). The source function can be any built-in function except CAST, COALESCE, HASH, LAND, LOR, MAX, MIN, NODENAME, NODENUMBER, PARTITION, POSITION, RRN, STRIP, SUBSTRING, TRIM, VALUE, and XOR, or any previously created user-defined function. It can be a system-generated user-defined function (generated when a user-defined type was created).

The source function can be one of the following built-in functions only if one argument is specified: BLOB, CHAR, CLOB, DBCLOB, DECIMAL, TRANSLATE, VARCHAR, VARGRAPHIC, and ZONED.

If you base the sourced function directly or indirectly on a scalar function, the sourced function inherits the attributes of the scalar function. This can involve several layers of sourced functions. For example, assume that function A is sourced on function B, which in turn is sourced on function C. Function C is a scalar function. Functions A and B inherit all of the attributes that are specified on CREATE FUNCTION statement for function C.

If unqualified, the CURRENT PATH is used to locate the function.

FUNCTION *function-name*

The *function-name* must identify exactly one function that exists at the current server. The function may have any number of parameters defined for it. If there is more than one function of the specified name in the specified or implicit collection, an error is returned.

FUNCTION *function-name (parameter-type2, ...)*

The *function-name (parameter-type2, ...)* must identify a function with the specified function signature that exists at the current server. The specified parameters must match the data types, that were specified on the CREATE FUNCTION statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance which is to be used as the source function.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type is implied. For more information on the default attributes see "CREATE TABLE" on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

SPECIFIC *specific-name*

The *specific-name* must identify a specific function that exists at the current server.

The number of input parameters in the function that is being created must be the same as the number of parameters in the source function. If the data type of each input parameter is not the same as or castable to the corresponding parameter of the source function, an error occurs. The data type of the final result of the source function must match or be castable to the result of the sourced function.

Notes

When a sourced function is created, a small service program object is created that represents the function. When this service program is saved and restored to another system, the attributes from the CREATE FUNCTION statement are automatically added to the catalog on that system.

Any attributes specified on the source function are propagated to the new sourced function (for example, PARAMETER STYLE, STATIC DISPATCH, etc.).

Example 1

Assume that you created a distinct type HATSIZE which is based on the built-in INTEGER data type. Create an AVG function to compute the average hat size of different departments.

```
EXEC SQL
   CREATE FUNCTION AVG (HATSIZE) RETURNS HATSIZE
   SOURCE AVG (INTEGER);
```

Example 2

After Smith registered the external scalar function CENTER in his collection, you decide that you want to use this function, but you want it to accept two INTEGER arguments instead of one INTEGER argument and one FLOAT argument. Create a sourced function that is based on CENTER.

```
EXEC SQL
   CREATE FUNCTION MYCENTERG (INTEGER, INTEGER)
     RETURNS FLOAT
     SOURCE SMITH.CENTER (INTEGER, FLOAT);
```

CREATE INDEX

The CREATE INDEX statement creates an index on a table.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - *USE to the Create Logical File (CRTLF) command
  - *EXECUTE and *ADD to the library into which the index is created
  - *CHANGE to the data dictionary if the library into which the index is created is an SQL collection with a data dictionary
- Administrative authority

The privileges held by the authorization ID of the statement must also include at least one of the following:

- The INDEX privilege on the table
- Administrative authority

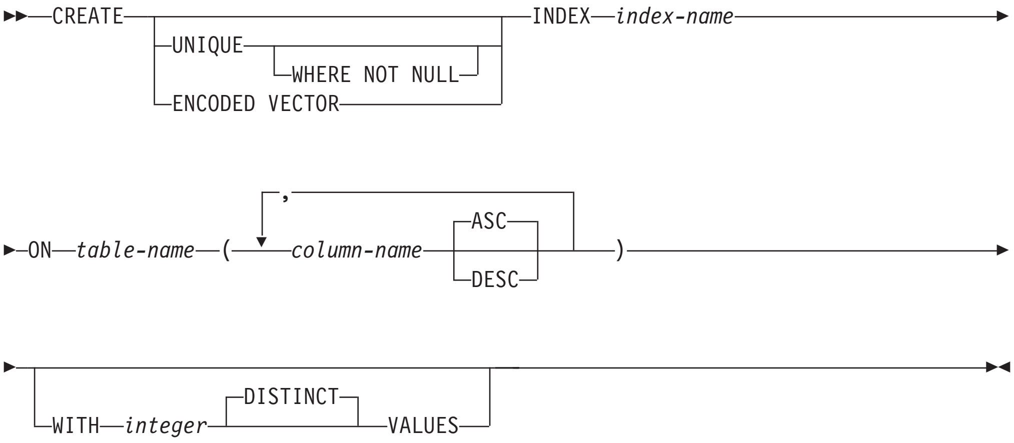
The authorization ID of the statement has the INDEX privilege on the table when:

- It is the owner of the table,
- It has been granted the INDEX or ALTER privilege to the table, or
- It has been granted the system authorities of either *OBJALTER or *OBJMGT to the table

If SQL names are specified and a user profile exists that has the same name as the library into which the table is created, and that name is different from the authorization ID of the statement, then the privileges held by the authorization ID of the statement must include at least one of the following:

- The system authority *ADD to the user profile with that name
- Administrative authority

Syntax



Description

UNIQUE

Prevents the table from containing two or more rows with the same value of the index key. The constraint is enforced when rows of the table are updated or new rows are inserted.

The constraint is also checked during the execution of the CREATE INDEX statement. If the table already contains rows with duplicate key values, the index is not created.

When UNIQUE is used, null values are treated as any other values. For example, if the key is a single column that can contain null values, that column can contain no more than one null value.

UNIQUE WHERE NOT NULL

Prevents the table from containing two or more rows with the same nonnull value of the index key. Multiple null values are allowed; otherwise, this is identical to UNIQUE.

ENCODED VECTOR

Indicates that the resulting index will be an encoded vector index (EVI).

An encoded vector index cannot be used to ensure an ordering of rows. It is used by the database manager to improve the performance of queries. For more information, see the Database Performance and Query Optimization book.

index-name
Names the index. The name, including the implicit or explicit qualifier, must not be the same as an index, table, view, alias, or file that already exists at the current server.

If SQL names were specified, the index will be created in the collection or library specified by the implicit or explicit qualifier. The qualifier is the *owner* of the index if a user profile with that name exists. Otherwise, the *owner* of the index is the user profile or group user profile of the job calling the statement. If the owner of the index is a member of a group profile, that group profile will also have authority to the index. (The user profile of the owner specifies this authority.)

If system names were specified, the index name will be created in the collection or library that is specified by the qualifier. If not qualified, the index name will be created in the same collection or library as the table over which the index is created. The *owner* of the index is the user profile or group user profile of the job executing the statement.

If the owner of the index is a member of a group profile (GRPPRF keyword) and group authority is specified (GRPAUT keyword), that group profile will also have authority to the index.

If the index name is not a valid system name, DB2 UDB for AS/400 will generate a system name. For information on the rules for generating a name, see "Rules for Table Name Generation" on page 361.

ON *table-name*
Identifies the table on which the index is to be created. The *table-name* must identify a base table (not a view) that exists at the current server.

(column-name, ...)
Identifies the list of columns that will be part of the index key.

Each *column-name* must be an unqualified name that identifies a column of the table. The *column-names* must not identify a LOB or DATALINK column. The number of columns must not exceed 120, and the sum of their lengths must not exceed 2000−n, where n is the number of columns specified that allows nulls. The same column may be specified more than once.

ASC
Puts the index entries in ascending order by the column. That is the default.

DESC
Puts the index entries in descending order by the column.

WITH *integer* **DISTINCT VALUES**
Indicates the estimated number of distinct key values. This clause may be specified for any type of index.

For encoded vector indexes this is used to determine the initial size of the codes assigned to each distinct key value. The default value is 256.

For non-encoded vector indexes, this is used as a hint to the optimizer.

Notes

An index is created as a keyed logical file. If SQL names are used, indexes are created with the system authority of *EXCLUDE on *PUBLIC. If system names are used, indexes are created with the authority to *PUBLIC as determined by the create authority (CRTAUT) parameter of the collection or library.

When an index is created, the file wait time and record wait time attributes are set to the default that is specified on the WAITFILE and WAITRCD keywords of the Create Logical File (CRTLF) command.

If the named table already contains data, CREATE INDEX creates the index entries for it. If the table does not yet contain data, CREATE INDEX creates a description of the index. The index entries are created when data is inserted into the table. The index always reflects the current condition of the table.

Any index created over columns containing SBCS or mixed data is created with the sort sequence in effect at the time the statement is executed. For sort sequences other than *HEX, the key for SBCS data or mixed data is the weighted value of the key based on the sort sequence.

An index created over a distributed table is created on all of the AS/400s across which the table is distributed. For more information on distributed tables, see the DB2 Multisystem book.

Examples

Example 1

Create an index named UNIQUE_NAM on the PROJECT table. The purpose of the index is to ensure that there are not two entries in the table with the same value for project name (PROJNAME). The index entries are to be in ascending order.

```
CREATE UNIQUE INDEX UNIQUE_NAME
  ON PROJECT(PROJNAME)
```

Example 2

Create an index named JOB_BY_DPT on the EMPLOYEE table. Arrange the index entries in ascending order by job title (JOB) within each department (WORKDEPT).

```
CREATE INDEX JOB_BY_DPT
  ON EMPLOYEE (WORKDEPT, JOB)
```

CREATE PROCEDURE

The CREATE PROCEDURE statement creates an external or SQL procedure.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

| - For the SYSPROCS catalog view and SYSPARMS catalog table:
| - The INSERT privilege on the table, and
| - The system authority *EXECUTE on library QSYS2

- Administrative authority

The authorization ID of the statement has the INSERT privilege on a table when:

- It is the owner of the table,
- It has been granted the INSERT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *ADD on the table.

For external procedures, if the external program exists, the privileges held by the authorization ID of the statement must include at least one of the following:

- For the external program referenced in the SQL statement:
  - The system authority *EXECUTE on the external program, and
  - The system authority *EXECUTE on the library containing the external program
- Administrative authority

For SQL procedures, the privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - *USE on the Create Structured Query Language ILE C (CRTSQLCI) command, and
  - *USE on the Create ILE C/400 Module (CRTCMOD) command, and
  - *USE on the Create Program (CRTPGM) command, and
  - *EXECUTE and *ADD on the library into which the procedure is created.
- Administrative authority

For SQL procedures, if SQL names are specified and a user profile exists that has the same name as the library into which the procedure is created, and that name is different from the authorization ID of the statement, then the privileges held by the authorization ID of the statement must include at least one of the following:

- The system authority *ADD to the user profile with that name
- Administrative authority

Syntax

```
>>--CREATE--PROCEDURE--procedure-name------------------------------------------->

>--+-------------------------------------------------------------------------+-->
   '-(--+---------------------------------------------------------------+--)-'
        |   .-,------------------------------------------------------.  |
        |   V  .-IN----.                                              |  |
        '------+-------+--+----------------+--data-type--+-----------+-+--'
               +-OUT---+  '-parameter-name-'             |       (1) |
               '-INOUT-'                                 '-AS LOCATOR-'

>--+--------------------------------------------+--+------------------------+-->
   |  .-DYNAMIC-.                               |  |             (2)        |
   '--+---------+--RESULT--+-SET--+--integer----'  '-LANGUAGE--+-C--------+--'
                           '-SETS-'                            +-C++------+
                                                               +-CL-------+
                                                               +-COBOL----+
                                                               +-COBOLLE--+
                                                               +-FORTRAN--+
                                                               +-JAVA-----+
                                                               +-PLI------+
                                                               +-REXX-----+
                                                               +-RPG------+
                                                               +-RPGLE----+
                                                               '-SQL------'

                                                 (3)
                               .-NOT DETERMINISTIC-.  .-MODIFIES SQL DATA-.  .-FENCED-----.
>--+-------------------------+--+-------------------+--+-------------------+--+------------+-->
   '-SPECIFIC--specific-name-'  '-DETERMINISTIC-----'  +-NO SQL------------+  '-NOT FENCED-'
                                                       +-CONTAINS SQL------+
                                                       '-READS SQL DATA----'

                     (4)
   .-CALLED ON NULL INPUT-.  .-NO DBINFO-.
>--+----------------------+--+-----------+--+-external-procedure-body-+---------><
                             '-DBINFO----'  '-procedure-body----------'
```

external-procedure-body:

```
   .-EXTERNAL-----------------------------.  .-PARAMETER STYLE-.  .-SQL-------------------.
|--+--------------------------------------+--+-----------------+--+-----------------------+--|
   '-EXTERNAL NAME--external-program-name-'                       +-DB2SQL----------------+
                                                                  |                (5)    |
                                                                  +-DB2GENERAL------------+
                                                                  |          (6)          |
                                                                  +-GENERAL---------------+
                                                                  +-GENERAL WITH NULLS----+
                                                                  '-JAVA------------------'
```

Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

2 The optional clauses can be specified in a different order. If LANGUAGE SQL is specified, it must be first.

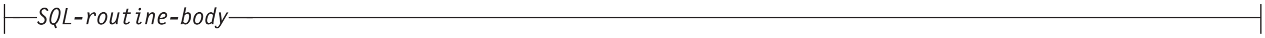
3 The keywords VARIANT and NOT VARIANT can be used as a synonym for NOT DETERMINISTIC and DETERMINISTIC.

4 The keywords NULL CALL can be used as a synonym for CALLED ON NULL INPUT.

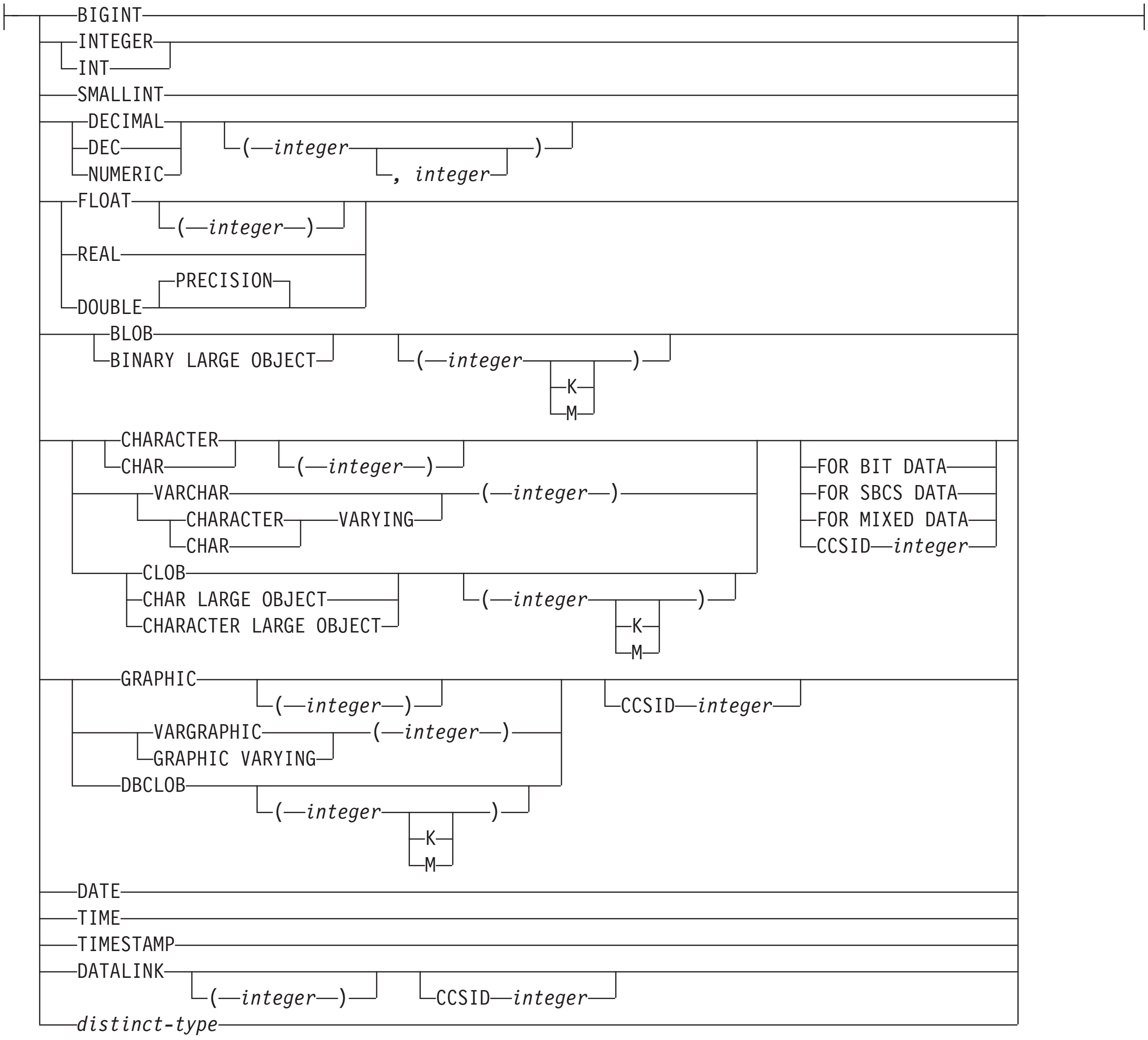
5 The keyword DB2GENRL can be used as a synonym for DB2GENERAL.

6 The keywords SIMPLE CALL can be used as a synonym for GENERAL.

procedure-body:



data-type:



Description

procedure-name

Names the procedure. The combination of name, collection name, the number of parameters must not identify a procedure that exists at the current server. The specified procedure information is added to the catalog tables SYSROUTINES and SYSPARMS.

For SQL naming, the procedure will be created in the collection or library specified by the implicit or explicit qualifier.

For system naming, the procedure will be created in the collection or library specified by the qualifier. If no qualifier is specified, the procedure will be created in the current library (*CURLIB).

IN Specifies this parameter as an input parameter.[39] If IN is specified for a parameter in an SQL procedure, the parameter cannot be modified within the SQL procedure body.

OUT
Specifies this parameter as an output parameter. If OUT is specified for a parameter in an SQL procedure, the parameter can only be set within the SQL procedure body. The parameter cannot be checked or used to set other variables. If the parameter is not set, the null value is returned.

A DataLink or a distinct type based on a DataLink may not be specified as an output parameter.

INOUT
Specifies this parameter as both an input and output parameter.

A DataLink or a distinct type based on a DataLink may not be specified as an inoput and output parameter.

parameter-name
Names the parameter. *parameter-name* is required for SQL procedures.

data-type
Specifies the attributes of the parameter.

The data type must be valid for the language specified in the language clause. All data types are valid for SQL procedures. DataLinks are not valid for external procedures. For more information on data types, see “CREATE TABLE” on page 340, and the SQL Programming Concepts book.

If a CCSID is specified, the parameter will be converted to that CCSID prior to passing it to the procedure.

AS LOCATOR
Specifies that the input parameter is a locator to the value rather than the actual value. You can specify AS LOCATOR only if the input parameter has a LOB data type or a distinct type based on a LOB data type. The AS LOCATOR clause is not allowed for SQL procedures.

RESULT SETS *integer*
Specifies the maximum number of result sets that can be returned from the procedure. *integer* must be greater than or equal to zero. If zero is specified, no result sets are returned. A procedure can have any number of result sets, but at any time, only 100 procedures can have result sets that are waiting to be fetched.

Result sets are only returned if:

- the procedure is called from a Client Access client ODBC or JDBC driver, JDBC on the AS/400, or the SQL Call Level Interface, and
- if the procedure is an external procedure, the external program must not have an attribute of ACTGRP(*NEW).

For more information on result sets see “SET RESULT SETS” on page 495.

---

[39] When the language type is REXX, all parameters must be input parameters.

LANGUAGE

Specifies the language that the external program is written in. The language clause is required if the external program is a REXX procedure.

If LANGUAGE is not specified, the LANGUAGE is determined from the program attribute information associated with the external program at the time the procedure is created. If the program attribute information associated with the program does not identify a recognizable language or the program cannot be found, then the language is assumed to be C.

C The external program is written in C.

C++
The external program is written in C++.

CL
The external program is written in CL.

COBOL
The external program is written in COBOL.

COBOLLE
The external program is written in ILE COBOL/400.

FORTRAN
The external program is written in FORTRAN.

JAVA
The external program is written in JAVA.

PLI
The external program is written in PL/I.

REXX
The external program is a REXX procedure.

RPG
The external program is written in RPG.

RPGLE
The external program is written in ILE RPG/400.

SQL
Specifies that an SQL procedure is created. If SQL is specified, an SQL-*procedure-body* must be specified.

SPECIFIC *specific-name*

Specifies a qualified or unqualified name that uniquely identifies the procedure. The *specific-name*, including the implicit or explicit qualifier, must be the same as the *procedure-name*.

If no qualifier is specified, the implicit or explicit qualifier of the *procedure-name* is used. If a qualifier is specified, the qualifier must be the same as the explicit or implicit qualifier of the *procedure-name*.

If *specific-name* is not specified, it is the same as the procedure name. If a function or procedure with that specific name already exists, a unique name is generated similar to the rules used to generate unique table names.

DETERMINISTIC or NOT DETERMINISTIC

Indicates whether the procedure is deterministic.

NOT DETERMINISTIC
Specifies that the procedure will not always return the same result from successive calls with identical input arguments.

DETERMINISTIC
Specifies that the procedure will always return the same result from successive calls with identical input arguments.

CONTAINS SQL, READS SQL DATA, MODIFIES SQL DATA, or NO SQL
Indicates whether the procedure contains SQL, reads SQL data, or modifies SQL data.

CONTAINS SQL
Indicates that the procedure contains SQL. The procedure can only contain:

- Non-executable statements (such as DECLARE statements),
- CALL statements to procedures with a NO SQL or CONTAINS SQL attribute,
- FREE LOCATOR,
- SET RESULT SET,
- SET assignment and VALUES INTO as long as a only variables or constants are referenced,
- COMMIT, ROLLBACK, or SET TRANSACTION, and
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION.

NO SQL
Indicates that the external procedure does not contain SQL. NO SQL cannot be specified for an SQL procedure.

READS SQL DATA
Indicates that the procedure possibly reads data using SQL. The procedure can contain any SQL statement other than:

- COMMIT, ROLLBACK, or SET TRANSACTION
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION
- DELETE, INSERT, or UPDATE
- ALTER TABLE, COMMENT ON, any CREATE statement, DROP, any GRANT statement, LABEL ON, RENAME, or any REVOKE statement

MODIFIES SQL DATA
Indicates that the procedure possibly modifies data using SQL. The procedure can contain any SQL statement other than:

- COMMIT, ROLLBACK, or SET TRANSACTION
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION

FENCED or NOT FENCED
This parameter is allowed for compatibility with other products and is not used by DB2 UDB for AS/400.

DBINFO
Indicates whether or not the procedure requires the database information be passed.

DBINFO
Indicates that the database manager should pass a structure to the procedure which contains the following information:

- Relational database name - the name of the current server.
- Authorization ID - the run-time authorization ID.

- CCSID - identifies the CCSID of the job. If a CCSID is not explicitly specified for a parameter on the CREATE FUNCTION statement, the input string is assumed to be encoded in this CCSID and the string is passed without conversion to the external program. If a CCSID is explicitly specified for a parameter on the CREATE FUNCTION statement, the input string passed to the external function will be converted to the explicitly specified CCSID before calling the external program.
- Version and release - identifies the version, release, and modification level of the database manager.
- Platform - contains the server's platform type.

DBINFO is only allowed with PARAMETER STYLE DB2SQL.

NO DBINFO

Indicates that the procedure does not require the database information to be passed.

external-procedure-body

Specifies the body of an external procedure.

EXTERNAL NAME *external-program-name*

Specifies the program that will be executed when the procedure is called by the CALL statement. The program name must identify a program that exists at the application server at the time the procedure is called. If the naming option is *SYS and the program name is not qualified, the library list will be used to search for the program at the time the procedure is called. The program cannot be an ILE service program.

The validity of the name is checked at the application server. If the format of the name is not correct, an error is returned.

If external-program-name is not specified, the external program name is assumed to be the same as the procedure name.

The external program need not exist at the time the procedure is created, but it must exist at the time the procedure is called.

PARAMETER STYLE

Defines the parameter passing convention for procedure. If you specify the PARAMETER STYLE keywords, then you must specify one of the following:

SQL

All applicable parameters are passed. The parameters are defined to be in the following order:

- The first N parameters are the parameters that are specified on the CREATE PROCEDURE statement.
- N parameters for indicator variables for the parameters.
- A CHAR(5) output parameter for SQLSTATE. The SQLSTATE returned indicates the success or failure of the function. The SQLSTATE returned either be:
  - the SQLSTATE from the last SQL statement executed in the external program,
  - an SQLSTATE that is assigned by the external program.

The user may set the SQLSTATE in the external program to return an error or warning from the function. In this case, the SQLSTATE must contain:

- ’00000’ to indicate success;
- ’01Hxx’, where xx is any two digits or uppercase letters, to indicate a warning; or
- ’38yxx’, where y is an uppercase letter between ’I’ and ’Z’ and xx is any two digits or uppercase letters, to indicate an error.

- A VARCHAR(517) input parameter for the fully qualified function name.
- A VARCHAR(128) input parameter for the specific name.
- A VARCHAR(70) output parameter for the message text.

DB2SQL

Identical to the SQL convention, but the following parameter could be added at the end:

- A parameter for the dbinfo structure, if DBINFO was specified on the CREATE PROCEDURE statement.

DB2GENERAL

The stored procedure will use a parameter passing convention that is defined for use with Java methods. This can only be specified when LANGUAGE JAVA is used. For details on passing parameters in JAVA, see the SQL Programming Concepts book.

GENERAL

A general call to the procedure is performed. Additional arguments are not passed for indicator variables.

GENERAL WITH NULLS

A general call to the procedure is performed. An additional argument is passed for indicator variables. For more information on how the indicators are handled, see the SQL Programming Concepts book.

JAVA

The stored procedure will use a parameter passing convention that conforms to the Java language and SQLJ Routines specification. INOUT and OUT parameters will be passed as single entry arrays to facilitate returning values. This can only be specified when LANGUAGE JAVA is used. For increased portability, you should write Java stored procedures that use the PARAMETER STYLE JAVA conventions. For details on passing parameters in JAVA, see the SQL Programming Concepts book.

SQL-routine-body

Specifies a single SQL statement, including a compound statement. See “Chapter 6. SQL Procedures and Functions” on page 513 for more information on defining SQL procedures.

Notes

CONNECT, SET CONNECTION, RELEASE, DISCONNECT, COMMIT, ROLLBACK and SET TRANSACTION statements are not allowed in a procedure that is running on a remote application server. COMMIT and ROLLBACK statements are not allowed in an ATOMIC SQL procedure.

If a DECLARE PROCEDURE statement defines a procedure with the same name as a created procedure, and a static CALL statement where the procedure name is not identified by a host variable is executed from the same source program, the attributes from the DECLARE PROCEDURE statement will be used rather than the attributes from the CREATE PROCEDURE statement.

The maximum number of parameters allowed in CREATE PROCEDURE is 255. If GENERAL WITH NULLS is specified, the maximum is 254. If the procedure is an SQL procedure, the maximum is 253. If parameter style SQL is specified, only 90 parameters are allowed. The maximum number of parameters is also limited by the maximum number of parameters allowed by the licensed program used to compile the external program.

The CREATE PROCEDURE statement applies to static and dynamic CALL statements as well as to a CALL statement where the procedure name is identified by a host variable.

When an SQL procedure or an external procedure associated with an ILE external program or service program is created, an attempt is made to save the function's attributes in the associated program or service program object. If the *PGM or *SRVPGM object is saved and then restored to this or another system, the catalogs are automatically updated with those attributes.

The attributes can always be saved for SQL procedures. The attributes can saved for external procedures subject to the following restrictions:

- The external program library must not be QSYS or QSYS2.
- The external program must exist when the CREATE PROCEDURE statement is issued.
- The external program must be an ILE *PGM or *SRVPGM object.
- The external program or service program must contain at least one SQL statement.

During restore of the procedure:

- If the specific name was specified when the procedure was originally created and it is not unique, an error is issued.
- If the specific name was not specified, a unique name is generated if necessary.
- If the procedure name and number of parameters is not unique, the procedure cannot be registered, and an error is issued.

Notes for SQL Procedures

When an SQL procedure is created, SQL creates a temporary source file that will contain C source code with embedded SQL statements. A program object is then created using the CRTSQLCI and CRTPGM commands. The options used to create the program are the options that are in effect at the time the CREATE PROCEDURE statement is executed. The DB2 UDB Query Manager and SQL Development Kit and ILE C products must be installed on the system when the SQL procedure is created. OS/400 Option 13, System Openness Includes must also be installed.

SQL procedures must be called using the SQL CALL statement. When called, the SQL procedure runs in the activation group of the calling program.

The procedure name is used as the name of the member in the source file and the name of the program object, if it is a valid system name. If the procedure name is not a valid system name, a unique name is generated. If a source file member with the same name already exists, the member is overlaid. If a module or a program with the same name already exists, the objects are not overlaid, and a unique name is generated. The unique names are generated according to the rules for generating system table names.

Notes for External Procedures

When an external procedure is invoked, it runs in whatever activation group was specified when the external program was created. However, ACTGRP(*CALLER) should normally be used so that the procedure runs in the same activation group as the calling program.

When creating an external procedure, if the external program exists and is an ILE *PGM, an attempt is made to add the information specified on the CREATE PROCEDURE statement to the actual program object. If the information is saved, when the object is saved and restored to another system, it will automatically be registered into the catalogs. If the object cannot be updated, the procedure will still be created.

Notes for Java Procedures

To be able to run Java procedures, you must have the following product installed on your system:

- AS/400 Developer Kit for Java (5769-JV1)

Otherwise, an SQLCODE of -443 will be returned and a CPDB521 message will be placed in the job log.

Java procedures cannot return result sets; consequently, you cannot specify RESULT SET when creating a Java stored procedure.

If an error occurs while running a Java stored procedure, an SQLCODE of -443 will be returned. Depending on the error, other messages may exist in the job log of the job where the stored procedure was run.

Example

Create an external procedure PROC1 in a PL/I program. When the procedure is called using the CALL statement, a COBOL program named PGM1 in library LIB1 will be called.

```
EXEC SQL
  CREATE PROCEDURE PROC1
          (CHAR(10), CHAR(10))
          EXTERNAL NAME LIB1.PGM1
          LANGUAGE COBOL GENERAL;

EXEC SQL
   CALL PROC1 ('FIRSTNAME ','LASTNAME  ');
```

CREATE SCHEMA

The CREATE SCHEMA statement defines a collection and optionally creates tables, views, aliases, indexes, and distinct types. Comments and labels may be added in the catalog description of tables, views, aliases, indexes, columns, and distinct types. Table, view, and distinct type privileges can be granted to users.

Invocation

This statement can only be issued using the RUNSQLSTM command.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The privileges defined for the following SQL statements:
  - CREATE COLLECTION and
  - Each SQL statement included in the CREATE SCHEMA statement
- Administrative authority

If the AUTHORIZATION clause is specified, the privileges held by the authorization ID of the statement must also include at least one of the following:

- The system authority *ADD to the user profile identified by authorization-name
- Administrative authority

Syntax

```
►►──CREATE SCHEMA──┬─collection-name──────────────────────┬──────────────────────────►
                   └─AUTHORIZATION──authorization-name────┘

►──┬────────────────┬──┬──────────────────────┬───────────────────────────────────────►
   └─IN ASP──integer─┘  └─WITH DATA DICTIONARY─┘

►──┬──────────────────────────────────────────────────────────┬───────────────────────►◄
   │   ┌──────────────────────────────────────────────────┐   │
   │   ▼                                                  │   │
   └───┴──┬─COMMENT ON statement────────────────────────┬─┴───┘
          ├─CREATE ALIAS statement──────────────────────┤
          ├─CREATE DISTINCT TYPE statement──────────────┤
          ├─CREATE INDEX statement──────────────────────┤
          ├─CREATE TABLE statement──────────────────────┤
          ├─CREATE VIEW statement───────────────────────┤
          ├─GRANT (Table Privileges) statement──────────┤
          ├─GRANT (User-Defined Type Privileges) statement┤
          │                    (1)                      │
          └─LABEL ON statement──────────────────────────┘
```

Notes:

1 Labels and comments on packages, procedures, functions, and parameters are not supported in the CREATE SCHEMA statement.

Description

collection-name
Names the schema. A collection is created using this name. If collection-name is specified, the authorization ID of the statement is the run-time authorization ID. The name must not be the same as the name of an existing collection or library at the current server.

authorization-name
Identifies the authorization ID of the statement. This authorization name is also the collection-name. The name must not be the same as the name of an existing collection or library at the current server.

IN ASP *integer*
Specifies the auxiliary storage pool (ASP) in which to create the collection. The integer must be between 1 and 16. If 1 is specified, the collection is created on the system ASP. If this clause is omitted, an ASP of 1 is assumed.

WITH DATA DICTIONARY
If this clause is specified, an IDDU data dictionary is created in the collection.

COMMENT ON statement
Adds or replaces comments in the catalog descriptions of tables, views, or columns. Comments on packages are not allowed. See the COMMENT ON statement on page 273.

CREATE ALIAS statement
Creates an alias into the collection. See the CREATE ALIAS statement on page 291.

CREATE DISTINCT TYPE statement
Creates a user-defined distinct type into the collection. See the CREATE DISTINCT TYPE statement “CREATE DISTINCT TYPE” on page 295.

CREATE INDEX statement
Creates an index into the collection. See the CREATE INDEX statement on page 324.

CREATE TABLE statement
Creates a table into the collection. See the CREATE TABLE statement on page 340.

CREATE VIEW statement
Creates a view into the collection. See the CREATE VIEW statement on page 362.

GRANT (Table Privileges) statement
Grants privileges for tables and views in the collection. See the GRANT statement “GRANT (Table Privileges)” on page 429.

GRANT (User-Defined Type Privileges) statement
Grants privileges for user-defined types in the collection. See the GRANT statement “GRANT (User-Defined Type Privileges)” on page 434.

LABEL ON statement
Adds or replaces labels in the catalog descriptions of tables, views, or columns in the collection. Labels on packages are not allowed. See the LABEL ON statement on page 443.

Notes

If a CREATE TABLE, CREATE INDEX, CREATE ALIAS, CREATE DISTINCT TYPE, or CREATE VIEW statement contains a qualified name for the table, index, alias, distinct type, or view being created, the collection name specified in that qualified name must be the same as the name of the collection being created. Any other table or view names referenced within the schema definition may be qualified by any collection name. Unqualified table, index, alias, distinct type, or view names in any SQL statement are implicitly qualified with the name of the created collection. The maximum length of any individual CREATE TABLE, CREATE INDEX, CREATE DISTINCT TYPE, CREATE VIEW, COMMENT ON, LABEL ON, or GRANT statements within the CREATE SCHEMA statement is 32766.

Delimiters are not used between the SQL statements.

The owner of the created objects is determined as follows:

- If an AUTHORIZATION clause is specified, the specified authorization ID owns all objects created by the statement.
- If an AUTHORIZATION clause is not specified and SQL names are specified, the owner of all objects created by the statement is the user profile with the same name as the collection-name (if a user profile with that name exists).
- Otherwise, the owner of all objects created by the statement is the user profile (or the group user profile) of the job executing the statement.

Examples

Example 1

Create a collection that has an inventory part table and an index over the part number. Give authority to the schema to the user profile JONES.

```
CREATE SCHEMA INVENTORY

CREATE TABLE PART (PARTNO SMALLINT NOT NULL,
                   DESCR  VARCHAR(24),
                   QUANTITY INT)

CREATE INDEX PARTIND ON PART (PARTNO)

GRANT ALL ON PART TO JONES
```

Example 2

Create a collection using the authorization ID of SMITH. Create a student table that has a comment on the student number column.

```
CREATE SCHEMA AUTHORIZATION SMITH

CREATE TABLE SMITH.STUDENT (STUDNBR SMALLINT NOT NULL UNIQUE,
                            LASTNAME CHAR(20),
                            FIRSTNAME CHAR(20),
                            ADDRESS CHAR(50))

COMMENT ON STUDENT (STUDNBR IS 'THIS IS A UNIQUE ID#')
```

CREATE TABLE

The CREATE TABLE statement defines a table. The definition must include its name and the names and attributes of its columns. The definition may include other attributes of the table such as primary key.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - *USE to the Create Physical File (CRTPF) command
  - *EXECUTE and *ADD to the library into which the table is created
  - *OBJOPR and *OBJMGT to the journal
  - *CHANGE to the data dictionary if the library into which the table is created is an SQL collection with a data dictionary

- Administrative authority

If SQL names are specified and a user profile exists that has the same name as the library into which the table is created, and that name is different from the authorization ID of the statement, then the privileges held by the authorization ID of the statement must include at least one of the following:

- The system authority *ADD to the user profile with that name
- Administrative authority

To define a foreign key, the privileges held by the authorization ID of the statement must include at least one of the following on the parent table:

- The REFERENCES privilege or object management authority for the table
- The REFERENCES privilege on each column of the specified parent key
- Ownership of the table
- Administrative authority

The authorization ID of the statement has the REFERENCES privilege on a table when one of the following is true:

- It is the owner of the table.
- It was granted the REFERENCES privilege to the table.
- It was granted the system authorities of either *OBJREF or *OBJMGT to the table.

The authorization ID of the statement has the REFERENCES privilege on a column of the table when one of the following is true:

- It is the owner of the table.
- It was granted the REFERENCES privilege to the column.
- It was granted the system authority of *OBJREF to the column or the system authority of *OBJMGT to the table.

If a user-defined type is referenced, the privileges held by the authorization ID of the statement must include at least one of the following:

- For each user-defined type identified in the statement:
  - The USAGE privilege on the user-defined type, and
  - The system authority *EXECUTE on the library containing the user-defined type
- Administrative authority

The authorization ID of the statement has the USAGE privilege on a user-defined type when one of the following is true:

- It is the owner of the user-defined type.
- It was granted the USAGE privilege to the user-defined type.
- It was granted the system authorities of *OBJOPR and *EXECUTE to the user-defined type.

If a user-defined cast function is referenced, the privileges held by the authorization ID of the statement must include at least one of the following:

- For each user-defined function identified in the statement:
  - The EXECUTE privilege on the user-defined function, and

   - The system authority *EXECUTE on the library containing the user-defined function
- Administrative authority

The authorization ID of the statement has the EXECUTE privilege on a user-defined function when one of the following is true:

- It is the owner of the user-defined function.
- It was granted the EXECUTE privilege to the user-defined function.
- It was granted the system authorities of *OBJOPR and *EXECUTE to the user-defined function.

Syntax

```
                                    ┌─,────────────────────────┐
                                    ▼                          │
►►──CREATE TABLE──table-name──(────┬─column-definition──────┬──┴──)──┬──────────────────┬──────────►◄
                                   ├─unique-constraint──────┤        └─nodegroup-clause─┘
                                   ├─referential-constraint─┤
                                   └─check-constraint───────┘
```

column-definition:

```
├──column-name──┬────────────────────────────────────────┬──data-type──────────────────────────►
                │       ┌─COLUMN─┐                         │
                └─FOR───┴────────┴───system-column-name───┘

   ┌──────────────────────────────────────────────────────────────────────┐
   ▼                                                                      │
►──┬────────────────────────────────────────────────────────────────────┬─┴─────────────────────┤
   ├─NOT NULL───────────────────────────────────────────────────────────┤
   ├─default-clause─────────────────────────────────────────────────────┤
   │                 (1)                                                │
   ├─datalink-options───────────────────────────────────────────────────┤
   └──┬───────────────────────────────┬──┬─┬─UNIQUE──────┬──────────────┬┘
      └─CONSTRAINT──constraint-name───┘  │ └─PRIMARY KEY─┘              │
                                         ├─references-clause────────────┤
                                         └─CHECK──(──check-condition──)─┘
```

Notes:

1 The datalink-options can only be specified for DATALINKs and distinct-types sourced on DATALINKs.

data-type:

```
├──┬─BIGINT────────────────────────────────────────────────────────────────────────────────────┬──┤
   ├─┬─INTEGER─┬───────────────────────────────────────────────────────────────────────────────┤
   │ └─INT─────┘                                                                               │
   ├─SMALLINT──────────────────────────────────────────────────────────────────────────────────┤
   ├─┬─DECIMAL─┬──┬─────────────────────────────────────┬──────────────────────────────────────┤
   │ ├─DEC─────┤  └─(──integer──┬──────────────┬──)────┘                                       │
   │ └─NUMERIC─┘                └─, integer────┘                                               │
   ├─┬─FLOAT──┬───────────────────┬─┬──────────────────────────────────────────────────────────┤
   │ │        └─(──integer──)─────┘ │                                                          │
   │ ├─REAL─────────────────────────┤                                                          │
   │ │        ┌─PRECISION─┐         │                                                          │
   │ └─DOUBLE─┴───────────┴─────────┘                                                          │
   ├───┬─BLOB───────────────┬──┬──────────────────────────┬──┬─────────────────────┬───────────┤
   │   └─BINARY LARGE OBJECT─┘  └─(──integer──┬───┬──)────┘  └─allocate-clause─────┘           │
   │                                          ├─K─┤                                            │
   │                                          └─M─┘                                            │
   ├─┬─┬─CHARACTER─┬──┬──────────────────┬───────────────────────────────────┬─┬─────────────────┬─┤
   │ │ └─CHAR──────┘  └─(──integer──)────┘                                   │ ├─FOR BIT DATA────┤ │
   │ ├─┬─VARCHAR──────────────────────────────(──integer──)─┬──┬─────────────────────┬──┤ ├─FOR SBCS DATA───┤ │
   │ │ │ └─┬─CHARACTER─┬──VARYING─┘                          │  └─allocate-clause─────┘  │ ├─FOR MIXED DATA──┤ │
   │ │ │   └─CHAR──────┘                                     │                           │ └─CCSID──integer──┘ │
   │ │ └─LONG VARCHAR────────────────────────────────────────┘                           │                     │
   │ └─┬─CLOB───────────────────┬──┬─────────────────────────┬──┬─────────────────────┬──┘                     │
   │   ├─CHAR LARGE OBJECT──────┤  └─(──integer──┬───┬──)────┘  └─allocate-clause─────┘                        │
   │   └─CHARACTER LARGE OBJECT─┘                ├─K─┤                                                         │
   │                                             └─M─┘                                                         │
   ├─┬─GRAPHIC──┬──────────────────┬────────────────────────────────────────┬─┬──────────────────┬─┤
   │ │          └─(──integer──)────┘                                        │ └─CCSID──integer───┘ │
   │ ├─┬─┬─VARGRAPHIC──────┬──(──integer──)─┬──┬─────────────────────┬──────┤                      │
   │ │ │ └─GRAPHIC VARYING─┘                │  └─allocate-clause─────┘      │                      │
   │ │ └─LONG VARGRAPHIC────────────────────┘                               │                      │
   │ └─DBCLOB──┬─────────────────────────┬──┬─────────────────────┬─────────┘                      │
   │           └─(──integer──┬───┬──)────┘  └─allocate-clause─────┘                                │
   │                         ├─K─┤                                                                 │
   │                         └─M─┘                                                                 │
   ├─DATE──────────────────────────────────────────────────────────────────────────────────────┤
   ├─TIME──────────────────────────────────────────────────────────────────────────────────────┤
   ├─TIMESTAMP─────────────────────────────────────────────────────────────────────────────────┤
   ├─DATALINK──┬──────────────────┬──┬─────────────────────┬──┬──────────────────┬─────────────┤
   │           └─(──integer──)────┘  └─allocate-clause─────┘  └─CCSID──integer───┘             │
   └─distinct-type─────────────────────────────────────────────────────────────────────────────┘
```

allocate-clause:

```
├──ALLOCATE──(integer)──────────────────────────────────────────────────────────┤
```

default-clause:

```
    ┌─WITH─┐
├───┴──────┴──DEFAULT──┬────────────────────────────────────────────────────────┬──────────────┤
                       ├─constant───────────────────────────────────────────────┤
                       ├─NULL───────────────────────────────────────────────────┤
                       ├─USER───────────────────────────────────────────────────┤
                       ├─CURRENT_DATE───────────────────────────────────────────┤
                       ├─CURRENT_TIME───────────────────────────────────────────┤
                       ├─CURRENT_TIMESTAMP──────────────────────────────────────┤
                       │                                                 (1)    │
                       └─cast-function-name──(──┬─constant───────────┬──)───────┘
                                                ├─USER───────────────┤
                                                ├─CURRENT_DATE───────┤
                                                ├─CURRENT_TIME───────┤
                                                └─CURRENT_TIMESTAMP──┘
```

datalink-options:

```
                ┌─NO LINK CONTROL──────────────────────────────┐
├──LINKTYPE URL─┼──────────────────────────────────────────────┼──────────────┤
                └─FILE LINK CONTROL──┬─file-link-options─┬─────┘
                                     └─MODE DB2OPTIONS───┘
```

file-link-options:

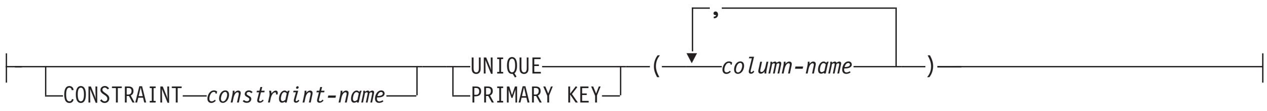
```
   ┌──────────────────────────────────────┐
   │    (2)                               │
   ▼                                      │
├──────┬──────────────────────────────┬───┴──────────────────────┤
       ├─INTEGRITY ALL────────────────┤
       ├─┬─READ PERMISSION FS─┬───────┤
       │ └─READ PERMISSION DB─┘       │
       ├─┬─WRITE PERMISSION FS──────┬─┤
       │ └─WRITE PERMISSION BLOCKED─┘ │
       ├─RECOVERY NO──────────────────┤
       └─┬─ON UNLINK RESTORE─┬────────┘
         └─ON UNLINK DELETE──┘
```

Notes:

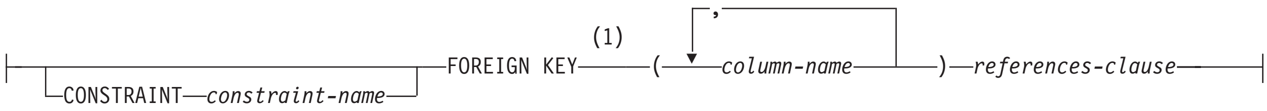
1 This form of the DEFAULT value can only be used with columns that are defined as a distinct type.

2 The file-link-options can be specified in any order.

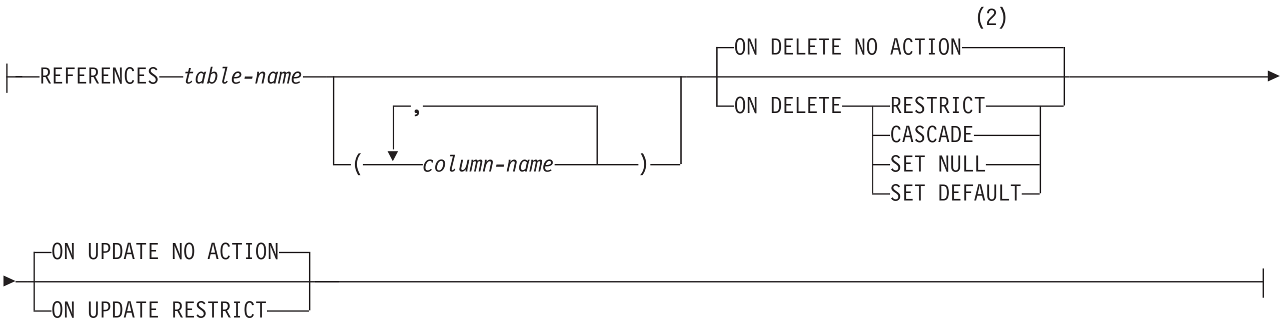
unique-constraint:



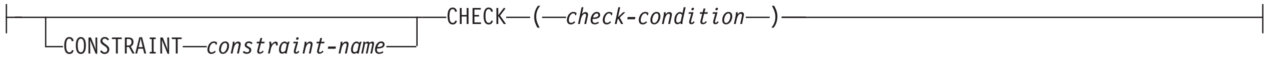
referential-constraint:



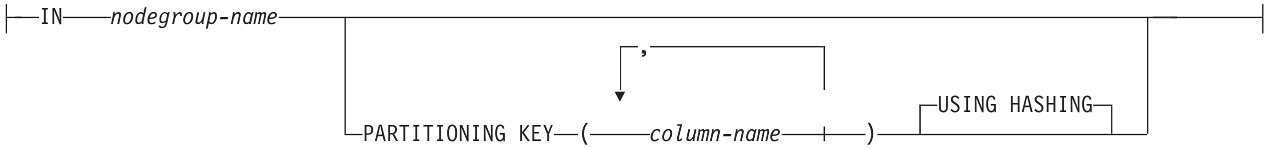
references-clause:



check-constraint:



nodegroup-clause:



Notes:

1 For compatibility with other products, constraint-name (without the CONSTRAINT keyword) may be specified following FOREIGN KEY.

2 The ON DELETE and ON UPDATE clauses may be specified in either order.

Description

table-name
Names the table. The name, including the implicit or explicit qualifier, must not be the same as an index, table, view, alias, or file that already exists at the current server.

If SQL names were specified, the table will be created in the collection or library specified by the implicit or explicit qualifier. The qualifier is the *owner* of the table if a user profile with that name exists. Otherwise, the *owner* of the table is the user profile or group user profile of the job executing the statement.

If system names were specified, the table will be created in the collection or library that is specified by the qualifier. If not qualified, the table will be created in the current library (*CURLIB). If there is no current library, the table will be created in QGPL. The owner of the table is the user profile or group user profile of the job executing the statement.

If the owner of the table is a member of a group profile (GRPPRF keyword) and group authority is specified (GRPAUT keyword), that group profile will also have authority to the table.

column-definition

Defines the attributes of a column. There must be at least one column definition and no more than 8000 column definitions.

The sum of the record buffer byte counts of the columns must not be greater than 32766 or, if a VARCHAR or VARGRAPHIC column is specified, 32740. Additionally, if a LOB is specified, the sum record data byte counts of the columns must not be greater than 15 728 640. For information on the byte counts of columns according to data type, see “Notes” on page 358.

column-name
Names a column of the table. Do not qualify *column-name* and do not use the same name for more than one column of the table or for a system-column-name of the table.

FOR COLUMN *system-column-name*
Provides an OS/400 name for the column. Do not use the same name for more than one column of the table or for a column-name of the table.

If the system-column-name is not specified, and the column-name is not a valid system-column-name, a system column name is generated. For more information on how system column names are generated, see “Rules for Column Name Generation” on page 360.

data-type
Specifies the data type of the column. Use:

BIGINT
For a big integer.

INTEGER or **INT**
For a large integer.

SMALLINT
For a small integer.

DECIMAL(*integer***,***integer***)** or **DEC(***integer***,***integer***)**

DECIMAL(*integer***)** or **DEC(***integer***)**

DECIMAL or **DEC**
For a packed decimal number. The first integer is the precision of the number; that is, the total number of digits; it can range from 1 to 31. The

second integer is the scale of the number (the number of digits to the right of the decimal point). It can range from 0 to the precision of the number.

You can use DECIMAL(*p*) for DECIMAL(*p*,0), and DECIMAL for DECIMAL(5,0).

NUMERIC(*integer***,***integer***)**

NUMERIC(*integer***)**

NUMERIC
For a zoned decimal number. The first integer is the precision of the number, that is, the total number of digits; it may range from 1 to 31. The second integer is the scale of the number, (the number of digits to the right of the decimal point). It may range from 0 to the precision of the number.

You can use NUMERIC(*p*) for NUMERIC(*p*,0), and NUMERIC for NUMERIC(5,0).

FLOAT
For a double-precision floating-point number.

FLOAT(*integer***)**
For a single- or double-precision floating-point number, depending on the value of integer. The value of integer must be in the range 1 through 53. The values 1 through 24 indicate single-precision, the values 25 through 53 indicate double-precision.

REAL
For single-precision floating point.

DOUBLE PRECISION or **DOUBLE**
For double-precision floating point.

BLOB(*integer*[**K|M**]) or **BINARY LARGE OBJECT(***integer***[K|M])**

BLOB or **BINARY LARGE OBJECT**
For a binary large object string of the specified maximum length. The maximum length must be in the range of 1 through 15 728 640. If the length specification is omitted, a length of 1 megabyte is assumed. A BLOB is not allowed in a distributed table.

integer
The maximum value for integer is 15 728 640. The maximum length of the string is *integer*.

integer **K**
The maximum value for integer is 15 360. The maximum length of the string is 1024 times *integer*.

integer **M**
The maximum value for integer is 15. The maximum length of the string is 1 048 576 times *integer*.

CHARACTER(*integer***)** or **CHAR(***integer***)**

CHARACTER or **CHAR**
For a fixed-length character string of length *integer*. The integer can range from 1 through 32766 (32765 if null capable). If FOR MIXED DATA or a mixed data CCSID is specified, the range is 4 through 32766 (32765 if null capable). If the length specification is omitted, a length of 1 character is assumed.

VARCHAR(*integer***)**

CHARACTER VARYING (*integer***)** or **CHAR VARYING (***integer***)**
For a varying-length character string of maximum length *integer*, which can range from 1 through 32740 (32739 if null capable). If FOR MIXED DATA or a mixed data CCSID is specified, the range is 4 through 32740 (32739 if null capable).

LONG VARCHAR [40]
For a varying length character string whose maximum length is determined by the amount of space available in the row. For information on how to calculate the maximum length, see "Rules for determining LONG VARCHAR and LONG VARGRAPHIC size" on page 360.

CLOB(*integer***[K|M])** or **CHAR LARGE OBJECT(***integer***[K|M])** or **CHARACTER LARGE OBJECT(***integer***[K|M])**

CLOB or **CHAR LARGE OBJECT** or **CHARACTER LARGE OBJECT**
For a character large object string of the specified maximum length. The maximum length must be in the range of 1 through 15 728 640. If FOR MIXED DATA or a mixed data CCSID is specified, the range is 4 through 15 728 640. If the length specification is omitted, a length of 1 megabyte is assumed. A CLOB is not allowed in a distributed table.

integer
The maximum value for integer is 15 728 640. The maximum length of the string is *integer*.

integer **K**
The maximum value for integer is 15 360. The maximum length of the string is 1024 times *integer*.

integer **M**
The maximum value for integer is 15. The maximum length of the string is 1 048 576 times *integer*.

GRAPHIC(*integer***)**

GRAPHIC
For a fixed-length graphic string of length *integer*, which can range from 1 through 16383 (16382 if null capable). If the length specification is omitted, a length of 1 character is assumed.

VARGRAPHIC(*integer***)** or **GRAPHIC VARYING(***integer***)**
For a varying-length graphic string of maximum length *integer*, which can range from 1 through 16370 (16369 if null capable).

LONG VARGRAPHIC [40]
For a varying length graphic string whose maximum length is determined by the amount of space available in the row. For information on how to calculate the maximum length, see "Rules for determining LONG VARCHAR and LONG VARGRAPHIC size" on page 360.

DBCLOB(*integer***[K|M])**

DBCLOB
For a double-byte character large object string of the specified maximum length. The maximum length must be in the range of 1 through 7 864 320.

---

[40] This option is provided for compatibility with other products. It is recommended that VARCHAR(integer) or VARGRAPHIC(integer) be specified instead.

If the length specification is omitted, a length of 1 megabyte is assumed. A DBCLOB is not allowed in a distributed table.

integer
The maximum value for integer is 7 864 320. The maximum length of the string is *integer*.

integer **K**
The maximum value for integer is 7 680. The maximum length of the string is 1024 times *integer*.

integer **M**
The maximum value for integer is 7. The maximum length of the string is 1 048 576 times *integer*.

DATE
For a date.

TIME
For a time.

TIMESTAMP
For a timestamp.

DATALINK(*integer***)** or **DATALINK**
For a DataLink of the specified maximum length. The maximum length must be in the range of 1 through 32718 (32717 if null capable). If FOR MIXED DATA or a mixed data CCSID is specified, the range is 4 through 32718 (32717 if null capable). The specified length must be sufficient to contain both the largest expected URL and any DataLink comment. If the length specification is omitted, a length of 200 is assumed. A DATALINK is not allowed in a distributed table.

A DATALINK value is an encapsulated value with a set of built-in scalar functions. The DLVALUE function creates a DATALINK value. The following functions can be used to extract attributes from a DATALINK value.

- DLCOMMENT
- DLLINKTYPE
- DLURLCOMPLETE
- DLURLPATH
- DLURLPATHONLY
- DLURLSCHEME
- DLURLSERVER

A DataLink cannot be part of any index. Therefore, it cannot be included as a column of a primary key, foreign key, or unique constraint.

distinct-type
For a user-defined type that is a distinct type. The length and scale of the column are respectively the length and scale of the source type of the distinct type. If a distinct type name is specified without a collection name, the distinct type name is resolved by searching the collections on the SQL path.

ALLOCATE(*integer***)**
Specifies for VARCHAR, VARGRAPHIC, and LOB types the space to be reserved for the column in each row. Column values with lengths less than or equal to the allocated value are stored in the fixed-length portion of the

row. Column values with lengths greater than the allocated value are stored in the variable-length portion of the row and require additional input/output operations to retrieve. The allocated value may range from 1 to maximum length of the string, subject to the maximum record buffer size limit. For information on the maximum record buffer size, see "Maximum record sizes" on page 359. If FOR MIXED or a mixed data CCSID is specified, the range is 4 to the maximum length of the string. If the allocated length specification is omitted, an allocated length of 0 is assumed. For VARGRAPHIC, the integer is the number of DBCS or UCS-2 characters. If a constant is specified for the default value and the ALLOCATE length is less than the length of the default value, the ALLOCATE length is assumed to be the length of the default value.

FOR BIT DATA

Indicates that the values of the column are not associated with a coded character set and are never converted. FOR BIT DATA is only valid for CHARACTER or VARCHAR columns. The CCSID of a FOR BIT DATA column is 65535.

FOR SBCS DATA

Indicates that the values of the column contain SBCS (single-byte character set) data. FOR SBCS DATA is the default for CHAR, VARCHAR, and CLOB columns if the default CCSID at the current server at the time the table is created is not DBCS-capable or if the length of the column is less than 4. FOR SBCS DATA is only valid for CHARACTER, VARCHAR, or CLOB columns. The CCSID of FOR SBCS DATA is determined by the default CCSID at the current server at the time the table is created.

FOR MIXED DATA

Indicates that the values of the column contain both SBCS data and DBCS data. FOR MIXED DATA is the default for CHAR, VARCHAR, and CLOB columns if the default CCSID at the current server at the time the table is created is DBCS-capable and the length of the column is greater than 3. Every FOR MIXED DATA column is a DBCS-open database field. FOR MIXED DATA is only valid for CHARACTER, VARCHAR, or CLOB columns. The CCSID of FOR MIXED DATA is determined by the default CCSID at the current server at the time the table is created.

CCSID integer

Indicates that the values of the column contain data of CCSID integer. If the integer is an SBCS CCSID, the column is SBCS data. If the integer is a mixed data CCSID, the column is mixed data and the length of the column must be greater than 3. For character columns, the CCSID must be an SBCS CCSID or a mixed data CCSID. For graphic columns, the CCSID must be a DBCS or UCS-2 CCSID. If a CCSID is not specified for a graphic column, the CCSID is determined by the default CCSID at the current server at the time the table is created. For a list of valid CCSIDs, see "Appendix E. CCSID Values" on page 569.

NOT NULL

Prevents the column from containing null values. Omission of NOT NULL implies that the column can be null.

DEFAULT

Specifies a default value for the column. This clause cannot be specified more than once in a *column-definition*. If a value is not specified and the column is nullable, the default value is the null value. If a value is not specified and the column is not nullable, the default depends on the data type of the column:

Data type	**Default value**
Numeric	0
Fixed-length string	Blanks
Varying-length string	A string length of 0
Date	The current date at the time of INSERT
Time	The current time at the time of INSERT
Timestamp	The current timestamp at the time of INSERT
Datalink	A value corresponding to DLVALUE('','URL','')
distinct-type	The default value of the corresponding source type of the distinct type.

Omission of NOT NULL and DEFAULT from a *column-definition* is an implicit specification of DEFAULT NULL.

constant
Specifies the constant as the default for the column. The specified constant must represent a value that could be assigned to the column in accordance with the rules of assignment as described in "Assignments and Comparisons" on page 66. A floating-point constant must not be used for a SMALLINT, INTEGER, DECIMAL, or NUMERIC column. A decimal constant must not contain more digits to the right of the decimal point than the specified scale of the column.

NULL
Specifies null as the default for the column. If NOT NULL is specified, DEFAULT NULL must not be specified within the same column definition.

USER
Specifies the value of the USER special register at the time of INSERT or UPDATE as the default value of the column. The data type of the column must be CHAR or VARCHAR with a length attribute greater than or equal to 18.

CURRENT_DATE
Specifies the current date as the default for the column. If CURRENT_DATE is specified, the data type of the column must be DATE.

CURRENT_TIME
Specifies the current time as the default for the column. If CURRENT_TIME is specified, the data type of the column must be TIME.

CURRENT_TIMESTAMP
Specifies the current timestamp as the default for the column. If CURRENT_TIMESTAMP is specified, the data type of the column must be TIMESTAMP.

cast-function-name
This form of a default value can only be used with columns defined as a distinct type, BLOB, CLOB, DBCLOB, DATE, TIME or TIMESTAMP data types. The following table describes the allowed uses of these *cast-functions*.

Data Type	Cast Function Name
Distinct type N based on a BLOB, CLOB, or DBCLOB	BLOB, CLOB, or DBCLOB *
Distinct type N based on a DATE, TIME, or TIMESTAMP	N (the user-defined cast function that was generated when N was created) ** or DATE, TIME, or TIMESTAMP *
Distinct type N based on other data types	N (the user-defined cast function that was generated when N was created) **
BLOB, CLOB, or DBCLOB	BLOB, CLOB, or DBCLOB *
DATE, TIME, or TIMESTAMP	DATE, TIME, or TIMESTAMP *

Notes:

* The name of the function must match the name of the data type (or the source type of the distinct type) with an implicit or explicit schema name of QSYS2

** The name of the function must match the name of the distinct type for the column. If qualified with a collection name, it must be the same as the collection name for the distinct type. If not qualified, the collection name from function resolution must be the same as the collection name for the distinct type.

constant

Specifies a constant as the argument. The constant must conform to the rules of a constant for the source type of the distinct type or for the data type if not a distinct type. For BLOB, CLOB, DBCLOB, DATE, TIME, and TIMESTAMP functions, the constant must be a string constant.

USER

Specifies the value of the USER special register at the time of INSERT or UPDATE as the default value for the column. The data type of the source type of the distinct type of the column must be CHAR or VARCHAR with a length attribute greater than or equal to 18.

CURRENT_DATE

Specifies the current date as the default for the column. If CURRENT_DATE is specified, the data type of the source type of the distinct type of the column must be DATE.

CURRENT_TIME

Specifies the current time as the default for the column. If CURRENT_TIME is specified, the data type of the source type of the distinct type of the column must be TIME.

CURRENT_TIMESTAMP

Specifies the current timestamp as the default for the column. If CURRENT_TIMESTAMP is specified, the data type of the source type of the distinct type of the column must be TIMESTAMP.

datalink-options

Specifies the options associated with a DATALINK data type.

LINKTYPE URL

Defines the type of link as a Uniform Resource Locator (URL).

NO LINK CONTROL

Specifies that there will not be any check made to determine that the linked files exist. Only the syntax of the URL will be checked. There is no database manager control over the linked files.

FILE LINK CONTROL
Specifies that a check should be made for the existence of the linked files. Additional options may be used to give the database manager further control over the linked files.

If FILE LINK CONTROL is specified, each file can only be linked once. That is, its URL can only be specified in a single FILE LINK CONTROL column in a single table.

file-link-options
Additional options to define the level of database manager control of the linked files.

INTEGRITY
Specifies the level of integrity of the link between a DATALINK value and the actual file.

ALL
Any file specified as a DATALINK value is under the control of the database manager and may NOT be deleted or renamed using standard file system programming interfaces.

READ PERMISSION
Specifies how permission to read the file specified in a DATALINK value is determined.

FS The read access permission is determined by the file system permissions. Such files can be accessed without retrieving the file name from the column.

DB
The read access permission is determined by the database. Access to the file will only be allowed by passing a valid file access token, returned on retrieval of the DATALINK value from the table, in the open operation. If READ PERMISSION DB is specified, WRITE PERMISSION BLOCKED must be specified.

WRITE PERMISSION
Specifies how permission to write to the file specified in a DATALINK value is determined.

FS The write access permission is determined by the file system permissions. Such files can be accessed without retrieving the file name from the column.

BLOCKED
Write access is blocked. The file cannot be directly updated through any interface. An alternative mechanism must be used to perform updates to the information. For example, the file is copied, the copy updated, and then the DATALINK value updated to point to the new copy of the file.

RECOVERY
Specifies whether or not DB2 will support point in time recovery of files referenced by values in this column.

NO
Specifies that point in time recovery will not be supported.

ON UNLINK
Specifies the action taken on a file when a DATALINK value is changed or deleted (unlinked). Note that this is not applicable when WRITE PERMISSION FS is used.

RESTORE
Specifies that when a file is unlinked, the DataLink File Manager will attempt to return the file to the owner with the permissions that existed at the time the file was linked. In the case where the user is no longer registered with the file server, the result depends on the file system that contains the files. If the files are in the AIX file system, the owner is ″dfmunknown″. If the files are in IFS, the owner is QDLFM. This can only be specified when INTEGRITY ALL and WRITE PERMISSION BLOCKED are also specified.

DELETE
Specifies that the file will be deleted when it is unlinked. This can only be specified when READ PERMISSION DB and WRITE PERMISSION BLOCKED are also specified.

MODE DB2OPTIONS
This mode defines a set of default file link options. The defaults defined by DB2OPTIONS are:

- INTEGRITY ALL
- READ PERMISSION FS
- WRITE PERMISSION FS
- RECOVERY NO

CONSTRAINT *constraint-name*
Names the constraint. A constraint-name must not identify a constraint that already exists at the current server.

If the clause is not specified, a unique constraint name is generated by the database manager.

PRIMARY KEY
Provides a shorthand method of defining a primary key composed of a single column. Thus, if PRIMARY KEY is specified in the definition of column C, the effect is the same as if the PRIMARY KEY(C) clause is specified as a separate clause.

This clause must not be specified in more than one column definition and must not be specified at all if the UNIQUE clause is specified in the column definition. When a primary key is added, a CHECK constraint is implicitly added to enforce the rule that the NULL value is not allowed in the column that makes up the primary key.

UNIQUE
Provides a shorthand method of defining a unique key composed of a single column. Thus, if UNIQUE is specified in the definition of column C, the effect is the same as if the UNIQUE(C) clause is specified as a separate clause.

This clause cannot be specified more than once in a column definition and must not be specified if PRIMARY KEY is specified in the column definition.

references-clause
The *references-clause* of a column-definition provides a shorthand method of defining a foreign key composed of a single column. Thus, if a

references-clause is specified in the definition of column C, the effect is the same as if that references-clause were specified as part of a FOREIGN KEY clause in which C is the only identified column.

CHECK(*check-condition***)**
Provides a shorthand method of defining a check constraint whose *check-condition* only references a single column. Thus, if CHECK is specified in the column definition of column C, no columns other than C can be referenced in the *check-condition* of the check constraint. The effect is the same as if the check constraint were specified as a separate clause.

unique-constraint

CONSTRAINT *constraint-name*
Names the constraint. A *constraint-name* must not identify a constraint that already exists at the current server.

If the clause is not specified, a unique constraint name is generated by the database manager.

PRIMARY KEY(*column-name***,...)**
Defines a primary key composed of the identified columns. A table can only have one primary key. Thus, this clause cannot be specified more than once and cannot be specified at all if the shorthand form has been used to define a primary key for the table. The identified columns cannot be the same as the columns specified in another UNIQUE constraint specified earlier in the CREATE TABLE statement. For example, PRIMARY KEY(A,B) would not be allowed if UNIQUE(B,A) had already been specified.

Each *column-name* must be an unqualified name that identifies a column of the table. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of identified columns must not exceed 120, and the sum of their lengths must not exceed 2000-n, where n is the number of columns specified that allow nulls. The unique index is created as part of the AS/400 physical file, not a separate AS/400 logical file. When a primary key is added, a CHECK constraint is implicitly added to enforce the rule that the NULL value is not allowed in any of the columns that make up the primary key.

UNIQUE(*column-name***,...)**
Defines a unique key composed of the identified columns. The UNIQUE clause can be specified more than once. The identified columns cannot be the same as the columns specified in another UNIQUE constraint or PRIMARY KEY that was specified earlier in the CREATE TABLE statement. For determining if a unique constraint is the same as another constraint specification, the column lists are compared. For example, UNIQUE(A,B) is the same as UNIQUE(B,A).

Each column-name must be an unqualified name that identifies a column of the table. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of identified columns must not exceed 120, and the sum of their lengths must not exceed 2000-n, where n is the number of columns specified that allows nulls.

A unique index on the identified column is created during the execution of the CREATE TABLE statement. The unique index is created as part of the AS/400 physical file, not as a separate AS/400 logical file.

referential-constraint

CONSTRAINT *constraint-name*
Names the constraint. A *constraint-name* must not identify a constraint that already exists at the current server.

If the clause is not specified, a unique constraint name is generated by the database manager.

FOREIGN KEY
Each specification of the FOREIGN KEY clause defines a referential constraint.

(*column-name***,...)**
The foreign key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of the table. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of identified columns must not exceed 120, and the sum of their lengths must not exceed 2000-n, where n is the number of columns specified that allow nulls.

REFERENCES *table-name*
The *table-name* specified in a REFERENCES clause must identify the table being created or a base table that already exists at the application server, but it must not identify a catalog table.

A referential constraint is a *duplicate* if its foreign key, parent key, and parent table are the same as the foreign key, parent key, and parent table of a previously specified referential constraint. Duplicate referential constraints are allowed, but not recommended.

Let T2 denote the identified parent table and let T1 denote the table being created.

The specified foreign key must have the same number of columns as the parent key of T2. The description of the *n*th column of the foreign key and the description of the *n*th column of that parent key must have identical data types and lengths.

(*column-name***,...)**
The parent key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of T2. The same column must not be identified more than once. The column must not be a LOB or DATALINK column. The number of identified columns must not exceed 120, and the sum of their lengths must not exceed 2000-n, where n is the number of columns specified that allow nulls.

The list of column names must be identical to the list of column names in the primary key of T2 or a UNIQUE constraint that exists on T2. The names need not be specified in the same order as in the primary key; however, they must be specified in corresponding order to the list of columns in the *foreign key* clause. If a column name list is not specified, then T2 must have a primary key. Omission of the column name list is an implicit specification of the columns of that primary key.

The referential constraint specified by a FOREIGN KEY clause defines a relationship in which T2 is the parent and T1 is the dependent.

ON DELETE

Specifies what action is to take place on the dependent tables when a row of the parent table is deleted.

SET NULL must not be specified unless some column of the foreign key allows null values.

CASCADE must not be specified if T1 contains a DataLink column with FILE LINK CONTROL.

The delete rule applies when a row of T2 is the object of a DELETE or propagated delete operation and that row has dependents in T1. Let *p* denote such a row of T2.

- If RESTRICT or NO ACTION is specified, an error occurs and no rows are deleted.
- If CASCADE is specified, the delete operation is propagated to the dependents of *p* in T1.
- If SET NULL is specified, each nullable column of the foreign key of each dependent of *p* in T1 is set to null.
- If SET DEFAULT is specified, each column of the foreign key of each dependent of *p* in T1 is set to its default value.

ON UPDATE

Specifies what action is to take place on the dependent tables when a row of the parent table is updated.

The update rule applies when a row of T2 is the object of an UPDATE or propagated update operation and that row has dependents in T1. Let *p* denote such a row of T2.

- If RESTRICT or NO ACTION is specified, an error occurs and no rows are updated.

check-constraint

CONSTRAINT *constraint-name*

Names the check constraint. A *constraint-name* must not identify a constraint that already exists at the current server.

If the clause is not specified, a unique constraint name is generated by the database manager.

CHECK (*check-condition***)**

Defines a check constraint. At any time, the *check-condition* must be true or unknown for every row of the table.

The *check-condition* is a *search-condition* except:

- It can only refer to columns of the table
- It must not contain any of the following:
  - Subqueries
  - Column functions
  - Host variables
  - Parameter markers

- CURRENT TIMEZONE, CURRENT SERVER, CURRENT PATH, and USER special registers
- NODENAME scalar function
- User-defined functions
- Functions that were implicitly generated with the creation of a distinct type
- ATAN2, DIFFERENCE, RAND, RADIANS, and SOUNDEX scalar functions
- DLVALUE, DLURLPATH, DLURLPATHONLY, DLURLSERVER, or DLURLSCHEME scalar functions
- DLURLCOMPLETE scalar function (for DataLinks with an attribute of FILE LINK CONTROL and READ PERMISSION DB)

For more information on search-condition, see “Search Conditions” on page 128. For more information on check constraints involving LOB data types and expressions, see the Database Programming book.

nodegroup-clause

IN *nodegroup-name*

Specifies the nodegroup across which the data in the table will be partitioned. The name must identify a nodegroup that exists at the current server. If this clause is specified, the table is created as a distributed table across all the AS/400 systems in the nodegroup.

A LOB or DATALINK column is not allowed in a distributed table.

The DB2 Multisystem product must be installed to create a distributed table. For more information on distributed tables, see the DB2 Multisystem book.

PARTITIONING KEY(*column-name***,...)**

Specifies the partitioning key. The partitioning key is used to determine on which node in the nodegroup a row will be placed. Each *column-name* must be an unqualified name that identifies a column of the table. The same column must not be identified more than once. If the PARTITIONING KEY clause is not specified, the first column of the primary key is used as the partitioning key. If there is no primary key, the first column of the table that is not floating point, date, time, or timestamp is used as the partitioning key.

The columns that make up the partitioning key must be a subset of the columns that make up any unique constraints over the table. Floating point, date, time, and timestamp columns cannot be used in a partitioning key.

USING HASHING

Specifies that the data in the partitioning key will be hashed in order to distribute the row to the appropriate AS/400 in the nodegroup.

Notes

Tables are created as physical files. If SQL names are used, tables are created with the system authority of *EXCLUDE on *PUBLIC. If system names are used, tables are created with the authority to *PUBLIC as determined by the create authority (CRTAUT) parameter of the collection or library. When a table is created, journaling is automatically started on the journal named QSQJRN in the collection or library.

When a table is created, the file wait time and record wait time attributes are set to the default that is specified on the WAITFILE and WAITRCD keywords of the Create Physical File (CRTPF) command.

Maximum record sizes

There are two maximum record size restrictions referred to in the description of *column-definition*.

- The maximum record buffer size is 32766 or, if a VARCHAR, VARGRAPHIC, or LOB column is specified, 32740.
- The maximum record data size is 15 728 640, if a LOB is specified. If a LOB is not specified, then the maximum record data size is 32766 or, if a VARCHAR or VARGRAPHIC column is specified, 32740.

To determine the length of a record buffer and/or record data add the corresponding length of each column of that record based on the byte counts of the data type.

The follow table gives the byte counts of columns by data type for columns that do not allow null values. If any column allows null values, one byte is required for every eight columns.

Data Type	**Record Buffer Byte Count**	**Record Data Byte Count**
SMALLINT	2	2
INTEGER	4	4
BIGINT	8	8
DECIMAL(*p*, *s*)	The integral part of (*p*/2) + 1	The integral part of (*p*/2) + 1
NUMERIC(*p*, *s*)	*p*	*p*
FLOAT (single precision)	4	4
FLOAT (double precision)	8	8
BLOB(*n*)	29+*pad*	*n*+29
CHAR(*n*)	*n*	*n*
VARCHAR(*n*)	*n*+2	*n*+2
CLOB(*n*)	29+*pad*	*n*+29
GRAPHIC(*n*)	*n**2	*n**2
VARGRAPHIC (n)	*n**2+2	*n**2+2
DBCLOB(*n*)	29+*pad*	*n**2+29
DATE	10	4
TIME	8	3
TIMESTAMP	26	10
DATALINK(*n*)	*n*+24	*n*+24
distinct-type	The byte count for the source type.	The byte count for the source type.
Notes: *pad* is a value from 1 to 15 necessary for boundary alignment.		

Precision as described to the database:

- Floating-point fields are defined in the AS/400 database with a decimal precision, not a bit precision. The algorithm used to convert the number of bits to decimal is *decimal precision = CEILING(n/3.31)*, where *n* is the number of bits to convert. The decimal precision is used to determine how many digits to display using interactive SQL.

- SMALLINT fields are stored with a decimal precision of 4,0.
- INTEGER fields are stored with a decimal precision of 9,0.
- BIGINT fields are stored with a decimal precision of 19,0.

Rules for determining LONG VARCHAR and LONG VARGRAPHIC size

The length of a LONG column is determined as follows. Let:

- `m` be the maximum row size
- `i` be the sum of the byte counts of all columns in the table that are not LONG VARCHAR or LONG VARGRAPHIC
- `j` be the number of LONG VARCHAR and LONG VARGRAPHIC columns in the table
- `k` be the number of columns in the row that allow nulls.

The length of each LONG VARCHAR column is INTEGER(`(m-24-i-((k+7)/8))/j`).

The length of each LONG VARGRAPHIC column is determined by taking the length calculated for a LONG VARCHAR column and dividing it by 2. The integer portion of the result is the length.

Reuse of deleted records

SQL tables are created so that space used by deleted rows will be reclaimed by future insert requests. This attribute can be changed via the AS/400 command *CHGPF* and specifying the *REUSEDLT(*NO)* parameter. For more information on the *CHGPF* command, see the CL Reference information in the **Programming** category of the AS/400 Information Center.

Rules for System Name Generation

There are specific instances when the system generates a system table, view, index, or column name. These instances and the name generation rules are described in the following sections.

Rules for Column Name Generation

A system-column-name is generated if the system-column-name is not specified when a table or view is created and the column-name is not a valid system-column-name.

If the column-name does not contain special characters and is longer than 10 characters, a 10-character system-column-name will be generated as:

- The first 5 characters of the name
- A 5 digit unique number

For example:

```
The system-column-name for LONGCOLUMNNAME would be LONGC00001
```

If the column name is delimited:

- The first 5 characters from within the delimiters will be used as the first 5 characters of the system-column-name. If there are fewer than 5 characters within the delimiters, the name will be padded on the right with underscore (_) characters. Lower case characters are folded to upper case characters. The only valid characters in a system-column-name are: A-Z, 0-9, @, #, $, and _. Any other characters will be changed to the underscore (_) character. If the first character ends up as an underscore, it will be changed to the letter Q.

- A 5 digit unique number is appended to the 5 characters.

For example:

```
The system-column-name for "abc" would be ABC__00001
The system-column-name for "COL2.NAME" would be COL2_00001
The system-column-name for "C 3" would be C_3__00001
The system-column-name for "??" would be Q____00001
The system-column-name for "*column1" would be QCOLU00001
```

Rules for Table Name Generation

A system name will be generated if a table, view, alias, or index is created with either:

- A name longer than 10 characters
- A name that contains characters not valid in a system name

The SQL name or its corresponding system name may both be used in SQL statements to access the file once it is created. However, the SQL name is only recognized by DB2 UDB for AS/400 and the system name must be used in other environments.

If the name does not contain special characters and is longer than 10 characters, a 10-character system name will be generated as:

- The first 5 characters of the name
- A 5 digit unique number

For example:

```
The system name for LONGTABLENAME would be LONGT00001
```

If the SQL name contains special characters, the system name is generated as:

- The first 4 characters of the name
- A 4 digit unique number

In addition:

- All special characters are replaced by the underscore (_)
- Any trailing blanks are removed from the name
- The name is delimited by double quotes (") if the delimiters are required for the name to be a valid system name.

For example:

```
The system name for "??" would be "__0001"
The system name for "longtablename" would be "long0001"
The system name for "LONGTableName" would be LONG0001
The system name for "A b   " would be "A_b0001"
```

SQL ensures the system name is unique by searching the cross reference file. If the name already exists in the cross reference file, the number is incremented until the name is no longer a duplicate.

Examples

Example 1

Given that you have administrative authority, create a table named 'ROSSITER.INVENTORY' with the following columns:

- Part number: Integer between 1 and 9 999, must not be null
- Description: Character of length 0 to 24
- Quantity on hand: Integer between 0 and 100000

The primary key is PARTNO.

```
CREATE TABLE ROSSITER.INVENTORY
             (PARTNO         SMALLINT     NOT NULL,
              DESCR          VARCHAR(24 ),
              QONHAND        INT,
              PRIMARY KEY(PARTNO))
```

Example 2

Create a table named CORPDATA.DEPT with the following columns:

- Department number: Character of length 3, must not be null
- Department name: Character of length 0 through 36, must not be null
- Manager number: Character of length 6
- Administrative department: Character of length 3, must not be null

```
CREATE TABLE CORPDATA.DEPT
             (DEPTNO    CHAR(3)     NOT NULL,
              DEPTNAME  VARCHAR(36) NOT NULL,
              MGRNO     CHAR(6),
              ADMRDEPT  CHAR(3)     NOT NULL)
```

CREATE VIEW

The CREATE VIEW statement creates a view on one or more tables or views.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - *USE to the Create Logical File (CRTLF) CL command
  - *EXECUTE and *ADD to the library into which the view is created
  - *CHANGE to the data dictionary if the library into which the table is created is an SQL collection with a data dictionary
- Administrative authority

The privileges held by the authorization ID of the statement must also include at least one of the following:

- For each table and view referenced directly through the subselect, or indirectly through views referenced in the subselect:
  - The SELECT privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

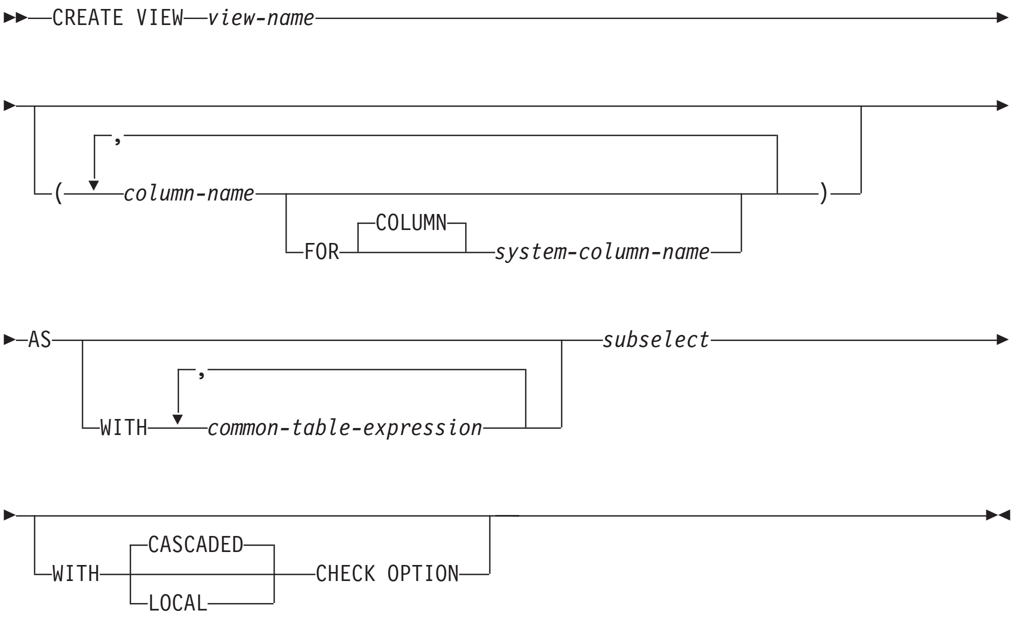
The authorization ID of the statement has the SELECT privilege on a table when:

- It is the owner of the table,

- It has been granted the SELECT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *READ on the table.

The authorization ID of the statement has the SELECT privilege on a view when:
- It is the owner of the view,
- It has been granted the SELECT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *READ on the view and the system authority *READ on all tables and views that this view is directly or indirectly dependent on. That is, all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth.

Syntax



Description

view-name
Names the view. The name, including the implicit or explicit qualifier, must not be the same as any table, view, index, alias, or file that already exists at the application server.

If SQL names were specified, the view will be created in the collection or library specified by the implicit or explicit qualifier. The qualifier is the *owner* of the view if a user profile with that name exists. Otherwise, the *owner* of the view is the user profile or group user profile of the job executing the statement.

If system names were specified, the view will be created in the collection or library that is specified by the qualifier. If not qualified, the view name will be created in the same collection or library as the first table specified on the first FROM clause (including FROM clauses in any common table expressions or nested table expressoin) . The *owner* of the view is the user profile or group user profile of the job executing the statement.

If the owner of the view is a member of a group profile (GRPPRF keyword) and group authority is specified (GRPAUT keyword), that group profile will also have authority to the view.

The owner always acquires the SELECT privilege on the view and the authorization to drop the view. The SELECT privilege can be granted to others only if the owner also has the authority to grant the SELECT privilege on every table or view identified in the subselect.

The owner can also acquire the INSERT, UPDATE, and DELETE privileges on the view. If the view is not read-only, then the same privileges will be acquired on the new view as the owner has on the table or view identified in the first FROM clause of the subselect. These privileges can be granted only if the privileges from which they are derived can also be granted.

If a view name is not a valid system name, DB2 UDB for AS/400 SQL will generate a system name. For information on the rules for generating the name, see “Rules for Table Name Generation” on page 361.

(column-name, ...)
Names the columns in the view. If you specify a list of column names, it must consist of as many names as there are columns in the result table of the subselect. Do not qualify column-name and do not use the same name for more than one column of the view or for a system-column-name of the view. If you do not specify a list of column names, the columns of the view inherit the names of the columns and system names of the columns of the result table of the subselect.

You must specify a list of column names if the result table of the subselect has duplicate column names, duplicate system column names, or an unnamed column. For more information about unnamed columns, see “Names of result columns” on page 222.

FOR COLUMN *system-column-name*
Provides an OS/400 name for the column. Do not use the same name for more than one column of the view or for a column-name of the view.

If the system-column-name is not specified, and the column-name is not a valid system-column-name, a system column name is generated. For more information on how system column names are generated, see “Rules for Column Name Generation” on page 360.

AS *subselect*
Defines the view. At any time, the view consists of the rows that would result if the subselect were executed.

common-table-expression defines a common table expression for use with the subselect that follows. For more information see “common-table-expression” on page 233.

Subselect must not reference host variables. For an explanation of *subselect*, see “Chapter 4. Queries” on page 219.

WITH CASCADED CHECK OPTION
Specifies the constraint that every row that is inserted or updated through the

view must conform to the definition of the view. A row that does not conform to the definition of the view is a row that cannot be retrieved using that view.

WITH CHECK OPTION must not be specified if the view is read-only or if the definition of the view includes a subquery. If WITH CHECK OPTION is specified for an updateable view that does not allow inserts, then the constraint applies to updates only.

If WITH CHECK OPTION is omitted, the definition of the view is not used in the checking of any insert or update operations that use the view. Some checking might still occur during insert or update operations if the view is directly or indirectly dependent on another view that includes WITH CHECK OPTION. Because the definition of the view is not used, rows that do not conform to the definition of the view might be inserted or updated through the view.

The WITH CHECK OPTION constraint on a view V is inherited by any updateable view that is directly or indirectly dependent on V. Thus, if an updateable view is defined on V, the constraint on V also applies to that view, even if WITH CHECK OPTION is not specified on that view. For example, consider the following updateable views:

```
CREATE VIEW V1 AS SELECT COL1 FROM T1 WHERE COL1 > 10

CREATE VIEW V2 AS SELECT COL1 FROM V1 WITH CHECK OPTION

CREATE VIEW V3 AS SELECT COL1 FROM V2 WHERE COL1 < 100
```

The following INSERT statement using V1 will succeed because V1 does not have a WITH CHECK OPTION and V1 is not dependent on any other view that has a WITH CHECK OPTION.

```
INSERT INTO V1 VALUES(5)
```

The following INSERT statement using V2 will result in an error because V2 has a WITH CHECK OPTION and the insert would produce a row that did not conform to the definition of V2.

```
INSERT INTO V2 VALUES(5)
```

The following INSERT statement using V3 will result in an error even though it does not have WITH CHECK OPTION because V3 is dependent on V2 which does have a WITH CHECK OPTION.

```
INSERT INTO V3 VALUES(5)
```

The following INSERT statement using V3 will succeed because even though it does not conform to the definition of V3 (V3 does not have a WITH CHECK OPTION), it does conform to the definition of V2 (which does have a WITH CHECK OPTION).

```
INSERT INTO V3 VALUES(200)
```

WITH LOCAL CHECK OPTION

WITH LOCAL CHECK OPTION is identical to WITH CASCADED CHECK OPTION except that it is still possible to update a row so that it no longer conforms to the definition of the view when the view is defined with WITH LOCAL CHECK OPTION. This can only happen when the view is directly or indirectly dependent on a view that was defined without either WITH CASCADED CHECK OPTION or WITH LOCAL CHECK OPTION clauses.

WITH LOCAL CHECK OPTION specifies that the search conditions of only those dependent views that have the WITH LOCAL CHECK OPTION or WITH CASCADED CHECK OPTION are checked when a row is inserted or updated. In contrast, WITH CASCADED CHECK OPTION specifies that the search conditions of all dependent views are checked when a row is inserted or updated.

The difference between CASCADED and LOCAL is best shown by example. Consider the following updateable views where x and y represent either LOCAL or CASCADED:

- V1 defined on T0
- V2 defined on V1 WITH x CHECK OPTION
- V3 defined on V2
- V4 defined on V3 WITH y CHECK OPTION
- V5 defined on V4

The following table describes which views search conditions are checked during an INSERT or UPDATE operation:

Table 24. Views whose search conditions are checked during INSERT and UPDATE

View used in INSERT or UPDATE	**x = LOCAL** **y = LOCAL**	**x = CASCADED** **y = CASCADED**	**x = LOCAL** **y = CASCADED**	**x = CASCADED** **y = LOCAL**
V1	none	none	none	none
V2	V2	V2 V1	V2	V2 V1
V3	V2	V2 V1	V2	V2 V1
V4	V4 V2	V4 V3 V2 V1	V4 V3 V2 V1	V4 V2 V1
V5	V4 V2	V4 V3 V2 V1	V4 V3 V2 V1	V4 V2 V1

Notes

Views are created as nonkeyed logical files. If SQL names are used, views are created with the system authority of *EXCLUDE on *PUBLIC. If system names are used, views are created with the authority to *PUBLIC as determined by the create authority (CRTAUT) parameter of the collection or library.

When a view is created, the file wait time and record wait time attributes are set to the default that is specified on the WAITFILE and WAITRCD keywords of the Create Logical File (CRTLF) command.

The view is created with the sort sequence in effect at the time the CREATE VIEW statement is executed. The sort sequence of the view applies to all comparisons involving SBCS data and mixed data in the view subselect. When the view is included in a query, an intermediate result table is generated from the view subselect. The sort sequence in effect when the query is executed applies to any selection specified in the query.

A view cannot be the object table in an UPDATE statement unless the first SELECT clause contains at least one result column that is derived solely from a column. That is, at least one result column must not be derived from an expression that contains an operator, scalar function, constant, or a column that itself is derived from such expressions.

A view cannot refer to more than 32 real tables, including real tables referred to by underlying views.

A view cannot address more than 8000 columns. The number of tables referred to in the view, the column name lengths, and the length of the WHERE clause also reduce this number.

A view created over a distributed table is created on all of the AS/400 systems across which the table is distributed. If a view is created over more than one distributed table, and those tables are not distributed using the same nodegroup, then the view is created only on the system that performs the CREATE VIEW statement. For more information on distributed tables, see the DB2 Multisystem book.

Read-only views

A view is read-only if any of the following appear in its definition:

- The first FROM clause identifies more than one table or view.
- The first FROM clause identifies a read-only view.
- The first SELECT clause specifies the keyword DISTINCT.
- The outer subselect contains a GROUP BY clause.
- The outer subselect contains a HAVING clause.
- The first SELECT clause contains a column function.
- The subselect contains a subquery such that the base object of the outer subselect, and of the subquery, is the same table.

A read-only view cannot be the object of an INSERT, UPDATE, or DELETE statement.

Testing a view definition

You can test the semantics of your view definition by executing SELECT * FROM *view-name*.

Examples

Example 1

Create a view named MA_PROJ over the PROJECT table that contains only those rows with a project number (PROJNO) starting with the letters ‘MA’.

```
CREATE VIEW MA_PROJ
  AS SELECT * FROM PROJECT
        WHERE SUBSTR(PROJNO, 1, 2) = 'MA'
```

Example 2

Create a view as in example 1, but select only the columns for project number (PROJNO), project name (PROJNAME) and employee in charge of the project (RESPEMP).

```
CREATE VIEW MA_PROJ2
  AS SELECT PROJNO, PROJNAME, RESPEMP FROM PROJECT
       WHERE SUBSTR(PROJNO, 1, 2) = 'MA'
```

Example 3

Create a view as in example 2, but, in the view, call the column for the employee in charge of the project IN_CHARGE.

```
CREATE VIEW MA_PROJ (PROJNO, PROJNAME, IN_CHARGE)
  AS SELECT PROJNO, PROJNAME, RESPEMP FROM PROJECT
       WHERE SUBSTR(PROJNO, 1, 2) = 'MA'
```

Note: Even though you are changing only one of the column names, the names of all three columns in the view must be listed in the parentheses that follow MA_PROJ.

Example 4

Create a view named PRJ_LEADER that contains the first four columns (PROJNO, PROJNAME, DEPTNO, RESPEMP) from the PROJECT table together with the last name (LASTNAME) of the person who is responsible for the project (RESPEMP). Obtain the name from the EMPLOYEE table by matching EMPNO in EMPLOYEE to RESEMP in PROJECT.

```
CREATE VIEW PRJ_LEADER
  AS SELECT PROJNO, PROJNAME, DEPTNO, RESPEMP, LASTNAME
       FROM PROJECT, EMPLOYEE
       WHERE RESPEMP = EMPNO
```

Example 5

Create a view as in example 4, but in addition to the columns PROJNO, PROJNAME, DEPTNO, RESEMP and LASTNAME, show the total pay (SALARY + BONUS +COMM) of the employee who is responsible. Also select only those projects with mean staffing (PRSTAFF) greater than one.

```
CREATE VIEW PRJ_LEADER (PROJNO, PROJNAME, DEPTNO, RESPEMP, LASTNAME, TOTAL_PAY)
  AS SELECT PROJNO, PROJNAME, DEPTNO, RESPEMP, LASTNAME, SALARY+BONUS+COMM
       FROM PROJECT, EMPLOYEE
       WHERE RESPEMP = EMPNO AND PRSTAFF > 1
```

DECLARE CURSOR

The DECLARE CURSOR statement defines a cursor.

Invocation

This statement can only be embedded in an application program. It is not an executable statement.

Authorization

No authorization is required to use this statement. However to use OPEN or FETCH for the cursor, the privileges held by the authorization ID of the statement must include at least one of the following:

- For each table or view identified in the SELECT statement of the cursor:
  - The SELECT privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the SELECT privilege on a table when:

- It is the owner of the table,
- It has been granted the SELECT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *READ on the table

The authorization ID of the statement has the SELECT privilege on a view when:

- It is the owner of the view,
- It has been granted the SELECT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *READ on the view and the system authority *READ on all tables and views that this view is

directly or indirectly dependent on. That is, all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth.

The SELECT statement of the cursor is one of the following:

- The prepared select-statement identified by the *statement-name*.
- The specified *select-statement*.

If ***statement-name*** is specified:

- The authorization ID of the statement is the run-time authorization ID unless DYNUSRPRF(*OWNER) was specified on the CRTSQLxxx command when the program was created. For more information, see "Authorization IDs and Authorization-Names" on page 48.
- The authorization check is performed when the select-statement is prepared unless DLYPRP(*YES) is specified on the CRTSQLxxx command.
- The authorization check is performed when the cursor is opened for programs compiled with the DLYPRP(*YES) parameter.

If the ***select-statement*** is specified:

- If USRPRF(*OWNER) or USRPRF(*NAMING) with SQL naming was specified on the CRTSQLxxx command, the authorization ID of the statement is the owner of the SQL program or package.
- If USRPRF(*USER) or USRPRF(*NAMING) with system naming was specified on the CRTSQLxxx command, the authorization ID of the statement is the run-time authorization ID.
- In REXX, the authorization ID of the statement is the run-time authorization ID.
- The authorization check is performed when the cursor is opened.

Syntax

```
►►──DECLARE──cursor-name──┬─────────────┬──┬────────────────────┬──────────►
                          └─INSENSITIVE─┘  └─┬─────────┬─SCROLL─┘
                                             └─DYNAMIC─┘

           ┌─,────────────┐
           ▼              │
►──CURSOR──┬─────────────┬┴──FOR──┬─select-statement─┬───────────────────►◄
           ├─WITH HOLD───┤        └─statement-name───┘
           └─WITH RETURN─┘
```

Description

cursor-name
  Names a cursor. The name must not be the same as the name of another cursor declared in your source program.

INSENSITIVE
  Specifies that once the cursor is opened, it does not have sensitivity to inserts, updates, or deletes performed by this or any other activation group. If INSENSITIVE is specified, the cursor is read-only and a temporary result is created when the cursor is opened. In addition, the SELECT statement cannot

contain a FOR UPDATE clause and the application must allow a copy of the data (ALWCPYDTA(*OPTIMIZE) or ALWCPYDTA(*YES)).

SCROLL
Specifies that the cursor is scrollable. The cursor may or may not have immediate sensitivity to inserts, updates, and deletes done by other activation groups. If DYNAMIC is not specified, the cursor is read-only. In addition, the SELECT statement cannot contain a FOR UPDATE clause.

DYNAMIC SCROLL
Specifies that the cursor is updateable if the result table is updateable, and that the cursor will usually have immediate sensitivity to inserts, updates, and deletes done by other application processes. However, in the following cases, the keyword DYNAMIC is ignored and the cursor will not have immediate sensitivity to the inserts, updates, and deletes:

- Queries that are implemented as temporary result tables. A temporary result table is created when:
  - The total length in bytes of storage for the columns specified in an ORDER BY clause exceeds 2000 bytes.
  - The ORDER BY and GROUP BY clauses specify different columns or columns in a different order.
  - The ORDER BY and GROUP BY clauses include a user-defined function or one of the following scalar functions: DLVALUE, DLURLPATH, DLURLPATHONLY, DLURLSERVER, DLURLSCHEME, or DLURLCOMPLETE for DataLinks with an attribute of FILE LINK CONTROL and READ PERMISSION DB.
  - The UNION or DISTINCT clauses are specified.
  - The ORDER BY or GROUP BY clauses specify columns which are not all from the same table.
  - A logical file defined by the JOINDFT data definition specifications (DDS) keyword is joined to another file.
  - A logical file that is based on multiple database file members is specified.
  - The CURRENT or RELATIVE scroll options are specified on the FETCH statement when the select statement of the DECLARE CURSOR contains a GROUP BY clause.
- Queries that include a subquery where:
  - The outermost query does not provide correlated values to any inner subselects.
  - No IN, = ANY, = SOME, or <> ALL subqueries are referenced by the outermost query.

WITH HOLD
Prevents the cursor from being closed as a consequence of a commit operation. A cursor declared using the WITH HOLD clause is implicitly closed at commit time only if the connection associated with the cursor is ended during the commit operation.

When WITH HOLD is specified, a commit operation commits all the changes in the current unit of work, but releases only locks that are not required to maintain the cursor. Afterwards, a FETCH statement is required before a Positioned UPDATE or DELETE statement can be executed.

All cursors are implicitly closed by a CONNECT (Type 1) or rollback operation. All cursors associated with a connection are implicitly closed by a disconnect of the connection. A cursor is also implicitly closed by a commit operation if WITH HOLD is not specified, or if the connection associated with the cursor is in the release-pending state.

If a cursor is closed before the commit operation, the effect is the same as if the cursor was declared without the WITH HOLD option.

WITH RETURN
This clause indicates that the cursor is intended for use as a result set from a stored procedure. WITH RETURN is relevant only if the DECLARE CURSOR statement is contained with the source code for a stored procedure. In other cases, the precompiler may accept the clause, but it has no effect.

Within an SQL procedure, cursors declared using the WITH RETURN clause that are still open when the SQL procedure ends, define the result sets from the SQL procedure. All other open cursors in an SQL procedure are closed when the SQL procedure ends. Within an external stored procedure (one not defined using LANGUAGE SQL), the WITH RETURN clause has no effect, and any cursors open at the end of an external procedure are considered the result sets.

The result set consists of all rows from the current cursor position to the end of the result set when the procedure returns to the caller.

select-statement
Specifies the SELECT statement of the cursor. See "select-statement" on page 233 for more information.

The *select-statement* must not include parameter markers (except for REXX), but can include references to host variables. In host languages, other than RPG, PL/I, and REXX, the declarations of the host variables must precede the DECLARE CURSOR statement in the source program. Host variable declarations can follow the DECLARE CURSOR statement in RPG and PL/I. In REXX, parameter markers must be used in place of host variables and the statement must be prepared.

statement-name
The SELECT statement of the cursor is the prepared select-statement identified by the *statement-name* when the cursor is opened. The *statement-name* must not be identical to a *statement-name* specified in another DECLARE CURSOR statement of the source program. See "PREPARE" on page 453 for an explanation of prepared statements.

The DECLARE CURSOR statement must precede all statements that explicitly reference the cursor by name.

A cursor in the open state designates a *result table* and a position relative to the rows of that table. The table is the result table specified by the SELECT statement of the cursor.

The result table is *read-only* if any of the following are true:
- The first FROM clause identifies more than one table or view.
- The first FROM clause identifies a read-only view.
- The first SELECT clause specifies the keyword DISTINCT.
- The outer subselect contains a GROUP BY clause.
- The outer subselect contains a HAVING clause.

- The first SELECT clause contains a column function.
- The select-statement contains a UNION or UNION ALL operator.
- The select-statement contains an ORDER BY clause, and the FOR UPDATE OF clause and DYNAMIC SCROLL are not specified.
- The select-statement includes a FOR FETCH ONLY clause.
- The SCROLL keyword is specified without DYNAMIC.
- The select list includes a DATALINK column and a FOR UPDATE OF clause is not specified.
- The first subselect requires a temporary result table.

Cursors whose result tables are not read-only may be updated.

Notes

The scope of *cursor-name* is the source program in which it is defined, that is, the program submitted to the precompiler. Thus, you can only reference a cursor by statements that are precompiled with the cursor declaration. For example, a program called from another separately compiled program cannot use a cursor that was opened by the calling program.

The scope of cursor-name is also limited to the thread in which the program that contains the cursor is running. For example, if the same program is running in two separate threads in the same job, the second thread cannot use a cursor that was opened by the first thread.

A cursor can only be referred to in the same instance of the program in the program stack unless CLOSQLCSR(*ENDJOB), CLOSQLCSR(*ENDSQL), or CLOSQLCSR(*ENDACTGRP) is specified on the CRTSQLxxx commands.

- If CLOSQLCSR(*ENDJOB) is specified, the cursor can be referred to by any instance of the program on the program stack.
- If CLOSQLCSR(*ENDSQL) is specified, the cursor can be referred to by any instance of the program on the program stack until the last SQL program on the program stack ends.
- If CLOSQLCSR(*ENDACTGRP) is specified, the cursor can be referred to by all instances of the module in the activation group until the activation group ends.

Although the scope of a cursor is the program in which it is declared, each package created from the program includes a separate instance of the cursor and more than one cursor can exist at run time. For example, assume a program using CONNECT (Type 2) statements connects to location X and location Y in the following sequence:

```
EXEC SQL DECLARE C CURSOR FOR...
EXEC SQL CONNECT TO X;
EXEC SQL OPEN C;
EXEC SQL FETCH C INTO...
EXEC SQL CONNECT TO Y;
EXEC SQL OPEN C;
EXEC SQL FETCH C INTO...
```

The second OPEN C statement does not cause an error because it refers to a different instance of cursor C.

The ALWCPYDTA precompile option is ignored for DYNAMIC SCROLL cursors. If sensitivity to inserts, updates, and deletes must be maintained, a temporary copy of the data is never made unless a temporary result is required to implement the query.

A SELECT statement is evaluated at the time the cursor is opened. If the same cursor is opened, closed, and then opened again, the results may be different. Multiple cursors using the same SELECT statement can be opened concurrently. They are each considered independent activities.

If ORDER BY is specified and FOR UPDATE OF is specified, the columns in the FOR UPDATE OF clause cannot be the same as any columns specified in the ORDER BY clause.

If the FOR UPDATE OF clause is omitted, only the columns in the SELECT clause of the subselect that can be updated can be changed.

If host variables are used on the DECLARE CURSOR statement within a REXX procedure, then the DECLARE CURSOR must be the object of a PREPARE and EXECUTE.

Examples

Example 1

In a PL/I program, use the cursor C1 to fetch the values for a given project (PROJNO) from the first four columns of the EMP_ACT table a row at a time and put them into the following host variables: EMP (char(6)), PRJ (char(6)), ACT (smallint), and TIM (dec(5,2)). Obtain the value of the project to search for from the host variable SEARCH_PRJ (char(6)).

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  EMP              CHAR(6);
  DCL  PRJ              CHAR(6);
  DCL  SEARCH_PRJ       CHAR(6);
  DCL  ACT              BINARY FIXED(15);
  DCL  TIM              DEC    FIXED(5,2);
EXEC SQL  END DECLARE SECTION;
  .
  .
  .
EXEC SQL  DECLARE C1 CURSOR FOR
            SELECT EMPNO, PROJNO, ACTNO, EMPTIME
              FROM EMP_ACT
              WHERE PROJNO = :SEARCH_PRJ;

EXEC SQL  OPEN C1;

EXEC SQL  FETCH C1 INTO :EMP, :PRJ, :ACT, :TIM;

IF SQLSTATE = '02000' THEN
  CALL DATA_NOT_FOUND;
ELSE
  DO WHILE (SUBSTR(SQLSTATE,1,2) = '00'
  | SUBSTR(SQLSTATE,1,2) = '01');
    EXEC SQL  FETCH C1 INTO :EMP, :PRJ, :ACT, :TIM;
  END;

EXEC SQL  CLOSE C1;
  .
  .
  .
```

Example 2

In a PL/I program, declare a cursor named INCREASE to return from the EMPLOYEE table all the employee numbers (EMPNO), surnames (LASTNAME) and price (SALARY increased by 10 percent) of people who have the job of clerk (JOB). Order the result table in descending order by the increased salary.

```
EXEC SQL  DECLARE INCREASE CURSOR FOR
            SELECT EMPNO, LASTNAME, SALARY * 1.1
              FROM EMPLOYEE
              WHERE JOB = 'CLERK'
              ORDER BY 3 DESC;
```

Example 3

In a PL/I program, declare a cursor named UP_CUR to update all the columns of the DEPARTMENT table.

```
EXEC SQL  DECLARE UP_CUR CURSOR FOR
            SELECT *
              FROM DEPARTMENT
              FOR UPDATE OF DEPTNO, DEPTNAME, MGRNO, ADMRDEPT;
```

Example 4

In a PL/I program, declare a cursor named DEL_CUR to examine, and potentially delete, rows in the DEPARTMENT table.

```
EXEC SQL  DECLARE DEL_CUR CURSOR FOR
            SELECT *
              FROM DEPARTMENT;
```

Example 5

This example is similar to Example 1. The difference is that the right-hand side of the WHERE clause is to be specified dynamically; thus the entire select-statement is placed into a host variable and dynamically prepared.

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  EMP             CHAR(6);
  DCL  PRJ             CHAR(6);
  DCL  SEARCH_PRJ      CHAR(6);
  DCL  ACT             BINARY     FIXED(15);
  DCL  TIM             DEC        FIXED(5,2);
  DCL  SELECT_STMT     CHAR(200)  VARYING;
EXEC SQL  END DECLARE SECTION;


SELECT_STMT = 'SELECT EMPNO, PROJNO, ACTNO, EMPTIME ' ||
                'FROM EMP_ACT ' ||
                'WHERE PROJNO = ?';
.
.
.
EXEC SQL  PREPARE SELECT_PRJ FROM :SELECT_STMT;

EXEC SQL  DECLARE C1 CURSOR FOR SELECT_PRJ;

EXEC SQL  OPEN C1 USING :SEARCH_PRJ;

EXEC SQL  FETCH C1 INTO :EMP, :PRJ, :ACT, :TIM;

IF SQLSTATE = '02000' THEN
  CALL DATA_NOT_FOUND;
ELSE
  DO WHILE (SUBSTR(SQLSTATE,1,2) = '00'
  | SUBSTR(SQLSTATE,1,2) = '01');
    EXEC SQL  FETCH C1 INTO :EMP, :PRJ, :ACT, :TIM;
  END;
```

```
EXEC SQL  CLOSE C1;
.
.
.
```

Example 6

The DECLARE CURSOR statement associates the cursor name C1 with the results of the SELECT. C1 is an updateable, scrollable cursor.

```
EXEC SQL DECLARE C1 DYNAMIC SCROLL CURSOR FOR
    SELECT DEPTNO, DEPTNAME, MGRNO
    FROM CORPDATA.TDEPT
    WHERE ADMRDEPT = 'A00';
```

Example 7

Declare a cursor in order to fetch values from four columns and assign the values to host variables using the Serializable (RR) isolation level:

```
DECLARE CURSOR1 CURSOR FOR
  SELECT COL1, COL2, COL3, COL4
  FROM TBLNAME WHERE COL1 = :varname
  WITH RR
```

DECLARE PROCEDURE

The DECLARE PROCEDURE statement defines an external procedure.

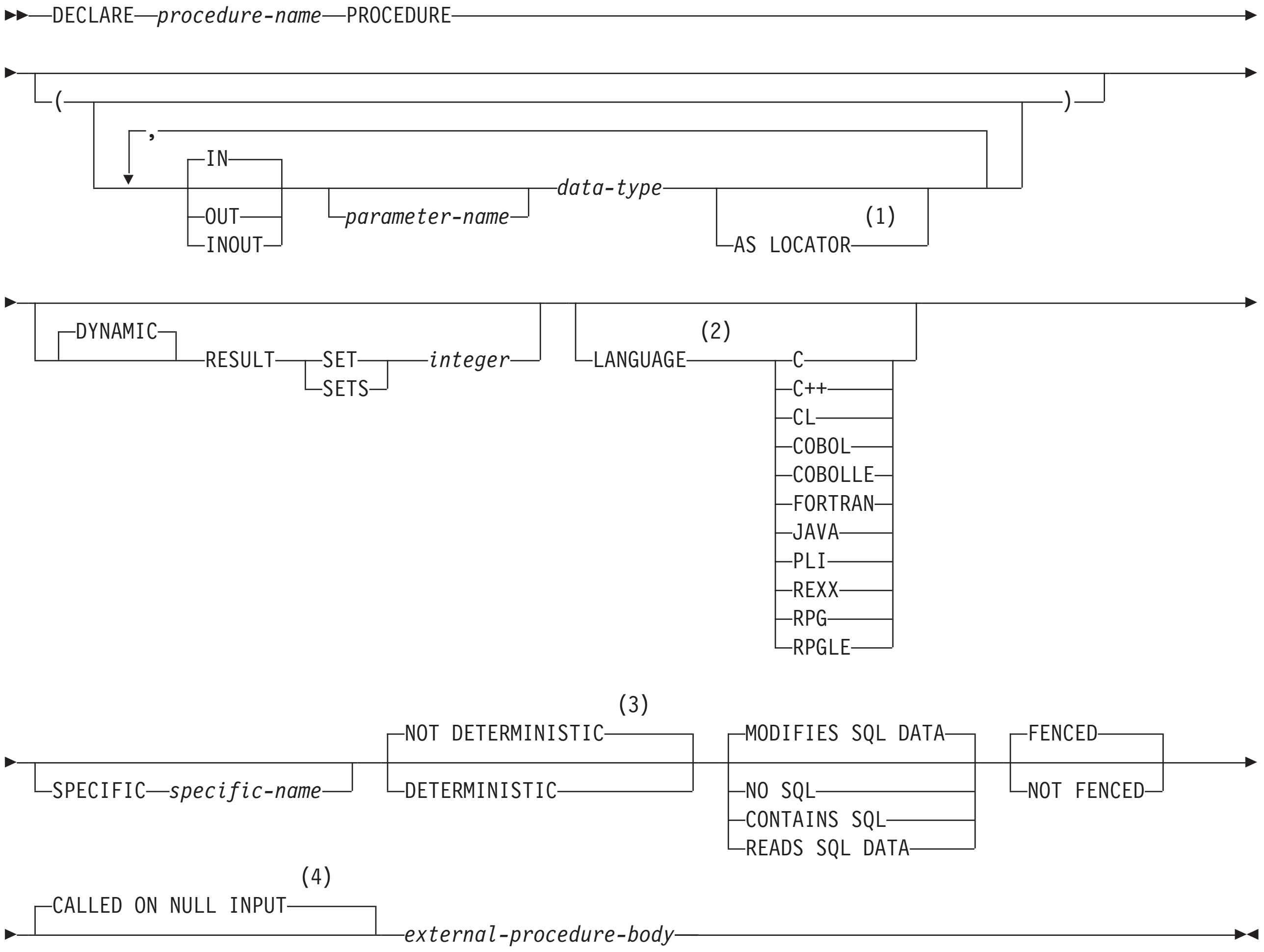
Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in REXX.

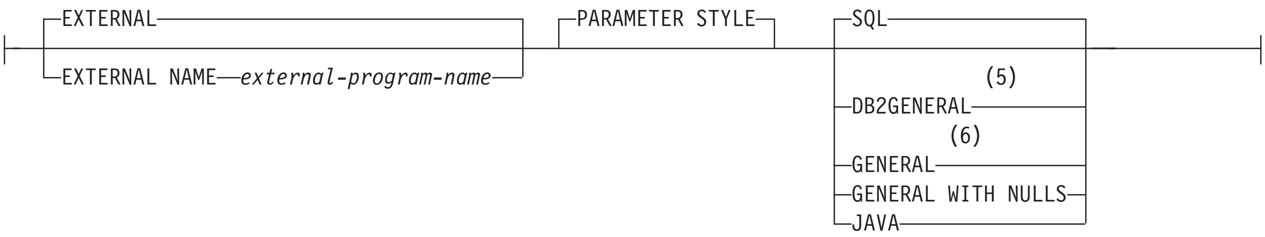
Authorization

None.

Syntax



external-procedure-body:



Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

2 The optional clauses can be specified in any order.

3 The keywords VARIANT and NOT VARIANT can be used as a synonym for NOT DETERMINISTIC and DETERMINISTIC.

4 The keywords NULL CALL can be used as a synonym for CALLED ON NULL INPUT.

5 The keyword DB2GENRL can be used as a synonym for DB2GENERAL.

6 The keywords SIMPLE CALL can be used as a synonym for GENERAL.

data-type:

```
├──┬─BIGINT──────────────────────────────────────────────────────────────────────────┬──────────┤
   ├─┬─INTEGER─┬─────────────────────────────────────────────────────────────────────┤
   │ └─INT─────┘                                                                     │
   ├─SMALLINT────────────────────────────────────────────────────────────────────────┤
   ├─┬─DECIMAL─┬──┬────────────────────────────────┬─────────────────────────────────┤
   │ ├─DEC─────┤  └─(─integer──┬─────────────┬─)───┘                                 │
   │ └─NUMERIC─┘               └─, integer───┘                                       │
   ├─┬─FLOAT─┬─────────────────┬─┬───────────────────────────────────────────────────┤
   │ │       └─(─integer─)─────┘ │                                                   │
   │ ├─REAL──────────────────────┤                                                   │
   │ │       ┌─PRECISION─┐       │                                                   │
   │ └─DOUBLE┴───────────┴───────┘                                                   │
   ├───┬─BLOB────────────────┬───┬──────────────────────────┬────────────────────────┤
   │   └─BINARY LARGE OBJECT─┘   └─(─integer─┬─────┬─)──────┘                        │
   │                                         ├─K───┤                                 │
   │                                         └─M───┘                                 │
   ├──┬─┬─CHARACTER─┬──┬─────────────────┬─────────────────┬──┬─────────────────┬────┤
   │  │ └─CHAR──────┘  └─(─integer─)─────┘                 │  ├─FOR BIT DATA────┤    │
   │  ├───┬─VARCHAR─────────────────────┬─(─integer─)──────┤  ├─FOR SBCS DATA───┤    │
   │  │   └─┬─CHARACTER─┬───VARYING─────┘                  │  ├─FOR MIXED DATA──┤    │
   │  │     └─CHAR──────┘                                  │  └─CCSID─integer───┘    │
   │  └───┬─CLOB───────────────────┬──┬─────────────────────────┬                     │
   │      ├─CHAR LARGE OBJECT──────┤  └─(─integer─┬─────┬─)─────┘                     │
   │      └─CHARACTER LARGE OBJECT─┘              ├─K───┤                            │
   │                                              └─M───┘                            │
   ├──┬─GRAPHIC──────┬───────────────────┬──────┬──┬─────────────────┬───────────────┤
   │  │              └─(─integer─)───────┘      │  └─CCSID─integer───┘               │
   │  ├───┬─VARGRAPHIC──────┬─(─integer─)───────┤                                    │
   │  │   └─GRAPHIC VARYING─┘                   │                                    │
   │  └─DBCLOB───┬──────────────────────────┬───┘                                    │
   │             └─(─integer─┬─────┬─)──────┘                                        │
   │                         ├─K───┤                                                 │
   │                         └─M───┘                                                 │
   ├─DATE────────────────────────────────────────────────────────────────────────────┤
   ├─TIME────────────────────────────────────────────────────────────────────────────┤
   ├─TIMESTAMP───────────────────────────────────────────────────────────────────────┤
   ├─DATALINK──┬─────────────────┬──┬─────────────────┬──────────────────────────────┤
   │           └─(─integer─)─────┘  └─CCSID─integer───┘                              │
   └─distinct-type───────────────────────────────────────────────────────────────────┘
```

Description

procedure-name
Names the procedure. The name must not be the same as the name of another procedure declared in your source program.

IN
Specifies this parameter as an input parameter. [41]

A DataLink or a distinct type based on a DataLink may not be specified as an output parameter.

OUT
Specifies this parameter as an output parameter.

---

[41] When the language type is REXX, all parameters must be input parameters.

ADataLink or a distinct type based on a DataLink may not be specified as an input and output parameter.

INOUT
Specifies this parameter as both an input and output parameter.

parameter-name
Names the parameter.

data-type
Specifies the attributes of the parameter.

The data type must be valid for the language specified in the language clause.All data types are valid for SQL procedures. DataLinks are not valid for external procedures. For more information on data types, see “CREATE TABLE” on page 340, and the SQL Programming Concepts book.

AS LOCATOR
Specifies that the input parameter is a locator to the value rather than the actual value. You can specify AS LOCATOR only if the input parameter has a LOB data type or a distinct type based on a LOB data type.

RESULT SETS *integer*
Specifies the maximum number of result sets that can be returned from the procedure. *integer* must be greater than or equal to zero. If zero is specified, no result sets are returned. A procedure can have any number of result sets, but at any time, only 100 procedures can have result sets that are waiting to be fetched.

Result sets are only returned if the procedure is called from a Client Access client or the SQL Call Level Interface. For more information on result sets see “SET RESULT SETS” on page 495.

LANGUAGE
Specifies the language that the external program is written in. The language clause is required if the external program is a REXX procedure.

If LANGUAGE is not specified, the LANGUAGE is determined from the program attribute information associated with the external program. If the program attribute information associated with the program does not identify a recognizable language, then the language is assumed to be C.

C
The external program is written in C.

C++
The external program is written in C++.

CL
The external program is written in CL.

COBOL
The external program is written in COBOL.

COBOLLE
The external program is written in ILE COBOL/400.

FORTRAN
The external program is written in FORTRAN.

JAVA
The external program is written in JAVA.

PLI
The external program is written in PL/I.

REXX
The external program is a REXX procedure.

RPG
The external program is written in RPG.

RPGLE
The external program is written in ILE RPG/400.

SPECIFIC *specific-name*
Specifies a qualified or unqualified name that uniquely identifies the procedure. The *specific-name*, including the implicit or explicit qualifier, must be the same as the *procedure-name*.

If no qualifier is specified, the implicit or explicit qualifier of the *procedure-name* is used. If a qualifier is specified, the qualifier must be the same as the explicit or implicit qualifier of the *procedure-name*.

If *specific-name* is not specified, it is the same as the procedure name.

DETERMINISTIC or NOT DETERMINISTIC
Indicates whether the procedure is deterministic.

NOT DETERMINISTIC
Specifies that the procedure will not always return the same result from successive calls with identical input arguments.

DETERMINISTIC
Specifies that the procedure will always return the same result from successive calls with identical input arguments.

CONTAINS SQL, READS SQL DATA, MODIFIES SQL DATA, or NO SQL
Indicates whether the procedure contains SQL, reads SQL data, or modifies SQL data.

CONTAINS SQL
Indicates that the procedure contains SQL. The procedure can only contain:

- Non-executable statements (such as DECLARE statements),
- CALL statements to procedures with a NO SQL or CONTAINS SQL attribute,
- FREE LOCATOR,
- SET RESULT SET,
- SET assignment and VALUES INTO as long as a only variables or constants are referenced,
- COMMIT, ROLLBACK, or SET TRANSACTION, and
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION.

NO SQL
Indicates that the external procedure does not contain SQL data. NO SQL cannot be specified for an SQL procedure.

READS SQL DATA
Indicates that the procedure possibly reads data using SQL. The procedure can contain any SQL statement other than:

- COMMIT, ROLLBACK, or SET TRANSACTION
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION

- DELETE, INSERT, or UPDATE
- ALTER TABLE, COMMENT ON, any CREATE statement, DROP, any GRANT statement, LABEL ON, RENAME, or any REVOKE statement

MODIFIES SQL DATA

Indicates that the procedure possibly modifies data using SQL. The procedure can contain any SQL statement other than:

- COMMIT, ROLLBACK, or SET TRANSACTION
- CONNECT, DISCONNECT, RELEASE, or SET CONNECTION

FENCED or NOT FENCED

This parameter is allowed for compatibility with other products and is not used by DB2 UDB for AS/400.

external-procedure-body

Specifies the body of an external procedure.

EXTERNAL NAME *external-program-name*

Specifies the program that will be executed when the procedure is called by the CALL statement. The program name must identify a program that exists at the application server. The program cannot be an ILE service program.

The validity of the name is checked at the application server. If the format of the name is not correct, an error is returned.

If external-program-name is not specified, the external program name is assumed to be the same as the procedure name.

PARAMETER STYLE

Defines the parameter passing convention for procedure.

SQL

All applicable parameters are passed. The parameters are defined to be in the following order:

- The first N parameters are the parameters that are specified on the DECLARE PROCEDURE statement.
- N parameters for indicator variables for the parameters.
- A CHAR(5) output parameter for SQLSTATE. The SQLSTATE returned indicates the success or failure of the function. The SQLSTATE returned either be:
  - the SQLSTATE from the last SQL statement executed in the external program,
  - an SQLSTATE that is assigned by the external program.

    The user may set the SQLSTATE in the external program to return an error or warning from the function. In this case, the SQLSTATE must contain:
    - ’00000’ to indicate success;
    - ’01Hxx’, where xx is any two digits or uppercase letters, to indicate a warning; or
    - ’38yxx’, where y is an uppercase letter between ’I’ and ’Z’ and xx is any two digits or uppercase letters, to indicate an error.
- A VARCHAR(517) input parameter for the fully qualified function name.
- A VARCHAR(128) input parameter for the specific name.

- A VARCHAR(70) output parameter for the message text.

DB2GENERAL
The stored procedure will use a parameter passing convention that is defined for use with Java methods. This can only be specified when LANGUAGE JAVA is used. For details on passing parameters in JAVA, see the SQL Programming Concepts book.

GENERAL
A general call to the procedure is performed. Additional arguments are not passed for indicator variables.

GENERAL WITH NULLS
A general call to the procedure is performed. An additional argument is passed for indicator variables. For more information on how the indicators are handled, see the SQL Programming Concepts book.

JAVA
The stored procedure will use a parameter passing convention that conforms to the Java language and SQLJ Routines specification. INOUT and OUT parameters will be passed as single entry arrays to facilitate returning values. This can only be specified when LANGUAGE JAVA is used. For details on passing parameters in JAVA, see the SQL Programming Concepts book.

Notes

The scope of the *procedure-name* is the source program in which it is defined; that is, the program submitted to the precompiler. Thus, a program called from another separately compiled program or module will not use the attributes from a DECLARE PROCEDURE statement in the calling program.

The DECLARE PROCEDURE statement should precede all CALL statements that reference that procedure.

The maximum number of parameters allowed in DECLARE PROCEDURE is 255. If GENERAL WITH NULLS is specified, the maximum is 254. If parameter style SQL is specified, only 90 parameters are allowed.The maximum number of parameters is also limited by the maximum number of parameters allowed by the licensed program used to compile the external program.

The DECLARE PROCEDURE statement only applies to static CALL statements. It does not apply to any dynamically prepared CALL statements or a CALL statement where the procedure name is identified by a host variable.

Example

Declare an external procedure PROC1 in a PL/I program. When the procedure is called using the CALL statement, a COBOL program named PGM1 in library LIB1 will be called.

```
EXEC SQL
DECLARE PROC1 PROCEDURE
        (CHAR(10), CHAR(10))
        EXTERNAL NAME LIB1.PGM1
        LANGUAGE COBOL GENERAL;

EXEC SQL
CALL PROC1 ('FIRSTNAME ','LASTNAME  ');
```

DECLARE STATEMENT

The DECLARE STATEMENT statement is used for program documentation. It declares names that are used to identify prepared SQL statements.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. This statement is not allowed in REXX.

Authorization

None required.

Syntax

```
                 ┌─,──────────────┐
                 ▼                │
►►──DECLARE───────statement-name──┴──STATEMENT──────────────────────────────►◄
```

Description

statement-name
Lists one or more names that are used in your program to identify prepared SQL statements.

Example

This example shows the use of the DECLARE STATEMENT statement in a PL/I program.

```
EXEC SQL DECLARE OBJ_STMT STATEMENT;

(Allocate storage from SQLDA)

( SRCE_STMT is "SELECT DEPTNO, DEPTNAME,
  MGRNO FROM CORPDATA.DEPARTMENT WHERE ADMRDEPT = 'A00'"  )

EXEC SQL INCLUDE SQLDA;
EXEC SQL DECLARE C1 CURSOR FOR OBJ_STMT;

EXEC SQL PREPARE OBJ_STMT FROM :SRCE_STMT;
EXEC SQL DESCRIBE OBJ_STMT INTO :SQLDA;

(Examine SQLDA)  (Set SQLDATA pointer addresses)

EXEC SQL OPEN C1;

DO WHILE (SQLCODE = 0);
  EXEC SQL FETCH C1 USING DESCRIPTOR :SQLDA;

(Print results)

END;

EXEC SQL CLOSE C1;
```

DECLARE VARIABLE

The DECLARE VARIABLE statement is used to assign a subtype or CCSID other than the default to a host variable.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in REXX.

Authorization

None required.

Syntax

```
               ┌─,─────────────┐
               ↓               │
►►──DECLARE────host-variable───┴──VARIABLE──┬─────────────────────┬──────────►◄
                                            ├─┬─FOR SBCS DATA──┬──┤
                                            │ ├─FOR MIXED DATA─┤  │
                                            │ ├─CCSID──integer─┤  │
                                            │ └─FOR BIT DATA───┘  │
                                            └─┬─DATE──────┬───────┘
                                              ├─TIME──────┤
                                              └─TIMESTAMP─┘
```

Description

host-variable
Names a character or graphic-string host variable defined in the program. An indicator variable cannot be specified for the host-variable. The host-variable definition may either precede or follow a DECLARE VARIABLE statement that refers to that variable.

FOR BIT DATA
Indicates that the values of the host-variable are not associated with a coded character set and, therefore, are never converted. The CCSID of a FOR BIT DATA host variable is 65535. FOR BIT DATA cannot be specified for graphic host-variables.

FOR SBCS DATA
Indicates that the values of the host variable contain SBCS (single-byte character set) data. FOR SBCS DATA is the default if the CCSID attribute of the job at the application requester is not DBCS-capable or if the length of the host variable is less than 4. The CCSID of FOR SBCS DATA is determined by the CCSID attribute of the job at the application requester. FOR SBCS DATA cannot be specified for graphic host-variables.

FOR MIXED DATA
Indicates that the values of the host variable contain both SBCS data and DBCS data. FOR MIXED DATA is the default if the CCSID attribute of the job at the application requester is DBCS-capable and the length of the host variable is greater than 3. The CCSID of FOR DBCS DATA is determined by the CCSID attribute of the job at the application requester. FOR MIXED DATA cannot be specified for graphic host-variables.

CCSID *integer*
Indicates that the values of the host variable contain data of CCSID integer. If

the integer is an SBCS CCSID, the host variable is SBCS data. If the integer is a mixed data CCSID, the host variable is mixed data. For character host variables, the CCSID specified must be an SBCS or mixed CCSID. For graphic host variables the CCSID specified must be a DBCS or UCS-2 CCSID. For a list of valid CCSIDs, see “Appendix E. CCSID Values” on page 569.

DATE
Indicates that the values of the host variable contain data that is a date.

TIME
Indicates that the values of the host variable contain data that is a time.

TIMESTAMP
Indicates that the values of the host variable contain data that is a timestamp.

Notes

The DECLARE VARIABLE statement can be specified anywhere in an application program that SQL statements are valid with the following exceptions:

If the host language is COBOL or RPG, the DECLARE VARIABLE statement must occur before an SQL statement that refers to a host variable specified in the DECLARE VARIABLE statement.

If DATE, TIME, or TIMESTAMP is specified for a nul-terminated character string in C, the length of the C declaration will be reduced by one.

The following situations result in an error message during precompile:

- A reference is made to a variable that does not exist.
- A reference is made to a numeric variable.
- A reference is made to a variable that has been referred to already.
- A reference is made to a variable that is not unique.
- The DECLARE VARIABLE statement occurs after an SQL statement where the SQL statement and the DECLARE VARIABLE statement refer to the same variable.
- The FOR BIT DATA, FOR SBCS DATA, or FOR MIXED DATA clause is specified for a graphic host variable.
- A SBCS or mixed CCSID is specified for a graphic host variable.
- A DBCS or UCS-2 CCSID is specified for a character host variable.
- DATE, TIME, or TIMESTAMP is specified for a host variable that is not character.
- The length of a host variable used for DATE, TIME, or TIMESTAMP is not long enough for the minimum date, time, or timestamp value.

Example

In this example, declare PL/I program variables FRED and PETE as mixed data, and JEAN and DAVE as SBCS data with CCSID 37.

```
EXEC SQL BEGIN DECLARE SECTION;
  DCL FRED CHAR(10);
      EXEC SQL DECLARE :FRED VARIABLE  FOR MIXED DATA;
  DCL MARY DEC FIXED(6);
  DCL PETE CHAR(4);
  DCL JEAN CHAR(30) VARYING;
  DCL DAVE CHAR(9);
      EXEC SQL DECLARE :JEAN, :DAVE VARIABLE  CCSID 37;
EXEC SQL END DECLARE SECTION;
EXEC SQL DECLARE :PETE VARIABLE FOR MIXED DATA;
```

DELETE

The DELETE statement deletes rows from a table or view. Deleting a row from a view deletes the row from the table on which the view is based.

There are two forms of this statement:

- The *Searched* DELETE form is used to delete one or more rows (optionally determined by a search condition).
- The *Positioned* DELETE form is used to delete exactly one row (as determined by the current position of a cursor).

Invocation

A Searched DELETE statement can be embedded in an application program or issued interactively. A positioned DELETE must be embedded in an application program. Both Searched DELETE and Positioned DELETE are executable statements that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the table or view identified in the statement:
  - The DELETE privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the DELETE privilege on a table when:

- It is the owner of the table,
- It has been granted the DELETE privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *DLT on the table.

The authorization ID of the statement has the DELETE privilege on a view when:[42]

- It has been granted the DELETE privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *DLT on the view, and the system authority *DLT on the first table or view that this view is directly or indirectly dependent on. That is, the first table or view referenced in the view definition, and if a view is referenced, the first table or view referenced in its definition, and so forth.

If the *search-condition* in a Searched DELETE contains a reference to a column of the table or view, then the privileges held by the authorization ID of the statement must also include one of the following:

- The SELECT privilege on the table or view
- Administrative authority

If the *search-condition* includes a subquery, the privileges held by the authorization ID of the statement must also include at least one of the following:

- For each table or view identified in the subquery:

---

[42] When a view is created, the owner does not necessarily acquire the DELETE privilege on the view. The owner only acquires the DELETE privilege if the view allows deletes and the owner also has the DELETE privilege on the first table referenced in the subselect.

  - The SELECT privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the SELECT privilege on a table when:
- It is the owner of the table,
- It has been granted the SELECT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *READ on the table.

The authorization ID of the statement has the SELECT privilege on a view when:
- It is the owner of the view,
- It has been granted the SELECT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *READ on the view and the system authority *READ on all tables and views that this view is directly or indirectly dependent on. That is, all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth.

Syntax

Searched DELETE:

```
►►──DELETE FROM──┬─table-name─┬──┬────────────────────┬──────────────────────►
                 └─view-name──┘  └─correlation-clause─┘

►──┬──────────────────────────┬──┬──────────────────┬──────────────────────►◄
   └─WHERE──search-condition──┘  └─isolation-clause─┘
```

Positioned DELETE:

```
►►──DELETE FROM──┬─table-name─┬──┬────────────────────┬──────────────────────►
                 └─view-name──┘  └─correlation-clause─┘

►─WHERE CURRENT OF──cursor-name────────────────────────────────────────────►◄
```

Description

FROM *table-name* or *view-name*
: Identifies the table or view from which you want to delete. The name must identify a table or view that exists at the application server, but it must not identify a catalog table, a view of a catalog table, or a read-only view. For an explanation of read-only views, see “Read-only views” on page 367.

correlation-clause
: Can be used within the *search-condition* to designate the table or view and column names of the table or view. For an explanation of *correlation-clause*, see “Chapter 4. Queries” on page 219. For an explanation of *correlation-name*, see “Correlation Names” on page 90.

WHERE

Specifies the rows to be deleted. You can omit the clause, give a search condition, or name a cursor. If you omit the clause, all rows of the table or view are deleted.

search-condition

Is any search condition as described in Chapter 2. Each *column-name* in the search condition, other than in a subquery, must identify a column of the table or view.

The *search-condition* is applied to each row of the table or view and the deleted rows are those for which the result of the *search-condition* is true.

If the search condition contains a subquery, the subquery can be thought of as being executed each time the *search condition* is applied to a row, and the results of the subquery used in applying the *search condition*. In actuality, a subquery with no correlated references is executed once, whereas a subquery with a correlated reference may have to be executed once for each row.

If a subquery refers to the object table of the DELETE statement or a dependent table with a delete rule of CASCADE, SET NULL, or SET DEFAULT, the subquery is completely evaluated before any rows are deleted.

CURRENT OF *cursor-name*

Identifies the cursor to be used in the delete operation. The *cursor-name* must identify a declared cursor as explained in the Notes for the DECLARE CURSOR statement.

The table or view named must also be identified in the FROM clause of the SELECT statement of the cursor, and the result table of the cursor must not be read-only. For an explanation of read-only result tables, see "DECLARE CURSOR" on page 368.

When the DELETE statement is executed, the cursor must be positioned on a row; that row is the one deleted. After the deletion, the cursor is positioned before the next row of its result table. If there is no next row, the cursor is positioned after the last row.

isolation-clause

Specifies the isolation level to be used for this statement. For an explanation of *isolation-clause*, see isolation-clause.

DELETE Rules

Triggers

If the identified table or the base table of the identified view has a delete trigger, the trigger is fired for each row deleted.

Referential Integrity

If the identified table or the base table of the identified table is a parent table, the rows selected must not have any dependents in a relationship with a delete rule of RESTRICT or NO ACTION, and the DELETE must not cascade to descendent rows that have dependents in a relationship with a delete rule of RESTRICT or NO ACTION.

If the delete operation is not prevented by a RESTRICT or NO ACTION delete rule, the selected rows are deleted. Any rows that are dependents of the selected rows are also affected:

- The nullable columns of the foreign keys of any rows that are their dependents in a relationship with a delete rule of SET NULL are set to the null value.
- The columns of the foreign keys of any rows that are their dependents in a relationship with a delete rule of SET DEFAULT are set to the corresponding default value.
- Any rows that are their dependents in a relationship with a delete rule of CASCADE are also deleted, and the above rules apply, in turn to those rows.

The referential constraints (other than a referential constraint with a RESTRICT delete rule), are effectively checked at the end of the statement. In the case of a multiple-row delete, this would occur after all rows were deleted and any associated triggers were fired.

Notes

If an error occurs during the execution of a DELETE statement and COMMIT(*NONE) was not specified, all changes made during the execution of the statement are backed out. However, other changes in the unit of work made prior to the error are not backed out. If COMMIT(*NONE) is specified, changes are not backed out.

Unless appropriate locks already exist, one or more exclusive locks are acquired during the execution of a successful DELETE statement. Until the locks are released by a commit or rollback operation, they can prevent other application processes from performing operations on the table. For further information about locking, see the description of the COMMIT, ROLLBACK, and LOCK TABLE statements, and “Isolation Level” on page 17.

If an application process deletes a row on which any of its non-updateable cursors are positioned, those cursors are positioned before the next row of their result table. Let C be a cursor that is positioned before the next row R (as the result of an OPEN, a DELETE through C, a DELETE through some other cursor, or a Searched DELETE). In the presence of INSERT, UPDATE, and DELETE operations that affect the base table from which R is derived, the next FETCH operation referencing C does not necessarily position C on R. For example, the operation can position C on R’ where R’ is a new row that is now the next row of the result table.

When a DELETE statement is completed, the number of rows deleted is returned in SQLERRD(3) in the SQLCA. The value in SQLERRD(3) does not include the number of rows that were deleted as a result of a CASCADE delete rule or a trigger.

SQLERRD(5) in the SQLCA shows the number of rows affected by referential constraints. It includes rows that were deleted as the result of a CASCADE delete rule and rows in which foreign keys were set to NULL or the default value as the result of a SET NULL or SET DEFAULT delete rule.

For a description of the SQLCA, see “Appendix B. SQL Communication Area” on page 541.

A maximum of 4000000 rows can be deleted or changed in any single DELETE statement when COMMIT(*RR), COMMIT(*ALL), COMMIT(*CS), or

COMMIT(*CHG) was specified. The number of rows changed includes any rows inserted, updated, or deleted under the same commitment definition as a result of a trigger, a CASCADE, SET NULL, or SET DEFAULT referential integrity delete rule.

Host variables cannot be used in the DELETE statement within a REXX procedure. Instead, the DELETE must be the object of a PREPARE and EXECUTE using parameter markers.

Examples

Example 1

Delete department (DEPTNO) 'D11' from the DEPARTMENT table.

```
DELETE FROM DEPARTMENT
  WHERE DEPTNO = 'D11'
```

Example 2

Delete all the departments from the DEPARTMENT table (that is, empty the table).

```
DELETE FROM DEPARTMENT
```

Example 3

Use a PL/I program statement to delete all the subprojects (MAJPROJ is NULL) from the PROJECT table for a department (DEPTNO) equal to that in the host variable HOSTDEPT (char(6)).

```
EXEC SQL DELETE FROM PROJECT
            WHERE DEPTNO = :HOSTDEPT AND MAJPROJ IS NULL;
```

Example 4

Code a portion of a PL/I program that will be used to display retired employees (JOB) and then, if requested to do so, remove certain employees from the EMPLOYEE table.

```
EXEC SQL  DECLARE C1 CURSOR FOR
           SELECT *
             FROM EMPLOYEE
               WHERE JOB = 'RETIRED';

EXEC SQL  OPEN C1;

EXEC SQL  FETCH C1 INTO ...     ;

PUT ...      ;
GET LIST (REMOVE);
IF REMOVE = 'YES' THEN
  EXEC SQL  DELETE FROM EMPLOYEE
              WHERE CURRENT OF C1;

EXEC SQL  CLOSE C1;
```

DESCRIBE

The DESCRIBE statement obtains information about a prepared statement. For an explanation of prepared statements, see "PREPARE" on page 453.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required. See “PREPARE” on page 453 for the authorization required to create a prepared statement.

Syntax

```
►►──DESCRIBE──statement-name──INTO──descriptor-name──────────────────────────────►

►─┬─────────────────────────┬────────────────────────────────────────────────────►◄
  └─USING──┬─NAMES────────┬─┘
           ├─SYSTEM NAMES─┤
           ├─LABELS───────┤
           ├─ANY──────────┤
           ├─BOTH─────────┤
           └─ALL──────────┘
```

Description

statement-name
Identifies the statement that you want described. When the DESCRIBE statement is executed, the name must identify a prepared statement at the application server.

INTO *descriptor-name*
Identifies an SQL descriptor area (SQLDA), which is described in “Appendix C. SQL Descriptor Area (SQLDA)” on page 551. Before the DESCRIBE statement is executed, the following variable in the SQLDA must be set. (The rules for REXX are different. For more information, see the SQL Programming with Host Languages book.)

SQLN Indicates the number of SQLVAR occurrences provided in the SQLDA. SQLN must be set to a value greater than or equal to zero before the DESCRIBE statement is executed. For information on techniques to determine the number of occurrences requires, see “Determining How Many SQLVAR Occurrences are Needed” on page 554.

When the DESCRIBE statement is executed, the database manager assigns values to the variables of the SQLDA as follows:

Variable	Information returned by the database manager
SQLDAID	'SQLDA '
SQLDABC	Length of the SQLDA.
SQLD	If the prepared statement is a SELECT, the number of columns in its result table; otherwise, 0.
SQLVAR	If the value of SQLD is 0, or greater than the value of SQLN, no values are assigned to occurrences of SQLVAR. If the value of SQLD is *n*, where *n* is greater than 0 but less than or equal to the value of SQLN, values are assigned to the first *n* occurrences of SQLVAR so that the first occurrence of SQLVAR contains a description of the first column of the result table, the second occurrence of SQLVAR contains a description of the second column of the result table, and so on. For information on the

values assigned to SQLVAR occurrences, see "Field Descriptions in an Occurrence of SQLVAR" on page 552.

USING
Indicates what value to assign to each SQLNAME variable in the SQLDA. If the requested value does not exist, SQLNAME is set to a length of 0.

NAMES
Assigns the name of the column. This is the default. For the DESCRIBE of a prepared statement where the name is explicitly listed in the select-list, the name specified is returned.

SYSTEM NAMES
Assigns the system column name of the column.

LABELS
Assigns the label of the column. (Column labels are defined by the LABEL ON statement.) Only the first 20 bytes of the label are returned.

ANY
Assigns the column label. If the column has no label, the column name is used instead.

BOTH
Assigns both the label and name of the column. In this case, two or three occurrences of SQLVAR per column, depending on whether the result set contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to 2**n* or 3**n*(where *n* is the number of columns in the table or view). The first *n* occurrences of SQLVAR contain the column names. Either the second or third *n* occurrences contain the column labels. If there are no distinct types, the labels are returned in the second set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries.

ALL
Assigns the label, column name, and system column name. In this case three or four occurrences of SQLVAR per column, depending on whether the result set contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to 3**n* or 4**n* (where *n* is the number of columns in the result table). The first *n* occurrences of SQLVAR contain the system column names. The second or third *n* occurrences contain the column labels. The third or fourth *n* occurrences contain the column names. If there are no distinct types, the labels are returned in the second set of SQLVAR entries and the column names are returned in the third set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries and the column names are returned in the fourth set of SQLVAR entries.

Notes

Information about a prepared statement can also be obtained by using the INTO clause of the PREPARE statement.

Allocating the SQLDA

Before the DESCRIBE or PREPARE INTO statement is executed, the value of SQLN must be set to a value greater than or equal to zero to indicate how many occurrences of SQLVAR are provided in the SQLDA and enough storage must be allocated to contain SQLN occurrences. (In REXX, storage does not need to be allocated for the SQLDA.) To obtain the description of the columns of the result table of a prepared SELECT statement, the number of occurrences of SQLVAR must not be less than the number of columns. Furthermore, if USING BOTH or USING ALL is specified, or if the columns include LOBs or distinct types, the number of occurrences of SQLVAR should be two, three, or four times the number of columns. See "Determining How Many SQLVAR Occurrences are Needed" on page 554 for more information.

If not enough occurrences are provided to return all sets of occurrences, SQLN is set to the total number of occurrences necessary to return all information. Otherwise, SQLN is set to the number of columns.

Among the possible ways to allocate the SQLDA are the three described below.

First Technique: Allocate an SQLDA with enough occurrences of SQLVAR to accommodate any select list that the application will have to process. At the extreme, the number of SQLVARs could equal four times the maximum number of columns allowed in a result table. Having done the allocation, the application can use this SQLDA repeatedly.

This technique uses a large amount of storage that is never deallocated, even when most of this storage is not used for a particular select list.

Second Technique: Repeat the following two steps for every processed select list:

1. Execute a DESCRIBE statement with an SQLDA that has no occurrences of SQLVAR; that is, an SQLDA for which SQLN is zero. The value returned for SQLD is equal to the required number of occurrences of SQLVAR.
2. Use the returned value of SQLD to allocate an SQLDA with enough occurrences of SQLVAR.
3. Execute the DESCRIBE statement again, using the new SQLDA.

This technique allows better storage management than the first technique, but it doubles the number of DESCRIBE statements.

Third Technique: Allocate an SQLDA that is large enough to handle most, and perhaps all, select lists but is also reasonably small. If an execution of DESCRIBE fails because the SQLDA is too small, allocate a larger SQLDA and execute DESCRIBE again. For the new SQLDA, use the value of SQLD returned from the first execution of DESCRIBE for the number of occurrences of SQLVAR.

This technique is a compromise between the first two techniques. Its effectiveness depends on a good choice of size for the original SQLDA.

Example

In a PL/I program, execute a DESCRIBE statement with an SQLDA that has no occurrences of SQLVAR. If SQLD is greater than zero, use the value to allocate an SQLDA with the necessary number of occurrences of SQLVAR and then execute a DESCRIBE statement using that SQLDA.

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  STMT1_STR   CHAR(200)  VARYING;
EXEC SQL  END DECLARE SECTION;
EXEC SQL  INCLUDE SQLDA;
EXEC SQL  DECLARE DYN_CURSOR CURSOR FOR STMT1_NAME;

... /* code to prompt user for a query, then to generate */
    /* a select-statement in the STMT1_STR             */
EXEC SQL  PREPARE STMT1_NAME FROM :STMT1_STR;
```

```
... /* code to set SQLN to zero and to allocate the SQLDA */
EXEC SQL  DESCRIBE STMT1_NAME INTO :SQLDA;

... /* code to check that SQLD is greater than zero, to set */
    /* SQLN to SQLD, then to re-allocate the SQLDA          */
EXEC SQL  DESCRIBE STMT1_NAME INTO :SQLDA;

... /* code to prepare for the use of the SQLDA            */
EXEC SQL  OPEN DYN_CURSOR;

... /* loop to fetch rows from result table                */
EXEC SQL  FETCH DYN_CURSOR USING DESCRIPTOR :SQLDA;
.
.
.
```

DESCRIBE TABLE

The DESCRIBE TABLE statement obtains information about a table or view.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the table or view identified in the statement:
  - The system authority of *OBJOPR on the table or view
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

Syntax

```
►►──DESCRIBE TABLE──host-variable──INTO──descriptor-name──────────────────────►


►──┬────────────────────────┬───────────────────────────────────────────────►◄
   └─USING──┬─NAMES────────┬┘
            ├─SYSTEM NAMES─┤
            ├─LABELS───────┤
            ├─ANY──────────┤
            ├─BOTH─────────┤
            └─ALL──────────┘
```

Description

host-variable
: Identifies the table or view about which you want to obtain information. When the DESCRIBE TABLE statement is executed:

- The name must identify a table or view that exists at the application server.
- The host-variable must be a character-string or UCS-2 graphic-string variable and must not include an indicator variable.

- The table name that is contained within the host-variable must be left-justified and must be padded on the right with blanks if its length is less than that of the host-variable.
- The name of the table must be in uppercase unless it is a delimited name.

When the DESCRIBE TABLE statement is executed, the database manager assigns values to the variables of the SQLDA as follows:

INTO *descriptor-name*
Identifies an SQL descriptor area (SQLDA), which is described in "Appendix C. SQL Descriptor Area (SQLDA)" on page 551. Before the DESCRIBE TABLE statement is executed, the following variable in the SQLDA must be set. (The rules for REXX are different. For more information, see the SQL Programming with Host Languages book.)

SQLN Indicates the number of SQLVAR occurrences provided in the SQLDA. SQLN must be set to a value greater than or equal to zero before the DESCRIBE TABLE statement is executed. For information on techniques to determine the number of occurrences requires, see "Determining How Many SQLVAR Occurrences are Needed" on page 554.

Variable	Information returned by the database manager
SQLDAID	'SQLDA '
SQLDABC	Length of the SQLDA.
SQLD	The number of columns in the referenced table or view.
SQLVAR	If the value of SQLD is 0, or greater than the value of SQLN, no values are assigned to occurrences of SQLVAR. If the value of SQLD is *n*, where *n* is greater than 0 but less than or equal to the value of SQLN, values are assigned to the first *n* occurrences of SQLVAR so that the first occurrence of SQLVAR contains a description of the first column of the table or view, the second occurrence of SQLVAR contains a description of the second column of the table or view, and so on. For information on the values assigned to SQLVAR occurrences, see "Field Descriptions in an Occurrence of SQLVAR" on page 552.

USING
Indicates what value to assign to each SQLNAME variable in the SQLDA. If the requested value does not exist, SQLNAME is set to a length of 0.

NAMES
Assigns the name of the column. This is the default.

SYSTEM NAMES
Assigns the system column name of the column.

LABELS
Assigns the label of the column. (Column labels are defined by the LABEL ON statement.) Only the first 20 bytes of the label are returned.

ANY
Assigns the column label. If the column has no label, the column name is used instead.

BOTH
Assigns both the label and name of the column. In this case, two or three occurrences of SQLVAR per column, depending on whether the result set contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to 2**n* or 3**n*(where *n* is the number of columns in the table or view). The first *n* occurrences of SQLVAR contain the column names. Either the second or third *n* occurrences contain the column labels. If there are no distinct types, the labels are returned in the second set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries.

ALL
Assigns the label, column name, and system column name. In this case three or four occurrences of SQLVAR per column, depending on whether the result set contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to 3**n* or 4**n* (where *n* is the number of columns in the result table). The first *n* occurrences of SQLVAR contain the system column names. The second or third *n* occurrences contain the column labels. The third or fourth *n* occurrences contain the column names. If there are no distinct types, the labels are returned in the second set of SQLVAR entries and the column names are returned in the third set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries and the column names are returned in the fourth set of SQLVAR entries.

Notes

Before the DESCRIBE TABLE statement is executed, the value of SQLN must be set to a value greater than or equal to zero to indicate how many occurrences of SQLVAR are provided in the SQLDA and enough storage must be allocated to contain SQLN occurrences. To obtain the description of the columns of the table or view, the number of occurrences of SQLVAR must not be less than the number of columns. Furthermore, if USING BOTH or USING ALL is specified, or if the columns include LOBs or distinct types, the number of occurrences of SQLVAR should be two, three, or four times the number of columns. See “Determining How Many SQLVAR Occurrences are Needed” on page 554 for more information.

If not enough occurrences are provided to return all sets of occurrences, SQLN is set to the total number of occurrences necessary to return all information. Otherwise, SQLN is set to the number of columns.

For a description of techniques that can be used to allocate the SQLDA, see “DESCRIBE” on page 389.

Example

In a PL/I program, execute a DESCRIBE TABLE statement with an SQLDA that has no occurrences of SQLVAR. If SQLD is greater than zero, use the value to allocate an SQLDA with the necessary number of occurrences of SQLVAR and then execute a DESCRIBE TABLE statement using that SQLDA.

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  TABLE_NAME   CHAR(200)  VARYING;
EXEC SQL  END DECLARE SECTION;
EXEC SQL  INCLUDE SQLDA;

... /* code to prompt user for a table or view            */
... /* code to set SQLN to zero and to allocate the SQLDA   */
EXEC SQL  DESCRIBE TABLE :TABLE_NAME INTO :SQLDA;
```

```
... /* code to check that SQLD is greater than zero, to set */
    /* SQLN to SQLD, then to re-allocate the SQLDA          */
EXEC SQL  DESCRIBE TABLE :TABLE_NAME INTO :SQLDA;
.
.
.
```

DISCONNECT

The DISCONNECT statement ends one or more connections for unprotected conversations.

Invocation

This statement can only be embedded in an application program or issued interactively. It is an executable statement that cannot be dynamically prepared. It must not be specified in REXX.

DISCONNECT is not allowed in a trigger program. DISCONNECT is not allowed in an external procedure if the external procedure is called on a remote application server.

Authorization

None required.

Syntax

```
►►──DISCONNECT───┬─server-name───┬────────────────────────────────────────►◄
                 ├─host-variable─┤
                 ├─CURRENT───────┤
                 │      ┌─SQL─┐  │
                 └─ALL──┴─────┴──┘
```

Description

server-name or *host-variable*
: Identifies the application server by the specified server name or the server name contained in the host variable. If a host variable is specified:

- It must be a character-string variable.
- It must not be followed by an indicator variable
- The server name must be left-justified within the host variable and must conform to the rules for forming an ordinary identifier
- If the length of the server name is less than the length of the host variable, it must be padded on the right with blanks.

When the DISCONNECT statement is executed, the specified server name or server name contained in the host variable must identify an existing dormant or current connection of the activation group. The identified connection cannot use a protected conversation.

CURRENT
: Identifies the current connection of the activation group. The activation group must be in the connected state. The current connection must not use a protected conversation.

ALL or **ALL SQL**
Identifies all existing connections of the activation group (local as well as remote connections). An error or warning does not occur if no connections exist when the statement is executed. None of the connections can use protected conversations.

Notes

An identified connection must not be a connection that was used to execute SQL statements during the current unit of work and must not be a connection for a protected conversation. To end connections on protected conversations, use the RELEASE statement. Local connections are never considered to be protected conversations.

If the DISCONNECT statement is successful, each identified connection is ended. If the current connection is destroyed, the activation group is placed in the unconnected state.

If the DISCONNECT statement is unsuccessful, the connection state of the activation group and the states of its connections are unchanged.

Using CONNECT (Type 1) semantics does not prevent using DISCONNECT.

DISCONNECT closes cursors, releases resources, and prevents further use of the connection.

ROLLBACK does not reconnect a connection that has been ended by DISCONNECT.

Resources are required to create and maintain remote connections. Thus, a remote connection that is not going to be reused should be ended as soon as possible and a remote connection that is going to be reused should not be destroyed.

The DISCONNECT statement should be executed immediately after a commit operation. If DISCONNECT is used to end the current connection, the next executed SQL statement must be CONNECT or SET CONNECTION.

DISCONNECT ALL ends the connection to the local application server. A connection is ended even though it has an open cursor defined with WITH HOLD.

Examples

Example 1: The connection to TOROLAB1 is no longer needed. The following statement is executed after a commit operation.

```
EXEC SQL DISCONNECT TOROLAB1;
```

Example 2: The current connection is no longer needed. The following statement is executed after a commit operation.

```
EXEC SQL DISCONNECT CURRENT;
```

Example 3: The existing connections are no longer needed. The following statement is executed after a commit operation.

```
EXEC SQL DISCONNECT ALL;
```

DROP

The DROP statement deletes an object. Any objects that are directly or indirectly dependent on that object are also deleted. Whenever an object is deleted, its description is deleted from the catalog.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

To drop a table, view, index, alias or package, the privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - The system authorities of *OBJOPR and *OBJEXIST on the object to be dropped
  - If the object is a table or view, the system authorities of *OBJOPR and *OBJEXIST on any views, indexes, and logical files that are dependent on that table or view
  - The system authority *EXECUTE on the library that contains the object to be dropped
- Administrative authority

To drop a collection, the privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - The system authorities of *OBJEXIST, *OBJOPR, *EXECUTE, and *READ on the library to be dropped.
  - The system authorities of *OBJOPR and *OBJEXIST on all objects in the collection and *OBJOPR and *OBJEXIST on any views, indexes and logical files that are dependent on tables and views in the collection.
  - Any additional authorities required to delete other object types that exist in the collection. For example, *OBJMGT to the data dictionary if the collection contains a data dictionary, and some system data authority to the journal receiver. For more information, see the *Security - Reference*, SC41-5302-04 book.
- Administrative authority

To drop a user-defined type, the privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - The system authorities of *OBJOPR and *OBJEXIST on the user-defined type to be dropped
  - The DELETE privilege on the SYSTYPES, SYSPARMS, and SYSROUTINES catalog tables, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

To drop a function, the privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:

  - For SQL functions, the system authority *OBJEXIST on the program object associated with the function, and
  - The DELETE privilege on the SYSFUNCS and SYSPARMS catalog tables, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

To drop a procedure, the privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - For SQL procedures, the system authority *OBJEXIST on the program object associated with the procedure, and
  - The DELETE privilege on the SYSPROCS and SYSPARMS catalog tables, and
  - The system authority *EXECUTE on library QSYS2
- Administrative authority

The authorization ID of the statement has the DELETE privilege on a table when:

- It is the owner of the table,
- It has been granted the DELETE privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *DLT on the table.

Syntax

```
                   (1)
►►──DROP──┬─ALIAS──────alias-name──────────────────────────────────────────┬──────────►◄
          │                  (2)                                           │
          ├──┬─COLLECTION─┬─────────collection-name──drop-option───────────┤
          │  └─SCHEMA─────┘                                                │
          ├──┬─────────────────┬──TYPE──type-name──┬────────────┬──────────┤
          │  │           (3)   │                   ├─RESTRICT───┤          │
          │  └─DISTINCT────────┘                   └─CASCADE────┘          │
          ├──┬─FUNCTION─┬──function-name──┬──────────────────────────┬─────┤
          │  └─ROUTINE──┘                 └─(──┬──────────────────┬──)─┘     │
          │                                    │ ┌─,────────────┐ │          │
          │                                    │ ▼              │ │          │
          │                                    └───parameter-type─┴─┘          │
          ├─INDEX──index-name──────────────────────────────────────────────┤
          │          (4)                                                   │
          ├─PACKAGE──────package-name──────────────────────────────────────┤
          ├──┬─PROCEDURE─┬──procedure-name──┬──────────────────────────┬───┤
          │  └─ROUTINE───┘                  └─(──┬──────────────────┬──)─┘   │
          │                                      │ ┌─,────────────┐ │        │
          │                                      │ ▼              │ │        │
          │                                      └───parameter-type─┴─┘        │
          ├─SPECIFIC──┬─FUNCTION───┬──specific-name────────────────────────┤
          │           ├─PROCEDURE──┤                                       │
          │           └─ROUTINE────┘                                       │
          ├─TABLE──table-name──drop-option─────────────────────────────────┤
          └─VIEW──view-name──drop-option───────────────────────────────────┘
```

drop-option:

```
    ┌─CASCADE──┐
├───┤          ├──────────────────────────────────────────────────────────┤
    └─RESTRICT─┘
```

Notes:

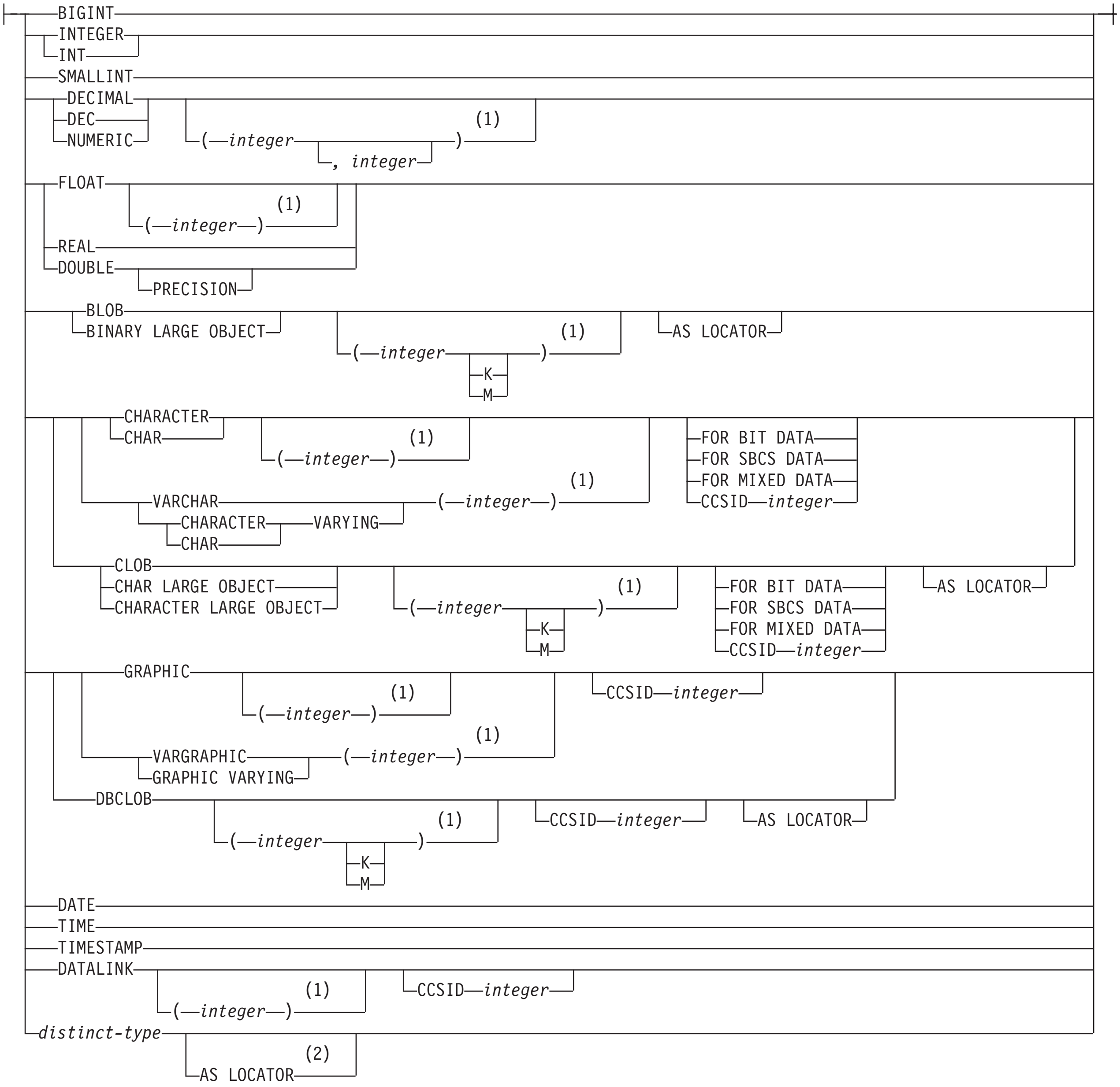
1 The keyword SYNONYM can be used as a synonym for ALIAS.

2 The keyword DATABASE can be used as a synonym for COLLECTION or SCHEMA.

3 The keyword DATA can be used when dropping any user-defined-type.

4 The keyword PROGRAM can be used as a synonym for PACKAGE.

parameter-type:



Notes:

1 The values that are specified for length, precision, or scale attributes must match the values that were specified when the function was created. Coding specific values is optional. Empty parentheses, (), can be used instead to indicate that DB2 ignores the attributes when determining whether data types match.

2 AS LOCATOR can be specified only for distinct type based on a LOB data type.

Description

ALIAS *alias-name*
Identifies the alias you want to drop. The *alias-name* must identify an alias that exists at the current server. The specified alias is deleted from the collection or library. Aliases can be dropped at any time except when they are in use.

Any access plans that reference the alias are implicitly prepared again when a program that uses the access plan is next run.

COLLECTION or **SCHEMA** *collection-name*

Identifies the collection you want to drop. The *collection-name* must identify a collection that exists at the current server. The specified collection is deleted. All objects in the collection are dropped.

Any access plans that reference any object in the collection are implicitly prepared again when a program that uses the access plan is next run. If the referenced object does not exist at that time, a negative value is returned in the SQLCODE field of the SQLCA.

DROP COLLECTION is only valid when the commit level is *NONE.

TYPE *type-name*

Identifies the user-defined type you want to drop. The *type-name* must identify a user-defined type that exists at the current server. The specified type is deleted from the collection or library.

If other objects are dependent on the user-defined type, the effect depends on the drop option:

- If neither RESTRICT nor CASCADE is specified, then the type cannot be dropped if any tables, views, logical files, indexes, or constraints are dependent on the type being dropped.

  For every procedure or function `R` that has parameters or a return value of the type being dropped, or a reference to the type being dropped, the following DROP statement is effectively executed:

  ```
  DROP ROUTINE R
  ```

  It is possible that this statement would cascade to drop dependent functions or procedures. If all of these functions or procedures are in the list to be dropped because of a dependency on the user-defined type, the drop of the user-defined type will succeed.
- If RESTRICT is specified, then the type cannot be dropped if any tables, views, logical files, indexes, constraints, functions (other than those functions that were created when the type was created), or procedures are dependent on the type being dropped.
- If CASCADE is specified, then any tables, views, logical files, indexes, constraints, functions, or procedures that are dependent on the type are also dropped.

FUNCTION

Identifies the function you want to drop. You can identify the particular function to be dropped by its name, function signature, or specific name. The rules for function resolution (and the path) are not used. Functions implicitly generated by the CREATE DISTINCT TYPE statement cannot be dropped.

The function cannot be dropped if another function is dependent on it. A function is dependent on another function if it was identified in the SOURCE clause of the CREATE FUNCTION statement.

FUNCTION *function-name*

The *function-name* must identify exactly one function that exists at the current server. Functions cannot be dropped if other functions are sourced on them. The function may have any number of parameters defined for it.

If there is more than one function of the specified name in the specified or implicit collection, an error is returned.

FUNCTION *function-name (parameter-type, ...)*

The *function-name (parameter-type, ...)* must identify a function with the specified function signature that exists at the current server. The specified parameters must match the data types, that were specified on the CREATE FUNCTION statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance which is to be dropped. If *function-name ()* is specified, the function identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision, or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. For more information on the default attributes see “CREATE TABLE” on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

SPECIFIC FUNCTION *specific-name*

The *specific-name* must identify a specific function that exists at the current server.

The specified function is deleted from the catalog tables SYSFUNCS and SYSPARMS. If this is an SQL function or sourced function, the service program (*SRVPGM) associated with the function is also dropped. If this is an external function, the information that was saved in the program or service program specified on the CREATE FUNCTION statement is removed from the object. All privileges on the function are also dropped.

INDEX *index-name*

Identifies the index you want to drop. The *index-name* must identify an index that exists at the current server. The specified index is deleted from the collection or library. Indexes can be dropped at any time except when they are in use.

Any access plans that reference the index are implicitly prepared again when a program that uses the access plan is next run.

PACKAGE *package-name*

Identifies the package you want to drop. The *package-name* must identify a package that exists at the current server. The specified package is deleted from the collection or library. All privileges on the package are also dropped.

PROCEDURE

Identifies the procedure you want to drop. You can identify the particular procedure to be dropped by its name, procedure signature, or specific name. The rules for procedure resolution (and the path) are not used.

PROCEDURE *procedure-name*

The *procedure-name* must identify exactly one procedure that exists at the current server. The procedure may have any number of parameters defined for it. If there is more than one procedure of the specified name in the specified or implicit collection, an error is returned.

PROCEDURE *procedure-name (parameter-type, ...)*

The *procedure-name (parameter-type, ...)* must identify a procedure with the specified procedure signature that exists at the current server. The specified parameters must match the data types, that were specified on the CREATE PROCEDURE statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific procedure instance which is to be dropped. If *procedure-name ()* is specified, the procedure identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision, or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE PROCEDURE statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. For more information on the default attributes see “CREATE TABLE” on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE PROCEDURE statement.

SPECIFIC PROCEDURE *specific-name*

The *specific-name* must identify a specific procedure that exists at the current server.

The specified procedure is deleted from the catalog tables SYSPROCS and SYSPARMS. If this is an SQL procedure, the program (*PGM) object associated with the SQL procedure is also dropped. All privileges on the procedure are also dropped.

TABLE *table-name*

Identifies the table you want to drop. The *table-name* must identify a base table that exists at the current server, but must not identify a catalog table. The specified table is deleted from the collection or library. All privileges, constraints, indexes, triggers, views, and logical files on the table are also dropped.

Any access plans that reference the table will be prepared again when a program that contains the access plan is next run. If the referenced table does not exist at that time, a negative value will be returned in the SQLCODE field of the SQLCA.

VIEW *view-name*
Identifies the view you want to drop. The *view-name* must identify a view that exists at the current server, but must not identify a catalog view. The specified view is deleted from the collection or library. Any view that is directly or indirectly dependent on that view is also deleted. When a view is dropped, all privileges on that view are dropped.

Any access plans that reference the view are implicitly prepared again when a program that uses the access plan is next run. If the referenced view does not exist at that time, a negative value will be returned in the SQLCODE field of the SQLCA.

CASCADE
Specifies that any tables, views, indexes, files, or referential constraints that are dependent on the object being dropped are also dropped.

RESTRICT
Specifies that the object cannot be dropped if any views, logical files, indexes, or constraints are dependent on the object being dropped. If the object being dropped is a collection, this includes all dependencies on the tables and views in the collection.

Examples

Example 1

Drop your table named MY_IN_TRAY. Do not allow the drop if any views or indexes are created over this table.

```
DROP TABLE MY_IN_TRAY RESTRICT
```

Example 2

Drop your view named MA_PROJ.

```
DROP VIEW MA_PROJ
```

Example 3

Drop the package named PERS.PACKA.

```
DROP PACKAGE PERS.PACKA
```

Example 4

Drop the distinct type DOCUMENT, if it is not currently in use:

```
DROP DISTINCT TYPE DOCUMENT RESTRICT
```

Example 5

Assume that you are SMITH and that ATOMIC_WEIGHT is the only function with that name in collection CHEM. Drop ATOMIC_WEIGHT.

```
DROP FUNCTION CHEM.ATOMIC_WEIGHT RESTRICT
```

Example 6

Assume that you are SMITH and that you created the function CENTER in collection SMITH. Drop CENTER, using the function signature to identify the function instance to be dropped.

```
DROP FUNCTION CENTER (INTEGER, FLOAT) RESTRICT
```

Example 7

Assume that you are SMITH and that you created another function named CENTER, which you gave the specific name FOCUS97, in schema JOHNSON. Drop CENTER, using the specific name to identify the function instance to be dropped.

```
DROP SPECIFIC FUNCTION JOHNSON.FOCUS97
```

Example 8

Assume that you are SMITH and that stored procedure OSMOSIS is in collection BIOLOGY. Drop OSMOSIS.

```
DROP PROCEDURE BIOLOGY.OSMOSIS
```

END DECLARE SECTION

The END DECLARE SECTION statement marks the end of an SQL declare section.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in RPG or REXX.

Authorization

None required.

Syntax

```
►►──END DECLARE SECTION─────────────────────────────────────────────────►◄
```

Description

The END DECLARE SECTION statement can be coded in the application program wherever declarations can appear in accordance with the rules of the host language. It is used to indicate the end of an SQL declare section. An SQL declare section starts with a BEGIN DECLARE SECTION statement as described on page 265.

The BEGIN DECLARE SECTION and the END DECLARE SECTION statements must be paired and cannot be nested.

SQL statements should not be included within the declare section, with the exception of the DECLARE VARIABLE and INCLUDE statement.

If SQL declare sections are specified in the program, only the variables declared within the SQL declare sections can be used as host variables. When SQL declare sections are not specified, all variables in the program are eligible for use as host variables.

SQL declare sections should be specified for host languages, other than RPG and REXX, so that the source program conforms to the IBM SQL standard. The SQL declare section should appear before the first reference to the variable. Host variables are declared without the use of these statements in RPG, and they are not declared at all in REXX.

Variables declared outside an SQL declare section should not have the same name as variables declared within an SQL declare section.

More than one SQL declare section can be specified in the program.

Examples

See “BEGIN DECLARE SECTION” on page 265 for examples using the END DECLARE SECTION statement.

EXECUTE

The EXECUTE statement executes a prepared SQL statement.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

The authorization rules are those defined for the SQL statement specified by EXECUTE. For example, see the description of INSERT

for the authorization rules that apply when an INSERT statement is executed using EXECUTE.

The authorization ID of the statement is the run-time authorization ID unless DYNUSRPRF(*OWNER) was specified on the CRTSQLxxx command when the program was created. For more information, see “Authorization IDs and Authorization-Names” on page 48.

Syntax

```
►►──EXECUTE──statement-name──┬────────────────────────────────────┬──────────►◄
                             │        ┌─,────────────┐            │
                             │        ▼              │            │
                             ├─USING───host-variable─┴────────────┤
                             └─USING DESCRIPTOR──descriptor-name──┘
```

Description

statement-name
: Identifies the prepared statement to be executed. *Statement-name* must identify a statement that was previously prepared. The prepared statement cannot be a SELECT statement.

USING
: Introduces a list of host variables whose values are substituted for the parameter markers (question marks) in the prepared statement. For an explanation of parameter markers, see “PREPARE” on page 453. If the prepared statement includes parameter markers, the USING clause must be used. USING is ignored if there are no parameter markers.

host-variable,...
: Identifies one of more host structures or variables that must be declared in the program in accordance with the rules for declaring host structures and

variables. A reference to a host structure is replaced by a reference to each of its variables. The number of variables must be the same as the number of parameter markers in the prepared statement. The *n*th variable corresponds to the *n*th parameter marker in the prepared statement.

DESCRIPTOR *descriptor-name*

Identifies an SQLDA that must contain a valid description of host variables.

Before the EXECUTE statement is processed, the user must set the following fields in the SQLDA. (The rules for REXX are different. For more information, see the SQL Programming with Host Languages book.)

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA.
- SQLDABC to indicate the number of bytes of storage allocated for the SQLDA.
- SQLD to indicate the number of variables used in the SQLDA when processing the statement.
- SQLVAR occurrences to indicate the attributes of the variables.

The SQLDA must have enough storage to contain all SQLVAR occurrences. Therefore, the value in SQLDABC must be greater than or equal to 16 + SQLN*(80), where 80 is the length of an SQLVAR occurrence. If LOBs or distinct types are specified, there must be two SQLVAR entries for each parameter marker and SQLN must be set to two times the number of parameter markers.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN. It must be the same as the number of parameter markers in the prepared statement. The *n*th variable described by the SQLDA corresponds to the *n*th parameter marker in the prepared statement. (For a description of an SQLDA, see “Appendix C. SQL Descriptor Area (SQLDA)” on page 551.)

Note that RPG/400 does not provide the function for setting pointers. Because the SQLDA uses pointers to locate the appropriate host variables, you have to set these pointers outside your RPG/400 application.

Parameter Marker Replacement

Before the prepared statement is executed, each parameter marker in the statement is effectively replaced by its corresponding host variable. With the exception of the LIKE predicate, the replacement of a parameter marker is an assignment operation in which the source is the value of the host variable, and the target is a variable within the database manager. The attributes of the target variable are determined as follows:

- If the parameter marker was specified as the operand of an arithmetic operator, the data type, scale, and precision of the target are the same as the other operand of that operator.
- If the parameter marker was specified in an assignment operand, the attributes of the target are the same as the other operand unless the data type of that operand is DATE, TIME, or TIMESTAMP, in which case, the target is effectively character with a length attribute of 32766. A parameter marker is an assignment operand in a SET clause of an UPDATE statement, in the VALUES clause of an INSERT statement, or in the select-list of a select-statement in an INSERT statement.

- If the parameter marker was specified as a comparison operand in any predicate other than the BETWEEN, IN, or LIKE predicates, the attributes of the target are the same as the other operand of the predicate, unless the data type of that operand is DATE, TIME, or TIMESTAMP, in which case, the target is effectively character with a length attribute of 32766.
- If the parameter marker was specified as a comparison operand in a BETWEEN or IN predicate, the attributes of the target are assigned as follows:
  - If only one operand is not a parameter marker, the attributes of the target are the attributes of that operand.
  - If more than one operand is not a parameter marker, the attributes of the target are the attributes that would result if those operands were specified in a VALUE scalar function, except the CCSID attribute is the CCSID of its corresponding host variable.
- If the parameter marker was specified as the pattern or ESCAPE character of a LIKE predicate, the host variable used to replace the parameter marker must be compatible with the first operand.

  If the parameter marker was specified as the pattern, the data type of the target is VARCHAR (if the first operand is CHAR or VARCHAR) or VARGRAPHIC (if the first operand is GRAPHIC or VARGRAPHIC). The length attribute of the target is the same as that of the first operand.

  If the parameter marker was specified as the ESCAPE character, the length attribute of the target is 1.

  Note: When the pattern specified in a LIKE predicate is a parameter marker, and a fixed-length character host variable is used to replace the parameter marker; specify a value for the host variable that is the correct length. If you do not specify the correct length, the select will not return the intended results.

  For example, if the host variable is defined as CHAR(10), and the value WYSE% is assigned to that host variable, the host variable is padded with blanks on assignment. The pattern used is ('WYSE%   '). This pattern requests the database manager to search for all values that start with ’WYSE’ and end with ’   ’. If you intended to search for only the values that start with ’WYSE’ you should assign the value ’WSYE%%%%%%’ to the host variable.
- If the parameter marker was specified as an operand in a VALUE, COALESCE, IFNULL, MIN, MAX, LAND, LOR, or XOR scalar function, the attributes of the target are assigned as follows:
  - If only one operand is not a parameter marker, the attributes of the target are the attributes of that operand.
  - If more than one operand is not a parameter marker, the attributes of the target are the attributes that would result if the parameter markers were removed from the scalar function.

Let V denote a host variable that corresponds to parameter marker P. The value of V is assigned to the target variable for P in accordance with the rules for assigning a value to a column. Thus:

- V must be compatible with the target.
- If V is a number, the absolute value of its integral part must not be greater than the maximum absolute value of the integral part of the target.
- If the attributes of V are not identical to the attributes of the target, the value is converted to conform to the attributes of the target.

- If the target cannot contain nulls, the value of V must not be null.

However, unlike the rules for assigning a value to a column:

- If V is a string, the value will be truncated (without an error), if its length is greater than the length attribute of the target.

When the prepared statement is executed, the value used in place of P is the value of the target variable for P. For example, if V is CHAR(6) and the target is CHAR(8), the value used in place of P is the value of V padded with two blanks.

Example

This example of portions of a COBOL program shows how an INSERT statement with parameter markers is prepared and executed.

```
   EXEC SQL  BEGIN DECLARE SECTION  END-EXEC.
     77 EMP              PIC X(6).
     77 PRJ              PIC X(6).
     77 ACT              PIC S9(4) COMP-4.
     77 TIM              PIC S9(3)V9(2).
     01 HOLDER.
        49  HOLDER-LENGTH    PIC S9(4) COMP-4.
        49  HOLDER-VALUE     PIC X(80).
   EXEC SQL  END DECLARE SECTION  END-EXEC.
   .
   .
   .
   MOVE 70 TO HOLDER-LENGTH.
   MOVE "INSERT INTO EMP_ACT (EMPNO, PROJNO, ACTNO, EMPTIME)
 -              "VALUES (?, ?, ?, ?)" TO HOLDER-VALUE.
   EXEC SQL  PREPARE MYINSERT FROM :HOLDER  END-EXEC.

   IF SQLCODE = 0
     PERFORM DO-INSERT THRU END-DO-INSERT
   ELSE
     PERFORM ERROR-CONDITION.

   DO-INSERT.
     MOVE "000010" TO EMP.
     MOVE "AD3100" TO PRJ.
     MOVE 160      TO ACT.
     MOVE .50      TO TIM.
     EXEC SQL  EXECUTE MYINSERT USING :EMP, :PRJ, :ACT, :TIM  END-EXEC.
   END-DO-INSERT.
   .
   .
   .
```

EXECUTE IMMEDIATE

The EXECUTE IMMEDIATE statement:

- Prepares an executable form of an SQL statement from a character string form of the statement
- Executes the SQL statement
- Destroys the executable form

EXECUTE IMMEDIATE combines the basic functions of the PREPARE and EXECUTE statements. It can be used to prepare and execute SQL statements that contain neither host variables nor parameter markers.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

The authorization rules are those defined for the SQL statement specified by EXECUTE IMMEDIATE. For example, see “INSERT” on page 437 for the authorization rules that apply when an INSERT statement is executed using EXECUTE IMMEDIATE.

The authorization ID of the statement is the run-time authorization ID unless DYNUSRPRF(*OWNER) was specified on the CRTSQLxxx command when the program was created. For more information, see “Authorization IDs and Authorization-Names” on page 48.

Syntax

```
►►──EXECUTE IMMEDIATE──┬─host-variable─────┬──────────────────────────────►◄
                       └─string-expression─┘
```

Description

host-variable
Identifies a host variable that must be declared in accordance with the rules for declaring character-string or UCS-2 graphic host variables. An indicator variable must not be specified.

string-expression
A *string-expression* is any PL/I *string-expression* that yields a character string. SQL expressions that yield a character string are not allowed. A *string-expression* is only allowed in PL/I.

The value of the identified host variable or string expression is called a *statement string*.

The statement string must be one of the following SQL statements:

ALTER TABLE
CALL
COMMENT ON
COMMIT
CREATE ALIAS
CREATE COLLECTION
CREATE DISTINCT TYPE
CREATE FUNCTION
CREATE INDEX
CREATE PROCEDURE
CREATE TABLE
CREATE VIEW
DELETE
DROP
GRANT
INSERT
LABEL ON
LOCK TABLE
RENAME
REVOKE
ROLLBACK
SET PATH
SET TRANSACTION
UPDATE

The statement string must not:

- Begin with EXEC SQL and end with END-EXEC or a semicolon (;).
- Include references to host variables.
- Include comments.
- Include parameter markers.

When an EXECUTE IMMEDIATE statement is executed, the specified statement string is parsed and checked for errors. If the SQL statement is not valid, it is not executed and the error condition that prevents its execution is reported in the SQLCA. If the SQL statement is valid, but an error occurs during its execution, that error condition is reported in the SQLCA.

Note

If the same SQL statement is to be executed more than once, it is more efficient to use the PREPARE and EXECUTE statements rather than the EXECUTE IMMEDIATE statement.

Example

Use PL/I program statements to move an SQL statement to the host variable QSTRING (char(80)) and prepare and execute whatever SQL statement is in the host variable QSTRING.

```
IF ACCOUNTS = 'BIG' THEN
  QSTRING = 'INSERT INTO WORK_TABLE SELECT * FROM EMP_ACT WHERE ACTNO < 100';
ELSE
  QSTRING = 'INSERT INTO WORK_TABLE SELECT * FROM EMP_ACT WHERE ACTNO >= 100';
.
.
.
EXEC SQL  EXECUTE IMMEDIATE :QSTRING;
```

FETCH

The FETCH statement positions a cursor on a row of the result table. It can return zero, one, or multiple rows, and it assigns the values of the rows returned to host variables.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. Multiple row fetch is not allowed in a REXX procedure.

Authorization

See “DECLARE CURSOR” on page 368 for an explanation of the authorization required to use a cursor.

Syntax

```
                                     ┌─FROM─┐
►►──FETCH──┬──────────────────────┬──┴──────┴──cursor-name──────────────►
           ├─NEXT─────────────────┤
           ├─PRIOR────────────────┤
           ├─FIRST────────────────┤
           ├─LAST─────────────────┤
           │       (1)            │
           ├─BEFORE───────────────┤
           │      (2)             │
           ├─AFTER────────────────┤
           ├─CURRENT──────────────┤
           └─RELATIVE──┬─host-variable─┬┘
                       └─integer───────┘
```

```
►─┬─────────────────────┬──────────────────────────────────────────────►◄
  ├─single-fetch────────┤
  └─multiple-row-fetch──┘
```

single-fetch:

```
           ┌─,─────────────────┐
           ▼                   │
├──┬─INTO─────host-variable────┴──────┬─────────────────────────────────┤
   │                  (3)             │
   └─INTO DESCRIPTOR──────descriptor-name─┘
```

multiple-row-fetch:

```
├──FOR──┬─host-variable─┬──ROWS──────────────────────────────────────────►
        └─integer───────┘

►──┬─INTO──host-structure-array─────────────────────────────────────┬───┤
   └─USING DESCRIPTOR──descriptor-name──INTO──row-storage-area──────┘
```

row-storage-area:

```
├──:──host-identifier-1──┬─────────────────────────────────────┬───────┤
                         │ ┌─INDICATOR─┐                       │
                         └─┴───────────┴──:──host-identifier-2─┘
```

Notes:

1 If BEFORE is specified, a single-fetch-clause or multiple-row-fetch-clause must not be specified.

2 If AFTER is specified, a single-fetch-clause or multiple-row-fetch-clause must not be specified.

3 USING DESCRIPTOR may be used as a synonym for INTO DESCRIPTOR in the single-fetch-clause.

Description

The following keywords specify a new position for the cursor: NEXT, PRIOR, FIRST, LAST, BEFORE, AFTER, CURRENT, and RELATIVE. Of those keywords, only NEXT may be used for cursors that have not been declared SCROLL.

NEXT
Positions the cursor on the next row of the result table relative to the current cursor position. NEXT is the default if no other cursor orientation is specified.

PRIOR
Positions the cursor on the previous row of the result table relative to the current cursor position.

FIRST
Positions the cursor on the first row of the result table.

LAST
Positions the cursor on the last row of the result table.

BEFORE
Positions the cursor before the first row of the result table.

AFTER
Positions the cursor after the last row of the result table.

CURRENT
Does not reposition the cursor, but maintains the current cursor position. If the cursor has been declared as DYNAMIC SCROLL and the current row has been updated so its place within the sort order of the result table is changed, an error is returned.

RELATIVE
Host-variable or *integer* is assigned to an integer value *k*. RELATIVE positions the cursor to the row in the result table that is either *k* rows after the current row if *k*>0, or *k* rows before the current row if *k*<0. If a *host-variable* is specified, it must be a numeric variable with zero scale and it must not include an indicator variable.

Table 25. Synonymous Scroll Specifications

Specification	Alternative
RELATIVE +1	NEXT
RELATIVE -1	PRIOR
RELATIVE 0	CURRENT

FROM
This keyword is provided for clarity only. If a scroll position option is specified, then this keyword is required. If no scrolling option is specified, then the FROM keyword is optional.

cursor-name
Identifies the cursor to be used in the fetch operation. The *cursor-name* must identify a declared cursor as explained in “Description” on page 369 for the DECLARE CURSOR statement. When the FETCH statement is executed, the cursor must be in the open state.

If a single- or multiple-row fetch clause is not specified, no data is returned to the user. However, the cursor is positioned and a record lock may be acquired. For more information on locking, see “Isolation Level” on page 17.

single-fetch

INTO *host-variable***,...**
Identifies one or more host structures or host variables that must be declared in accordance with the rules for declaring host structures and host variables. In the operational form of INTO, a host structure is replaced by a reference to each of its variables. The first value in the result row is assigned to the first host variable in the list, the second value to the second host variable, and so on.

INTO DESCRIPTOR *descriptor-name*
Identifies an SQLDA that must contain a valid description of zero or more host variables.

Before the FETCH statement is processed, the user must set the following fields in the SQLDA. (The rules for REXX are different. For more information see the SQL Programming with Host Languages book.)

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA
- SQLDABC to indicate the number of bytes of storage allocated for the SQLDA
- SQLD to indicate the number of variables used in the SQLDA when processing the statement
- SQLVAR occurrences to indicate the attributes of the variables

The SQLDA must have enough storage to contain all SQLVAR occurrences. Therefore, the value in SQLDABC must be greater than or equal to 16 + SQLN*(80), where 80 is the length of an SQLVAR occurrence.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN. For more information, see "Appendix C. SQL Descriptor Area (SQLDA)" on page 551.

multiple-row-fetch

FOR *k* **ROWS**

Evaluates *host-variable* or *integer* to an integral value *k*. If a *host-variable* is specified, it must be a numeric host variable with zero scale and it must not include an indicator variable. *k* must be in the range of 1 to 32767. The cursor is positioned on the row specified by the orientation keyword (for example, NEXT), and that row is fetched. Then the next *k*-1 rows are fetched (moving forward in the table), until the end of the cursor is reached. After the fetch operation, the cursor is positioned on the last row fetched.

For example, ″FETCH PRIOR FROM C1 FOR 3 ROWS″ causes the previous row, the current row, and the next row to be returned, in that order. The cursor is positioned on the next row. ″FETCH RELATIVE -1 FROM C1 FOR 3 ROWS″ returns the same result. ″FETCH FIRST FROM C1 FOR :x ROWS″ returns the first *x* rows, and leaves the cursor positioned on row number *x*.

When a multiple-row-fetch is successfully executed, three variables are set in the SQLCA:

- SQLERRD(3) shows the number of rows retrieved.
- SQLERRD(4) contains the length of the row retrieved.
- SQLERRD(5) contains +100 if the last row was fetched.

INTO *host-structure-array*

host-structure-array identifies an array of host structures defined in accordance with the rules for declaring host structures.

The first structure in the array corresponds to the first row, the second structure in the array corresponds to the second row, and so on. In addition, the first value in the row corresponds to the first item in the structure, the second value in the row corresponds to the second item in the structure, and so on. The number of rows to be fetched must be less than or equal to the dimension of the host structure array.

USING DESCRIPTOR *descriptor-name*

Identifies an SQLDA that must contain a valid description of zero or more host variables that describe the format of a row in the row-storage-area.

Before the FETCH statement is processed, the user must set the following fields in the SQLDA:

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA.
- SQLDABC to indicate the number of bytes of storage allocated for the SQLDA.
- SQLD to indicate the number of variables used in the SQLDA when processing the statement.
- SQLVAR occurrences to indicate the attributes of the host variables.

The values of the other fields of the SQLDA (such as SQLNAME) may not be defined after the FETCH statement is executed and should not be used.

The SQLDA must have enough storage to contain all SQLVAR occurrences. Therefore, the value in SQLDABC must be greater than or equal to 16 + SQLN*(80), where 80 is the length of an SQLVAR occurrence. If LOBs or distinct types are specified, there must be two SQLVAR entries for each parameter marker and SQLN must be set to two times the number of parameter markers.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN. For more information, see “Appendix C. SQL Descriptor Area (SQLDA)” on page 551.

On completion of the FETCH, the SQLDATA pointer in the first SQLVAR entry addresses the returned value for the first column in the allocated storage in the first row, the SQLDATA pointer in the second SQLVAR entry addresses the returned value for the second column in the allocated storage in the first row, and so on. The SQLIND pointer in the first nullable SQLVAR entry addresses the first indicator value, the SQLIND pointer in the second nullable SQLVAR entry addresses the second indicator value, and so on. The SQLDA must be allocated on a 16-byte boundary.

INTO *row-storage-area*

host-identifier-1 specified with a host variable identifies an allocation of storage in which to return the rows. The rows are returned into the storage area in the format described by the SQLDA. *host-identifier-1* must be large enough to hold all the rows requested.

host-identifier-2 identifies the optional indicator area. It should be specified if the SQLTYPE of any SQLVAR occurrence is nullable. The indicators are returned as small integers. *host-identifier-2* must be large enough to contain an indicator for each nullable value for each row to be returned.

The *nth* host variable identified by the INTO clause or described in the SQLDA corresponds to the *nth* column of the result table of the cursor. The data type of each host variable must be compatible with its corresponding column.

Each assignment to a variable is made according to the rules described in “Chapter 2. Language Elements” on page 35. If the number of variables is less than the number of values in the row, the SQLWARN3 field of the SQLCA is set to 'W'. Note that there is no warning if there are more variables than the number of result columns. If the value is null, an indicator variable must be provided. If an assignment error occurs, the value is not assigned to the variable, and no more values are assigned to variables. Any values that have already been assigned to variables remain assigned.

If an error occurs as the result of an arithmetic expression in the SELECT list of an outer SELECT statement (division by zero, or overflow) or a character conversion error occurs, the result is the null value. As in any other case of a null value, an indicator variable must be provided. The value of the host variable is undefined. In this case, however, the indicator variable is set to -2. Processing of the statement continues as if the error had not occurred. (However, this error causes a positive SQLCODE.) If you do not provide an indicator variable, a negative value is returned in the SQLCODE field of the SQLCA. It is possible that some values have already been assigned to host variables and will remain assigned when the error occurs.

Notes

An open cursor has three possible positions:

- Before a row
- On a row
- After the last row

If a cursor is positioned on a row, that row is called the current row of the cursor. A cursor referenced in an UPDATE or DELETE statement must be positioned on a row. A cursor can only be positioned on a row as a result of a FETCH statement.

It is possible for an error to occur that makes the state of the cursor unpredictable.

If the specified host variable is character and is not large enough to contain the result, 'W' is assigned to SQLWARN1 in the SQLCA. The actual length of the result is returned in the indicator variable associated with the host-variable, if an indicator variable is provided.

If the specified host variable is a C NUL-terminated host variable and is not large enough to contain the result and the NUL-terminator:

- If the *CNULRQD option is specified on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*YES) on the SET OPTION statement), the following occurs:
  - The result is truncated.
  - The last character is the NUL-terminator.
  - The value ‘W’ is assigned to SQLWARN1 in the SQLCA.
- If the *NOCNULRQD option on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*NO) on the SET OPTION statement) is specified, the following occurs:
  - The NUL-terminator is not returned.
  - The value ‘N’ is assigned to SQLWARN1 in the SQLCA.

Example

Two tables, FORUM and ARCHIVE, each have the following columns:

Name:	**FORUM**	**RECEIVED**	**SOURCE**	**TOPIC**	**ENTRY_TEXT**
Type:	char(8) not null	timestamp not null	char(8) not null	char(64) not null	varchar(4000) not null

Name:	FORUM	RECEIVED	SOURCE	TOPIC	ENTRY_TEXT
Description:	Forum name	Date and time entry received	User ID of person adding entry	Topic within the forum	The text added in this entry table

The FORUM table contains a number of named forums. Each forum contains one or more topics and each topic contains one or more entries. When a topic is no longer current, its entries are either deleted or moved to the ARCHIVE table.

The following PL/I program is used to perform maintenance on the forum table. A user can invoke the program with one of three commands. Each command is accompanied by a string of text that can be found within the TOPIC column of the entries for a given topic (this need not be the entire TOPIC value). The three commands are:

- 1 (changes the contents of the TOPIC value for all that topic's entries)
- 2 (moves all entries for that topic to the ARCHIVE table)
- 3 (deletes all entries for that topic *without* archiving them)

```
CLEANUP:  PROC OPTIONS(MAIN);
  DCL NOT_END BIT(1);
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  ACTION       BINARY FIXED(15);   /* 1=chg-topic   2=archive   3=delete */
  DCL  SRCH_FORUM   CHAR(8);
  DCL  SRCH_TOPIC   CHAR(66) VARYING;
  DCL  NEW_TOPIC    CHAR(64) VARYING;
  DCL  FORUM        CHAR(8);
  DCL  TSTMP        CHAR(26);
  DCL  PERSON       CHAR(8);
  DCL  TOPIC        CHAR(64) VARYING;
  DCL  TXT          CHAR(2000) VARYING;
EXEC SQL  END DECLARE SECTION;
EXEC SQL  INCLUDE SQLCA;
EXEC SQL  WHENEVER NOT FOUND CONTINUE;
EXEC SQL  WHENEVER SQLWARNING CONTINUE;
EXEC SQL  WHENEVER SQLERROR GOTO ERRCHK;

EXEC SQL  CONNECT TO TOROLAB3;
GET LIST (ACTION, SRCH_FORUM, SRCH_TOPIC, NEW_TOPIC);
SRCH_TOPIC = '%' || SRCH_TOPIC || '%';
EXEC SQL  DECLARE CUR CURSOR FOR
             SELECT * FROM FORUM
                 WHERE FORUM = :SRCH_FORUM AND TOPIC LIKE :SRCH_TOPIC
                 FOR UPDATE OF TOPIC;
EXEC SQL  OPEN CUR;

NOT_END = '1'B;
DO WHILE (NOT_END);
  EXEC SQL  FETCH CUR INTO :FORUM, :TSTMP, :PERSON, :TOPIC, :TXT;
  IF SQLSTATE = '02000' THEN
    NOT_END = '0'B;
  ELSE DO;
    SELECT;
      WHEN (ACTION = 1)                /* change topic value */
        EXEC SQL  UPDATE FORUM
                    SET TOPIC = :NEW_TOPIC
                    WHERE CURRENT OF CUR;
      WHEN (ACTION = 2)                /* archive entry to another table */
        DO;
          EXEC SQL  INSERT INTO ARCHIVE
                      VALUES (:FORUM, :TSTMP, :PERSON, :TOPIC, :TXT);
          EXEC SQL  DELETE FROM FORUM WHERE CURRENT OF CUR;
        END;
        WHEN (ACTION = 3)                /* delete topic */
          EXEC SQL  DELETE FROM FORUM WHERE CURRENT OF CUR;
      END; /* select */
    END;  /* else do */
  END;  /* do while */

FINISHED:
  EXEC SQL  CLOSE CUR;
  EXEC SQL  COMMIT WORK;
  RETURN;
ERRCHK:
  DISPLAY ('Unexpected Error -changes will be backed out');
  PUT SKIP LIST (SQLCA);
  EXEC SQL  WHENEVER SQLERROR CONTINUE;  /* continue if error on rollback */
  EXEC SQL  ROLLBACK WORK;
  RETURN;
END;  /* CLEANUP */
```

FREE LOCATOR

The FREE LOCATOR statement removes the association between a locator variable and its value.

Invocation

This statement can only be embedded in an application program. It cannot be issued interactively. It is an executable statement that can be dynamically prepared. However, the EXECUTE statement with the USING clause must be used to execute the prepared statement. FREE LOCATOR cannot be used with the EXECUTE IMMEDIATE statement.

Authorization

None required.

Syntax

```
                  ┌─,─────────────┐
                  ▼               │
►►──FREE LOCATOR────host-variable─┴──────────────────────────────────►◄
```

Description

host-variable,...

Identifies a host variable that must be declared in accordance with the rules for declaring host variable locator variables. An indicator variable must not be specified. The locator variable type must be a binary large object locator, a character large object locator, or a double-byte character large object locator.

The host variable must currently have a locator assigned to it. That is, a locator must have been assigned during this unit of work (by a FETCH, SELECT INTO, SET variable, or VALUES INTO statement) and must not subsequently have been freed (by a FREE LOCATOR statement); otherwise, an error is raised.

If more than one host variable is specified in the FREE LOCATOR statement and an error occurs on one of the locators, no locators will be freed.

Example

Assume that the employee table contains columns RESUME, HISTORY, and PICTURE and that locators have been established in a program to represent the column values. Free the CLOB locator variables LOCRES and LOCHIST, and the BLOB locator variable LOCPIC.

```
FREE LOCATOR :LOCRES, :LOCHIST, :LOCPIC
```

GET DIAGNOSTICS

The GET DIAGNOSTICS statement obtains information about the previous SQL statement that was executed.

Invocation

This statement can only be embedded in the SQL-routine body of an SQL function or SQL procedure. It is an executable statement that cannot be dynamically prepared.

Authorization

None required.

Syntax

```
►►──GET DIAGNOSTICS──┬─SQL-variable-name──=──ROW_COUNT──────┬──────────────────►◄
                     ├─SQL-variable-name──=──RETURN_STATUS──┤
                     └─┤ condition-information ├────────────┘
```

condition-information:

```
├──EXCEPTION──1──┬─SQL-variable-name──=──MESSAGE_TEXT──────────┬───────────────┤
                 ├─SQL-variable-name──=──MESSAGE_LENGTH────────┤
                 └─SQL-variable-name──=──MESSAGE_OCTET_LENGTH──┘
```

Description

SQL-variable-name
: Identifies the variable that is the assignment target. If MESSAGE_TEXT is specified, the variable must be CHAR or VARCHAR. Otherwise, the variable must be an integer variable. SQL variables can be defined in a compound statement.

ROW_COUNT
: Identifies the number of rows associated with the previous SQL statement that was executed. If the previous SQL statement is a DELETE, INSERT, or UPDATE statement, ROW_COUNT identifies the number of rows deleted, inserted, or updated by that statement. If the previous statement is a PREPARE statement, ROW_COUNT identifies the estimated number of result rows in the prepared statement.

RETURN_STATUS
: Identifies the status value returned from the previous SQL CALL statement.

For more information, see "return-statement" on page 532. If the previous statement is not a CALL statement, the value returned has no meaning and is unpredictable.

condition-information

Specifies that error or warning information will be returned about the previous SQL statement.

If information is desired about an error, the GET DIAGNOSTICS statement must be the first statement specified in the handler that will handle the error.

If information is desired about a warning,

- If a handler will get control for the warning condition, the GET DIAGNOSTICS statement must be the first statement specified in that handler.
- If a handler will not get control for the warning condition, the GET DIAGNOSTICS statement must be the next statement executed after that previous statement.

MESSAGE_TEXT

Identifies the message text of the error or warning returned from the previous SQL statement that was executed. If the previous SQL statement completes with an SQLCODE equal to zero, an empty string or blanks is returned.

MESSAGE_LENGTH or MESSAGE_OCTET_LENGTH

Identifies the length of the message text of the error or warning returned from the previous SQL statement that was executed. If the previous SQL statement completes with an SQLCODE equal to zero, a length of 0 is returned.

Example

In an SQL procedure, execute a GET DIAGNOSTICS statement to determine how many rows were updated.

```
CREATE PROCEDURE sqlprocg (IN deptnbr VARCHAR(3)) LANGUAGE SQL
  BEGIN
    DECLARE SQLSTATE CHAR(5);
    DECLARE rcount INTEGER;
    UPDATE CORPDATA.PROJECT
      SET PRSTAFF = PRSTAFF + 1.5
      WHERE DEPTNO = deptnbr;
    GET DIAGNOSTICS rcount = ROW_COUNT;
    /* At this point, rcount contains the number of rows that were updated. */
  END;
```

In an SQL procedure, execute a GET DIAGNOSTICS statement to retrieve the message text for an error.

```
CREATE PROCEDURE testit ()
 LANGUAGE SQL
  A1: BEGIN
    DECLARE retval INTEGER DEFAULT 0;
    ...
    CALL tryit;
    GET DIAGNOSTICS retval = RETURN_STATUS;
    IF retval <> 0 THEN
       ...
       LEAVE A1;
    ELSE
```

```
          ...
        END IF;
      END A1;
```

In an SQL procedure, execute a GET DIAGNOSTICS statement to retrieve the message text for an error.

```
   CREATE PROCEDURE divide2 ( IN numerator INTEGER,
                     IN denominator INTEGER,
                   OUT divide_result INTEGER,
                        OUT divide_error VARCHAR(70) )
  LANGUAGE SQL
    BEGIN
       DECLARE CONTINUE HANDLER FOR SQLEXCEPTION
          GET DIAGNOSTICS EXCEPTION 1
           SET divide_error = MESSAGE_TEXT;
       SET divide_result = numerator / denominator;
    END;
```

GRANT (Function or Procedure Privileges)

This form of the GRANT statement grants privileges on a function or procedure.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

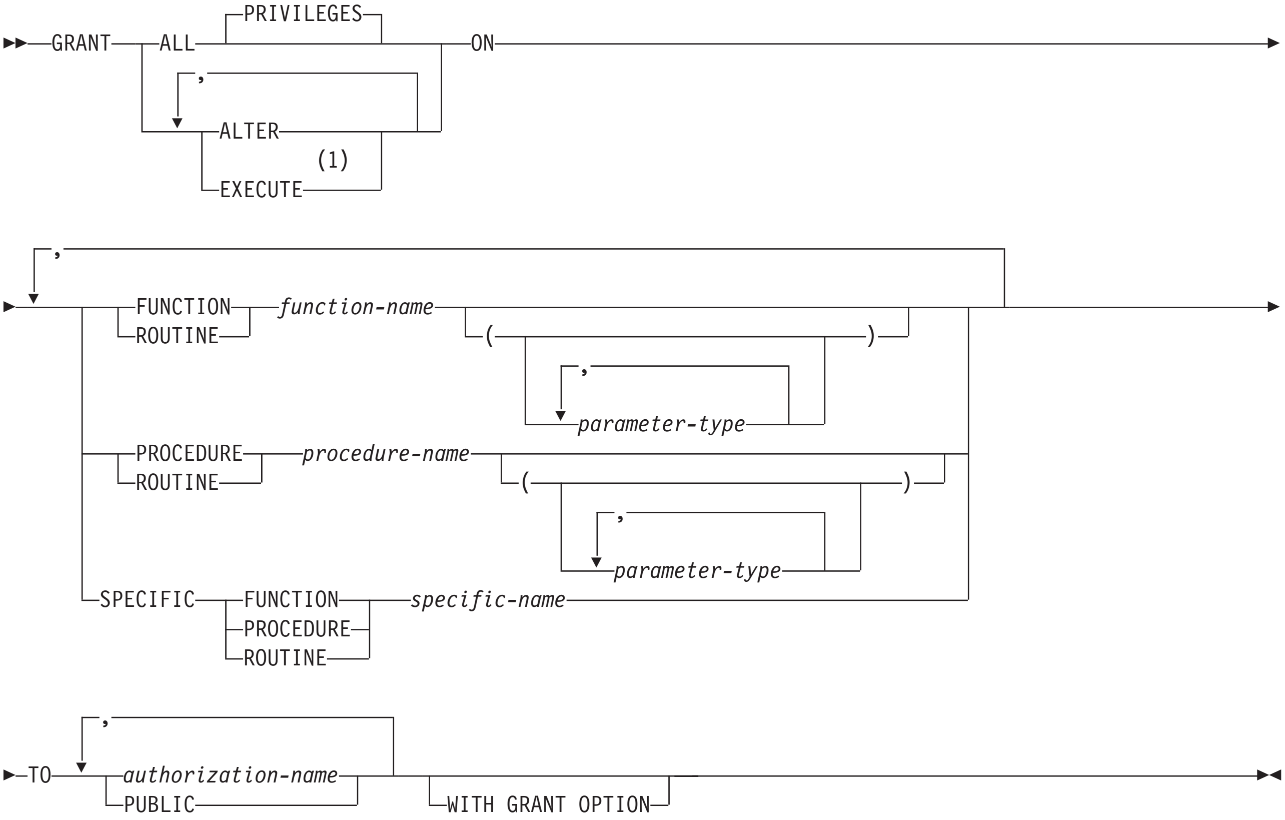
The privileges held by the authorization ID of the statement must include at least one of the following:

- For each function or procedure identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the function or procedure
  - The system authority *EXECUTE on the library containing the function or procedure
- Administrative authority

If WITH GRANT OPTION is specified, the privileges held by the authorization ID of the statement must include at least one of the following:

- Ownership of the function or procedure
- Administrative authority

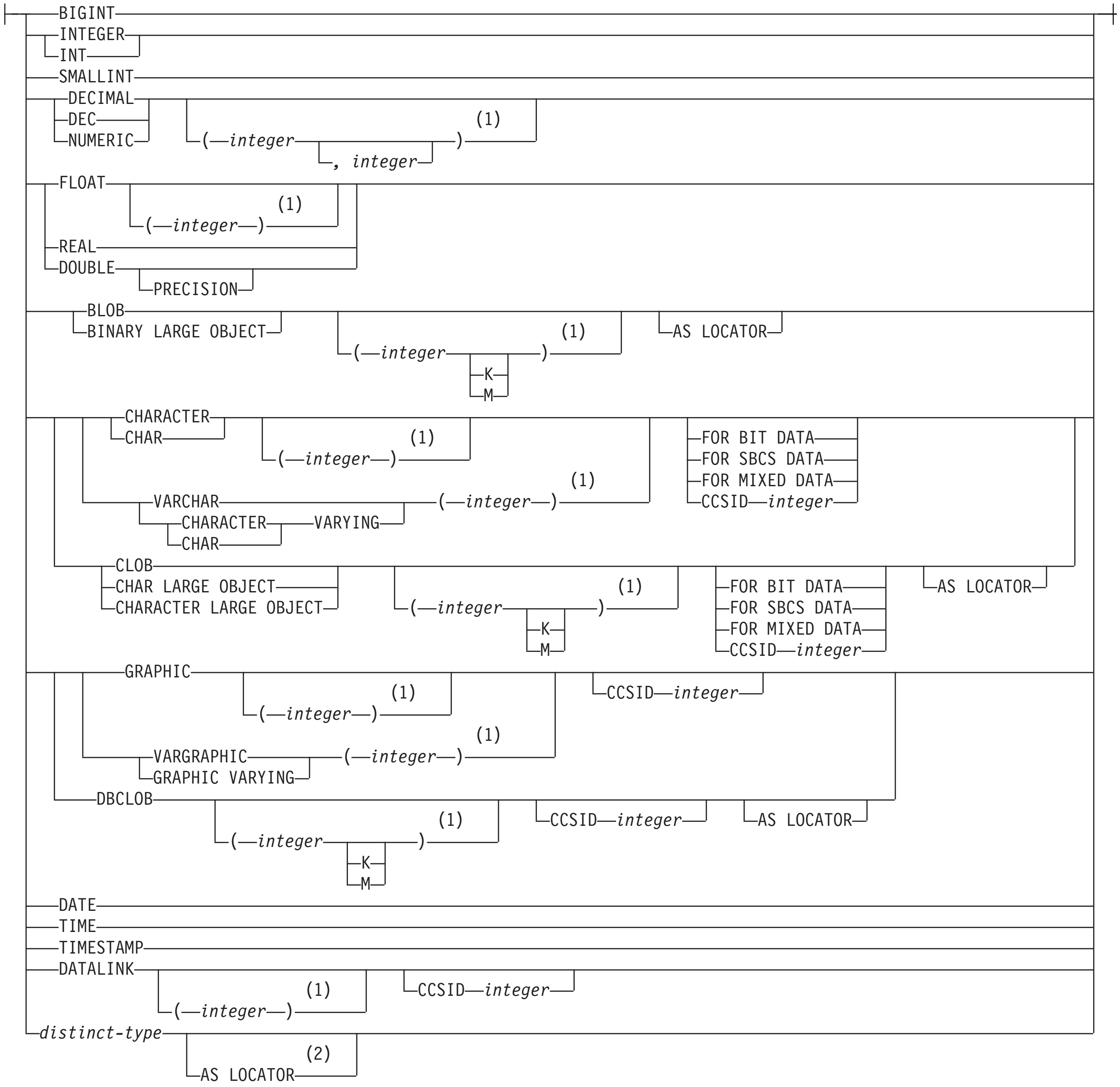
Syntax



Notes:

1 The keyword RUN can be used as a synonym for EXECUTE.

parameter-type:



Notes:

1 The values that are specified for length, precision, or scale attributes must match the values that were specified when the function was created. Coding specific values is optional. Empty parentheses, (), can be used instead to indicate that DB2 ignores the attributes when determining whether data types match.

2 AS LOCATOR can be specified only for distinct type based on a LOB data type.

Description

ALL or **ALL PRIVILEGES**
Grants one or more privileges. The privileges granted are all those grantable privileges that the authorization ID of the statement has on the specified functions or procedures. Note that granting ALL PRIVILEGES on a function or procedure is not the same as granting the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword grants the privilege described.

ALTER
Grants the privilege to use the COMMENT ON statement.

EXECUTE
Grants the privilege to execute the function or procedure.

FUNCTION
Identifies the function on which you are granting the privilege. You can identify the particular function by its name, function signature, or specific name. The rules for function resolution (and the path) are not used.

FUNCTION *function-name*
The *function-name* must identify exactly one function that exists at the current server. The function may have any number of parameters defined for it. If there is more than one function of the specified name in the specified or implicit collection, an error is returned.

FUNCTION *function-name (parameter-type, ...)*
The *function-name (parameter-type, ...)* must identify a function with the specified function signature that exists at the current server. The specified parameters must match the data types that were specified on the CREATE FUNCTION statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance which is to be granted. If *function-name ()* is specified, the function identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision, or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. For more information on the default attributes see "CREATE TABLE" on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

SPECIFIC FUNCTION *specific-name*
The *specific-name* must identify a specific function that exists at the current server.

PROCEDURE
Identifies the procedure on which you are granting the privilege. You can identify the particular procedure by its name, procedure signature, or specific name. The rules for procedure resolution (and the path) are not used.

PROCEDURE *procedure-name*

The *procedure-name* must identify exactly one procedure that exists at the current server. The procedure may have any number of parameters defined for it. If there is more than one procedure of the specified name in the specified or implicit collection, an error is returned.

PROCEDURE *procedure-name (parameter-type, ...)*

The *procedure-name (parameter-type, ...)* must identify a procedure with the specified procedure signature that exists at the current server. The specified parameters must match the data types that were specified on the CREATE PROCEDURE statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific procedure instance which is to be granted. If *procedure-name ()* is specified, the procedure identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision, or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE PROCEDURE statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. For more information on the default attributes see "CREATE TABLE" on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE PROCEDURE statement.

SPECIFIC PROCEDURE *specific-name*

The *specific-name* must identify a specific procedure that exists at the current server.

TO

Indicates to whom the privileges are granted.

authorization-name,...

Lists one or more authorization IDs.

PUBLIC

Grants the privileges to a set of users (authorization IDs).

The set consists of those users who do not have privately granted privileges on the function or procedure. For example, if ALTER has been granted to PUBLIC, and EXECUTE is then granted to HERNANDEZ, this private grant prevents HERNANDEZ from having the ALTER privilege.

WITH GRANT OPTION

Allows the specified *authorization-names* to grant privileges on the functions or procedures specified in the ON clause to other users.

If WITH GRANT OPTION is omitted, the specified *authorization-names* cannot grant privileges on the functions or procedures specified in the ON clause to another user unless they have received that authority from some other source (for example, from a grant of the system authority *OBJMGT).

Note

Privileges granted to either an SQL or external function or procedure are granted to its associated program (*PGM) or service program (*SRVPGM) object.

GRANT and REVOKE statements assign and remove AS/400 system authorities for SQL objects. The following table describes the AS/400 system authorities that correspond to the SQL privileges:

Table 26. Privileges Granted to or Revoked from Functions or Procedures

SQL Privilege	**Corresponding AS/400 System Authorities when Granting to or Revoking from a Function or Procedure**
ALL (Grant or revoke of ALL grants or revokes only those privileges the authorization ID of the statement has)	*OBJALTER *OBJOPR *EXECUTE *OBJMGT (Revoke only)
ALTER	*OBJALTER
EXECUTE	*EXECUTE *OBJOPR
WITH GRANT OPTION	*OBJMGT

Example

Grant the EXECUTE privilege on procedure CORPDATA.PROCA to PUBLIC.

```
GRANT EXECUTE
  ON PROCEDURE CORPDATA.PROCA
  TO PUBLIC
```

GRANT (Package Privileges)

This form of the GRANT statement grants privileges on a package.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For each package identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the package
  - The system authority *EXECUTE on the library containing the package
- Administrative authority

If WITH GRANT OPTION is specified, the privileges held by the authorization ID of the statement must include at least one of the following:

- Ownership of the package
- Administrative authority

Syntax

```
                  ┌─PRIVILEGES─┐                    (2)  ┌─,────────────┐
►►─GRANT─┬─ALL─┴────────────┴───┬─ON PACKAGE────────────▼─package-name─┴────────►
         │  ┌─,──────────────┐  │
         │  ▼                │  │
         └──┬─ALTER──────────┴──┘
            │          (1)  │
            └─EXECUTE───────┘

       ┌─,───────────────────┐
       ▼                     │
►─TO───┬─authorization-name─┬┴──┬───────────────────┬──────────────────►◄
       └─PUBLIC─────────────┘   └─WITH GRANT OPTION─┘
```

Notes:

1 The keyword RUN can be used as a synonym for EXECUTE.

2 The keyword PROGRAM can be used as a synonym for PACKAGE.

Description

ALL or **ALL PRIVILEGES**
Grants one or more privileges. The privileges granted are all those grantable privileges that the authorization ID of the statement has on the specified packages. Note that granting ALL PRIVILEGES on a package is not the same as granting the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword grants the privilege described.

ALTER
Grants the privilege to use the COMMENT ON and LABEL ON statements.

EXECUTE
Grants the privilege to execute statements in a package.

ON PACKAGE *package-name*
Identifies the packages on which you are granting the privilege. The *package-name* must identify a package that exists at the current server.

TO
Indicates to whom the privileges are granted.

authorization-name,...
Lists one or more authorization IDs.

PUBLIC
Grants the privileges to a set of users (authorization IDs).

The set consists of those users who do not have privately granted privileges on the package. For example, if ALTER has been granted to

PUBLIC, and EXECUTE is then granted to HERNANDEZ, this private grant prevents HERNANDEZ from having the ALTER privilege.

WITH GRANT OPTION

Allows the specified *authorization-names* to grant privileges on the packages specified in the ON clause to other users.

If WITH GRANT OPTION is omitted, the specified *authorization-names* cannot grant privileges on the packages specified in the ON clause to another user unless they have received that authority from some other source (for example, from a grant of the system authority *OBJMGT).

Note

GRANT and REVOKE statements assign and remove AS/400 system authorities for SQL objects. The following table describes the AS/400 system authorities that correspond to the SQL privileges:

Table 27. Privileges Granted to or Revoked from Packages

SQL Privilege	Corresponding AS/400 System Authorities when Granting to or Revoking from a Package
ALL (Grant or revoke of ALL grants or revokes only those privileges the authorization ID of the statement has)	*OBJALTER *OBJOPR *EXECUTE *OBJMGT (Revoke only)
ALTER	*OBJALTER
EXECUTE	*EXECUTE *OBJOPR
WITH GRANT OPTION	*OBJMGT

Example

Grant the EXECUTE privilege on package CORPDATA.PKGA to PUBLIC.

```
GRANT EXECUTE
  ON PACKAGE CORPDATA.PKGA
  TO PUBLIC
```

GRANT (Table Privileges)

This form of the GRANT statement grants privileges on tables or views.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

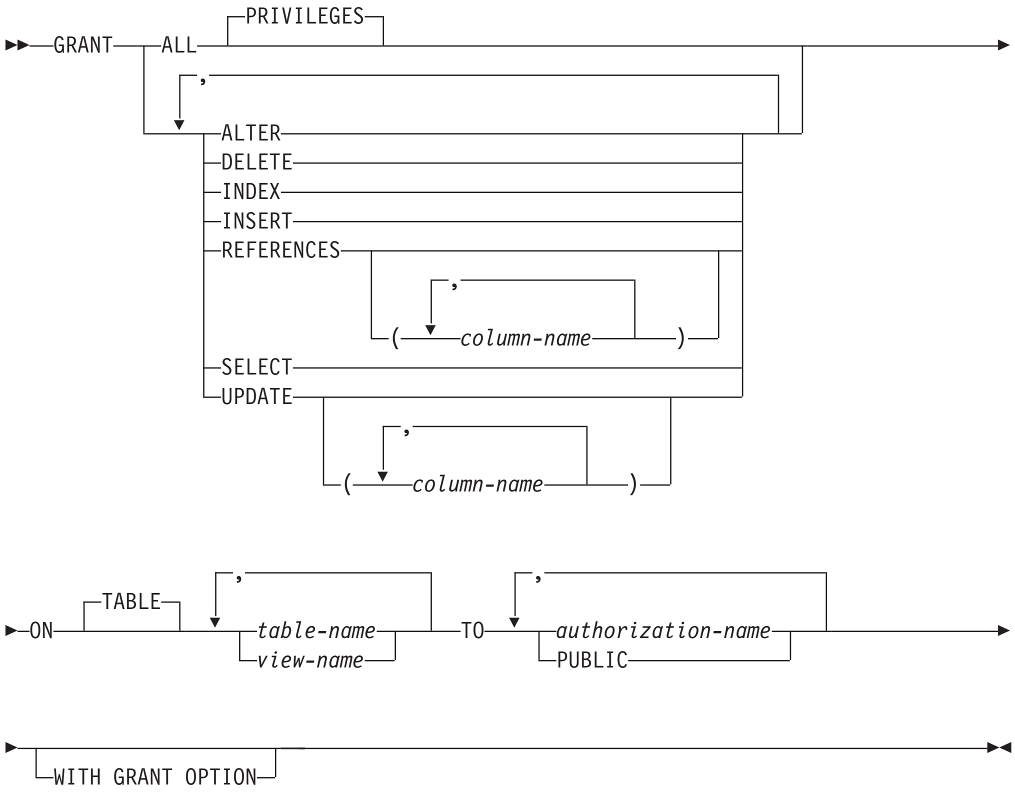
- For each table or view identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the table or view
  - The system authority *EXECUTE on the library containing the table or view

- Administrative authority

If WITH GRANT OPTION is specified, the privileges held by the authorization ID of the statement must include at least one of the following:

- Ownership of the table
- Administrative authority

Syntax



Description

ALL or **ALL PRIVILEGES**

Grants one or more privileges. The privileges granted are all those grantable privileges that the authorization ID of the statement has on the specified tables or views. Note that granting ALL PRIVILEGES on a table or view is not the same as granting the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword grants the privilege described, but only as it applies each table or view named in the ON clause. For example, the UPDATE, DELETE, and INSERT privileges do not apply to a read-only view.

ALTER

Grants the privilege to use the ALTER TABLE statement on tables. Grants the privilege to use the COMMENT ON and LABEL ON statements on tables and views.

DELETE
Grants the privilege to use the DELETE statement. DELETE cannot be granted to read-only views.

INDEX
Grants the privilege to use the CREATE INDEX statement. This privilege cannot be granted on a view.

INSERT
Grants the privilege to use the INSERT statement. INSERT cannot be granted to a view that does not allow inserts.

REFERENCES
Grants the privilege to add a referential constraint in which the table is a parent. If a list of columns is not specified or if REFERENCES is granted to all columns of the table or view via the specification of ALL PRIVILEGES, the grantee(s) can add referential constraints using all columns of each table specified in the ON clause as a parent key, even those added later via the ALTER TABLE statement. This privilege can be granted on a view, but the privilege is not used for a view.

REFERENCES (*column-name***,...)**
Grants the privilege to add a referential constraint using only those columns specified in the column list as a parent key. Each *column-name* must be an unqualified name that identifies a column of each table specified in the ON clause. This privilege can be granted on the columns of a view, but the privilege is not used for a view.

SELECT
Grants the privilege to use the SELECT or CREATE VIEW statement.

UPDATE
Grants the privilege to use the UPDATE statement. If a list of columns is not specified or if UPDATE is granted to all columns of the table or view via the specification of ALL PRIVILEGES, the grantee(s) can update all updateable columns on each table specified in the ON clause, even those added later via the ALTER TABLE statement. UPDATE cannot be granted to a view that does not allow updates.

UPDATE (*column-name***,...)**
Grants the privilege to use the UPDATE statement to update only those columns that are identified in the column list. Each *column-name* must be an unqualified name that identifies a column of each table and view specified in the ON clause. UPDATE cannot be granted to columns of a view that do not allow updates.

ON *table-name* or *view-name,...*
Identifies the tables or views on which you are granting the privileges. The table-name or view-name must identify a table or view that exists at the current server.

TO
Indicates to whom the privileges are granted.

authorization-name,...
Lists one or more authorization IDs.

PUBLIC
Grants the privileges to a set of users (authorization IDs).

The set consists of those users who do not have privately granted privileges on the table or view. For example, if SELECT has been granted to PUBLIC, and UPDATE is then granted to HERNANDEZ, this private grant prevents HERNANDEZ from having the SELECT privilege.

WITH GRANT OPTION

Allows the specified *authorization-names* to grant privileges on the tables and views specified in the ON clause to other users.

If WITH GRANT OPTION is omitted, the specified *authorization-names* cannot grant privileges on the tables and views specified in the ON clause unless they have received that authority from some other source (for example, from a grant of the system authority *OBJMGT).

Notes

The GRANT and REVOKE statements assign and remove AS/400 system authorities for SQL objects. The following table describes the AS/400 system authorities that correspond to the SQL privileges when granting to a table. The left column lists the SQL privilege. The right column lists the equivalent AS/400 system authorities that are granted or revoked.

Table 28. Privileges Granted to or Revoked from Tables

SQL Privilege	Corresponding AS/400 Authorities when Granting to or Revoking from a Table
ALL (GRANT or revoke of ALL only grants or revokes those privileges the authorization ID of the statement has)	*OBJALTER [43] *OBJMGT (Revoke only) *OBJOPR *OBJREF *ADD *DLT *READ *UPD
ALTER	*OBJALTER [44]
DELETE	*OBJOPR *DLT
INDEX	*OBJALTER [44]
INSERT	*OBJOPR *ADD
REFERENCES	*OBJREF [44]
SELECT	*OBJOPR *READ
UPDATE	*OBJOPR *UPD
WITH GRANT OPTION	*OBJMGT

The following table describes the AS/400 system authorities that correspond to the SQL privileges when granting to a view. The left column lists the SQL privilege. The middle column lists the equivalent AS/400 system authorities that are granted to or revoked from the view itself. The right column lists the AS/400 system

---

[43] The SQL INDEX and ALTER privilege correspond to the same system authority of *OBJALTER. Granting both INDEX and ALTER will not provide the user with any additional authorities.

[44] If the WITH GRANT OPTION is given to a user, the user will also be able to perform the functions given by ALTER and REFERENCES authority.

authorities that are granted to all tables and views referenced in the views definition, and if a view is referenced, all tables and views referenced in its definition, and so on. [45]

If a view references more than one table or view, the *DLT, *ADD, and *UPD system authorities are only granted to the first table or view in the subselect of the view definition. The *READ system authority is granted to all tables and views referenced in the view definition.

If more than one system authority will be granted with an SQL privilege, and any one of the authorities cannot be granted, then a warning occurs and no authorities will be granted for that privilege. Unlike GRANT, REVOKE only revokes system authorities to the view. No system authorities are revoked from the referenced tables and views.

Table 29. Privileges Granted to or Revoked from Views

SQL Privilege	**Corresponding AS/400 Authorities Granted to or Revoked from View**	**Corresponding AS/400 Authorities Granted to or Revoked from Referenced Tables and Views**
ALL (GRANT or REVOKE of ALL only grants or revokes those privileges the authorization ID of the statement has)	*OBJALTER *OBJMGT (Revoke only) *OBJOPR *OBJREF *ADD *DLT *READ *UPD	*ADD *DLT *READ *UPD
ALTER	*OBJALTER [46]	None
DELETE	*OBJOPR *DLT	*DLT
INDEX	Not Applicable	Not Applicable
INSERT	*OBJOPR *ADD	*ADD
REFERENCES	*OBJREF [46]	None
SELECT	*OBJOPR *READ	*READ
UPDATE	*OBJOPR *UPD	*UPD
WITH GRANT OPTION	*OBJMGT	None

Examples

Example 1

Given that you have authority, grant all the privileges that you have on the table WESTERN_CR (in collection KATHLEEN) to PUBLIC.

```
GRANT ALL ON KATHLEEN.WESTERN_CR
TO PUBLIC
```

---

[45] The specified rights are only granted to the tables and views referenced in the view definition if the user to whom the rights are being granted doesn't already have the rights from another authority source, for example public authority.

[46] If the WITH GRANT OPTION is given to a user, the user will also be able to perform the functions given by ALTER and REFERENCES authority.

Example 2

Grant the appropriate privileges on the CALENDAR table so that ROANNA and EMMA can read it and insert new entries into it. Do not allow them to change or remove any existing entries.

```
GRANT SELECT, INSERT ON CALENDAR
TO ROANNA, EMMA
```

Example 3

Grant column privileges on TABLE1 and VIEW1 to FRED. Note that both columns specified in this GRANT statement must be found in both TABLE1 and VIEW1.

```
GRANT UPDATE(column_1, column_2)
  ON  TABLE1, VIEW1
  TO FRED WITH GRANT OPTION
```

GRANT (User-Defined Type Privileges)

This form of the GRANT statement grants privileges on a user-defined type.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

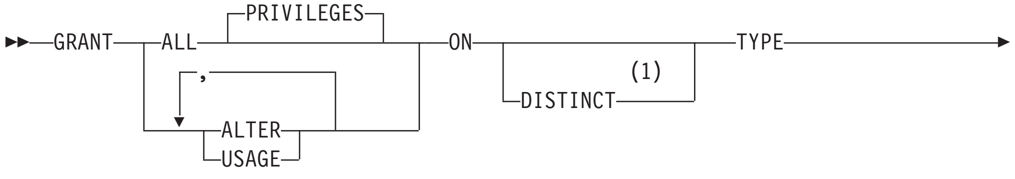
The privileges held by the authorization ID of the statement must include at least one of the following:

- For each user-defined type identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the user-defined type
  - The system authority *EXECUTE on the library containing the user-defined type
- Administrative authority

If WITH GRANT OPTION is specified, the privileges held by the authorization ID of the statement must include at least one of the following:

- Ownership of the user-defined type
- Administrative authority

Syntax



```
   ┌─,─────────┐      ┌─,─────────────────────┐
   ▼           │      ▼                       │
►──┴─type-name─┴──TO──┴─┬─authorization-name─┬┴──┬───────────────────┬──►◄
                        └─PUBLIC─────────────┘   └─WITH GRANT OPTION─┘
```

Notes:

1 The keyword DATA can be used when granting to any user-defined-type.

Description

ALL or **ALL PRIVILEGES**
Grants one or more privileges. The privileges granted are all those grantable privileges that the authorization ID of the statement has on the specified user-defined types. Note that granting ALL PRIVILEGES on a user-defined type is not the same as granting the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword grants the privilege described.

ALTER
Grants the privilege to use the COMMENT ON statement.

USAGE
Grants the privilege to use the user-defined type in tables, functions, procedures, or as the source type in a CREATE DISTINCT TYPE statement.

ON TYPE *type-name*
Identifies the user-defined types on which you are granting the privilege. The *type-name* must identify a user-defined type that exists at the current server.

TO
Indicates to whom the privileges are granted.

authorization-name,...
Lists one or more authorization IDs.

PUBLIC
Grants the privileges to a set of users (authorization IDs).

The set consists of those users who do not have privately granted privileges on the user-defined type. For example, if ALTER has been granted to PUBLIC, and USAGE is then granted to HERNANDEZ, this private grant prevents HERNANDEZ from having the ALTER privilege.

WITH GRANT OPTION
Allows the specified *authorization-names* to grant privileges on the user-defined types specified in the ON clause to other users.

If WITH GRANT OPTION is omitted, the specified *authorization-names* cannot grant privileges on the user-defined types specified in the ON clause to another user unless they have received that authority from some other source (for example, from a grant of the system authority *OBJMGT).

Note

GRANT and REVOKE statements assign and remove AS/400 system authorities for SQL objects. The following table describes the AS/400 system authorities that correspond to the SQL privileges:

Table 30. Privileges Granted to or Revoked from User-Defined Types

SQL Privilege	Corresponding AS/400 System Authorities when Granting to or Revoking from a User-Defined Type
ALL (Grant or revoke of ALL grants or revokes only those privileges the authorization ID of the statement has)	*OBJALTER *OBJOPR *EXECUTE *OBJMGT (Revoke only)
ALTER	*OBJALTER
USAGE	*EXECUTE *OBJOPR
WITH GRANT OPTION	*OBJMGT

Example

Grant the USAGE privilege on distinct type SHOE_SIZE to user JONES. This GRANT statement does not give JONES the privilege to execute the cast functions that are associated with the distinct type SHOE_SIZE.

```
GRANT USAGE
  ON DISTINCT TYPE SHOE_SIZE
  TO JONES
```

INCLUDE

The INCLUDE statement inserts declarations or statements into a source program.

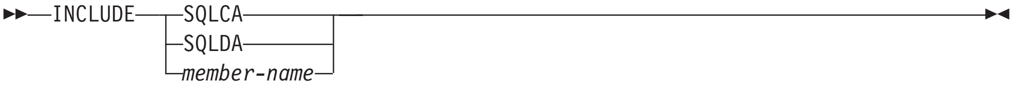
Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in REXX.

Authorization

The authorization ID of the statement must have the system authorities *OBJOPR and *READ on the file that contains the member.

Syntax



Description

SQLCA

Indicates the description of an SQL communication area (SQLCA) is to be included. INCLUDE SQLCA must not be specified more than once in the same program. Include SQLCA must not be specified if the program includes a stand-alone SQLCODE or a stand-alone SQLSTATE.

An SQLCA can be specified for C, COBOL, and PL/I. If the SQLCA is not specified, the variable SQLCODE or SQLSTATE must appear in the program. For more information, see “SQL Return Codes” on page 244.

The SQLCA should not be specified for RPG programs. In an RPG program, the precompiler automatically includes the SQLCA.

For a description of the SQLCA, see "Appendix B. SQL Communication Area" on page 541.

SQLDA

Indicates the description of an SQL descriptor area (SQLDA) is to be included. INCLUDE SQLDA can be specified in C, COBOL, PL/I, and ILE RPG/400.

For a description of the SQLDA, see "Appendix C. SQL Descriptor Area (SQLDA)" on page 551.

member-name

Identifies a member to be included from the file specified on the INCFILE parameter of the CRTSQL*xxx* command.

The member can contain any host language statements and any SQL statements other than an INCLUDE statement. In COBOL, INCLUDE *member-name* must not be specified in other than the DATA DIVISION or PROCEDURE DIVISION.

When your program is precompiled, the INCLUDE statement is replaced by source statements.

The INCLUDE statement must be specified at a point in your program where the resulting source statements are acceptable to the compiler.

Notes

If the CCSID of the source file specified on the SRCFILE parameter is different from the CCSID of the source file specified on the INCFILE parameter, the source from the INCLUDE statement is converted to the CCSID of the source file.

Example

Include an SQL communication area in a PL/I program.

```
EXEC SQL  INCLUDE SQLCA;
```

INSERT

The INSERT statement inserts rows into a table or view. Inserting a row into a view also inserts the row into the table on which the view is based.

There are three forms of this statement:

- The *INSERT using VALUES* form is used to insert a single row into the table or view using the values provided or referenced.
- The *INSERT using SELECT* form is used to insert one or more rows into the table or view using values from other tables or views.
- The *INSERT using n ROWS* form is used to insert multiple rows into the table or view using the values provided in a host-structure-array.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared with the exception of the n ROWS form, which must be a static statement embedded in an application program. The n ROWS form is not allowed in a REXX procedure.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the table or view identified in the statement:
  - The INSERT privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the INSERT privilege on a table when:

- It is the owner of the table,
- It has been granted the INSERT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *ADD on the table.

The authorization ID of the statement has the INSERT privilege on a view when:[47]

- It has been granted the INSERT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *ADD on the view and the system authority *ADD on the first table or view in the first FROM clause of the view definition; and if this is a view, then the system authority *ADD on the first table or view in the first FROM clause of that view definition; and so forth.

If a subselect is specified, the privileges held by the authorization ID of the statement must also include one of the following:

- For each table or view identified in the subselect:
  - The SELECT privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the SELECT privilege on a table when:

- It is the owner of the table,
- It has been granted the SELECT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *READ on the table

The authorization ID of the statement has the SELECT privilege on a view when:

- It is the owner of the view,
- It has been granted the SELECT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *READ on the view and the system authority *READ on all tables and views that this view is directly or indirectly dependent on. That is, all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth.

---

[47] When a view is created, the owner does not necessarily acquire the INSERT privilege on the view. The owner only acquires the INSERT privilege if the view allows inserts and the owner also has the INSERT privilege on the first table referenced in the subselect.

Syntax

```
►►──INSERT INTO──┬─table-name─┬──┬──────────────────────────────┬──────────────────────────────►
                 └─view-name──┘  │     ┌─,──────────────┐       │
                                 │     ▼                │       │
                                 └─(───────column-name──┴───)───┘
```

```
                  ┌─,──────────────────┐
                  ▼                    │     (1)
►──┬──┬─VALUES──(───┬─expression─┬─────┴──)─────┬──┬────────────────────┬──┬─────────────►◄
   │  │             ├─NULL───────┤              │  └─isolation-clause───┘  │
   │  │             └─DEFAULT────┘              │                          │
   │  └─insert-multiple-rows────────────────────┘                          │
   └───────────────────────────────────────────────────────────────────────┘
     └─select-statement─┘
```

insert-multiple-rows:

```
├──┬─integer────────┬──ROWS──VALUES──(──host-structure-array──)──────────────────────────────┤
   └─host-variable──┘
```

Notes:

1 If only one value is specified in the list, the parentheses around the value are optional.

Description

INTO *table-name* or *view-name*

Identifies the object of the insert operation. The name must identify a table or view that exists at the current server, but it must not identify a catalog table, a view of a catalog table, or a read-only view.

A value cannot be inserted into a view column that is derived from:

- A constant, expression, or scalar function.
- The same base table column as some other column of the view.

If the object of the insert operation is a view with such columns, a list of column names must be specified, and the list must not identify these columns.

(*column-name***,...)**

Specifies the columns for which insert values are provided. Each name must be an unqualified name that identifies a column of the table or view. The same column must not be identified more than once. A view column that cannot accept insert values must not be identified.

Omission of the column list is an implicit specification of a list in which every column of the table or view is identified in left-to-right order. This list is established when the statement is prepared and, therefore, does not include columns that were added to a table after the statement was prepared.

If the INSERT statement is embedded in an application and the referenced table or view exists at create program time, the statement is prepared at create program time. Otherwise, the statement is prepared at the first successful execute of the INSERT statement.

VALUES

Specifies one new row in the form of a list of values.

The number of values in the VALUES clause must equal the number of names in the column list. The first value is inserted in the first column in the list, the second value in the second column, and so on.

expression
Specifies the value for a column is assigned from an expression.. The *expression* is any expression of the type described in “Expressions” on page 105. It must not include a column function or column name.

If expression is a single host variable, the host variable can identify a structure. Each host variable in the clause must identify a host structure or host variable that is declared in accordance with the rules for declaring host structures and host variables. In the operational form of the statement, a reference to a host structure is replaced by a reference to each of its variables. For an explanation of *host-variable*, see Chapter 2.

NULL
Specifies the value for a column is the null value. NULL should only be specified for nullable columns.

DEFAULT
Specifies that the default value is assigned to a column. The value that is inserted depends on how the column was defined, as follows:

- If the WITH DEFAULT clause is used, the default inserted is as defined for the column (see *default-clause* in *column-definition* in “CREATE TABLE” on page 340).
- If the WITH DEFAULT clause or the NOT NULL clause is not used, the value inserted is NULL.
- If the NOT NULL clause is used and the WITH DEFAULT clause is not used or DEFAULT NULL is used, the DEFAULT keyword cannot be specified for that column.

select-statement
Specifies a set of new rows in the form of the result table of a select-statement. The FOR READ ONLY, FOR UPDATE, and OPTIMIZE clauses are not valid for a select-statement used with insert. If an ORDER BY clause is specified on the select-statement, the rows are inserted according to the values of the columns identified in the ORDER BY clause.

The select-statement may produce values by combining two result tables with the UNION or UNION ALL operators. There can be one, more than one, or zero rows inserted when using the select-statement. If no rows are inserted, SQLCODE is set to +100 and SQLSTATE is set to '02000'.

When the base object of the INSERT and a base object of any subselect in the select statement are the same table, the select statement is completely evaluated before any rows are inserted.

The number of columns in the result table must equal the number of names in the column list. The value of the first column of the result is inserted in the first column in the list, the second value in the second column, and so on. For an explanation of select-statement, see “select-statement” on page 233.

isolation-clause
Specifies the isolation level you want to use for the INSERT statement. For an explanation of isolation-clause, see “isolation-clause” on page 237.

insert-multiple-rows

integer or *host-variable* **ROWS**

Specifies the number of rows to be inserted. If a host-variable is specified, it must be numeric with zero scale and cannot include an indicator variable.

VALUES (*host-structure-array***)**

Specifies a set of new rows in the form of an array of host structures. The host-structure-array must be declared in the program in accordance with the rules for declaring host structure arrays. A parameter marker may be used in place of the host-structure-array name.

The number of variables in the host structure must equal the number of names in the column-list. The first host structure in the array corresponds to the first row, the second host structure in the array corresponds to the second row, and so on. In addition, the first variable in the host structure corresponds with the first column of the row, the second variable in the host structure corresponds with the second column of the row, and so on.

For an explanation of arrays of host structures see “Host Structure Arrays in C, C++, COBOL, PL/I, and RPG” on page 100.

INSERT Rules

Default values

The value inserted in any column that is not in the column list is the default value of the column. Columns without a default value must be included in the column list. Similarly, if you insert into a view, the default value is inserted into any column of the base table that is not included in the view. Hence, all columns of the base table that are not in the view must have default values.

Assignment

Insert values are assigned to columns in accordance with the assignment rules described in Chapter 2

Validity

If the identified table or the base table of the identified view has one or more unique indexes or unique constraints, each row inserted into the table must conform to the constraints imposed by those indexes.

The unique indexes and unique constraints are effectively checked at the end of the statement unless COMMIT(*NONE) was specified. In the case of a multiple-row insert, this would occur after all rows were inserted and any associated triggers were fired. If COMMIT(*NONE) is specified, checking is performed as each row is inserted.

If the identified table or the base table of the identified view has one or more check constraints, each check constraint must be true or unknown for each row inserted into the table.

The check constraints are effectively checked at the end of the statement. In the case of a multiple-row insert, this would occur after all rows were inserted.

If a view is identified, the inserted rows must conform to any applicable WITH CHECK OPTION. For more information, see “CREATE VIEW” on page 362.

Triggers
If the identified table or the base table of the identified view has an insert trigger, the trigger is fired for each row inserted.

Referential Integrity
Each nonnull insert value of a foreign key must equal some value of the parent key of the parent table in the relationship.

The referential constraints (other than a referential constraint with a RESTRICT delete rule) are effectively checked at the end of the statement. In the case of a multiple-row insert, this would occur after all rows were inserted and any associated triggers were fired.

Notes

If an insert value violates any constraints, or if any other error occurs during the execution of an INSERT statement and COMMIT(*NONE) was not specified, all changes made during the execution of the statement are backed out. However, other changes in the unit of work made prior to the error are not backed out. If COMMIT(*NONE) is specified, changes are not backed out.

After executing an INSERT statement, the value of SQLERRD(3) of the SQLCA is the number of rows that the database manager inserted.

If COMMIT(*RR), COMMIT(*ALL), COMMIT(*CS), or COMMIT(*CHG) is specified, one or more exclusive locks are acquired during the execution of a successful INSERT statement. Until the locks are released by a commit or rollback operation, an inserted row can only be accessed by:

- The application process that performed the insert
- Another application process using COMMIT(*NONE) or COMMIT(*CHG) through a read-only cursor, SELECT INTO statement, or subquery

The locks can prevent other application processes from performing operations on the table. For further information about locking, see the description of the COMMIT, ROLLBACK, and LOCK TABLE statements. Also, see "Isolation Level" on page 17 and the Database Programming book.

A maximum of 4000000 rows can be inserted or changed in any single INSERT statement when COMMIT(*RR), COMMIT(*ALL), COMMIT(*CS), or COMMIT(*CHG) was specified. The number of rows changed includes any rows inserted, updated, or deleted under the same commitment definition as a result of a trigger.

Host variables cannot be used in the INSERT statement within a REXX procedure. Instead, the INSERT must be the object of a PREPARE and EXECUTE using parameter markers.

Examples

Example 1

Insert a new department with the following specifications into the DEPARTMENT table:

- Department number (DEPTNO) is 'E31'
- Department name (DEPTNAME) is 'ARCHITECTURE'
- Managed by (MGRNO) a person with number '00390'

- Reports to (ADMRDEPT) department ‘E01’

```
INSERT INTO DEPARTMENT
  VALUES ('E31', 'ARCHITECTURE', '00390', 'E01')
```

Example 2

Insert a new department into the DEPARTMENT table as in example 1, but do not assign a manager to the new department.

```
INSERT INTO DEPARTMENT (DEPTNO, DEPTNAME, ADMRDEPT)
  VALUES ('E31', 'ARCHITECTURE', 'E01')
```

Example 3

Create a temporary table MA_EMP_ACT with the same columns as the EMP_ACT table. Load MA_EMP_ACT with the rows from the EMP_ACT table with a project number (PROJNO) starting with the letters ‘MA’.

```
CREATE TABLE MA_EMP_ACT
        (EMPNO     CHAR(6)  NOT NULL,
         PROJNO    CHAR(6)  NOT NULL,
         ACTNO     SMALLINT  NOT NULL,
         EMPTIME   DEC(5,2),
         EMSTDATE  DATE,
         EMENDATE  DATE )
INSERT INTO MA_EMP_ACT
  SELECT * FROM EMP_ACT
    WHERE SUBSTR(PROJNO, 1, 2) = 'MA'
```

Example 4

Use a PL/I program statement to add a skeleton project to the PROJECT table. Obtain the project number (PROJNO), project name (PROJNAME), department number (DEPTNO), and responsible employee (RESPEMP) from host variables. Use the current date as the project start date (PRSTDATE). Assign a NULL value to the remaining columns in the table.

```
EXEC SQL  INSERT INTO PROJECT  (PROJNO, PROJNAME, DEPTNO, RESPEMP, PRSTDATE)
            VALUES (:PRJNO, :PRJNM, :DPTNO, :REMP, CURRENT DATE);
```

Example 5

In a PL/I program, use a blocked insert to add 10 rows to table DEPARTMENT. The host structure array DEPT contains the data to be inserted.

```
DCL  1  DEPT(10),
        3  DEPT  CHAR(3),
        3  LASTNAME  CHAR(29)  VARYING,
        3  WORKDEPT  CHAR(6),
        3  JOB  CHAR(3);

EXEC SQL INSERT INTO CORPDATA.DEPARTMENT 10 ROWS VALUES (:DEPT);
```

Example 6

Insert a new project into the EMP_ACT table using the Read Uncommitted (UR, CHG) option:

```
INSERT INTO EMP_ACT
  VALUES ('000140', 'PL2100', 30)
  WITH CHG
```

LABEL ON

The LABEL ON statement adds or replaces labels in the catalog descriptions of tables, views, aliases, packages, or columns.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the table, view, alias, or package identified in the statement,
  - The ALTER privilege on the table, view, alias, or package, and
  - The system authority *EXECUTE on the library containing the table, view, alias, or package
- Administrative authority

The authorization ID of the statement has the ALTER privilege on the table, view or package when:

- It is the owner of the table, view or package,
- It has been granted the ALTER privilege to the table, view or package, or
- It has been granted the system authorities of either *OBJALTER or *OBJMGT to the table, view, or package

The authorization ID of the statement has the ALTER privilege on an alias when:

- It is the owner of the alias, or
- It has been granted the system authorities of either *OBJALTER or *OBJMGT to the alias

Syntax

```
►►──LABEL ON──────────────────────────────────────────────────────────────────────►

►──┬──┬─ALIAS──alias-name─────────────────────────┬──IS──string-constant──────┬──────────►◄
   │  ├─COLUMN──┬─table-name.column-name─┬──┬──────┬┤                         │
   │  │         └─view-name.column-name──┘  └─TEXT─┘│                         │
   │  │         (1)                                 │                         │
   │  ├─PACKAGE───────package-name──────────────────┤                         │
   │  └─TABLE──┬─table-name─┬───────────────────────┘                         │
   │           └─view-name──┘                                                 │
   │                                      ┌─,────────────────────────────┐    │
   │  ┌─COLUMN─┐                          ▼                              │    │
   ├──┴────────┴──┬─table-name─┬──(───────column-name──IS──string-constant┴──)─┤
   │              └─view-name──┘                                              │
   │                                      ┌─,────────────────────────────────────┐  │
   │  ┌─COLUMN─┐                          ▼                                      │  │
   └──┴────────┴──┬─table-name─┬──(───────column-name──TEXT──IS──string-constant─┴─)┘
                  └─view-name──┘
```

Notes:

1 The keyword PROGRAM can be used as a synonym for PACKAGE.

Description

ALIAS
Indicates that the label is for an alias. Labels on aliases are implemented as AS/400 object text.

alias-name

Identifies the alias to which the label applies. The name must identify an alias that exists at the current server.

COLUMN

Indicates that the label is for a column. Labels on columns are implemented as AS/400 column headings or column text. Column headings are used when displaying or printing query results.

table-name.column-name or *view-name.column-name*

Identifies the column, which is qualified by the name of the table or view in which it appears. The column-name must identify a column of the specified table or view that exists at the current server.

TEXT

Indicates that OS/400 column text is specified. If TEXT is omitted, a column heading is specified.

PACKAGE

Indicates that the label is for a package. Labels on packages are implemented as AS/400 object text.

package-name

Identifies the package to which the label applies. The name must identify a package that exists at the current server.

TABLE

Indicates that the label is for a table or a view. Labels on tables or views are implemented as AS/400 object text.

table-name or *view-name*

Identifies the table or view on which you want to add a label. The *table-name* or *view-name* must identify a table or view that exists at the current server.

IS

Introduces the label you want to provide.

string-constant

Can be any SQL character-string constant of up to either 50 bytes in length for tables, views, aliases, SQL packages, or column text, or 60 bytes in length for column headings. The constant may contain single-byte and double-byte characters.

The label for a column heading consists of three 20-byte segments. Interactive SQL, the Query/400 program, DB2 UDB Query Manager for AS/400, and other products can display or print each 20-byte segment on a separate line. If the label for a column contains mixed data, each 20-byte segment must be a valid mixed data character string. The shift characters must be paired within each 20-byte segment.

Notes

Column headings are used when displaying or printing query results. The first column heading is displayed or printed on the first line, the second column heading is displayed or printed on the second line, and the third column heading is displayed or printed on the third line. The column headings can be up to 60 bytes in length, where the first 20 bytes is the first column heading, the second 20 bytes is the second column heading, and the third 20 bytes is the third column heading. Blanks are trimmed from the end of each 20-byte column heading.

All 60 bytes of column heading information are available in the catalog view SYSCOLUMNS; however, only the first column heading is returned in an SQLDA on a DESCRIBE or DESCRIBE TABLE statement.

Column text is not returned on a DESCRIBE or DESCRIBE TABLE statement. When the database manager changes the column heading information in a record format description that is shared, the change is reflected in all files sharing the format description. To find out if a file shares a format with another file, use the RCDFMT parameter on the CL command, Display Database Relations (DSPDBR).

Examples

- Enter a label on the DEPTNO column of table CORPDATA.DEPARTMENT.

```
LABEL ON COLUMN CORPDATA.DEPARTMENT.DEPTNO
  IS 'DEPARTMENT NUMBER'
```

- Enter a label on the DEPTNO column of table CORPDATA.DEPARTMENT where the column heading is shown on two separate lines.

```
LABEL ON COLUMN CORPDATA.DEPARTMENT.DEPTNO
  IS 'Department          Number'
```

- Enter a label on the PAYROLL package.

```
LABEL ON PACKAGE CORPDATA.PAYROLL
  IS 'Payroll Package'
```

LOCK TABLE

The LOCK TABLE statement either prevents concurrent application processes from changing a table or prevents concurrent application processes from using a table.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the table identified in the statement,
  - The system authority of *OBJOPR on the table, and
  - The system authority *EXECUTE on the library containing the table
- Administrative authority

Syntax

```
►►──LOCK TABLE──table-name──IN──┬─SHARE MODE────────────────┬────────────────────►◄
                                ├─EXCLUSIVE MODE ALLOW READ─┤
                                └─EXCLUSIVE MODE────────────┘
```

Description

table-name
: Identifies the table to be locked. The table-name must identify a base table that exists at the current server, but must not identify a catalog table.

IN SHARE MODE
Acquires a shared lock (*SHRNUP) for the application process in which the statement is executed. Until the lock is released, it prevents concurrent application processes from executing any but read-only operations on the table. Other application processes may also acquire a shared lock (*SHRNUP) and prevent this application process from executing any but read-only operations.

IN EXCLUSIVE MODE ALLOW READ
Acquires an exclusive allow read lock (*EXCLRD) for the application process in which the statement is executed. Until the lock is released, it prevents concurrent application processes from executing any but read-only operations on the table. Other application processes may not acquire a shared lock (*SHRNUP) and cannot prevent this application process from executing updates, deletes, and inserts on the table.

IN EXCLUSIVE MODE
Acquires an exclusive lock (*EXCL) for the application process in which the statement is executed. Until the lock is released, it prevents concurrent application processes from executing any operations at all on the table.

The lock is acquired when the LOCK TABLE statement is executed.

The lock is released:

- When the unit of work ends, unless the unit of work is ended by a COMMIT HOLD or ROLLBACK HOLD
- When the first SQL program in the program stack ends, unless CLOSQLCSR(*ENDJOB) or CLOSQLCSR(*ENDACTGRP) was specified on the CRTSQLxxx command
- When the activation group ends
- When the connection is changed using a CONNECT (Type 1) statement
- When the connection associated with the lock is disconnected using the DISCONNECT statement
- When the connection is in the release-pending state and a successful COMMIT occurs

You may also issue the Deallocate Object (DLCOBJ) command to unlock the table.

Because the statement is synchronous, conflicting locks already held by other application processes will cause your application to wait up to the default wait time.

Example

Obtain a lock on the DEPARTMENT table. Do not allow others to either update or read from DEPARTMENT while it is locked.

```
LOCK TABLE DEPARTMENT IN EXCLUSIVE MODE
```

OPEN

The OPEN statement opens a cursor.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

See “DECLARE CURSOR” on page 368 for the authorization required to use a cursor.

Syntax

```
►►──OPEN──cursor-name──┬─────────────────────────────────────┬──────────────►◄
                       │          ┌─,─────────────┐          │
                       │          ▼               │          │
                       ├─USING──────host-variable─┴──────────┤
                       └─USING DESCRIPTOR──descriptor-name───┘
```

Description

cursor-name

Identifies the cursor to be opened. The *cursor-name* must identify a declared cursor as explained in the Notes for the DECLARE CURSOR statement. When the OPEN statement is executed, the cursor must be in the closed state.

The SELECT statement associated with the cursor is either:

- The *select-statement* specified in the DECLARE CURSOR statement, or
- The prepared *select-statement* identified by the *statement-name* specified in the DECLARE CURSOR statement. If the statement has not been successfully prepared, or is not a *select-statement*, the cursor cannot be successfully opened.

The result table of the cursor is derived by evaluating the SELECT statement. The evaluation uses the current values of any special registers specified in the SELECT statement and the current values of any host variables specified in the SELECT statement or the USING clause of the OPEN statement. The rows of the result table can be derived during the execution of the OPEN statement and a temporary table can be created to hold them; or they can be derived during the execution of subsequent FETCH statements. In either case, the cursor is placed in the open state and positioned before the first row of its result table. If the table is empty the position of the cursor is effectively “after the last row.”

USING

Introduces a list of host variables whose values are substituted for the parameter markers (question marks) of a prepared statement. For an explanation of parameter markers, see “PREPARE” on page 453. If the DECLARE CURSOR statement names a prepared statement that includes parameter markers, you must use USING. If the prepared statement does not include parameter markers, USING is ignored.

host-variable,...

Identifies host structures or host variables that must be declared in the program in accordance with the rules for declaring host structures and host variables. A reference to a host structure is replaced by a reference to each of its variables. The number of variables must be the same as the number of parameter markers in the prepared statement. The *n*th variable corresponds to the *n*th parameter marker in the prepared statement.

DESCRIPTOR *descriptor-name*

Identifies an SQLDA that must contain a valid description of host variables.

Before the OPEN statement is processed, the user must set the following fields in the SQLDA. (The rules for REXX are different. For more information see the SQL Programming with Host Languages book.)

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA
- SQLDABC to indicate the number of bytes of storage allocated for the SQLDA
- SQLD to indicate the number of variables used in the SQLDA when processing the statement
- SQLVAR occurrences to indicate the attributes of the variables

The SQLDA must have enough storage to contain all SQLVAR occurrences. Therefore, the value in SQLDABC must be greater than or equal to 16 + SQLN*(80), where 80 is the length of an SQLVAR occurrence. If LOBs or distinct types are specified, there must be two SQLVAR entries for each parameter marker and SQLN must be set to two times the number of parameter markers.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN. It must be the same as the number of parameter markers in the prepared statement. The *n*th variable described by the SQLDA corresponds to the *n*th parameter marker in the prepared statement. For a description of an SQLDA, see "Appendix C. SQL Descriptor Area (SQLDA)" on page 551.

Note that because RPG/400 does not provide the facility for setting pointers and the SQLDA uses pointers to locate the appropriate host variables, you will have to set these pointers outside your RPG/400 application.

Parameter Marker Replacement

When the SELECT statement of the cursor is evaluated, each parameter marker in the statement is effectively replaced by its corresponding host variable. With the exception of the LIKE predicate, the replacement of a parameter marker is an assignment operation in which the source is the value of the host variable, and the target is a variable within the database manager. The attributes of the target variable are determined as follows:

- If the parameter marker was specified as the operand of an arithmetic operator, the data type, scale, and precision of the target are the same as the other operand of that operator.
- If the parameter marker was specified as a comparison operand in any predicate other than the BETWEEN, IN, or LIKE predicates, the attributes of the target are the same as the other operand of the predicate, unless the data type of that operand is DATE, TIME, or TIMESTAMP, in which case, the target is effectively character with a length attribute of 32766.
- If the parameter marker was specified as a comparison operand in a BETWEEN or IN predicate, the attributes of the target are assigned as follows:
  - If only one operand is not a parameter marker, the attributes of the target are the attributes of the operand.

  - If more than one operand is not a parameter marker, the attributes of the target are those that would result if those operands were specified in a VALUE scalar function, except the CCSID attribute is the CCSID of its corresponding host variable.
- If the parameter marker was specified as the pattern or ESCAPE character of a LIKE predicate, the host variable used to replace the parameter marker must be compatible with the first operand.

  If the parameter marker was specified as the pattern, the data type of the target is VARCHAR (if the first operand is CHAR or VARCHAR) or VARGRAPHIC (if the first operand is GRAPHIC or VARGRAPHIC). The length attribute of the target is the same as that of the first operand.

  If the parameter marker was specified as the ESCAPE character, the length attribute of the target is 1.

  Note:

  When the pattern specified in a LIKE predicate is a parameter marker, and a fixed-length character host variable is used to replace the parameter marker; specify a value for the host variable that is the correct length. If you do not specify the correct length, the select will not return the intended results.

  For example, if the host variable is defined as CHAR(10), and the value WYSE% is assigned to that host variable, the host variable is padded with blanks on assignment. The pattern used is

  ```
  'WYSE%     '
  ```

  This pattern requests the database manager to search for all values that start with WYSE and end with five blank spaces. If you intended to search for only the values that start with ’WYSE’ you should assign the value ’WSYE%%%%%%’ to the host variable.
- If the parameter marker was specified as an operand in a VALUE, COALESCE, IFNULL, MIN, MAX, LAND, LOR, or XOR scalar function, the attributes of the target are assigned as follows:
  - If only one operand is not a parameter marker, the attributes of the target are the attributes of the operand.
  - If more than one operand is not a parameter marker, the attributes of the target are those that would result if the parameter markers were removed from the scalar function.

Let V denote a host variable that corresponds to parameter marker P. The value of V is assigned to the target variable for P in accordance with the rules for assigning a value to a column. Thus:

- V must be compatible with the target.
- If V is a number, the absolute value of its integral part must not be greater than the maximum absolute value of the integral part of the target.
- If the attributes of V are not identical to the attributes of the target, the value is converted to conform to the attributes of the target.
- If the target cannot contain nulls, the value of V must not be null.

However, unlike the rules for assigning a value to a column:

- If V is a string, the value will be truncated (without an error), if its length is greater than the length attribute of the target.

When the SELECT statement of the cursor is evaluated, the value used in place of P is the value of the target variable for P. For example, if V is CHAR(6), and the target is CHAR(8), the value used in place of P is the value of V padded with two blanks.

The USING clause is intended for a prepared SELECT statement that contains parameter markers. However, it can also be used when the SELECT statement of the cursor is part of the DECLARE CURSOR statement. In this case the OPEN statement is executed as if each host variable in the SELECT statement were a parameter marker, except that the attributes of the target variables are the same as the attributes of the host variables in the SELECT statement. The effect is to override the values of the host variables in the SELECT statement of the cursor with the values of the host variables specified in the USING clause.

Notes

Closed state of cursors

All cursors in a program are in the closed state when:

- The program is called:
  - If CLOSQLCSR(*ENDPGM) is specified, all cursors are in the closed state each time the program is called.
  - If CLOSQLCSR(*ENDSQL) is specified, all cursors are in the closed state only the first time the program is called as long as one SQL program remains on the call stack.
  - If CLOSQLCSR(*ENDJOB) is specified, all cursors are in the closed state only the first time the program is called as long as the job remains active.
  - If CLOSQLCSR(*ENDMOD) is specified, all cursors are in the closed state each time the module is initiated.
  - If CLOSQLCSR(*ENDACTGRP) is specified, all cursors are in the closed state only the first time the module in the program is initiated in the activation group.
- A program starts a new unit of work by executing a COMMIT or ROLLBACK statement without a HOLD option. Cursors declared with the HOLD option are not closed by a COMMIT statement.
- A CONNECT (Type 1) statement was executed.

A cursor can also be in the closed state because:

- A CLOSE statement was executed.
- A DISCONNECT statement disconnected the connection with which the cursor was associated.
- The connection with which the cursor was associated was in the release-pending state and a successful COMMIT occurred.

You must execute a FETCH statement when the cursor is open to retrieve rows from the result table of a cursor. The only way to change the state of a cursor from closed to open is to execute an OPEN statement.

Effect of temporary tables

If the result table of a cursor is not read-only, its rows are derived during the execution of subsequent FETCH statements. The same method may be used for a read-only result table. However, if a result table is read-only, DB2 UDB for AS/400 may choose to use the temporary table method instead. With this method the entire result table is inserted into a temporary table during the execution of the OPEN statement. When a temporary table is used, the results of a program can differ in these two ways:

- An error can occur during OPEN that would otherwise not occur until some later FETCH statement.
- The INSERT, UPDATE, and DELETE statements that are executed while the cursor is open cannot affect the result table.

Conversely, if a temporary table is not used, INSERT, UPDATE, and DELETE statements executed while the cursor is open can affect the result table. The effect of such operations is not always predictable. For example, if cursor C is positioned on a row of its result table defined as SELECT * FROM T, and you insert a row into T, the effect of that insert on the result table is not predictable because its rows are not ordered. A subsequent FETCH C might or might not retrieve the new row of T.

Examples

Example 1

Write the embedded statements in a COBOL program that will:

1. Define a cursor C1 that is to be used to retrieve all rows from the DEPARTMENT table for departments that are administered by (ADMRDEPT) department ‘A00’
2. Place the cursor C1 before the first row to be fetched.

```
EXEC SQL  DECLARE C1 CURSOR FOR
           SELECT DEPTNO, DEPTNAME, MGRNO FROM DEPARTMENT
              WHERE ADMRDEPT = 'A00'  END-EXEC.

EXEC SQL  OPEN C1  END-EXEC.
```

Example 2

Code an OPEN statement to associate a cursor DYN_CURSOR with a dynamically defined select-statement in a PL/I program. Assume each prepared select-statement always defines two items in its select list with the first item having a data type of integer and the second item having a data type of varchar(64). (The related host variable definitions, PREPARE statement, and DECLARE CURSOR statement are also shown in the example below.)

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  HV_INT      BINARY    FIXED(31);
  DCL  HV_VCHAR64  CHAR(64)  VARYING;
  DCL  STMT1_STR   CHAR(200)  VARYING;
EXEC SQL  END DECLARE SECTION;

EXEC SQL  PREPARE STMT1_NAME FROM :STMT1_STR;

EXEC SQL  DECLARE DYN_CURSOR CURSOR FOR STMT1_NAME;

EXEC SQL  OPEN DYN_CURSOR USING :HV_INT, :HV_VCHAR64;
```

Example 3

Code an OPEN statement as in example 3, but in this case the number and data types of the items in the select statement are not known.

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  STMT1_STR   CHAR(200)  VARYING;
EXEC SQL  END DECLARE SECTION;
EXEC SQL  INCLUDE SQLDA;

EXEC SQL  PREPARE STMT1_NAME FROM :STMT1_STR;
EXEC SQL  DECLARE DYN_CURSOR CURSOR FOR STMT1_NAME;

EXEC SQL  OPEN DYN_CURSOR USING DESCRIPTOR :SQLDA;
```

PREPARE

The PREPARE statement creates an executable form of an SQL statement from a character-string form of the statement. The character-string form is called a *statement string*, and the executable form is called a *prepared statement*.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

The authorization rules are the same as those defined for the SQL statement specified by the PREPARE statement. For example, see "select-statement" on page 233 for the authorization rules that apply when a SELECT statement is prepared.

If DLYPRP(*NO) is specified on the CRTSQLxxx command, the authorization checking is performed when the statement is prepared, except:

- If a DROP COLLECTION statement is prepared, the system authority *OBJEXIST on all objects in the collection is not checked until the statement is executed.
- If a DROP TABLE statement is prepared, the system authority *OBJEXIST on all views, indexes, and logical files that reference the table is not checked until the statement is executed.
- If a DROP VIEW statement is prepared, the system authority of *OBJEXIST on all views that reference the view is not checked until the statement is executed.

If DLYPRP(*YES) is specified on the CRTSQLxxx command, all authorization checking is deferred until the statement is executed or used in an OPEN statement.

The authorization ID of the statement is the run-time authorization ID unless DYNUSRPRF(*OWNER) was specified on the CRTSQLxxx command when the program was created. For more information, see "Authorization IDs and Authorization-Names" on page 48.

Syntax

```
►►──PREPARE──statement-name──────────────────────────────────────────────►

►──┬─────────────────────────────────────────────────┬──FROM─────────────►
   └─INTO──descriptor-name──┬──────────────────────┬─┘
                            └─USING──┬─NAMES────────┤
                                     ├─SYSTEM NAMES─┤
                                     ├─LABELS───────┤
                                     ├─ANY──────────┤
                                     ├─BOTH─────────┤
                                     └─ALL──────────┘
```

```
►──┬─string-expression─┬─────────────────────────────────────────►◄
   └─host-variable─────┘
```

Description

statement-name
Names the prepared statement. If the name identifies an existing prepared statement, that prepared statement is destroyed if:

- it was prepared in the same instance of the same program, or
- CLOSQLCSR(*ENDJOB), CLOSQLCSR(*ENDACTGRP), or CLOSQLCSR(*ENDSQL) are specified on the CRTSQLxxx commands associated with both prepared statements.

The name must not identify a prepared statement that is the SELECT statement of an open cursor of this instance of the program.

INTO *descriptor-name*
Identifies an SQL descriptor area (SQLDA), which is described in "Appendix C. SQL Descriptor Area (SQLDA)" on page 551. Before the PREPARE statement is executed, the following variable in the SQLDA must be set:

SQLN
Indicates the number of variables represented by SQLVAR. (SQLN provides the dimension of the SQLVAR array.) SQLN must be set to a value greater than or equal to zero before the PREPARE statement is executed. For information on techniques to determine the number of occurrences requires, see "Determining How Many SQLVAR Occurrences are Needed" on page 554.

If you use INTO, and the PREPARE statement is successfully executed, information about the prepared statement is placed in the SQLDA specified by the descriptor-name. Thus, the PREPARE statement:

```
EXEC SQL PREPARE S1 INTO :SQLDA FROM :V1;
```

is equivalent to:

```
EXEC SQL PREPARE S1 FROM :V1;
EXEC SQL DESCRIBE S1 INTO :SQLDA;
```

See "DESCRIBE" on page 389 for an explanation of the information that is placed in the SQLDA.

USING
Indicates what value to assign to each SQLNAME variable in the SQLDA. If the requested value does not exist, SQLNAME is set to length 0.

NAMES
Assigns the name of the column. This is the default. For a prepared statement where the names are explicitly specified in the select-list, the name specified is returned.

SYSTEM NAMES
Assigns the system column name of the column.

LABELS
Assigns the label of the column. (Column labels are defined by the LABEL ON statement.) Only the first 20 bytes of the label are returned.

ANY
Assigns the column label. If the column has no label, the label is the column name.

BOTH
Assigns both the label and name of the column. In this case, two or three occurrences of SQLVAR per column, depending on whether the result set contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to 2**n* or 3**n*(where *n* is the number of columns in the table or view). The first *n* occurrences of SQLVAR contain the column names. Either the second or third *n* occurrences contain the column labels. If there are no distinct types, the labels are returned in the second set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries.

If the same SQLDA is used on a subsequent FETCH statement, set SQLN to *n* after the PREPARE is complete.

ALL
Assigns the label, column name, and system column name. In this case three or four occurrences of SQLVAR per column, depending on whether the result set contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to 3**n* or 4**n* (where *n* is the number of columns in the result table). The first *n* occurrences of SQLVAR contain the system column names. The second or third *n* occurrences contain the column labels. The third or fourth *n* occurrences contain the column names. If there are no distinct types, the labels are returned in the second set of SQLVAR entries and the column names are returned in the third set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries and the column names are returned in the fourth set of SQLVAR entries.

If the same SQLDA is used on a subsequent FETCH statement, set SQLN to *n* after the PREPARE is complete.

FROM
Specifies the statement string. The statement string is the value of the specified *string-expression* or the identified *host-variable*.

string-expression
A *string-expression* is any PL/I *string-expression* that yields a character string. SQL expressions that yield a character string are not allowed. A *string-expression* is only allowed in PL/I.

host-variable
Identifies a host variable that is declared in the program in accordance with the rules for declaring character-string or UCS-2 graphic host variables. An indicator variable must not be specified.

The statement string must be one of the following SQL statements:

ALTER TABLE
CALL
COMMENT ON
COMMIT
CREATE ALIAS
CREATE COLLECTION
CREATE DISTINCT TYPE
CREATE PROCEDURE
CREATE TABLE
CREATE VIEW
DELETE
DROP
FREE LOCATOR
GRANT
LOCK TABLE
RENAME
REVOKE
ROLLBACK
select-statement
SET PATH
SET TRANSACTION

CREATE FUNCTION
CREATE INDEX
INSERT
LABEL ON
UPDATE

The statement string must not:

- Begin with EXEC SQL and end with END-EXEC or a semicolon (;).
- Include references to host variables.
- Include comments.

Parameter markers

Although a statement string cannot include references to host variables, it may include *parameter markers*. These can be replaced by the values of host variables when the prepared statement is executed. A parameter marker is a question mark (?) that is used where a host variable could be used if the statement string were a static SQL statement. For an explanation of how parameter markers are replaced by values, see "OPEN" on page 447 and "EXECUTE" on page 407.

Rules for parameter markers:

- Parameter markers must not be used:
  - In a select list (SELECT ? is not valid) unless it is in a subquery.
  - As an operand of the concatenation operator.
  - As both operands of a single arithmetic or comparison operator. For example, 'WHERE ? = ?' or 'WHERE ? = (SELECT ? ...)' are both not valid.
  - As an operand of a unary minus.
  - As an operand in a datetime arithmetic expression.
  - As the operand of a comparison operator where the other operand is a user-defined type.
- At least one of the operands of the BETWEEN or IN predicates must *not* be a parameter marker.
- An argument of a scalar function or user-defined function cannot be specified solely as a parameter marker. For example, INTEGER(?) is not valid.
- The first argument of the VALUE, COALESCE, MIN, MAX, LAND, LOR, and XOR scalar functions cannot be specified as a parameter marker. The first expression of the LIKE predicate must not be a parameter marker.
- If a scalar function has an argument that can be specified as an arithmetic expression, a parameter marker can be included in that expression, provided that it is the operand of an arithmetic operator and that the other operand is a number.
- A parameter marker can be used if it is assigned attributes using a CAST specification. For more information, refer to "CAST Specification" on page 117.

Notes

The scope of statement-name is the source program in which it is defined. You can only reference a prepared statement by other SQL statements that are precompiled with the PREPARE statement. For example, a program called from another separately compiled program cannot use a prepared statement that was created by the calling program.

The scope of statement-name is also limited to the thread in which the program that contains the statement is running. For example, if the same program is running in two separate threads in the same job, the second thread cannot use a statement that was prepared by the first thread.

Although the scope of a statement is the program in which it is defined, each package created from the program includes a separate instance of the prepared statement and more than one prepared statement can exist at run time. For example, assume a program using CONNECT (Type 2) statements connects to location X and location Y in the following sequence:

```
EXEC SQL CONNECT TO X;
EXEC SQL PREPARE S FROM :hv1;
EXEC SQL EXECUTE S;
.
.
.
EXEC SQL CONNECT TO Y;
EXEC SQL PREPARE S FROM :hv1;
EXEC SQL EXECUTE S;
```

The second prepare of S prepares another instance of S at Y.

When a PREPARE statement is executed, the statement string is parsed and checked for errors. If the statement string is invalid, a prepared statement is not created and the error condition that prevents its creation is reported in the SQLCA.

Prepared statements can be referred to in the following kinds of statements, with the following restrictions shown:

Statement	The prepared statement restrictions
DESCRIBE	None
DECLARE CURSOR	Must be SELECT when the cursor is opened
EXECUTE	Must not be SELECT

A prepared statement can be executed many times. If a prepared statement is not executed more than once and does not contain parameter markers, it is more efficient to use the EXECUTE IMMEDIATE statement rather than the PREPARE and EXECUTE statements.

A prepared statement can only be referenced in the same instance of the program in the program stack, unless CLOSQLCSR(*ENDJOB), CLOSQLCSR(*ENDACTGRP), or CLOSQLCSR(*ENDSQL) is specified on the CRTSQLxxx commands.

- If CLOSQLCSR(*ENDJOB) is specified, the prepared statement can be referred to by any instance of the program (that prepared the statement) on the program stack. In this case, the prepared statement is destroyed at the end of the job.
- If CLOSQLCSR(*ENDSQL) is specified, the prepared statement can be referred to by any instance of the program (that prepared the statement) on the program stack until the last SQL program on the program stack ends. In this case, the prepared statement is destroyed when the last SQL program on the program stack ends.
- If CLOSQLCSR(*ENDACTGRP) is specified, the prepared statement can be referred to by all instances of the module in the program that prepared the statement until the activation group ends. In this case, the prepared statement is destroyed when the activation group ends.

Prepared statements are also destroyed when:

- A CONNECT (Type 1) statement is executed.
- A DISCONNECT statement disconnects the connection with which the prepared statement is associated.
- A prepared statement is associated with a release-pending connection and a successful commit occurs.

Examples

Example 1

Prepare and execute a non-select-statement in a COBOL program. Assume the statement is contained in a host variable HOLDER and that the program will place a statement string into the host variable based on some instructions from the user. The statement to be prepared does not have any parameter markers.

```
EXEC SQL  PREPARE STMT_NAME FROM :HOLDER  END-EXEC.

EXEC SQL  EXECUTE STMT_NAME  END-EXEC.
```

Example 2

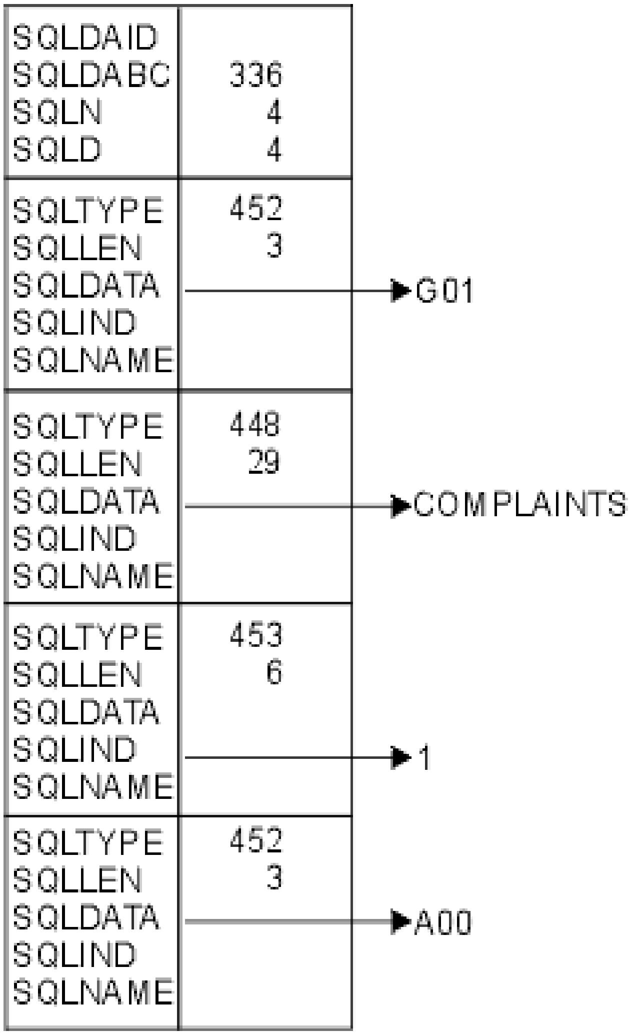
Prepare and execute a non-select-statement as in example 1, except code it for a PL/I program. Also assume the statement to be prepared can contain any number of parameter markers.

```
EXEC SQL  PREPARE STMT_NAME FROM :HOLDER;

EXEC SQL  EXECUTE STMT_NAME USING DESCRIPTOR :INSERT_DA;
```

Assume that the following statement is to be prepared:

```
INSERT INTO DEPARTMENT VALUES(?, ?, ?, ?)
```

To insert department number G01 named COMPLAINTS, which has no manager and reports to department A00, the structure INSERT_DA should have the following values before executing the EXECUTE statement.



RELEASE

The RELEASE statement places one or more connections in the release-pending state.

Invocation

This statement can only be embedded within an application program or issued interactively. It is an executable statement that cannot be dynamically prepared. It must not be specified in REXX.

RELEASE is not allowed in a trigger program. RELEASE is not allowed in an external procedure if the external procedure is called on a remote application server.

Authorization

None required.

Syntax

```
►►──RELEASE──┬─server-name───┬──────────────────────────────────────────►◄
             ├─host-variable─┤
             ├─CURRENT───────┤
             │     ┌─SQL─┐   │
             └─ALL─┴─────┴───┘
```

Description

server-name or *host-variable*
Identifies the application server by the specified server name or the server name contained in the host variable. If a host variable is specified:

- It must be a character-string variable.
- It must not be followed by an indicator variable.
- The server name must be left-justified within the host variable and must conform to the rules for forming an ordinary identifier.
- If the length of the server name is less than the length of the host variable, it must be padded on the right with blanks.

When the RELEASE statement is executed, the specified server name or the server name contained in the host variable must identify an existing connection of the activation group.

CURRENT
Identifies the current connection of the activation group. The activation group must be in the connected state.

ALL or **ALL SQL**
Identifies all existing connections of the activation group (local as well as remote connections).

An error or warning does not occur if no connections exist when the statement is executed.

If the RELEASE statement is successful, each identified connection is placed in the release-pending state and will therefore be ended during the next commit operation. If the RELEASE statement is unsuccessful, the connection state of the activation group and the states of its connections are unchanged.

Notes

Using CONNECT (Type 1) semantics does not prevent using RELEASE.

RELEASE does not close cursors, does not release any resources, and does not prevent further use of the connection.

ROLLBACK does not reset the state of a connection from release-pending to held.

Resources are required to create and maintain remote connections. Thus, a remote connection that is not going to be reused should be in the release-pending state and one that is going to be reused should not be in the release-pending state.

If the current connection is in the release-pending state when a commit operation is performed, the connection is ended and the activation group is in the unconnected state. In this case, the next executed SQL statement must be CONNECT or SET CONNECTION.

RELEASE ALL places the connection to the local application server in the release-pending state. A connection in the release-pending state is ended during a commit operation even though it has an open cursor defined with WITH HOLD.

Examples

Example 1: The connection to TOROLAB1 is not needed in the next unit of work. The following statement will cause it to be ended during the next commit operation.

```
EXEC SQL RELEASE TOROLAB1;
```

Example 2: The current connection is not needed in the next unit of work. The following statement will cause it to be ended during the next commit operation.

```
EXEC SQL RELEASE CURRENT;
```

Example 3: None of the existing connections are needed in the next unit of work. The following statement will cause it to be ended during the next commit operation.

```
EXEC SQL RELEASE ALL;
```

RENAME

| The RENAME statement renames a table, view, or index. The name and/or the
| system object name of the table, view, or index can be changed.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- The following system authorities:
  - If the name of the object is changed:
    - The system authority of *OBJMGT on the table, view, or index to be renamed
    - The system authority *EXECUTE on the library containing the table, view, or index to be renamed
  - If the system name of the object is changed:
    - The system authority of *OBJMGT on the table, view, or index to be renamed
    - The system authorities *EXECUTE and *UPD on the library containing the table, view, or index to be renamed
- Administrative authority

Syntax

```
                 ┌─TABLE─┐
►►──RENAME───────┼───────┴──┬─table-name─┬──┬──────────────────────────────────────────►
                 │          └─view-name──┘  │
                 └─INDEX──index-name────────┘

►─TO────┬─name──┬────────────────────────────────────┬─┬──────────────────────────►◄
        │       └─FOR SYSTEM NAME──system-object-name─┘ │
        └─SYSTEM NAME──system-object-name───────────────┘
```

Description

TABLE *table-name* or *view-name*

Identifies the table or view that will be renamed. The *table-name* or *view-name* must identify a table or view that exists at the current server, but must not identify a catalog table or catalog view. The specified name can be an alias name. The specified table or view is renamed to the new name. All privileges, constraints, indexes, triggers, views, and logical files on the table or view are preserved.

Any access plans that reference the table or view are implicitly prepared again when a program that uses the access plan is next run. Since the program refers to a table or view with the original name, if a table or view with the original name does not exist at that time, a negative value will be returned in the SQLCODE field of the SQLCA.

INDEX *index-name*

Identifies the index that will be renamed. The *index-name* must identify an index that exists at the current server. The specified index is renamed to the new name.

Any access plans that reference the index are not affected by rename.

name

Identifies the new *table-name*, *view-name*, or *index-name* of the table, view, or index, respectively. *name* must not be the same as a table, view, alias, or index that already exists at the current server. The *name* must be an unqualified SQL identifier.

SYSTEM NAME *system-object-name*

Identifies the new *system-object-name* of the table, view, or index, respectively. *system-object-name* must not be the same as a table, view, alias, or index that already exists at the current server. The *system-object-name* must be an unqualified system identifier.

If the name of the object and the system name of the object are the same and *name* is not specified, specifying *system-object-name* will be the new name and system object name. Otherwise, specifying *system-object-name* will only affect the system name of the object and not affect the name of the object.

If both *name* and *system-object-name* are specifyied, they cannot both be valid system object names.

Notes

The rename operation performed depends on the new name specified.

- If the new name is a valid system identifier,
  - the alternative name (if any) is removed, and
  - the system object name is changed to the new name.
- If the new name is not a valid system identifier,
  - the alternative name is added or changed to the new name, and
  - a new system object name is generated if the system object name (of the table or view) was specified as the table, view, or index to rename. For more information on generated table name rules, see "Rules for Table Name Generation" on page 361.

If an alias name is specified, the table or view that is identified by the alias is renamed. The alias is not changed and continues to refer to the old table or view name.

Examples

Example 1

Rename a table named MY_IN_TRAY to MY_IN_TRAY_94. The system object name will remain unchanged (MY_IN_TRAY).

```
RENAME TABLE MY_IN_TRAY TO MY_IN_TRAY_94
  FOR SYSTEM NAME MY_IN_TRAY
```

Example 2

Rename a table named MA_PROJ to MA_PROJ_94.

```
RENAME TABLE MA_PROJ
  TO SYSTEM NAME MA_PROJ_94
```

REVOKE (Function or Procedure Privileges)

This form of the REVOKE statement removes the privileges on a function or procedure.

Invocation

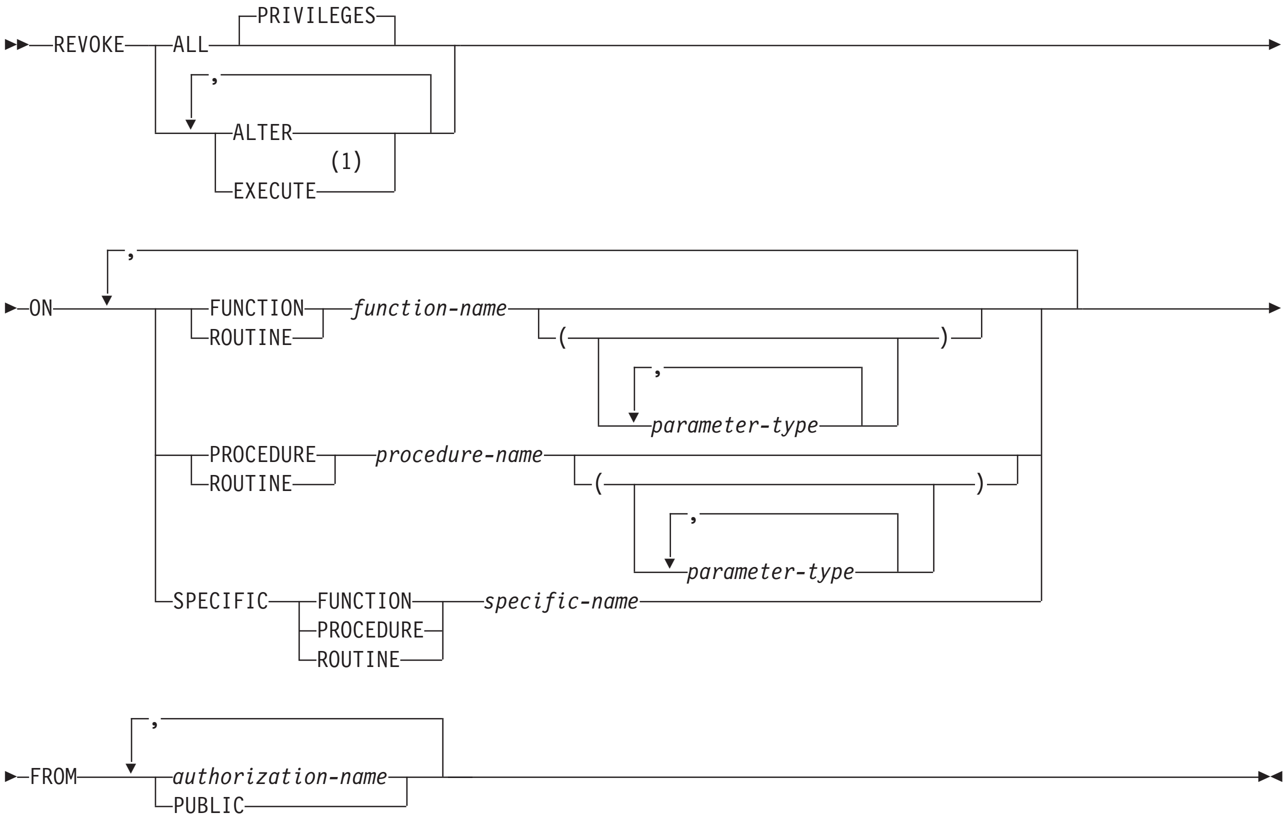
This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For each function or procedure identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the function or procedure
  - The system authority *EXECUTE on the library containing the function or procedure
- Administrative authority

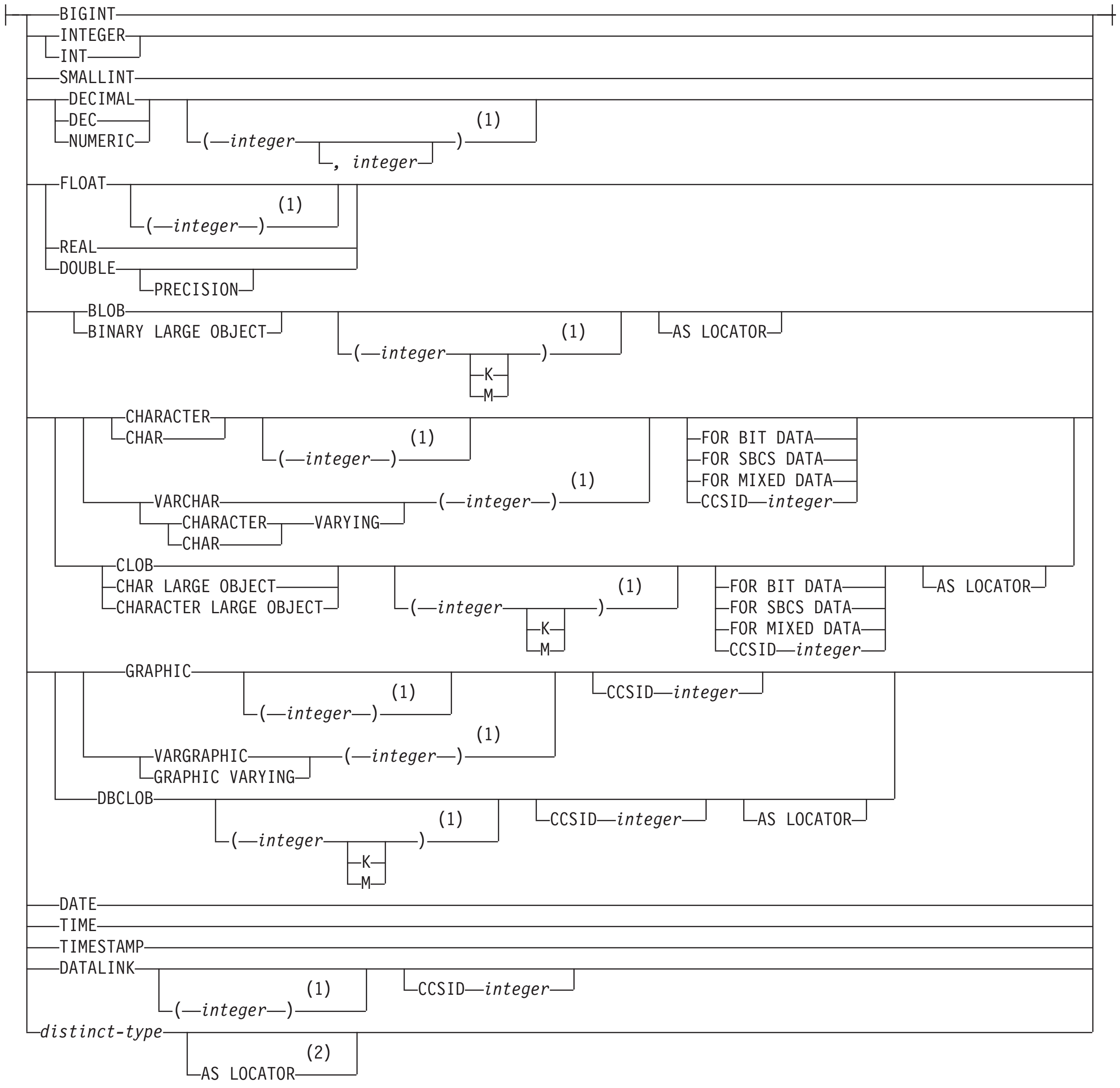
Syntax



Notes:

1 The keyword RUN can be used as a synonym for EXECUTE.

parameter-type:



Notes:

1 The values that are specified for length, precision, or scale attributes must match the values that were specified when the function was created. Coding specific values is optional. Empty parentheses, (), can be used instead to indicate that DB2 ignores the attributes when determining whether data types match.

2 AS LOCATOR can be specified only for distinct type based on a LOB data type.

Description

ALL or **ALL PRIVILEGES**
Revokes one or more function or procedure privileges from each *authorization-name*. The privileges revoked are those privileges on the identified

functions or procedures that were granted to the *authorization-names*. Note that revoking ALL PRIVILEGES on a function or procedure is not the same as revoking the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword revokes the privilege described.

ALTER
Revokes the privilege to use the COMMENT ON statement.

EXECUTE
Revokes the privilege to execute a function or procedure.

FUNCTION
Identifies the function to which you are revoking the privilege. You can identify the particular function by its name, function signature, or specific name. The rules for function resolution (and the path) are not used.

FUNCTION *function-name*
The *function-name* must identify exactly one function that exists at the current server. The function may have any number of parameters defined for it. If there is more than one function of the specified name in the specified or implicit collection, an error is returned.

FUNCTION *function-name (parameter-type, ...)*
The *function-name (parameter-type, ...)* must identify a function with the specified function signature that exists at the current server. The specified parameters must match the data types that were specified on the CREATE FUNCTION statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance which is to be revoked. If *function-name ()* is specified, the function identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision, or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. For more information on the default attributes see “CREATE TABLE” on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

SPECIFIC FUNCTION *specific-name*
The *specific-name* must identify a specific function that exists at the current server.

PROCEDURE

Identifies the procedure to which you are revoking the privilege. You can identify the particular procedure by its name, procedure signature, or specific name. The rules for procedure resolution (and the path) are not used.

PROCEDURE *procedure-name*

The *procedure-name* must identify exactly one procedure that exists at the current server. The procedure may have any number of parameters defined for it. If there is more than one procedure of the specified name in the specified or implicit collection, an error is returned.

PROCEDURE *procedure-name (parameter-type, ...)*

The *procedure-name (parameter-type, ...)* must identify a procedure with the specified procedure signature that exists at the current server. The specified parameters must match the data types that were specified on the CREATE PROCEDURE statement in the corresponding position. The number of data types, and the logical concatenation of the data types is used to identify the specific procedure instance which is to be revoked. If *procedure-name ()* is specified, the procedure identified must have zero parameters.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the collection name for the distinct type.

For data types that have a length, precision, or scale attribute, you can specify a value or use a set of empty parentheses.

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match.
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE PROCEDURE statement.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. For more information on the default attributes see “CREATE TABLE” on page 340.

For data types with a subtype or CCSID attribute, specifying the FOR DATA clause or CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE PROCEDURE statement.

SPECIFIC PROCEDURE *specific-name*

The *specific-name* must identify a specific procedure that exists at the current server.

FROM

Identifies from whom the privileges are revoked.

authorization-name,...

Lists one or more authorization IDs. Do not specify the same *authorization-name* more than once.

PUBLIC

Revokes the specified privileges from PUBLIC.

Notes

If you revoke a privilege on a function or procedure, it nullifies any grant of the privilege on that function or procedure, regardless of who granted it.

Privileges revoked from either an SQL or external function or procedure are revoked from its associated program (*PGM) or service program (*SRVPGM) object.

When a function or procedure privilege is revoked, the corresponding AS/400 system authorities are revoked. For information on the AS/400 system authorities that correspond to SQL privileges see “GRANT (Function or Procedure Privileges)” on page 422.

Example

Revoke the EXECUTE privilege on procedure CORPDATA.PROCA from PUBLIC.

```
REVOKE EXECUTE
  ON PROCEDURE CORPDATA.PROCA
  FROM PUBLIC
```

REVOKE (Package Privileges)

This form of the REVOKE statement removes the privileges on a package.

Invocation

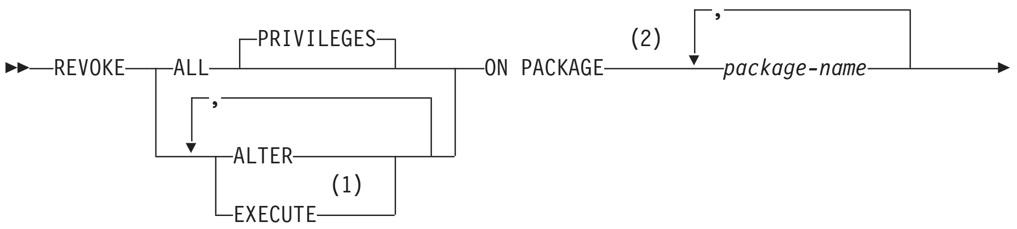
This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For each package identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the package
  - The system authority *EXECUTE on the library containing the package
- Administrative authority

Syntax



```
            ┌─,──────────────────┐
            ▼                    │
►─FROM──────┬─authorization-name─┬┴──────────────────────────────────────────►◄
            └─PUBLIC─────────────┘
```

Notes:

1 The keyword RUN can be used as a synonym for EXECUTE.

2 The keyword PROGRAM can be used as a synonym for PACKAGE.

Description

ALL or **ALL PRIVILEGES**
Revokes one or more package privileges from each *authorization-name*. The privileges revoked are those privileges on the identified packages that were granted to the *authorization-names*. Note that revoking ALL PRIVILEGES on a package is not the same as revoking the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword revokes the privilege described.

ALTER
Revokes the privilege to use the COMMENT ON and LABEL ON statements.

EXECUTE
Revokes the privilege to execute statements in a package.

ON PACKAGE *package-name*
Identifies the packages from which you are revoking privileges. The *package-name* must identify a package that exists at the current server.

FROM
Identifies from whom the privileges are revoked.

authorization-name,...
Lists one or more authorization IDs. Do not specify the same *authorization-name* more than once.

PUBLIC
Revokes the specified privileges from PUBLIC.

Notes

If you revoke a privilege on a package, it nullifies any grant of the privilege on that package, regardless of who granted it.

When a package privilege is revoked, the corresponding AS/400 system authorities are revoked. For information on the AS/400 system authorities that correspond to SQL privileges see “GRANT (Package Privileges)” on page 427.

Example

Revoke the EXECUTE privilege on package CORPDATA.PKGA from PUBLIC.

```
REVOKE EXECUTE
  ON PACKAGE CORPDATA.PKGA
  FROM PUBLIC
```

REVOKE (Table Privileges)

This form of the REVOKE statement removes privileges on a table or view.

Invocation

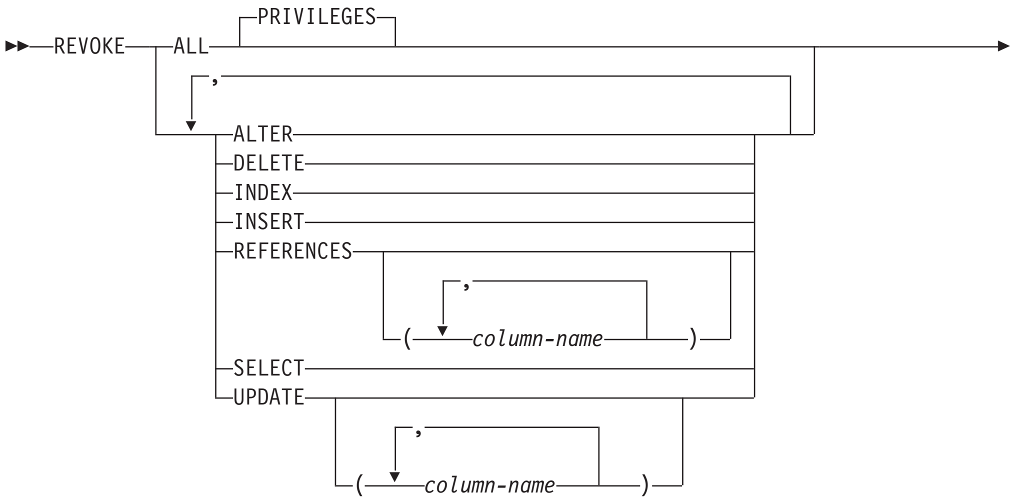
This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

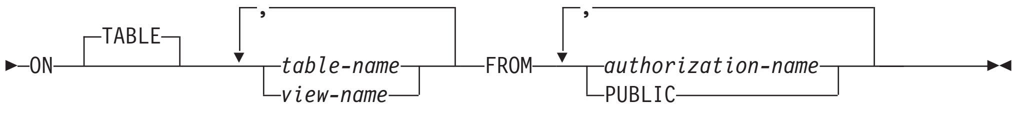
Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For each table or view identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the table or view
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

Syntax





Description

ALL or **ALL PRIVILEGES**

Revokes one or more privileges from each *authorization-name*. The privileges revoked are those privileges on the identified tables and views that were granted to the *authorization-names*. Note that revoking ALL PRIVILEGES on a table or view is not the same as revoking the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword revokes the privilege described, but only as it applies to the tables and views named in the ON clause.

ALTER
Revokes the privilege to use the ALTER TABLE statement on tables. Revokes the privilege to use the COMMENT ON and LABEL ON statements on tables and views.

DELETE
Revokes the privilege to use the DELETE statement.

INDEX
Revokes the privilege to use the CREATE INDEX statement.

INSERT
Revokes the privilege to use the INSERT statement.

REFERENCES
Revokes the privilege to add a referential constraint in which the table is a parent.

REFERENCES (*column-name***,...)**
Revokes the privilege to add a referential constraint using the specified column(s) in the parent key. Each column name must be an unqualified name that identifies a column in each table identified in the ON clause.

SELECT
Revokes the privilege to use the SELECT or CREATE VIEW statement.

UPDATE
Revokes the privilege to use the UPDATE statement.

UPDATE (*column-name***,...)**
Revokes the privilege to update the specified columns. Each column name must be an unqualified name that identifies a column in each table identified in the ON clause.

ON *table-name* or *view-name, ...*
Identifies the table or view on which you are revoking the privileges. The *table-name* or *view-name* must identify a table or view that exists at the current server.

FROM
Identifies from whom the privileges are revoked.

authorization-name,...
Lists one or more authorization IDs. Do not specify the same *authorization-name* more than once.

PUBLIC
Revokes the specified privileges from PUBLIC.

Notes

AS/400 system authorities

Revoking either the INDEX or ALTER privilege, revokes the AS/400 system authority *OBJALTER.

When a table or view privilege is revoked, the corresponding AS/400 system authorities are revoked, except:

- When revoking authorities to a table or view, *OBJOPR is revoked only when *ADD, *DLT, *READ, and *UPD have all been revoked.
- When revoking authorities to a view, authorities will not be revoked from any tables or views referenced in the subselect of the view definition.

If more than one system authority will be revoked with an SQL privilege, and any one of the authorities cannot be revoked, then a warning occurs and no authorities will be revoked for that privilege.

For information on the AS/400 system authorities that correspond to SQL privileges see "GRANT (Table Privileges)" on page 429.

Multiple Grants

If the same privilege is granted to the same user more than once, revoking that privilege from that user nullifies all those grants.

If you revoke a privilege, it nullifies any grant of that privilege, regardless of who granted it.

The only way to revoke the WITH GRANT OPTION is to revoke ALL.

Examples

Example 1

Revoke SELECT privileges on table CORPDATA.EMPLOYEE from user PULASKI.

```
REVOKE SELECT
  ON CORPDATA.EMPLOYEE
  FROM PULASKI
```

Example 2

Revoke update privileges on table CORPDATA.EMPLOYEE, previously granted to all local users. Note that grants to specific users are not affected.

```
REVOKE UPDATE
  ON CORPDATA.EMPLOYEE
  FROM PUBLIC
```

Example 3

Revoke all privileges on table CORPDATA.EMPLOYEE, from users KWAN and THOMPSON.

```
REVOKE ALL
  ON CORPDATA.EMPLOYEE
  FROM KWAN,THOMPSON
```

Example 4

Revoke the privilege to update column_1 in VIEW1 from FRED.

```
REVOKE UPDATE(column_1)
  ON VIEW1
  FROM FRED
```

REVOKE (User-Defined Type Privileges)

This form of the REVOKE statement removes the privileges on a user-defined type.

Invocation

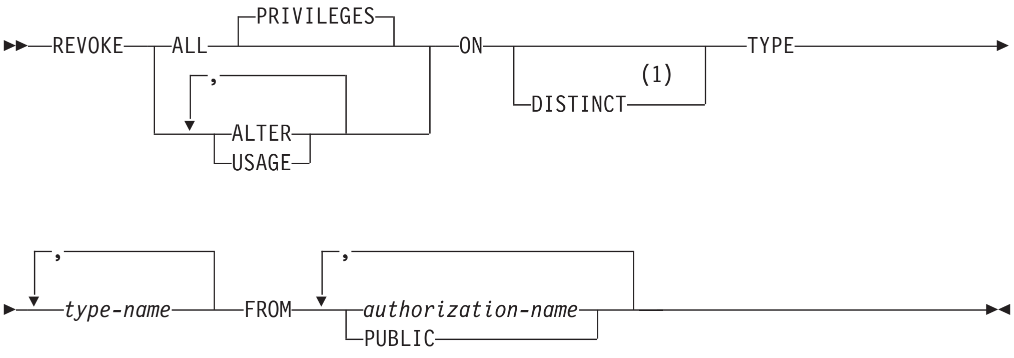
This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For each user-defined type identified in the statement:
  - Every privilege specified in the statement
  - The system authority of *OBJMGT on the user-defined type
  - The system authority *EXECUTE on the library containing the user-defined type
- Administrative authority

Syntax



Notes:

1 The keyword DATA can be used when revoking from any user-defined-type.

Description

ALL or **ALL PRIVILEGES**
Revokes one or more user-defined type privileges from each *authorization-name*. The privileges revoked are those privileges on the identified user-defined types that were granted to the *authorization-names*. Note that revoking ALL PRIVILEGES on a user-defined type is not the same as revoking the system authority of *ALL.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword revokes the privilege described.

ALTER
Revokes the privilege to use the COMMENT ON statement.

USAGE
Revokes the privilege to use user-defined types in tables, functions, procedures, or as the source type in a CREATE DISTINCT TYPE statement.

ON DISTINCT TYPE *type-name*
Identifies the user-defined types from which you are revoking privileges. The *type-name* must identify a user-defined type that exists at the current server.

FROM
Identifies from whom the privileges are revoked.

authorization-name,...
Lists one or more authorization IDs. Do not specify the same *authorization-name* more than once.

PUBLIC
Revokes the specified privileges from PUBLIC.

Notes

If you revoke a privilege on a user-defined type, it nullifies any grant of the privilege on that user-defined type, regardless of who granted it.

When a user-defined type privilege is revoked, the corresponding AS/400 system authorities are revoked. For information on the AS/400 system authorities that correspond to SQL privileges see "GRANT (User-Defined Type Privileges)" on page 434.

Example

Revoke the USAGE privilege on distinct type SHOESIZE from user JONES.

```
REVOKE USAGE
  ON DISTINCT TYPE SHOESIZE
  FROM JONES
```

ROLLBACK

The ROLLBACK statement is used to end a unit of work and to back out the database changes that were made by that unit of work.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

ROLLBACK is not allowed in a trigger program if the trigger program and the triggering program are run under the same commitment definition. ROLLBACK is not allowed in an external procedure if the external procedure and the program that issued the CALL statement run under the same commitment definition.

Authorization

None required.

Syntax

```
              ┌─WORK─┐
►►──ROLLBACK──┴──────┴──┬──────┬──────────────────────────────────►◄
                        └─HOLD─┘
```

Description

The ROLLBACK statement ends the unit of work in which it is executed and starts a new unit of work. All changes made by ALTER, CALL, COMMENT ON, CREATE, DELETE, DROP (except for DROP COLLECTION), GRANT, INSERT, LABEL ON, RENAME, REVOKE, and UPDATE statements executed during the unit of work are backed out.

WORK
ROLLBACK WORK has the same effect as ROLLBACK.

HOLD
Indicates a hold on resources. If specified, currently open cursors are not closed and all resources acquired during the unit of work, except locks on the rows of tables, are held. Locks on specific rows implicitly acquired during the unit of work, however, are released.

The following are true under this unit of work's commitment definition if HOLD is omitted:

- Cursors opened under this unit of work's commitment definition are closed.
- Table locks acquired by the LOCK TABLE statement under this unit of work's commitment definition are released.

At the end of a ROLLBACK HOLD, the cursor position is the same as it was at the start of the unit of work, unless ALWBLK(*ALLREAD) was specified when the program or routine that contains the cursor was created

Notes

The ending of the default activation group causes an implicit rollback. Thus, an explicit COMMIT or ROLLBACK statement should be issued before the end of the default activation group.

A ROLLBACK is automatically performed when:

1. The default activation group ends without a final COMMIT being issued.
2. A failure occurs that prevents the activation group from completing its work (for example, a power failure).

   If the unit of work is in the prepared state because a COMMIT was in progress when the failure occurred, a rollback is not performed. Instead, resynchronization of all the connections involved in the unit of work will occur. For more information, see the book *Backup and Recovery*, SC41-5304-04.
3. A failure occurs that causes a loss of the connection to an application server (for example, a communications line failure).

   If the unit of work is in the prepared state because a COMMIT was in progress when the failure occurred, a rollback is not performed. Instead, resynchronization of all the connections involved in the unit of work will occur. For more information, see the book *Backup and Recovery*, SC41-5304-04.
4. A nondefault activation group ends abnormally.

A unit of work may include the processing of up to and including 4 million rows, including rows retrieved during a SELECT INTO or FETCH statement[48], and rows inserted, deleted, or updated as part of INSERT, DELETE, and UPDATE operations.[49]

---

[48] Unless you specified COMMIT(*CHG) or COMMIT(*CS), in which case these rows are not included in this total.

[49] This limit also includes:

- Any records accessed or changed through files opened under commitment control through high-level language file processing
- Any rows deleted, updated, or inserted as a result of a trigger or CASCADE, SET NULL, or SET DEFAULT referential integrity delete rule.

The commit and rollback operations do not affect the DROP COLLECTION statement, and this statement is not, therefore, allowed in an application program that also specifies COMMIT(*CHG), COMMIT(*CS), COMMIT(*ALL), or COMMIT(*RR).

See the notes to the COMMIT statement for information on determining which commitment definition is used by SQL.

Any cursors associated with a prepared statement that is destroyed cannot be opened until the statement is prepared again. ROLLBACK has no effect on the state of connections.

If, within a unit of work, a CLOSE is followed by a ROLLBACK, all changes made within the unit of work are backed out. The CLOSE itself is not backed out and the file is not reopened.

Example

See the examples under COMMIT on page 280 for examples using the ROLLBACK statement.

SELECT INTO

The SELECT INTO statement produces a result table consisting of at most one row, and assigns the values in that row to host variables. If the table is empty, the statement assigns +100 to SQLCODE and '02000' to SQLSTATE and does not assign values to the host variables. If more than one row satisfies the search condition, statement processing is terminated, and an error occurs.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in REXX.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For each table or view identified in the statement,
  - The SELECT privilege on the table or view, and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the SELECT privilege on a table when:

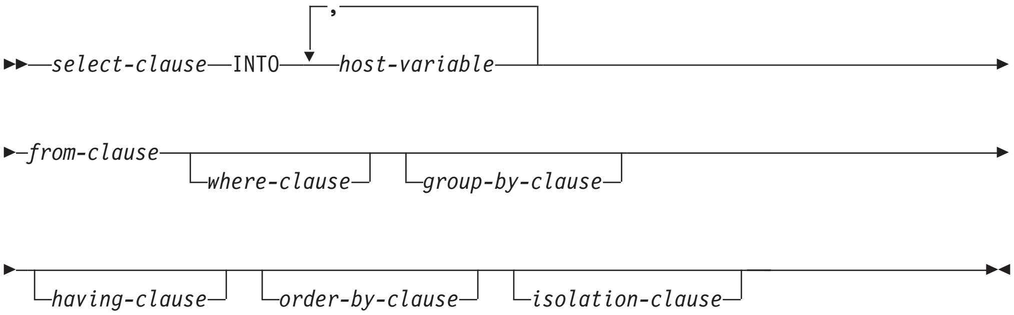
- It is the owner of the table,
- It has been granted the SELECT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *READ on the table.

The authorization ID of the statement has the SELECT privilege on a view when:

- It is the owner of the view,
- It has been granted the SELECT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *READ on the view and the system authority *READ on all tables and views that this view is

directly or indirectly dependent on. That is, all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth.

Syntax



Description

The result table is derived by evaluating the *from-clause*, *where-clause*, *group-by-clause*, *having-clause*, *select-clause*, and *order-by-clause*, in this order.

See “Chapter 4. Queries” on page 219 for a description of the *select-clause*, *from-clause*, *where-clause*, *group-by-clause*, *having-clause*, *order-by-clause*, and *isolation-clause*.

Note that the grouping, as specified by the *group-by-clause*, strongly implies a result table of more than one row, and that a *having-clause* is probably needed to reduce the table to at most one row.

INTO *host variable***,...**

Identifies one or more host structures or variables that must be declared in the program in accordance with the rules for declaring host structures and variables. In the operational form of the INTO clause, a reference to a host structure is replaced by a reference to each of its variables. The first value in the result row is assigned to the first host variable in the list, the second value to the second host variable, and so on. The data type of each host variable must be compatible with its corresponding column.

Each assignment to a host variable is performed according to the rules described in Chapter 2. If the number of variables is less than the number of values in the row, the SQLWARN3 field of the SQLCA is set to 'W'. Note that there is no warning if there are more host variables than the number of result columns. If the value is null, an indicator variable must be provided. If an assignment error occurs, the value of that host variable and any following host variables is unpredictable. Any values that have already been assigned to variables remain assigned.

If any of the following data mapping errors occur, when evaluating a result column in the select-clause, the result is a null value:

- Characters could not be converted
- Numeric conversion error (underflow or overflow)
- Arithmetic expression error (division by 0)

- Date or timestamp conversion error (a date or timestamp that is not within the valid range of the dates for the specified format)
- String representation of the datetime value is not valid
- Mixed data not properly formed
- A numeric value is not valid
- Argument of SUBSTR scalar function is out of range

As in any other case of a null value, an indicator variable must be provided. The value of the host variable is undefined. In this case, however, the indicator variable is set to -2. Processing of the statement continues as if the error had not occurred. (However, this error causes a positive SQLCODE.) If you do not provide an indicator variable, a negative value is returned in the SQLCODE field of the SQLCA. The value of the variable or any following variables is unpredictable. Any values that have already been assigned to variables remain assigned.

If an error occurs (SQLCODE equals -811) because the result table has more than one row, values are assigned to all host variables, but the row that is the source of the values is undefined and not predictable.

Examples

Example 1

Using a COBOL program statement, put the maximum salary (SALARY) from the EMPLOYEE table into the host variable MAX-SALARY (dec(9,2)) with isolation level Read Committed (CS).

```
EXEC SQL  SELECT MAX(SALARY)
            INTO :MAX-SALARY
            FROM EMPLOYEE WITH CS
END-EXEC.
```

Example 2

Using a PL/I program statement, select the row from the EMPLOYEE table with a employee number (EMPNO) value the same as that stored in the host variable HOST_EMP char(6)). Then put the last name (LASTNAME) and education level (EDLEVEL) from that row into the host variables HOST_NAME (char(20)) and HOST_EDUCATE (integer).

```
EXEC SQL  SELECT LASTNAME, EDLEVEL
            INTO :HOST_NAME, :HOST_EDUCATE
            FROM EMPLOYEE
            WHERE EMPNO = :HOST_EMP;
```

SET CONNECTION

The SET CONNECTION statement establishes the current server of the activation group by identifying one of its existing connections.

Invocation

This statement can only be embedded within an application program or issued interactively. It is an executable statement that cannot be dynamically prepared. It must not be specified in REXX.

SET CONNECTION is not allowed in a trigger program. SET CONNECTION is not allowed in an external procedure if the external procedure is called on a remote application server.

Authorization

None required.

Syntax

```
►►──SET CONNECTION──┬─server-name───┬───────────────────────────────────────►◄
                    └─host-variable─┘
```

Description

server-name or *host-variable*

Identifies the connection by the specified server name or the server name contained in the host variable. If a host variable is specified:

- It must be a character-string variable.
- It must not be followed by an indicator variable.
- The server name must be left-justified within the host variable and must conform to the rules for forming an ordinary identifier.
- If the length of the server name is less than the length of the host variable, it must be padded on the right with blanks.

Let S denote the specified server name or the server name contained in the host variable. S must identify an existing connection of the application process. If S identifies the current connection, the state of S and all other connections of the application process are unchanged, but information about S is placed in the SQLERRP field of the SQLCA. The following rules apply when S identifies a dormant connection.

If the SET CONNECTION statement is successful:

- Connection S is placed in the current state.
- S is placed in the CURRENT SERVER special register.
- Information about application server S is placed in the SQLERRP field of the SQLCA. If the application server is an IBM relational database product, the information has the form *pppvvrrm*, where:
  - *ppp* identifies the product as follows:
    ARI for DB2 for VSE and VM
    DSN for DB2 UDB for OS/390
    QSQ for DB2 UDB for AS/400
    SQL for all other DB2 products
  - *vv* is a two-digit version identifier such as '04'
  - *rr* is a two-digit release identifier such as '01'
  - *m* is a one-digit modification level such as '0'

  For example, if the application server is Version 4 of DB2 UDB for OS/390, the value of SQLERRP is 'DSN04010'.
- Additional information about the connection is placed in the SQLERRD(4) field of the SQLCA. SQLERRD(4) will contain values indicating whether the application server allows commitable updates to be performed. Following is a list of values and their meanings for the SQLERRD(4) field of the SQLCA on the CONNECT :

  - 1 - commitable updates can be performed and either the connection uses an unprotected conversation, is a connection established to an application requester driver program using a CONNECT (Type 1) statement, or is a local connection established using a CONNECT (Type 1) statement.
  - 2 - No commitable updates can be performed; conversation is unprotected.
  - 3 - It is unknown if commitable updates can be performed; conversation is protected.
  - 4 - It is unknown if commitable updates can be performed; conversation is unprotected.
  - 5 - It is unknown if commitable updates can be performed and the connection is either a local connection established using a CONNECT (Type 2) statement or a connection to an application requester driver program established using a CONNECT (Type 2) statement.
- Additional information about the connection is placed in the SQLERRMC field of the SQLCA. Refer to Appendix B, "SQL Communication Area" for a description of the information in the SQLERRMC field.
- Any previously current connection is placed in the dormant state.

If the SET CONNECTION statement is unsuccessful, the connection state of the activation group and the states of its connections are unchanged.

Notes

When a connection is used, made dormant, and then restored to the current state in the same unit of work, the status of locks, cursors, and prepared statements for that connection reflects its last use by the activation group.

Example

Execute SQL statements at TOROLAB1, execute SQL statements at TOROLAB2, and then execute more SQL statements at TOROLAB1.

```
EXEC SQL CONNECT TO TOROLAB1;
```

(Execute statements referencing objects at TOROLAB1)

```
EXEC SQL CONNECT TO TOROLAB2;
```

(Execute statements referencing objects at TOROLAB2)

```
EXEC SQL SET CONNECTION TOROLAB1;
```

(Execute statements referencing objects at TOROLAB1)

The first CONNECT statement creates the TOROLAB1 connection, the second CONNECT statement places it in the dormant state, and the SET CONNECTION statement returns it to the current state.

SET OPTION

The SET OPTION statement establishes the processing options to be used for SQL statements.

Invocation

This statement can be used in a REXX procedure or embedded in an application program. If used in a REXX procedure, it is an executable statement. If embedded in an application program, it is not executable and must precede any other SQL statements. This statement cannot be dynamically prepared.

Authorization

None required.

Syntax

```
                   ┌─,──────────────────────────────────┐
                   ▼                                    │
►►──SET OPTION──────┬─ALWBLK = ──alwblk-option─────────┬┴──────────────────────────►◄
                    ├─ALWCPYDTA = ──alwcpydta-option───┤
                    ├─CLOSQLCSR = ──closqlcsr-option───┤
                    ├─CNULRQD = ──cnulrqd-option───────┤
                    ├─COMMIT = ──commit-option─────────┤
                    ├─DATFMT = ──datfmt-option─────────┤
                    ├─DATSEP = ──datsep-option─────────┤
                    ├─DECMPT = ──decmpt-option─────────┤
                    ├─DFTRDBCOL = ──dftrdbcol-option───┤
                    ├─DLYPRP = ──dlyprp-option─────────┤
                    ├─DYNDFTCOL = ──dyndftcol-option───┤
                    ├─DYNUSRPRF = ──dynusrprf-option───┤
                    ├─LANGID = ──langid-option─────────┤
                    ├─NAMING = ──naming-option─────────┤
                    ├─OPTLOB = ──optlob-option─────────┤
                    ├─RDBCNNMTH = ──rdbcnnmth-option───┤
                    ├─SQLCURRULE = ──sqlcurrule-option─┤
                    ├─SQLPATH = ──sqlpath-option───────┤
                    ├─SRTSEQ = ──srtseq-option─────────┤
                    ├─TIMFMT = ──timfmt-option─────────┤
                    ├─TIMSEP = ──timsep-option─────────┤
                    └─USRPRF = ──usrprf-option─────────┘
```

alwblk-option:

```
├───┬─*READ────┬───────────────────────────────────────────────────────────────┤
    ├─*NONE────┤
    └─*ALLREAD─┘
```

alwcpydta-option:

```
├───┬─*YES──────┬──────────────────────────────────────────────────────────────┤
    ├─*NO───────┤
    └─*OPTIMIZE─┘
```

closqlcsr-option:

```
├──┬─*ENDACTGRP─┬──────────────────────────────────────────────────┤
   ├─*ENDMOD────┤
   ├─*ENDPGM────┤
   ├─*ENDSQL────┤
   └─*ENDJOB────┘
```

cnulrqd-option:

```
├──┬─*YES─┬────────────────────────────────────────────────────────┤
   └─*NO──┘
```

commit-option:

```
            (1)
├──┬─*CHG────────┬─────────────────────────────────────────────────┤
   │         (2) │
   ├─*NONE───────┤
   ├─*CS─────────┤
   │        (3)  │
   ├─*ALL────────┤
   └─*RR─────────┘
```

Notes:

1 *UR can be used as a synonym for *CHG.

2 *NC can be used as a synonym for *NONE.

3 *RS can be used as a synonym for *ALL.

datfmt-option:

```
├──┬─*JOB─┬────────────────────────────────────────────────────────┤
   ├─*ISO─┤
   ├─*EUR─┤
   ├─*USA─┤
   ├─*JIS─┤
   ├─*MDY─┤
   ├─*DMY─┤
   ├─*YMD─┤
   └─*JUL─┘
```

datsep-option:

```
├──┬─*JOB────┬──────────────────────────────────────────────────────────────┤
   ├─*SLASH──┤
   ├─'/'─────┤
   ├─*PERIOD─┤
   ├─'.'─────┤
   ├─*COMMA──┤
   ├─','─────┤
   ├─*DASH───┤
   ├─'-'─────┤
   ├─*BLANK──┤
   └─' '─────┘
```

decmpt-option:

```
├──┬─*PERIOD─┬──────────────────────────────────────────────────────────────┤
   ├─*COMMA──┤
   ├─*SYSVAL─┤
   └─*JOB────┘
```

dftrdbcol-option:

```
├──┬─*NONE───────────┬──────────────────────────────────────────────────────┤
   └─collection-name─┘
```

dlyprp-option:

```
├──┬─*YES─┬─────────────────────────────────────────────────────────────────┤
   └─*NO──┘
```

dyndftcol-option:

```
├──┬─*YES─┬─────────────────────────────────────────────────────────────────┤
   └─*NO──┘
```

dynusrprf-option:

```
├──┬─*OWNER─┬───────────────────────────────────────────────────────────────┤
   └─*USER──┘
```

langid-option:

```
├──┬─*JOB─────────┬─────────────────────────────────────────────────────────┤
   ├─*JOBRUN──────┤
   └─language-ID──┘
```

naming-option:

```
├──┬─*SYS─┬──────────────────────────────────────────────────────────┤
   └─*SQL─┘
```

optlob-option:

```
├──┬─*YES─┬──────────────────────────────────────────────────────────┤
   └─*NO──┘
```

rdbcnnmth-option:

```
├──┬─*DUW─┬──────────────────────────────────────────────────────────┤
   └─*RUW─┘
```

sqlcurrule-option:

```
├──┬─*DB2─┬──────────────────────────────────────────────────────────┤
   └─*STD─┘
```

sqlpath-option:

```
├──┬─*LIBL────────────────┬──────────────────────────────────────────┤
   └─path-string-constant─┘
```

srtseq-option:

```
├──┬─*JOB──────────────────────────────────────┬─────────────────────┤
   ├─*HEX──────────────────────────────────────┤
   ├─*JOBRUN───────────────────────────────────┤
   ├─*LANGIDUNQ────────────────────────────────┤
   ├─*LANGIDSHR────────────────────────────────┤
   │ ┌─*LIBL/────────┐                         │
   └─┼───────────────┼──srtseq-table-name──────┘
     ├─*CURLIB/──────┤
     └─library-name/─┘
```

timfmt-option:

```
├──┬─*HMS─┬──────────────────────────────────────────────────────────┤
   ├─*ISO─┤
   ├─*EUR─┤
   ├─*USA─┤
   └─*JIS─┘
```

timsep-option:

```
├──┬─*JOB────┬─────────────────────────────────────────────────────────────┤
   ├─*COLON──┤
   ├─':'─────┤
   ├─*PERIOD─┤
   ├─'.'─────┤
   ├─*COMMA──┤
   ├─','─────┤
   ├─*BLANK──┤
   └─' '─────┘
```

usrprf-option:

```
├──┬─*OWNER──┬─────────────────────────────────────────────────────────────┤
   ├─*USER───┤
   └─*NAMING─┘
```

Description

ALWBLK
Specifies whether the database manager can use record blocking and the extent to which blocking can be used for read-only cursors. This option will be ignored in REXX.

***ALLREAD**
Rows are blocked for read-only cursors if COMMIT is *NONE or *CHG. All cursors in a program that are not explicitly able to be updated are opened for read-only processing even though EXECUTE or EXECUTE IMMEDIATE statements may be in the program.

Specifying *ALLREAD:

- Allows record blocking under commitment control level *CHG in addition to the blocking allowed for *READ.
- Can improve the performance of almost all read-only cursors in programs, but limits queries in the following ways:
  - The Rollback (ROLLBACK) command, a ROLLBACK statement in host languages, or the ROLLBACK HOLD SQL statement does not reposition a read-only cursor when *ALLREAD is specified.
  - Dynamic running of a positioned UPDATE or DELETE statement (for example, using EXECUTE IMMEDIATE), cannot be used to update a row in a cursor unless the DECLARE statement for the cursor includes the FOR UPDATE clause.

***NONE**
Rows are not blocked for retrieval of data for cursors.

Specifying *NONE:

- Guarantees that the data retrieved is current.
- May reduce the amount of time required to retrieve the first row of data for a query.

- Stops the database manager from retrieving a block of data rows that is not used by the program when only the first few rows of a query are retrieved before the query is closed.
- Can degrade the overall performance of a query that retrieves a large number of rows.

***READ**

Records are blocked for read-only retrieval of data for cursors when:

- *NONE is specified on the COMMIT parameter, which indicates that commitment control is not used.
- The cursor is declared with a FOR READ ONLY clause or there are no dynamic statements that could run a positioned UPDATE or DELETE statement for the cursor.

Specifying *READ can improve the overall performance of queries that meet the above conditions and retrieve a large number of records.

ALWCPYDTA

Specifies whether a copy of the data can be used in a SELECT statement. This option will be ignored in REXX.

***OPTIMIZE**

The system determines whether to use the data retrieved directly from the database or to use a copy of the data. The decision is based on which method provides the best performance. If COMMIT is *CHG or *CS and ALWBLK in not *ALLREAD, or if COMMIT is *ALL or *RR, then a copy of the data is used only when it is necessary to run a query.

***YES**

A copy of the data is used only when necessary.

***NO**

A copy of the data is not allowed. If a temporary copy of the data is required to perform the query, an error message is returned.

CLOSQLCSR

Specifies when SQL cursors are implicitly closed, SQL prepared statements are implicitly discarded, and LOCK TABLE locks are released. SQL cursors are explicitly closed when you issue the CLOSE, COMMIT, or ROLLBACK (without HOLD) SQL statements. This option will be ignored in REXX. *ENDACTGRP and *ENDMOD are for use by ILE programs and modules. *ENDPGM, *ENDSQL, and *ENDJOB are for use by non-ILE programs.

***ENDACTGRP**

SQL cursors are closed, SQL prepared statements are implicitly discarded, and LOCK TABLE locks are released when the activation group ends.

***ENDMOD**

SQL cursors are closed and SQL prepared statements are implicitly discarded when the module is exited. LOCK TABLE locks are released when the first SQL program on the call stack ends.

***ENDPGM**

SQL cursors are closed and SQL prepared statements are discarded when the program ends. LOCK TABLE locks are released when the first SQL program on the call stack ends.

***ENDSQL**

SQL cursors remain open between calls and can be fetched without running another SQL OPEN. One of the programs higher on the call stack must have run at least one SQL statement. SQL cursors are closed, SQL prepared statements are discarded, and LOCK TABLE locks are released when the first SQL program on the call stack ends. If *ENDSQL is specified for a program that is the first SQL program called (the first SQL program on the call stack), the program is treated as if *ENDPGM was specified.

***ENDJOB**
SQL cursors remain open between calls and can be fetched without running another SQL OPEN. The programs higher on the call stack do not need to have run SQL statements. SQL cursors are left open, SQL prepared statements are preserved, and LOCK TABLE locks are held when the first SQL program on the call stack ends. SQL cursors are closed, SQL prepared statements are discarded, and LOCK TABLE locks are released when the job ends.

CNULRQD
Specifies whether a NUL-terminator is returned for character and graphic host variables. This option will only be used for SQL statements in C and C++ programs.

***YES**
Output character and graphic host variables always contain the NUL-terminator. If there is not enough space for the NUL-terminator, the data is truncated and the NUL-terminator is added. Input character and graphic host variables require a NUL-terminator.

***NO**
For output character and graphic host variables, the NUL-terminator is not returned when the host variable is exactly the same length as the data. Input character and graphic host variables do not require a NUL-terminator.

COMMIT
Specifies the isolation level to be used. In REXX, files that are referred to in the source are not affected by this option. Only tables, views, and packages referred to in SQL statements are affected. For more information on isolation levels, see “Isolation Level” on page 17

***CHG**
Specifies the isolation level of Uncommitted Read.

***NONE**
Specifies the isolation level of No Commit. If the DROP COLLECTION statement is included in a REXX procedure, *NONE must be used.

***CS**
Specifies the isolation level of Cursor Stability.

***ALL**
Specifies the isolation level of Read Stability.

***RR**
Specifies the isolation level of Repeatable Read.

DATFMT
Specifies the format used when accessing date result columns. All output date fields are returned in the specified format. For input date strings, the specified value is used to determine whether the date is specified in a valid format.

Note: An input date string that uses the format *USA, *ISO, *EUR, or *JIS is always valid.

***JOB:**
The format specified for the job is used. Use the Display Job (DSPJOB) command to determine the current date format for the job.

***ISO**
The International Organization for Standardization (ISO) date format (yyyy-mm-dd) is used.

***EUR**
The European date format (dd.mm.yyyy) is used.

***USA**
The United States date format (mm/dd/yyyy) is used.

***JIS**
The Japanese Industrial Standard date format (yyyy-mm-dd) is used.

***MDY**
The date format (mm/dd/yy) is used.

***DMY**
The date format (dd/mm/yy) is used.

***YMD**
The date format (yy/mm/dd) is used.

***JUL**
The Julian date format (yy/ddd) is used.

DATSEP
Specifies the separator used when accessing date result columns.

Note: This parameter applies only when *JOB, *MDY, *DMY, *YMD, or *JUL is specified on the DATFMT parameter.

***JOB**
The date separator specified for the job is used. Use the Display Job (DSPJOB) command to determine the current value for the job.

***SLASH** or **'/'**
A slash (/) is used.

***PERIOD** or **'.'**
A period (.) is used.

***COMMA** or **','**
A comma (,) is used.

***DASH** or **'-'**
A dash (-) is used.

***BLANK** or **' '**
A blank ( ) is used.

DECMPT
Specifies the symbol that you want to represent the decimal point. The possible choices are:

***PERIOD**
The representation for the decimal point is a period.

***COMMA**
The representation for the decimal point is a comma.

***SYSVAL**
The representation for the decimal point is the system value (QDECFMT).

***JOB**
The representation for the decimal point is the job value (DECFMT).

DFTRDBCOL
Specifies the collection name used for the unqualified names of tables, views, indexes, and SQL packages. This parameter applies only to static SQL statements. This option will be ignored in REXX.

***NONE**
The naming convention specified on the OPTION precompile parameter or by the SET OPTION NAMING option will be used.

collection-name
Specify the name of the collection. This value is used instead of the naming convention specified on the OPTION precompile parameter or by the SET OPTION NAMING option.

DLYPRP
Specifies whether the dynamic statement validation for a PREPARE statement is delayed until an OPEN, EXECUTE, or DESCRIBE statement is run. Delaying validation improves performance by eliminating redundant validation. This option will be ignored in REXX.

***NO**
Dynamic statement validation is not delayed. When the dynamic statement is prepared, the access plan is validated. When the dynamic statement is used in an OPEN or EXECUTE statement, the access plan is revalidated. Because the authority or the existence of objects referred to by the dynamic statement may change, you must still check the SQLCODE or SQLSTATE after issuing the OPEN or EXECUTE statement to ensure that the dynamic statement is still valid.

***YES**
Dynamic statement validation is delayed until the dynamic statement is used in an OPEN, EXECUTE, or DESCRIBE SQL statement. When the dynamic statement is used, the validation is completed and an access plan is built. If you specify *YES, you should check the SQLCODE and SQLSTATE after running an OPEN, EXECUTE, or DESCRIBE statement to ensure that the dynamic statement is valid.

Note: If you specify *YES, performance is not improved if the INTO clause is used on the PREPARE statement or if a DESCRIBE statement uses the dynamic statement before an OPEN is issued for the statement.

DYNDFTCOL
Specifies the collection name specified for the DFTRDBCOL parameter is also used for dynamic statements. This option will be ignored in REXX.

***NO**
Do not use the value specified for DFTRDBCOL for unqualified names of tables, views, indexes, and SQL packages for dynamic SQL statements. The naming convention specified on the OPTION precompile parameter or by the SET OPTION NAMING option will be used.

***YES**
The collection name specified for DFTRDBCOL will be used for the unqualified names of the tables, views, indexes, and SQL packages in dynamic SQL statements.

DYNUSRPRF
Specifies the user profile to be used for dynamic SQL statements. This option will be ignored in REXX.

***USER**
Local dynamic SQL statements are run under the user profile of the job. Distributed dynamic SQL statements are run under the user profile of the application server job.

***OWNER**
Local dynamic SQL statements are run under the user profile of the program's owner. Distributed dynamic SQL statements are run under the user profile of the SQL package's owner.

LANGID
Specifies the language identifier to be used when SRTSEQ(*LANGIDUNQ) or SRTSEQ(*LANGIDSHR) is specified.

***JOB** or ***JOBRUN**
The LANGID value for the job is used.

For distributed applications, LANGID(*JOBRUN) is valid only when SRTSEQ(*JOBRUN) is also specified.

language-id
Specify a language identifier to be used. For information on the values that can be used for the language identifier, see the book *International Application Development*, SC41-5603-01.

NAMING
Specifies whether the SQL naming convention or the system naming convention is to be used. The possible choices are:

***SYS**
The system naming convention will be used.

***SQL**
The SQL naming convention will be used.

OPTLOB
Specifies whether accesses to LOBs can be optimized when accessing through DRDA. The possible choices are:

***YES**
LOB accesses should be optimized. The first FETCH for a cursor determines how the cursor will be used for LOBs on all subsequent FETCHes. This option remains in effect until the cursor is closed.

If the first FETCH uses a LOB locator to access a LOB column, no subsequent FETCH for that cursor can fetch that LOB column into a LOB host variable.

If the first FETCH places the LOB column into a LOB host variable, no subsequent FETCH for that cursor can use a LOB locator for that column.

***NO**
LOB accesses should not be optimized. There is no restriction on whether a column is retrieved into a LOB locator or into a LOB host variable. This option can cause performance to degrade.

RDBCNNMTH
Specifies the semantics used for CONNECT statements. This option will be ignored in REXX.

***DUW**
CONNECT (Type 2) semantics are used to support distributed unit of work. Consecutive CONNECT statements to additional relational databases do not result in disconnection of previous connections.

***RUW**
CONNECT (Type 1) semantics are used to support remote unit of work. Consecutive CONNECT statements result in the previous connection being disconnected before a new connection is established.

SQLCURRULE
Specifies the semantics used for SQL statements.

***DB2**
The semantics of all SQL statements will default to the rules established for DB2. The following semantics are controlled by this option:

- Hexadecimal constants are treated as character data.

***STD**
The semantics of all SQL statements will default to the rules established by the ISO and ANSI SQL standards. The following semantics are controlled by this option:

- Hexadecimal constants are treated as binary data.

SQLPATH
Specifies the path to be used to find procedures, functions, and user defined types in static SQL statements. This option will be ignored in REXX.

***LIBL**
The path used is the library list at runtime.

character-string
A character constant with one or more collection names that are separated by blanks.

SRTSEQ
Specifies the sort sequence table to be used for string comparisons in SQL statements.

Note: *HEX must be specified if a REXX procedure connects to an application server that is not a DB2 UDB for AS/400 or an AS/400 system whose release level is prior to V2R3M0.

***JOB** or ***JOBRUN**
The SRTSEQ value for the job is used.

***HEX**
A sort sequence table is not used. The hexadecimal values of the characters are used to determine the sort sequence.

***LANGIDUNQ**
The sort sequence table must contain a unique weight for each character in the code page.

***LANGIDSHR**
The shared-weight sort table for the LANGID specified is used.

srtseq-table-name
Specify the name of the sort sequence table to be used with this program. The name of the sort sequence table can be qualified by one of the following library values:

***LIBL**
All libraries in the user and system portions of the job's library list are searched until the first match is found.

***CURLIB**
The current library for the job is searched. If no library is specified as the current library for the job, the QGPL library is used.

library-name
Specify the name of the library to be searched.

TIMFMT
Specifies the format used when accessing time result columns. All output time fields are returned in the specified format. For input time strings, the specified value is used to determine whether the time is specified in a valid format.

Note: An input time string that uses the format *USA, *ISO, *EUR, or *JIS is always valid.

***HMS**
The (hh:mm:ss) format is used.

***ISO**
The International Organization for Standardization (ISO) time format (hh.mm.ss) is used.

***EUR**
The European time format (hh.mm.ss) is used.

***USA**
The United States time format (hh:mm *xx*) is used, where *xx* is AM or PM.

***JIS**
The Japanese Industrial Standard time format (hh:mm:ss) is used.

TIMSEP
Specifies the separator used when accessing time result columns.

Note: This parameter applies only when *HMS is specified on the TIMFMT parameter.

***JOB**
The time separator specified for the job is used. Use the Display Job (DSPJOB) command to determine the current value for the job.

***COLON** or **':'**
A colon (:) is used.

***PERIOD** or **'.'**
A period (.) is used.

***COMMA** or **','**
A comma (,) is used.

***BLANK** or **' '**
A blank ( ) is used.

USRPRF
Specifies the user profile that is used when the compiled program object is run,

including the authority that the program object has for each object in static SQL statements. The profile of either the program owner or the program user is used to control which objects can be used by the program object. This option will be ignored in REXX.

***NAMING**
The user profile is determined by the naming convention. If the naming convention is *SQL, USRPRF(*OWNER) is used. If the naming convention is *SYS, USRPRF(*USER) is used.

***USER**
The profile of the user running the program object is used.

***OWNER**
The user profiles of both the program owner and the program user are used when the program is run.

Notes

At the start of a REXX procedure the options are set to their default value. The default value for each option is the first value listed in the syntax diagram. When an option is changed by a SET OPTION statement, the new value will stay in effect until the option is changed again or the REXX procedure ends.

For application programs, the processing options are initially set to the values specified on the CRTSQLxxx command. Each option is updated as it is encountered within a SET OPTION statement. All SET OPTION statements must precede any other embedded SQL statements.

Examples

Example 1: Set the isolation level to *ALL and the naming mode to SQL names.

```
EXECSQL SET OPTION COMMIT =*ALL, NAMING =*SQL
```

Example 2: Set the date format to European, the isolation level to *CS, and the decimal point to the comma.

```
EXECSQL SET OPTION DATFMT = *EUR, COMMIT = *CS, DECMPT = *COMMA
```

SET PATH

The SET PATH statement changes the value of the CURRENT PATH special register.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

No authorization is required to execute this statement.

Syntax

```
                             ┌─,────────────────┐
            (1)              ▼                  │
►►──SET PATH──┬───┬──┬──┬─collection-name──┬────┴──┬──────────────────────►◄
              └─=─┘  │  ├─SYSTEM PATH──────┤       │
                     │  ├─USER─────────────┤       │
                     │  │            (2)   │       │
                     │  ├─CURRENT PATH─────┤       │
                     │  ├─host-variable────┤       │
                     │  └─string-constant──┘       │
                     └─*LIBL───────────────────────┘
```

Notes:

1 SET CURRENT FUNCTION PATH and SET CURRENT PATH may be used as a synonym for SET PATH.

2 CURRENT_PATH or CURRENT FUNCTION PATH may be used as a synonym for CURRENT PATH.

Description

The value of the CURRENT PATH special register is replaced by the values specified.

collection-name
Identifies a collection or library. No validation that the collection exists is made at the time the path is set.

SYSTEM PATH
This value is the same as specifying the collection names ″QSYS″,″QSYS2″.

USER
This value is the USER special register.

CURRENT PATH
The value of the CURRENT PATH special register before the execution of this statement.

host-variable
A host variable which contains one or more collection names, separated by commas.

The host variable:

- Must be a character-string variable.
- Must not be followed by an indicator variable.
- Must include a collection that is left justified and must conform to the rules for forming an ordinary identifier.
- Must be padded on the right with blanks.
- Must not be the null value.

string-constant
A character constant with 1 or more collection names that are separated by commas.

Notes

A collection name must not appear more than once in the path.

The SET PATH statement is not a commitable operation. ROLLBACK has no effect on the CURRENT PATH.

The number of collections that can be specified is limited by the total length of the CURRENT PATH special register. The special register string is built by taking each schema name specified and removing trailing blanks, delimiting with double quotes, and separating each schema name by a comma. An error is returned if the length of the resulting string exceeds 558 bytes.

The initial value of the CURRENT PATH special register is *LIBL if system naming was used for the first SQL statement run in the activation group. The initial value is "QSYS","QSYS2", "X" (where X is the value of the USER special register) if SQL naming was used for the first SQL statement.

The collections QSYS and QSYS2 do not need to be specified. If not included in the path, they are implicitly assumed as the first collections (in this case, it is not included in the CURRENT PATH special register.

The CURRENT PATH special register is used to resolve user-defined distinct types and functions in dynamic SQL statements. For more information see “Collections and the SQL Path” on page 47.

Example

The following statement sets the CURRENT PATH special register.

```
SET PATH = FUNC_XYZ, "NewFun98", QSYS2
```

SET RESULT SETS

The SET RESULT SETS statement identifies one or more result sets that can be returned from a procedure when the procedure is called by a Client Access client or the SQL Call Level Interface.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It is not allowed in a REXX procedure.

Authorization

None required.

Syntax

```
►►──SET RESULT SETS──────────────────────────────────────────────────────────►


        ┌─,──────────────────────────────────────────────────────┐
        ▼                                                        │
►──┬────────┬─ARRAY──host-structure-array──FOR──host-variable──ROWS─┬─┴─┬──────────►◄
   │        └─CURSOR──cursor-name───────────────────────────────────┘   │
   └─NONE───────────────────────────────────────────────────────────────┘
```

Description

CURSOR *cursor-name*
Identifies a cursor to be used to define a result set that can be returned from a procedure. The *cursor-name* must identify a declared cursor as explained in "Description" on page 369 for the DECLARE CURSOR statement. When the SET RESULT SETS statement is executed, the cursor must be in the open state.

ARRAY *host-structure-array*
host-structure-array identifies an array of host structures defined in accordance with the rules for declaring host structures. The array cannot contain a C NUL-terminated host variable.

The first structure in the array corresponds to the first row of the result set, the second structure in the array corresponds to the second row of the result set, and so on. In addition, the first value in the row corresponds to the first item in the structure, the second value in the row corresponds to the second item in the structure, and so on.

Only one array can be specified in a SET RESULT SETS statement.

FOR *host-variable* **ROWS**
Specifies the number of rows in the result set. The *host-variable* must be a numeric host variable with zero scale, and it must not include an indicator variable. The number of rows specified must be in the range of 0 to 32767 and must be less than or equal to the dimension of the host structure array.

NONE
Specifies that no result sets will be returned. Cursors left open when the procedure ends will not be returned.

Notes

Result sets are only returned from a procedure when the procedure is called from a client using the Client Access Open Database Connectivity (ODBC) driver, a client using the Client Access Optimized SQL API, from the SQL Call Level Interface, or from JDBC. There are three ways to return result sets from a procedure:

- If a SET RESULT SETS statement is executed in the procedure, the SET RESULT SETS statement identifies the result sets. The result sets are returned in the order specified on the SET RESULT SETS statement.
- If a SET RESULT SETS statement is not executed in the procedure,
  - If no cursors have specified a WITH RETURN clause, each cursor that the procedure opens and leaves open when it returns identifies a result set. The result sets are returned in the order in which the cursors are opened.
  - If any cursors have specified a WITH RETURN clause, each cursor that is defined with WITH RETURN CLAUSE that the procedure opens and leaves open when it returns identifies a result set. The result sets are returned in the order in which the cursors are opened.

When a result set is returned using an open cursor, the rows are returned starting with the current cursor position.

Only one array can be specified in the SET RESULT SETS statement.

Example

The following SET RESULT SETS statement specifies cursor X as the result set that will be returned when the procedure is called. For more information and complete examples showing the use of result sets from ODBC clients, see the Client Access Express category in the AS/400 Information Center.

```
EXEC SQL SET RESULT SETS CURSOR X;
```

SET TRANSACTION

The SET TRANSACTION statement sets the isolation level for the current unit of work.

Invocation

This statement can be embedded within an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
                                                 (1)
►►──SET TRANSACTION──ISOLATION LEVEL──┬─NO COMMIT───────────────────┬──────►◄
                                      │                       (2)   │
                                      ├─READ UNCOMMITTED , READ WRITE─┤
                                      │               (3)           │
                                      ├─READ COMMITTED──────────────┤
                                      │                (4)          │
                                      ├─REPEATABLE READ─────────────┤
                                      │             (5)             │
                                      └─SERIALIZABLE────────────────┘
```

Notes:

1 The keywords NC or NONE can be used as synonyms for NO COMMIT.

2 The keywords UR and CHG can be used as synonyms for READ UNCOMMITTED, READ WRITE.

3 The keyword CS can be used as a synonym for READ COMMITTED.

4 The keywords RS or ALL can be used as synonyms for REPEATABLE READ.

5 The keyword RR can be used as a synonym for SERIALIZABLE.

Description

NO COMMIT
Specifies isolation level NC (COMMIT(*NONE)).

READ UNCOMMITTED, READ WRITE
Specifies isolation level UR (COMMIT(*CHG)).

READ COMMITTED
Specifies isolation level CS (COMMIT(*CS)).

REPEATABLE READ [50]
Specifies isolation level RS (COMMIT(*ALL)).

SERIALIZABLE
Specifies isolation level RR (COMMIT(*RR)).

Notes

The SET TRANSACTION statement sets the isolation level for SQL statements for the current activation group of the process. If that activation group has commitment control scoped to the job, then the SET TRANSACTION statement sets the isolation level of all other activation groups with job commit scoping as well.

The SET TRANSACTION statement can only be executed when it is the first SQL statement in a unit of work, unless it is executed in a trigger. The SET TRANSACTION statement can be executed in a trigger at any time, but it is recommended that it be executed as the first statement in the trigger. The SET TRANSACTION statement is useful within trigger programs to set the isolation level for SQL statements in the trigger program to the same level as the application which caused the trigger program to be fired.

A SET TRANSACTION statement is not allowed if the current connection is to a remote application server unless it is in a trigger program at the current server. Once a SET TRANSACTION statement is executed, CONNECT and SET CONNECTION statements are not allowed until the unit of work is committed or rolled back.

The scope of the SET TRANSACTION statement is based on the context in which it is run. If the SET TRANSACTION statement is run in a trigger program, the isolation level specified applies to all subsequent SQL statements until another SET TRANSACTION statement occurs or until the trigger program ends, whichever happens first. If the SET TRANSACTION statement is run outside a trigger program, the isolation level specified applies to all subsequent SQL statements until a COMMIT or ROLLBACK operation occurs.

| The SET TRANSACTION statement has no effect on WITH HOLD cursors that are
| still open when the SET TRANSACTION statement is executed.

For more information on isolation levels, see “Isolation Level” on page 17.

Examples

Example 1

The following SET TRANSACTION statement sets the isolation level to NONE (equivalent to specifying *NONE on the SQL precompiler command).

```
EXEC SQL SET TRANSACTION ISOLATION LEVEL NO COMMIT;
```

Example 2

The following SET TRANSACTION statement sets the isolation level to SERIALIZABLE.

```
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE
```

---

[50] REPEATABLE READ is the ISO and ANS standard term that corresponds to the isolation level of *ALL for DB2 UDB for AS/400 and the isolation level of Read Stability (RS) in IBM SQL. SERIALIZABLE is used in the ISO and ANS standard for what IBM SQL calls Repeatable Read (RR).

SET variable

The SET variable statement produces a result table consisting of at most one row and assigns the values in that row to host variables.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

If an *expression* includes a function, the authorization ID of the statement must include at least one of the following for each user-defined function:

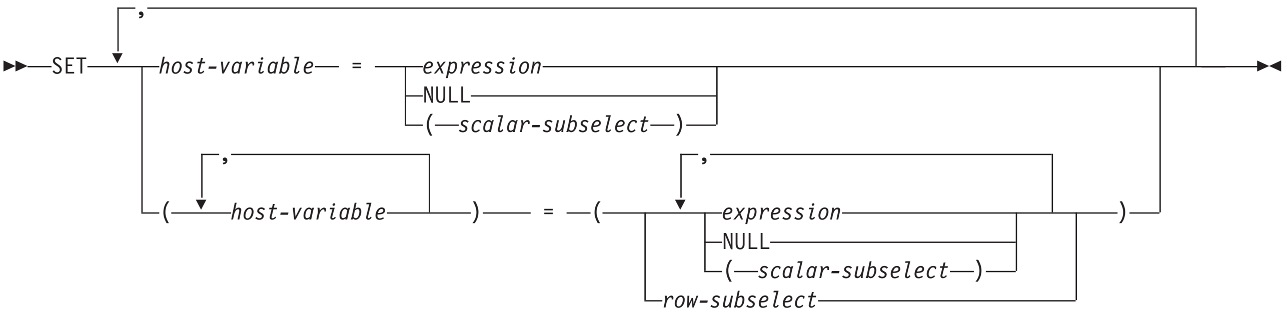
- The EXECUTE privilege on the function
- Administrative authority

The authorization ID of the statement has the EXECUTE privilege on a function when:

- It is the owner of the function,
- It has been granted the EXECUTE privilege on the function, or
- It has been granted the system authorities of *OBJOPR and *EXECUTE on the function.

If a *row-subselect* is specified, see "Chapter 4. Queries" on page 219 for an explanation of the authorization required for each subselect.

Syntax



Description

host-variable, ...

Identifies one or more host variables or host structures that must be declared in accordance with the rules for declaring host variables (see "References to Host Variables" on page 94). A host structure is logically replaced by a list of host variables that represent each of the elements of the host structure.

The value to be assigned to each *host-variable* can be specified immediately following the *host-variable*, for example, *host-variable* = *expression*, *host-variable* = *expression*. Or, sets of parentheses can be used to specify all the *host-variables* and then all the values, for example, (*host-variable*, *host-variable*) = (*expression*, *expression*).

The data type of each host variable must be compatible with its corresponding result column. Each assignment is made according to the rules described in “Assignments and Comparisons” on page 66. The number of *host-variables* specified to the left of the equal operator must equal the number of values in the corresponding result specified to the right of the equal operator. If the value is null, an indicator variable must be provided. If an assignment error occurs, the value is not assigned to the variable, and no more values are assigned to variables. Any values that have already been assigned to variables remain assigned.

If an error occurs as the result of an arithmetic expression in the *expression* or SELECT list of the subselect (division by zero, or overflow) or a character conversion error occurs, the result is the null value. As in any other case of a null value, an indicator variable must be provided. The value of the host variable is undefined. In this case, however, the indicator variable is set to -2. Processing of the statement continues as if the error had not occurred. (However, this error causes a positive SQLCODE.) If you do not provide an indicator variable, a negative value is returned in the SQLCODE field of the SQLCA. It is possible that some values have already been assigned to host variables and will remain assigned when the error occurs.

expression
Specifies the new value of the host variable. The *expression* is any expression of the type described in “Expressions” on page 105. It must not include a column name.

NULL
Specifies that the new value for the host variable is the null value.

scalar-subselect
A subselect that returns a single result row and a single result column. The result column value is assigned to the corresponding *host-variable*. If the result of the subselect is no rows, then the null value is assigned. An error is returned if there is more than one row in the result.

row-subselect
A subselect that returns a single result row. The result column values are assigned to each corresponding *host-variable*. If the result of the subselect is no rows, then null values are assigned. An error is returned if there is more than one row in the result.

Notes

If the specified host variable is character and is not large enough to contain the result, 'W' is assigned to SQLWARN1 in the SQLCA. The actual length of the result is returned in the indicator variable associated with the host-variable, if an indicator variable is provided.

If the specified host variable is a C NUL-terminated host variable and is not large enough to contain the result and the NUL-terminator:

- If the *CNULRQD option is specified on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*YES) on the SET OPTION statement), the following occurs:
  - The result is truncated.
  - The last character is the NUL-terminator.
  - The value ‘W’ is assigned to SQLWARN1 in the SQLCA.

- If the *NOCNULRQD option on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*NO) on the SET OPTION statement) is specified, the following occurs:
  - The NUL-terminator is not returned.
  - The value 'N' is assigned to SQLWARN1 in the SQLCA.

Examples

Example 1

Assign the value of the CURRENT PATH special register to host variable HV1.

```
EXEC SQL SET :HV1 = CURRENT PATH;
```

Example 2

Assume that LOB locator LOB1 is associated with a CLOB value. Assign a portion of the CLOB value to host variable DETAILS using the LOB locator.

```
EXEC SQL SET :DETAILS = SUBSTR(:LOB1,1,35);
```

UPDATE

The UPDATE statement updates the values of specified columns in rows of a table or view. Updating a row of a view updates a row of its base table.

There are two forms of this statement:

- The *Searched* UPDATE form is used to update one or more rows (optionally determined by a search condition).
- The *Positioned* UPDATE form is used to update exactly one row (as determined by the current position of a cursor).

Invocation

A Searched UPDATE statement can be embedded in an application program or issued interactively. A Positioned UPDATE must be embedded in an application program. Both forms are executable statements that can be dynamically prepared.

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

- For the table or view identified in the statement:
  - The UPDATE privilege on the table or view, or
  - The UPDATE privilege on each column to be updated, or
  - Ownership of the table; and
  - The system authority *EXECUTE on the library containing the table or view
- Administrative authority

The authorization ID of the statement has the UPDATE privilege on a table (or the specified columns of a table) when:

- It is the owner of the table,
- It has been granted the UPDATE privilege on the table or on the columns of the table, or
- It has been granted the system authorities of *OBJOPR and *UPD on the table.

The authorization ID of the statement has the UPDATE privilege on a view (or the specified columns of a view) when: [51]

- It has been granted the UPDATE privilege on the view or on the columns of the view, or
- It has been granted the system authorities of *OBJOPR and *UPD on the view and the system authority *UPD on the first table or view in the first FROM clause of the view definition; and if this is a view, then the system authority *UPD on the first table or view in the first FROM clause of that view definition; and so forth.

If the expression in the SET clause contains a reference to a column of the table or view, or if the *search-condition* in a Searched UPDATE contains a reference to a column of the table or view, then the privileges held by the authorization ID of the statement must also include one of the following:

- The SELECT privilege on the table or view
- Administrative authority

The authorization ID of the statement has the SELECT privilege on a table when:

- It is the owner of the table,
- It has been granted the SELECT privilege on the table, or
- It has been granted the system authorities of *OBJOPR and *READ on the table.

The authorization ID of the statement has the SELECT privilege on a view when:

- It is the owner of the view,
- It has been granted the SELECT privilege on the view, or
- It has been granted the system authorities of *OBJOPR and *READ on the view and the system authority *READ on all tables and views that this view is directly or indirectly dependent on. That is, all tables and views referenced in the view definition, and if a view is referenced, all tables and views referenced in its definition, and so forth.

If the *search-condition* includes a subquery or if the *assignment-clause* includes a *scalar-subselect* or *row-subselect*, see “Chapter 4. Queries” on page 219 for an explanation of the authorization required for each subselect.

Syntax

Searched UPDATE:

```
►►──UPDATE──┬─table-name─┬──┬────────────────────┬──SET──assignment-clause──────►
            └─view-name──┘  └─correlation-clause─┘

►──┬──────────────────────────┬──┬──────────────────┬─────────────────────────►◄
   └─WHERE──search-condition──┘  └─isolation-clause─┘
```

Positioned UPDATE:

---

[51] When a view is created, the owner does not necessarily acquire the UPDATE privilege on the view. The owner only acquires the UPDATE privilege if the view allows updates and the owner also has the UPDATE privilege on the first table referenced in the subselect.

```
►►──UPDATE──┬─table-name─┬──┬────────────────────┬──SET──assignment-clause──────►
            └─view-name──┘  └─correlation-clause─┘

►──WHERE CURRENT OF──cursor-name────────────────────────────────────────────────►◄
```

assignment-clause:

```
      ┌─,──────────────────────────────────────────────────────────────────────────┐
      ▼                                                                             │
►►──┬───┬─column-name── = ──┬─expression───────────────┬────────────────────────┬─┴─┬──────►◄
    │   │                   ├─NULL─────────────────────┤                        │   │
    │   │                   ├─DEFAULT──────────────────┤                        │   │
    │   │                   └─(──scalar-subselect──)───┘                        │   │
    │   │      ┌─,────────────┐                        ┌─,───────────────────┐  │   │
    │   │      ▼              │                        ▼                     │  │   │
    │   └─(────column-name────┴──)── = ──(──┬──────┬─expression──────────┬─┴─┬──)─┘   │
    │                                       │      ├─NULL────────────────┤   │        │
    │                                       │      ├─DEFAULT─────────────┤   │        │
    │                                       │      └─(──scalar-subselect──)─┘   │        │
    │                                       └─row-subselect──────────────────┘        │
    │              ┌─,──────────┐                                                     │
    │              ▼            │                                                     │
    └─ROW── = ──(──┬───┬─expression─┬─┴─┬──)──────────────────────────────────────────┘
                   │   ├─NULL───────┤   │
                   │   └─DEFAULT────┘   │
                   └─row-subselect──────┘
```

Description

table-name or *view-name*
Identifies the table or view you want to update. The name must identify a table or view that exists at the current server, but it must not identify a catalog table, a view of a catalog table, or a read-only view. For an explanation of read-only views and updateable views, see "CREATE VIEW" on page 362.

correlation-clause
Can be used within *search-condition* to designate the table or view. For an explanation of *correlation-clause*, see "Chapter 4. Queries" on page 219. For an explanation of *correlation-name*, see "Correlation Names" on page 90.

SET
Introduces a list of column names and values.

column-name
Identifies a column to be updated. The *column-name* must identify a column of the specified table or view, but must not identify a view column derived from a scalar function, constant, or expression. The column names must not be qualified, and a column must not be specified more than once.

For a Positioned UPDATE:

- If the UPDATE clause was specified in the SELECT statement of the cursor, each column name in the SET list must also appear in the UPDATE clause.
- If the UPDATE clause was not specified in the SELECT statement of the cursor, the name of any updateable column may be specified.

For more information, see ″update-clause″ on page 235.

A view column derived from the same column as another column of the view can be updated, but both columns cannot be updated in the same UPDATE statement.

If a list of *column-names* is specified, the number of *expressions*, NULLs, DEFAULTs, and *scalar-subselects* must match the number of *column-names*.

ROW

Identifies all the columns of the specified table or view. If a view is specified, none of the columns of the view may be derived from a scalar function, constant, or expression.

The number of *expressions*, NULLs, DEFAULTs, and *scalar-subselects* (or the number of result columns from a *row-subselect*) must match the number of columns in the row.

For a Positioned UPDATE, if the UPDATE clause was specified in the SELECT statement of the cursor, each column of the table or view must also appear in the UPDATE clause. For more information, see ″update-clause″ on page 235.

ROW may not be specified for a view that contains a view column derived from the same column as another column of the view, because both columns cannot be updated in the same UPDATE statement.

expression

Indicates the new value of the column. The *expression* is any expression of the type described in “Expressions” on page 105. It must not include a column function.

A *column-name* in an expression must name a column of the named table or view. For each row updated, the value of the column in the expression is the value of the column in the row before the row is updated.

NULL

Specifies the new value for a column is the null value. NULL should only be specified for nullable columns.

DEFAULT

Specifies that the default value is assigned to a column. The value that is used depends on how the column was defined, as follows:

- If the WITH DEFAULT clause is used, the default used is as defined for the column (see *default-clause* in *column-definition* in “CREATE TABLE” on page 340).
- If the WITH DEFAULT clause or the NOT NULL clause is not used, the value used is NULL.
- If the NOT NULL clause is used and the WITH DEFAULT clause is not used or DEFAULT NULL is used, the DEFAULT keyword cannot be specified for that column.

scalar-subselect

A subselect that returns a single result row and a single result column. The result column value is assigned to the corresponding *column-name*. If the result of the subselect is no rows, then the null value is assigned. An error is returned if there is more than one row in the result.

The *scalar-subselect* may contain references to columns of the target table of the UPDATE statement. For each row updated, the value of such a column in the expression is the value of the column in the row before the row is updated.

row-subselect

A subselect that returns a single result row. The number of result columns in the select list must match the number of *column-names* (or if ROW is specified, the number of columns in the row) specified for assignment. The result column values are assigned to each corresponding *column-name*. If the result of the subselect is no rows, then null values are assigned. An error is returned if there is more than one row in the result.

The *row-subselect* may contain references to columns of the target table of the UPDATE statement. For each row updated, the value of such a column in the expression is the value of the column in the row before the row is updated.

WHERE

Specifies the rows to be updated. You can omit the clause, give a search condition, or name a cursor. If the clause is omitted, all rows of the table or view are updated.

search-condition

Is any search described in “Search Conditions” on page 128. Each *column-name* in the search condition, other than in a subquery, must name a column of the table or view. When the search condition includes a subquery in which the same table is the base object of both the UPDATE and the subquery, the subquery is completely evaluated before any rows are updated.

The *search-condition* is applied to each row of the table or view. The updated rows are those for which the results of the *search-condition* are true.

If the search condition contains a subquery, the subquery can be thought of as being executed each time the search condition is applied to a row, and the results of that subquery used in applying the search condition. In actuality, a subquery with no correlated references is executed only once. A subquery with a correlated reference may have to be executed once for each row.

CURRENT OF *cursor-name*

Identifies the cursor to be used in the update operation. The *cursor-name* must identify a declared cursor as explained in “DECLARE CURSOR” on page 368.

The table or view named must also be named in the FROM clause of the SELECT statement of the cursor, and the result table of the cursor must not be read-only. For an explanation of read-only result tables, see “DECLARE CURSOR” on page 368.

When the UPDATE statement is executed, the cursor must be positioned on a row; that row is updated.

isolation-clause

Specifies the isolation level to be used for this statement. For an explanation of *isolation-clause*, see isolation-clause.

UPDATE Rules

Assignment
Update values are assigned to columns under the assignment rules described in Chapter 2

Validity
If the identified table, or the base table of the identified view, has one or more unique indexes or unique constraints, each row updated in the table must conform to the constraints imposed by those unique indexes.

The unique indexes and unique constraints are effectively checked at the end of the statement unless COMMIT(*NONE) was specified. In the case of a multiple-row update, this would occur after all rows were updated. If COMMIT(*NONE) is specified, checking is performed as each row is updated.

If the identified table or the base table of the identified view has one or more check constraints, each check constraint must be true or unknown for each row of the updated table.

The check constraints are effectively checked at the end of the statement. In the case of a multiple-row update, this would occur after all rows were updated.

If a view is identified, the updated rows must conform to any applicable WITH CHECK OPTION. For more information, see “CREATE VIEW” on page 362.

Triggers
If the identified table or the base table of the identified view has an update trigger, the trigger is fired for each row updated.

Referential Integrity
The value of the parent key in a parent row must not be changed.

If the update values produce a foreign key that is nonnull, the foreign key must be equal to some value of the parent key of the parent table of the relationship.

The referential constraints (other than a referential constraint with a RESTRICT delete rule) are effectively checked at the end of the statement. In the case of a multiple-row update, this would occur after all rows were updated.

Notes

If an update value violates any constraints, or if any other error occurs during the execution of the UPDATE statement and COMMIT(*NONE) was not specified, all changes made during the execution of the statement are backed out. However, other changes in the unit of work made prior to the error are not backed out. If COMMIT(*NONE) is specified, changes are not backed out.

It is possible for an error to occur that makes the state of the cursor unpredictable.

When an UPDATE statement completes execution, the value of SQLERRD(3) in the SQLCA is the number of rows updated. For a description of the SQLCA, see “Appendix B. SQL Communication Area” on page 541.

Unless appropriate locks already exist, one or more exclusive locks are acquired by the execution of a successful UPDATE statement. Until these locks are released by a commit or rollback operation, the updated rows can only be accessed by:

- The application process that performed the update.
- Another application process using COMMIT(*NONE) or COMMIT(*CHG) through a read-only cursor, SELECT INTO statement, or subquery.

The locks can prevent other application processes from performing operations on the table. For further information about locking, see the description of the COMMIT, ROLLBACK, and LOCK TABLE statements, and isolation levels in “Isolation Level” on page 17. Also, see the Database Programming book.

A maximum of 4000000 rows can be updated or changed in any single UPDATE statement when COMMIT(*RR), COMMIT(*ALL), COMMIT(*CS), or COMMIT(*CHG) has been specified. The number of rows changed includes any rows inserted, updated, or deleted under the same commitment definition as a result of a trigger.

Host variables cannot be used in the UPDATE statement within a REXX procedure. Instead, the UPDATE must be the object of a PREPARE and EXECUTE using parameter markers.

Examples

Example 1

Change the job (JOB) of employee number (EMPNO) ‘000290’ in the EMPLOYEE table to ‘LABORER’.

```
UPDATE EMPLOYEE
  SET JOB = 'LABORER'
  WHERE EMPNO = '000290'
```

Example 2

Increase the project staffing (PRSTAFF) by 1.5 for all projects that department (DEPTNO) ‘D21’ is responsible for in the PROJECT table.

```
UPDATE PROJECT
  SET PRSTAFF = PRSTAFF + 1.5
  WHERE DEPTNO = 'D21'
```

Example 3

All the employees except the manager of department (WORKDEPT) ‘E21’ have been temporarily reassigned. Indicate this by changing their job (JOB) to NULL and their pay (SALARY, BONUS, COMM) values to zero in the EMPLOYEE table.

```
UPDATE EMPLOYEE
  SET JOB=NULL, SALARY=0, BONUS=0, COMM=0
  WHERE WORKDEPT = 'E21' AND JOB <> 'MANAGER'
```

Example 4

In a PL/I program display the rows from the EMPLOYEE table and then, if requested to do so, change the job (JOB) of certain employees to the new job keyed in.

```
EXEC SQL  DECLARE C1 CURSOR FOR
            SELECT *
              FROM EMPLOYEE
              FOR UPDATE OF JOB;

EXEC SQL  OPEN C1;

EXEC SQL  FETCH C1 INTO ...     ;
```

```
PUT ...      ;
GET LIST (CHANGE, NEWJOB);
IF CHANGE = 'YES' THEN
  EXEC SQL  UPDATE EMPLOYEE
              SET JOB = :NEWJOB
              WHERE CURRENT OF C1;

EXEC SQL  CLOSE C1;
```

VALUES INTO

The VALUES INTO statement produces a result table consisting of at most one row and assigns the values in that row to host variables.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

If an *expression* includes a function, the authorization ID of the statement must include at least one of the following for each user-defined function:

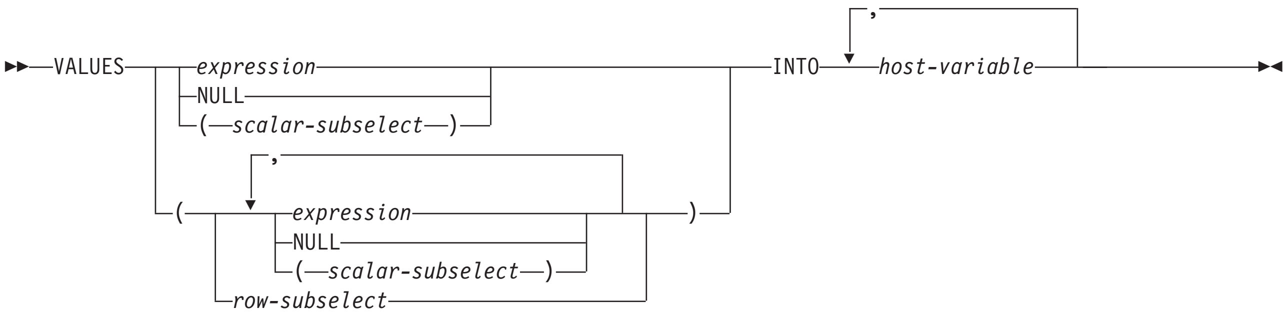
- The EXECUTE privilege on the function
- Administrative authority

The authorization ID of the statement has the EXECUTE privilege on a function when:

- It is the owner of the function,
- It has been granted the EXECUTE privilege on the function, or
- It has been granted the system authorities of *OBJOPR and *EXECUTE on the function.

If a *row-subselect* is specified, see “Chapter 4. Queries” on page 219 for an explanation of the authorization required for each subselect.

Syntax



Description

VALUES

Introduces a single row consisting of one of more columns.

expression
Specifies the new value of the host variable. The *expression* is any expression of the type described in “Expressions” on page 105. It must not include a column name. Host structures are not supported.

NULL
Specifies that the new value for the host variable is the null value.

scalar-subselect
A subselect that returns a single result row and a single result column. The result column value is assigned to the corresponding *host-variable*. If the result of the subselect is no rows, then the null value is assigned. An error is returned if there is more than one row in the result.

row-subselect
A subselect that returns a single result row. The result column values are assigned to each corresponding *host-variable*. If the result of the subselect is no rows, then null values are assigned. An error is returned if there is more than one row in the result.

INTO
Introduces a list of host variables and host structures. The first value in the result row is assigned to the first host variable in the list, the second value to the second host variable, and so on. The data type of each host variable must be compatible with its corresponding result column. Each assignment is made according to the rules described in “Assignments and Comparisons” on page 66 . If there are fewer host variables than values, the value ’W’ is assigned to the SQLWARN3 field of the SQLCA. (See “Appendix B. SQL Communication Area” on page 541.) Note that there is no warning if there are more variables than the number of result columns. If the value is null, an indicator variable must be provided. If an assignment error occurs, the value is not assigned to the variable, and no more values are assigned to variables. Any values that have already been assigned to variables remain assigned.

If an error occurs as the result of an arithmetic expression in the *expression* or SELECT list of the subselect (division by zero, or overflow) or a character conversion error occurs, the result is the null value. As in any other case of a null value, an indicator variable must be provided. The value of the host variable is undefined. In this case, however, the indicator variable is set to -2. Processing of the statement continues as if the error had not occurred. (However, this error causes a positive SQLCODE.) If you do not provide an indicator variable, a negative value is returned in the SQLCODE field of the SQLCA. It is possible that some values have already been assigned to host variables and will remain assigned when the error occurs.

host-variable, ...
Identifies one or more host structures or host variables that must be declared in accordance with the rules for declaring host structures and host variables, see “References to Host Variables” on page 94. In the operational form of INTO, a host structure is replaced by a reference to each of its variables.

Notes

If an error occurs, no value is assigned to the current host variable. However, if LOB values are involved, there is a possibility that the corresponding host variable was modified, but the variable’s contents are unpredictable.

If the specified host variable is character and is not large enough to contain the result, 'W' is assigned to SQLWARN1 in the SQLCA. The actual length of the result is returned in the indicator variable associated with the host-variable, if an indicator variable is provided.

If the specified host variable is a C NUL-terminated host variable and is not large enough to contain the result and the NUL-terminator:

- If the *CNULRQD option is specified on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*YES) on the SET OPTION statement), the following occurs:
  - The result is truncated.
  - The last character is the NUL-terminator.
  - The value 'W' is assigned to SQLWARN1 in the SQLCA.
- If the *NOCNULRQD option on the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*NO) on the SET OPTION statement) is specified, the following occurs:
  - The NUL-terminator is not returned.
  - The value 'N' is assigned to SQLWARN1 in the SQLCA.

Examples

Example 1

Assign the value of the CURRENT PATH special register to host variable HV1.

```
EXEC SQL VALUES CURRENT PATH INTO :HV1;
```

Example 2

Assume that LOB locator LOB1 is associated with a CLOB value. Assign a portion of the CLOB value to host variable DETAILS using the LOB locator.

```
EXEC SQL VALUES (SUBSTR(:LOB1,1,35)) INTO  :DETAILS;
```

WHENEVER

The WHENEVER statement specifies the action to be taken when a specified exception condition occurs.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in REXX. See the SQL Programming with Host Languages book for information on handling errors in REXX.

Authorization

None required.

Syntax

```
►►──WHENEVER──┬─NOT FOUND──┬──┬─CONTINUE──────────────────────────────┬──────────────►◄
              ├─SQLERROR───┤  └─┬─GOTO──┬──┬───┬──host-label──┘
              └─SQLWARNING─┘    └─GO TO─┘  └─:─┘
```

Description

The NOT FOUND, SQLERROR, or SQLWARNING clause is used to identify the type of exception condition.

NOT FOUND
Identifies any condition that results in an SQLCODE of +100 or an SQLSTATE of '02000'.

SQLERROR
Identifies any condition that results in a negative SQLCODE.

SQLWARNING
Identifies any condition that results in a warning condition (SQLWARN0 is 'W'), or that results in a positive SQLCODE other than +100 or in an SQLSTATE of class code 01.

The CONTINUE or GO TO clause is used to specify the next statement to be executed when the identified type of exception condition exists.

CONTINUE
Specifies the next sequential instruction of the source program.

GOTO or **GO TO** *host-label*
Specifies the statement identified by *host-label*. For host-label, substitute a single token, optionally preceded by a colon. The form of the token depends on the host language. In a COBOL program, for example, it can be a *section-name* or an unqualified *paragraph-name*.

Notes

There are three types of WHENEVER statements:
WHENEVER NOT FOUND
WHENEVER SQLERROR
WHENEVER SQLWARNING

Every executable SQL statement in a program is within the scope of one implicit or explicit WHENEVER statement of each type. The scope of a WHENEVER statement is related to the listing sequence of the statements in the program, not their execution sequence.

An SQL statement is within the scope of the last WHENEVER statement of each type that is specified before that SQL statement in the source program. If a WHENEVER statement of some type is not specified before an SQL statement, that SQL statement is within the scope of an implicit WHENEVER statement of that type in which CONTINUE is specified.

SQL does support nested programs in COBOL and C. However, SQL does not honor normal COBOL or C scoping rules. That is, the last WHENEVER statement specified in the program source prior to the nested program is still in effect for that nested program. The label referenced in the WHENEVER statement must be duplicated within that inner program. Alternatively, the inner program could specify a new WHENEVER statement.

In FORTRAN, the scope of a WHENEVER statement is limited to SQL statements within the same subprogram.

Example

Write the statements that need to be embedded in a COBOL program in order to:

1. Go to the label HANDLER for any statement that produces an error.

   ```
   EXEC SQL  WHENEVER SQLERROR GOTO HANDLER  END-EXEC.
   ```

2. Continue processing for any statement that produces a warning.

   ```
   EXEC SQL  WHENEVER SQLWARNING CONTINUE END-EXEC.
   ```

3. Go to the label ENDDATA for any statement that does not return data when expected to do so.

   ```
   EXEC SQL  WHENEVER NOT FOUND GOTO ENDDATA  END-EXEC.
   ```

Chapter 6. SQL Procedures and Functions

SQL procedures are created by specifying LANGUAGE SQL and an SQL-routine-body on the CREATE PROCEDURE statement. SQL functions are created by specifying LANGUAGE SQL and an SQL-routine-body on the CREATE FUNCTION statement. SQL routines can be SQL procedures or SQL functions.

The SQL-routine-body is the executable part of the procedure and is transformed by SQL into a program. When an SQL routine is created, SQL creates a temporary source file (QTEMP/QSQLSRC) that will contain C source code with embedded SQL statements. An SQL procedure is created as a program (*PGM) object using the CRTSQLCI and CRTPGM commands. An SQL function is created as a service program (*SRVPGM) object using the CRTSQLCI and CRTSRVPGM commands. The program is created in the library that is the implicit or explicit qualifier of the procedure or function name.

The specified procedure or function is registered in the SYSROUTINES and SYSPARMS catalog tables, and an internal link is created from SYSROUTINES to the program. When the procedure is called using the SQL CALL statement or when the function is invoked in an SQL statement, the program associated with the routine is called.

The SQL routine body must be a single SQL statement, including an SQL control statement. When the program is created, the SQL statements other than control statements become embedded SQL statements in the program.

The names used for SQL procedures and functions, SQL parameters, and SQL variables should not begin with 'SQL.'

SQL parameters and SQL variables can be referenced anywhere in the statement where an expression or host variable can be specified. Host variables cannot be specified in SQL routines. SQL parameters can be referenced anywhere in the routine and can be qualified with the routine name. SQL variables can be referenced anywhere in the compound statement in which they are declared and can be qualified with the label name specified at the beginning of the compound statement.

All SQL parameters and SQL variables are considered nullable. The name of an SQL parameter or SQL variable in an SQL routine can be the same as the name of a column in a table or view referenced in the routine. In this case, the name should be explicitly qualified to indicate whether it is a column, SQL variable, or SQL parameter. If the name is not qualified, the following rules describe whether the name refers to the column or to the SQL variable or parameter:

- If the tables and views specified in an SQL routine body exist at the time the routine is created, the name will first be checked as a column name. If not found as a column, it will then be checked as an SQL variable or SQL parameter name.
- If the referenced tables or views do not exist at the time the routine is created, the name will first be checked as an SQL variable or SQL parameter name. If not found, it will be assumed to be a column.

See the following topics for syntax and additional information:

- "SQL routine body" on page 514

- “SQL procedure statement” on page 515
- “SQL control statements” on page 515
- “assignment-statement” on page 516
- “call-statement” on page 517
- “case-statement” on page 518
- “compound-statement” on page 520
- “if-statement” on page 527
- “for-statement” on page 524
- “goto-statement” on page 526
- “leave-statement” on page 528
- “loop-statement” on page 529
- “repeat-statement” on page 529
- “resignal-statement” on page 530
- “return-statement” on page 532
- “signal-statement” on page 533
- “while-statement” on page 536

SQL routine body

The SQL routine body can be any one of the following SQL statements:

Syntax

```
                                            (1)
►►──┬─SQL-control-statement───────────┬─────────────────────────────────►◄
    ├─COMMENT ON statement────────────┤
    ├─COMMIT statement────────────────┤
    ├─CONNECT statement───────────────┤
    ├─CREATE statement────────────────┤
    ├─DELETE statement────────────────┤
    ├─DISCONNECT statement────────────┤
    ├─DROP statement──────────────────┤
    ├─EXECUTE IMMEDIATE statement─────┤
    ├─GRANT statement─────────────────┤
    ├─INSERT statement────────────────┤
    ├─LABEL ON statement──────────────┤
    ├─LOCK TABLE statement────────────┤
    ├─RELEASE statement───────────────┤
    ├─RENAME statement────────────────┤
    ├─REVOKE statement────────────────┤
    ├─ROLLBACK statement──────────────┤
    ├─SELECT INTO statement───────────┤
    ├─SET CONNECTION statement────────┤
    ├─SET RESULT SETS statement───────┤
    ├─SET TRANSACTION statement───────┤
    └─UPDATE statement────────────────┘
```

Notes:

1 COMMIT, ROLLBACK, CONNECT, DISCONNECT, SET CONNECTION, SET RESULT SETS, and SET TRANSACTION statements are only allowed in SQL procedures.

SQL procedure statement

If an SQL control statement is specified as the SQL routine body, multiple statements can be specified within the control statement. These statements are defined as SQL procedure statements.

Syntax

```
                                           (1)
►►──┬─SQL-control-statement─────────┬──────────────────────────────────►◄
    ├─ALTER-statement───────────────┤
    ├─CLOSE-statement───────────────┤
    ├─COMMENT ON-statement──────────┤
    ├─COMMIT-statement──────────────┤
    ├─CONNECT-statement─────────────┤
    ├─CREATE ALIAS-statement────────┤
    ├─CREATE COLLECTION-statement───┤
    ├─CREATE DISTINCT TYPE-statement┤
    ├─CREATE INDEX-statement────────┤
    ├─CREATE TABLE-statement────────┤
    ├─CREATE VIEW-statement─────────┤
    ├─DELETE-statement──────────────┤
    ├─DISCONNECT-statement──────────┤
    ├─DROP-statement────────────────┤
    ├─EXECUTE-statement─────────────┤
    ├─EXECUTE IMMEDIATE-statement───┤
    ├─FETCH-statement───────────────┤
    ├─GET DIAGNOSTICS-statement─────┤
    ├─GRANT-statement───────────────┤
    ├─INSERT-statement──────────────┤
    ├─LABEL ON-statement────────────┤
    ├─LOCK TABLE-statement──────────┤
    ├─OPEN-statement────────────────┤
    ├─PREPARE-statement─────────────┤
    ├─RELEASE-statement─────────────┤
    ├─RENAME-statement──────────────┤
    ├─REVOKE-statement──────────────┤
    ├─ROLLBACK-statement────────────┤
    ├─SELECT INTO-statement─────────┤
    ├─SET CONNECTION-statement──────┤
    ├─SET PATH-statement────────────┤
    ├─SET RESULT SETS-statement─────┤
    ├─SET TRANSACTION-statement─────┤
    └─UPDATE-statement──────────────┘
```

Notes:

1 COMMIT, ROLLBACK, CONNECT, DISCONNECT, SET CONNECTION, SET RESULT SETS, and SET TRANSACTION statements are only allowed in SQL procedures.

SQL control statements

SQL control statements provide the capability of adding logic and control flow to an SQL routine. SQL control statements can only be specified within an SQL routine.

Syntax

```
►►──┬─assignment-statement─┬─────────────────────────────────────────────►◄
    ├─call-statement───────┤
    ├─case-statement───────┤
    ├─compound-statement───┤
    ├─for-statement────────┤
    ├─goto-statement───────┤
    ├─if-statement─────────┤
    ├─leave-statement──────┤
    ├─loop-statement───────┤
    ├─repeat-statement─────┤
    ├─resignal-statement───┤
    ├─return-statement─────┤
    ├─signal-statement─────┤
    └─while-statement──────┘
```

---

assignment-statement

The assignment-statement assigns a value to an output parameter or to a local variable.

Syntax

```
►►──┬──────────┬──SET──┬─SQL-parameter-name─┬── = ─────────────────────────►
    └─label:───┘       └─SQL-variable-name──┘

►──┬─expression─────────────────┬───────────────────────────────────────►◄
   ├─NULL───────────────────────┤
   └─(──scalar-subselect──)─────┘
```

Description

SQL-parameter-name
Identifies the parameter that is the assignment target. The parameter must be an output parameter.

SQL-variable-name
Identifies the SQL variable that is the assignment target. SQL variables can be defined in a compound statement.

expression or **NULL**
Specifies the assignment source expression or value.

scalar-subselect
A subselect that returns a single result. The result is assigned to the corresponding SQL variable or parameter. If the result of the subselect is no rows, then the null value is assigned. An error is returned if there is more than one row in the result.

Notes

Assignments statements in SQL procedures must conform to the SQL assignment rules. See "Assignments and Comparisons" on page 66 for assignment rules.

The data type of the target and source must be compatible.

When a string is assigned to a fixed-length variable and the length of the string is less than the length attribute of the target, the string is padded on the right with the necessary number of single-byte, double-byte, or UCS-2 blanks.

When a string is assigned to a variable and the string is longer than the length attribute of the variable, a negative SQLCODE is set.

A string assigned to a variable is first converted, if necessary, to the coded character set of the target.

If truncation of the whole part of the number occurs on assignment to a numeric variable, a negative SQLCODE is set.

If the target of the assignment is a variable and source is a variable or constant, the assignment may be performed inline. In this case, the SQLCODE and SQLSTATE will not be reset.

Example

Increase the SQL variable p_salary by 10 percent.

```
SET p_salary = p_salary + (p_salary * .10);
```

Set SQL variable p_salary to the null value

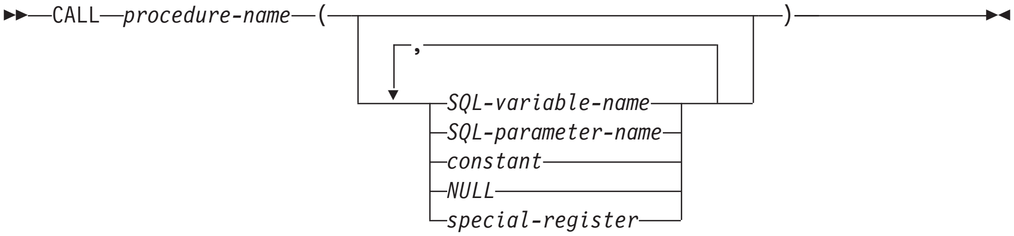
```
SET p_salary = NULL;
```

---

call-statement

The CALL statement invokes a procedure. Please refer to “CALL” on page 266.

Syntax



Description

procedure-name
Identifies the procedure to call. The *procedure-name* must identify a procedure that exists at the current server.

SQL-variable-name or SQL-parameter-name or constant or *special-register*
Identifies a list of values to pass as parameters to the procedure.

Notes

If the procedure name identifies a procedure that was defined by a CREATE PROCEDURE statement, each IN or INOUT parameter must be specified as an

SQL parameter or variable. The number of arguments specified must be the same as the number of parameters defined by that procedure.

See "CALL" on page 266 for more information.

Example

Call procedure *proc1* and pass SQL variables as parameters.

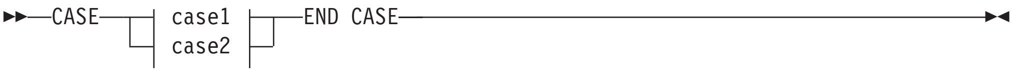
```
CALL proc1(v_empno, v_salary)
```

---

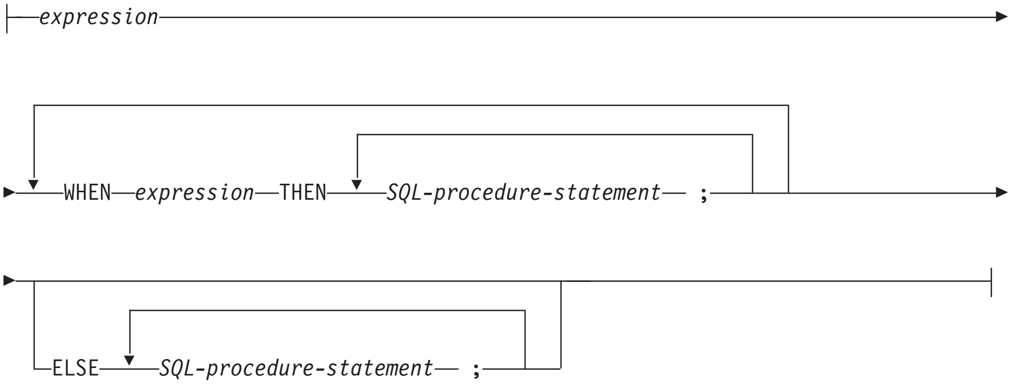
case-statement

The case-statement selects an execution path based on multiple conditions.

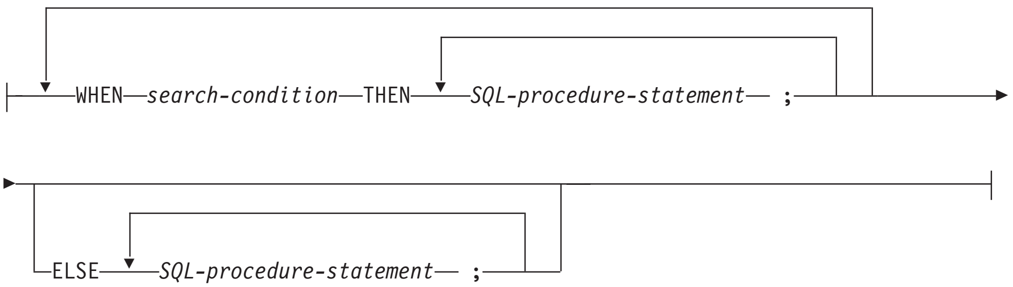
Syntax



case1:



case2:



Description

case1
: In case1, the value specified following CASE is compared to see if it equals the value specified following the WHEN keyword. If the comparison is true, the THEN statement is executed. If the result is unknown or false, processing continues to the next expression or the ELSE.

case2
: Case2 specifies the search condition for which the statements should be executed. If the search condition is true, the THEN statement is executed. If the result is unknown or false, processing continues to the next search condition or the ELSE.

| The *search-condition* in a *searched-when-clause* cannot contain a basic predicate with a subselect, a quantified predicate, an IN predicate using a subselect, or an EXISTS predicate.

SQL-procedure-statement
: Specifies a statement that should be executed.

Notes

If none of the conditions specified in the WHEN are true, and an ELSE is not specified, an error is issued at runtime and the execution of the case statement is terminated.

Case statements can be nested up to 3 levels when using the case1 form. There is no limit when using the case2 form.

Examples

Depending on the value of SQL variable v_workdept, update column DEPTNAME in table DEPARTMENT with the appropriate name.

The following example shows how to do this using the syntax for case1.

```
CASE v_workdept
  WHEN 'A00'
    THEN UPDATE department SET
               deptname = 'DATA ACCESS 1';
  WHEN 'B01'
    THEN UPDATE department SET
               deptname = 'DATA ACCESS 2';
    ELSE UPDATE department SET
               deptname = 'DATA ACCESS 3';
END CASE
```

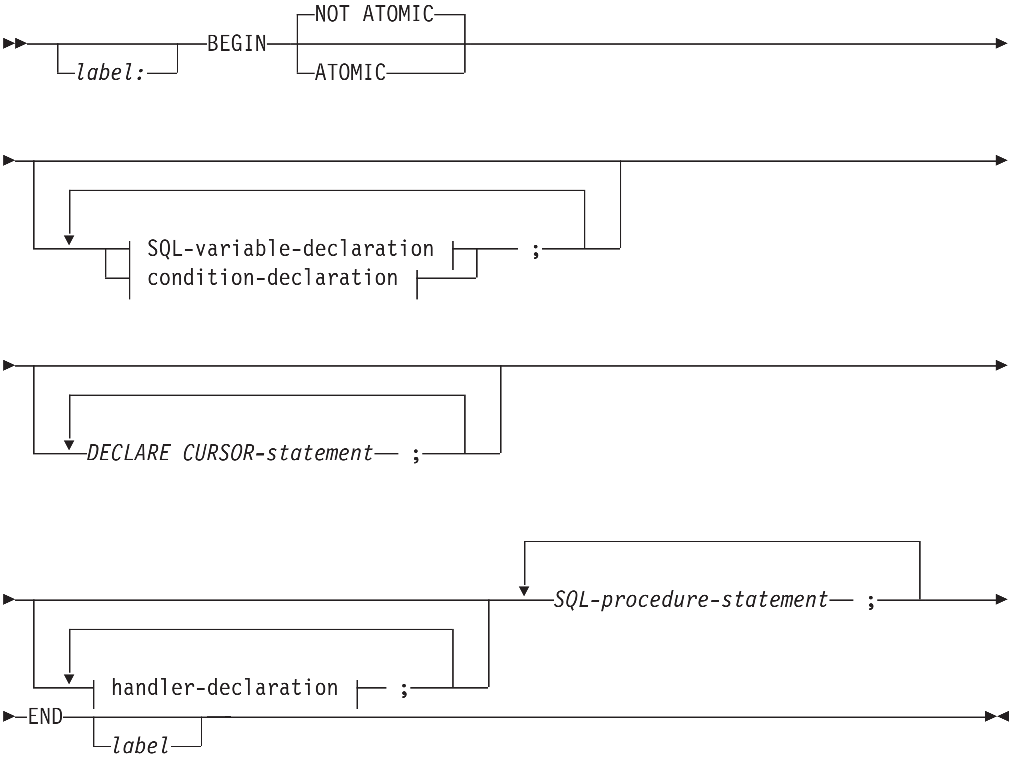
The following example shows how to do this using the syntax for case2:

```
CASE
  WHEN v_workdept = 'A00'
    THEN UPDATE department SET
               deptname = 'DATA ACCESS 1';
  WHEN v_workdept = 'B01'
    THEN UPDATE department SET
               deptname = 'DATA ACCESS 2';
    ELSE UPDATE department SET
               deptname = 'DATA ACCESS 3';
END CASE
```

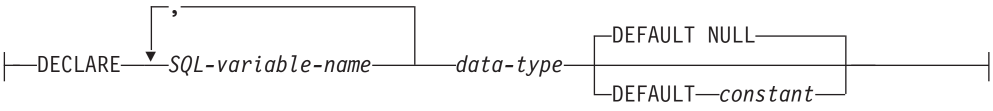
compound-statement

The compound statement groups other statements together in an SQL routine. Within a compound statement, SQL variables, cursors, and handlers can be declared.

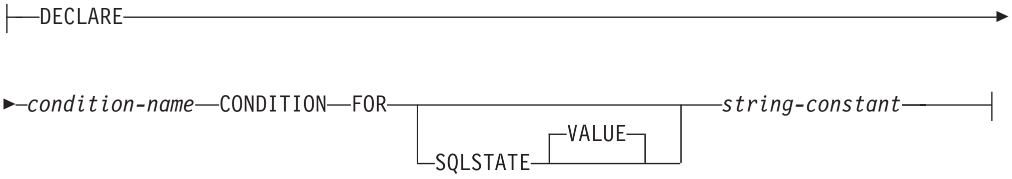
Syntax



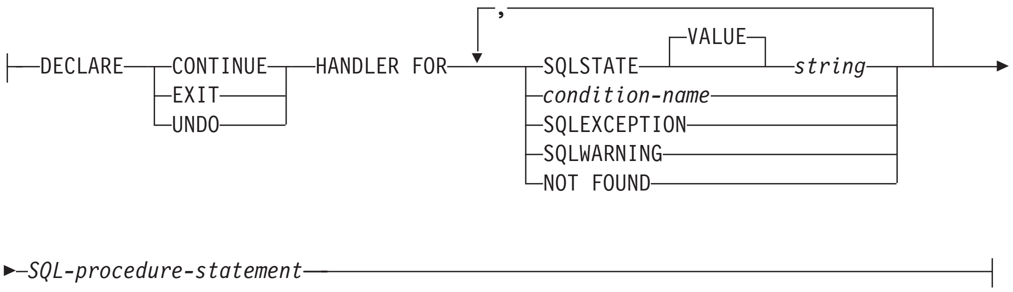
SQL-variable-declaration:



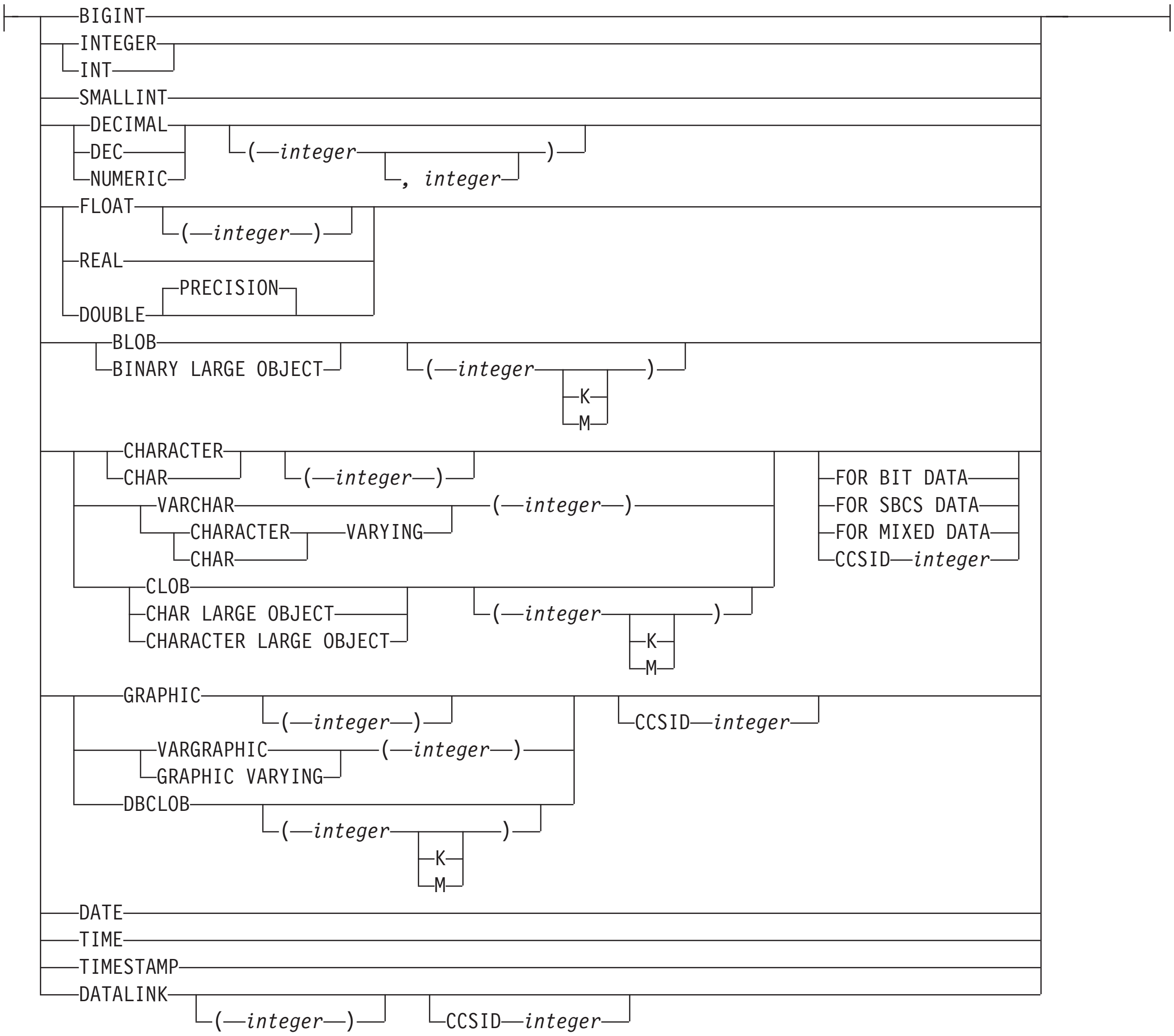
condition-declaration:



handler-declaration:



data-type:



Description

label
Defines the label for the code block. If the beginning label is specified, it can be used to qualify SQL variables declared in the compound statement and can also be specified on a LEAVE statement. If the ending label is specified, it must be the same as the beginning label.

ATOMIC or **NOT ATOMIC**
ATOMIC indicates that if an error occurs in the compound statement, all SQL statements in the compound statement will be rolled back. If ATOMIC is specified, COMMIT or ROLLBACK statements cannot be specified in the compound statement.

NOT ATOMIC indicates that an error within the compound statement does not cause the compound statement to be rolled back. ATOMIC cannot be specified for SQL functions.

SQL-variable-declaration
Declare a local variable.

SQL-variable-name
Defines the name of a local variable. The name cannot be the same as another SQL variable within the same compound statement and cannot be the same as a parameter name. SQL variable names should not be the same as column names. If an *SQL-variable-name* is specified in an SQL statement and a column of a table that is specified in the statement has the same name, the name will be bound as a column name, not as a variable name.

If SQLCODE is specified for an SQL-variable-name and the data-type is specified as INTEGER, the variable is used as a stand-alone SQLCODE in the procedure and can be checked to determine whether SQL statements are successful. Similarly, if SQLSTATE is specified and the data-type is specified as CHAR(5), the variable is used as a stand-alone SQLSTATE in the procedure. Once declared, the SQLCODE and SQLSTATE variables can be referenced anywhere in the procedure. The SQLCODE and SQLSTATE variables cannot be set to NULL.

data-type
Specifies the data type of the variable. See "CREATE TABLE" on page 340 for a description of data type.

DEFAULT *constant* or **NULL**
Defines the default for the SQL variable. The variable will be initialized when the SQL routine is called. If a default value is not specified, the following initialization occurs:

- A stand-alone SQLCODE variable is initialized to 0
- A stand-alone SQLSTATE variable is initialized to '00000'
- All other variables are initialized to NULL

condition-declaration
Declares a condition name and corresponding SQLSTATE value.

condition-name
Defines the name of the condition. The condition name must be unique within the procedure and can only be referenced within the compound statement in which it is declared.

FOR *string*
Defines the SQLSTATE associated with this condition. The string must be specified as 5 characters, and cannot be ’00000’.

declare-cursor-statement
Declares a cursor. The cursor name may not be the same name as another cursor defined in the procedure. An OPEN statement must be specified to open the cursor and a FETCH statement can be specified to read rows using the cursor. If a CLOSE statement is not specified and RESULT SET was not specified when the procedure was created, the cursor is closed at the end of the compound statement. The cursor can only be referenced from within the compound statement. For more information, see “DECLARE CURSOR” on page 368.

handler-declaration
Associates a handler with an exception or completion condition for the compound statement. Handlers are only active within the compound statement in which they are declared.

CONTINUE
Once the handler is invoked successfully, control is returned to the SQL statement following the one that raised the exception. If the error occurs while executing a comparison as in an IF, CASE, WHILE, or REPEAT, control returns to the statement following the END IF, END CASE, END WHILE, or END REPEAT.

EXIT
Once the handler is invoked successfully, control is returned to the end of the compound statement.

UNDO
ROLLBACK the changes made by the compound statement and invoke the handler. Once the handler is invoked successfully, control is returned to the end of the compound statement. If UNDO is specified, then ATOMIC must be specified.

SQLSTATE *string*
Defines an SQLSTATE to be associated with the handler. The SQLSTATE cannot be ’00000’.

condition-name
Defines the condition name. The condition name must be previously defined in a condition declaration.

SQLEXCEPTION
Defines an exception. SQLEXCEPTION corresponds to SQLSTATE values with a class value other than ″00″, ″01″, and ″02″.

SQLWARNING
Defines a warning. SQLWARNING corresponds to SQLSTATE values with a class value of ″01″.

NOT FOUND
Defines the NOT FOUND SQLSTATE. NOT FOUND corresponds to SQLSTATE values with a class value of ″02″.

Notes

Compound statements cannot be nested.

Handler declarations containing SQLEXCEPTION, SQLWARNING, or NOT FOUND cannot contain additional SQLSTATE or condition names.

Handler declarations within the same compound statement cannot contain duplicate conditions.

A handler declaration cannot contain the same condition value or SQLSTATE value more than once, and cannot contain a SQLSTATE value and a condition name that represents the same SQLSTATE value. For a list of SQLSTATE values as well as more information, see the SQL Programming Concepts book.

A created handler is activated when it is the most appropriate handler for an exception or completion condition. If an error occurs for which there is no handler, execution of the compound statement is ended.

Example

The following example creates an SQL procedure PROC1. The routine body of the procedure is a compound statement. The compound statement declares SQL variables, a condition for the SQLSTATE ’02000’, a continue handler, and a declare cursor statement. The WHILE statement loops on the FETCH statement. If a condition of ’02000’, end of file, is returned, the handler gets invoked, and SQL variable at_end is set to 1. Control is returned from the handler, and the WHILE loop is exited because at_end is no longer 0.

```
CREATE PROCEDURE PROC1 () LANGUAGE SQL
BEGIN
DECLARE v_firstnme VARCHAR(12);
DECLARE v_midinit CHAR(1);
DECLARE v_lastname VARCHAR(15);
DECLARE v_edlevel SMALLINT;
DECLARE v_salary DECIMAL(9,2);
DECLARE at_end INT DEFAULT 0;
DECLARE not_found
       CONDITION FOR SQLSTATE '02000';
DECLARE c1 CURSOR FOR
  SELECT firstnme, midinit, lastname,
                   edlevel, salary
  FROM employee;
DECLARE CONTINUE HANDLER FOR not_found
            SET at_end = 1;
OPEN c1;
FETCH c1 INTO v_firstnme, v_midinit,
            v_lastname, v_edlevel, v_salary;
WHILE at_end = 0 DO
   FETCH c1 INTO
              v_firstname, v_midinit,
              v_lastname, v_edlevel, v_salary;
END WHILE;
CLOSE c1;
END
```

---

for-statement

The for-statement executes a statement for each row of a table.

Syntax

```
►►──┬─────────┬──FOR──variable-name──AS──┬──────────────────────────┬──────────────►
    └─label:──┘                          └─cursor-name──CURSOR FOR──┘
```

```
                         ┌──────────────────────────────┐
                         ▼                              │
►─select-statement──DO──────SQL-procedure-statement── ;─┴──────────────────────►

►─END FOR──┬───────┬────────────────────────────────────────────────────────────►◄
           └─label─┘
```

Description

label
Defines the label for the code block. If the ending label is specified, it must be the same as the beginning label.

variable-name
This variable is not used in the implementation of the for-statement.

cursor-name
Names a cursor. The name must not be the same as the name of another cursor declared in the SQL procedure. If not specified, a unique cursor name is generated.

select-statement
Specifies the select statement of the cursor.

The select list must only consist of unique column names. If the AS clause is specified, that name is used for the variable and must be unique.

SQL-procedure-statement
SQL statements to be executed for each row of the table. The SQL statements cannot include a LEAVE statement specifying the label on the FOR statement and should not include an OPEN, FETCH, or CLOSE specifying the cursor name of the FOR statement.

Notes

The for-statement executes one or multiple statements for each row in a table. The cursor is defined by specifying a select list that describes the columns and rows selected. The statements within the for-statement are executed for each row selected.

The select list must consist of unique column names and the table specified in the select list must exist when the procedure is created.

The cursor specified in a for-statement cannot be referenced outside the for-statement and cannot be specified on an OPEN, FETCH, or CLOSE statement.

Example

In this example, the for-statement is used to specify a cursor that selects 3 columns from the `employee` table. For every row selected, SQL variable *fullname* is set to the last name followed by a comma, the first name, a blank, and the middle initial. Each value for *fullname* is inserted into table `TNAMES`.

```
BEGIN
  DECLARE fullname CHAR(40);
  FOR vl AS
      c1 CURSOR FOR
    SELECT firstnme, midinit, lastname FROM employee
```

```
                DO
                  SET fullname =
                     lastname || ', ' || firstnme ||' ' || midinit
                  INSERT INTO TNAMES VALUE ( fullname );
                END FOR;
           END;
```

---

goto-statement

The goto-statement is used to branch to a user-defined label within an SQL routine.

Syntax

```
►►──GOTO──label─────────────────────────────────────────────────►◄
```

Description

label
: Specifies the labelled statement where processing is to continue. The labelled statement and the GOTO statement must both be in the same scope:

- If the GOTO statement is defined in a FOR statement, *label* must be defined inside the same FOR statement, excluding a nested FOR statement.
- If the GOTO statement is defined outside a FOR statement, *label* must not be defined within a FOR statement.
- If the GOTO statement is defined in a handler, *label* must be defined inside the same handler.
- If the GOTO statement is defined outside a handler, *label* must not be defined within a handler.

Notes

Use the GOTO statement sparingly. Because the GOTO statement interferes with the normal sequence of processing, it makes a routine more difficult to read and maintain. Often, another statement, such as IF or LEAVE, can eliminate the need for a GOTO statement.

Example

In the following statement, the parameters *rating* and *v_empno* are passed in to the procedure. The time in service is returned as a date duration in output parameter *return_parm*. If the time in service with the company is less then 6 months, the GOTO statement transfers control to the end of the procedure and *new_salary* is left unchanged.

```
CREATE PROCEDURE adjust_salary (IN v_empno CHAR(6),
                                IN rating INTEGER,
                                OUT return_parm DECIMAL(8,2))
  LANGUAGE SQL
  MODIFIES SQL DATA
    BEGIN
       DECLARE new_salary DECIMAL(9,2);
       DECLARE service DECIMAL(8,2);
            SELECT salary, current_date - hiredate
               INTO new_salary, service
               FROM employee
```

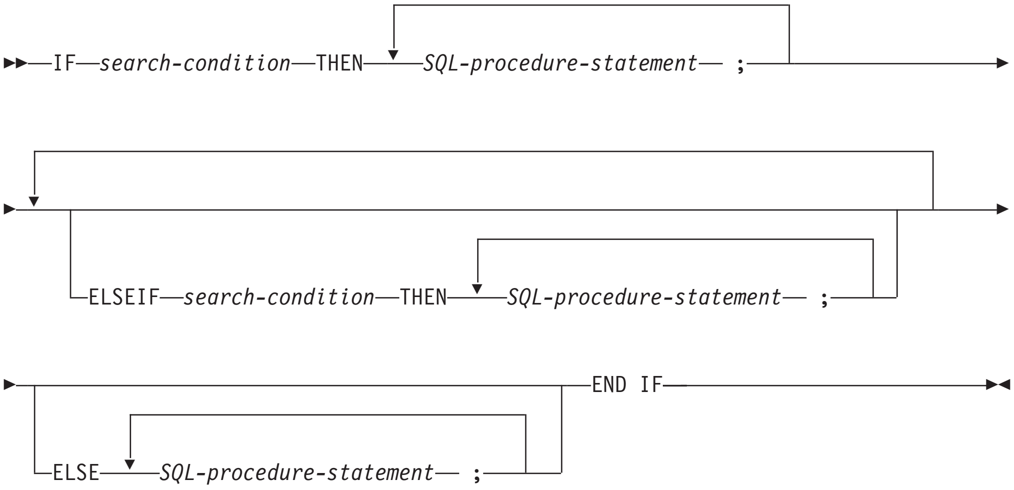
```
          WHERE empno = v_empno;
       IF service < 600
         THEN GOTO exit1;
       END IF;
       IF rating = 1
        THEN SET new_salary =
                     new_salary + (new_salary * .10);
        ELSEIF rating = 2
        THEN SET new_salary =
                     new_salary + (new_salary * .05);
       END IF;
       UPDATE employee
          SET salary = new_salary
          WHERE empno = v_empno;

  exit1: SET return_parm = service;
END;
```

---

if-statement

The if-statement provides conditional execution based on the truth value of a condition.

Syntax



Description

search-condition
Specifies the condition for which the SQL statement should be executed. If the condition is unknown or false, processing continues to the next search condition or ELSE clause.

SQL-procedure-statement
Specifies SQL statements that should be executed.

Example

In the following statement, the parameters *rating* and *v_empno* are passed in to the procedure.. Depending on the value of *rating*, the SQL variable *new_salary* is set to a new value and the employee table is updated.

```
CREATE PROCEDURE adjust_salary2 (IN v_empno CHAR(6),
                                  IN rating INTEGER,
                                  OUT return_parm DECIMAL(8,2))
  LANGUAGE SQL
  MODIFIES SQL DATA
          BEGIN
            DECLARE new_salary DECIMAL(9,2);
            SELECT salary
               INTO new_salary
               FROM employee
               WHERE empno = v_empno;
            IF rating = 1
             THEN SET new_salary =
                          new_salary + (new_salary * .10);
             ELSEIF rating = 2
             THEN SET new_salary =
                          new_salary + (new_salary * .05);
            END IF;
            UPDATE employee
               SET salary = new_salary
               WHERE empno = v_empno;
          END;
```

leave-statement

The leave-statement continues execution by leaving a block or loop.

Syntax

```
►►──LEAVE──label───────────────────────────────────────────────────►◄
```

Description

label
Specifies the label of the block or loop to exit.

Notes

When a LEAVE of a compound statement is executed, all cursors specified within the compound statement are closed, unless a value other than 0 was specified for RESULT SETS when the procedure was created.

Example

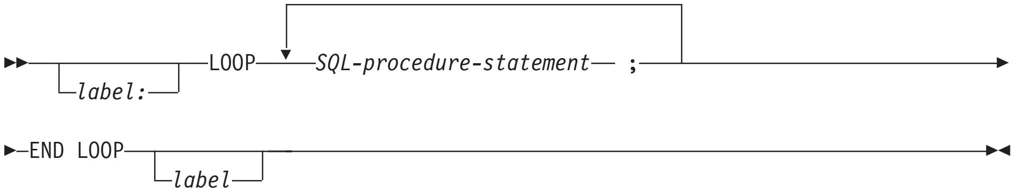
The example contains a loop that fetches data for cursor *c1*. If the fetch returns an SQLCODE other than 0, the LEAVE statement is executed to exit the loop. SQLCODE must be declared as an SQL variable of type INTEGER to be specified as a stand-alone SQLCODE.

```
fetch_loop:
LOOP
   FETCH c1 INTO
       v_firstnme, v_midinit,
       v_lastname
   IF SQLCODE <> 0 THEN
      LEAVE fetch_loop;
END LOOP fetch_loop;
CLOSE c1;
```

loop-statement

The loop-statement repeats the execution of a statement.

Syntax



Description

label
Defines the label for the code block. If the beginning label is specified, it can be specified on a LEAVE statement. If the ending label is specified, it must be the same as the beginning label.

SQL-procedure statement
Specifies the SQL statements to be executed in the loop

Example

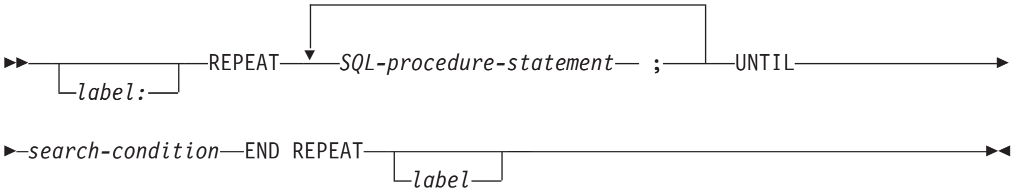
This example calls procedure RETURN_DEPTINFO, that returns information for a new department. If P_DEPT is not the null value, the information is inserted into the DEPARTMENT table. If it is the null value, the loop is exited.

```
ins_loop:
LOOP
   CALL RETURN_DEPTINFO (P_DEPT, PDEPTNAME, P_ADMDEPT);
   IF P_DEPT IS NULL THEN
     LEAVE ins_loop;
   ELSE
     INSERT INTO DEPARTMENT (P_DEPT,PDEPTNAME,P_ADMDEPT);
END LOOP;
```

repeat-statement

The repeat-statement repeats the execution of a statement.

Syntax



Description

label
Defines the label for the code block. If the ending label is specified, it must be the same as the beginning label.

SQL-procedure-statement
Specifies the SQL statement to be executed.

search-condition
The search-condition is evaluated after each execution of the loop. If the condition is true, the loop will exit. If the condition is unknown or false, the looping continues.

Example

This example uses a repeat-statement to loop on a FETCH statement.

```
fetch_loop:
REPEAT
FETCH c1 INTO
   v_firstnme, v_midinit,v_lastname;
until
    SQLCODE <> 0
END REPEAT fetch_loop;
CLOSE c1;
```

---

resignal-statement

The resignal-statement is used to resignal an error or warning condition. It causes an error or warning to be returned with the specified SQLSTATE and optional message text.

Syntax

```
►►──RESIGNAL──┬──────────────────────────────────────────────────┬──────────────►◄
              └─┤ signal-value ├──┬───────────────────────────┬──┘
                                  └─┤ signal-information ├────┘
```

signal-value:

```
         ┌─VALUE─┐
├──┬─SQLSTATE─┴───────┴─sqlstate-string-constant─┬──────────────────────────┤
   └─condition-name──────────────────────────────┘
```

signal-information:

```
├──SET──MESSAGE_TEXT──=──┬─SQL-variable-name─────────┬──────────────────────────┤
                         └─diagnostic-string-constant─┘
```

Description

SQLSTATE *sqlstate-string-constant*
Specifies the SQLSTATE error code that will be resignalled. The string must be specified as 5 characters, that follow the rules for SQLSTATEs:

- Each character must be from the set of digits (’0’ through ’9’) or non-accented upper case letters (’A’ through ’Z’).
- The SQLSTATE class (first two characters) cannot be ’00’ since this represents successful completion.

condition-name
Identifies a condition that will be resignalled. The condition name must be declared within the compound statement.

MESSAGE_TEXT
Specifies a string that describes the error or warning. The string is returned in the SQLERRMC field of the SQLCA. If the actual length of the string is longer than 70 characters, it is truncated without a warning.

SQL-variable-name
Identifies an SQL variable that must be declared within the compound statement. The SQL variable must be defined as CHAR or VARCHAR.

diagnostic-string-constant
Specifies a string constant that contains the message text.

Notes

If the RESIGNAL statement is specified without a SQLSTATE clause or a condition-name, the RESIGNAL statement must be in a handler. The SQL routine returns to the caller with the identical condition that invoked the handler.

When a RESIGNAL statement is issued and an SQLSTATE value or *condition-name* is specified, the SQLCODE returned in the SQLCA is set based on the SQLSTATE value.

- If the specified SQLSTATE class is either ’01’ or ’02’, a warning or not found is signalled and the SQLCODE is set to +438.
- Otherwise, an exception is resignalled and the SQLCODE is set to –438.

When a RESIGNAL statement is issued and neither an SQLSTATE value or *condition-name* is specified, the SQLCODE is not changed.

If the SQLSTATE or condition indicates that an exception (SQLSTATE class other than ’01’ or ’02’) is signalled,

- If a handler exists in the same compound statement as the signal statement, and the compound statement contains a handler for SQLEXCEPTION or the specified SQLSTATE or condition; the exception is handled and control is transferred to that handler.
- Otherwise, the exception is not handled and control is immediately returned to the caller of the routine.

If the SQLSTATE or condition indicates that a warning (SQLSTATE class ’01’) or not found (SQLSTATE class ’02’) is signalled,

- If a handler exists in the same compound statement as the signal statement, and the compound statement contains a handler for SQLWARNING (if the SQLSTATE class is ’01’), NOT FOUND (if the SQLSTATE class is ’02’), or the specified SQLSTATE or condition; the warning or not found condition is handled and control is transferred to that handler.

- Otherwise, the warning is not handled and processing continues with the next statement.

SQLSTATE values are comprised of a two-character class code value, followed by a three-character subclass code value. Class code values represent classes of successful and unsuccessful execution conditions.

Any valid SQLSTATE value can be used in the SIGNAL statement. However, it is recommended that programmers define new SQLSTATEs based on ranges reserved for applications. This prevents the unintentional use of an SQLSTATE value that might be defined by the database manager in a future release.

- SQLSTATE classes that begin with the characters ′7′ through ′9′ or ′I′ through ′Z′ may be defined. Within these classes, any subclass may be defined.
- SQLSTATE classes that begin with the characters ′0′ through ′6′ or ′A′ through ′H′ are reserved for the database manager. Within these classes, subclasses that begin with the characters ′0′ through ′H′ are reserved for the database manager. Subclasses that begin with the characters ′I′ through ′Z′ may be defined.

For more information on SQLSTATEs, see Appendix B of the SQL Programming Concepts book.

Example

This example detects a division by zero error. The IF statement uses a SIGNAL statement to invoke the overflow condition handler. The condition handler uses a RESIGNAL statement to return a different SQLSTATE value to the client application.

```
CREATE PROCEDURE divide ( IN numerator INTEGER,
                    IN denominator INTEGER,
                  OUT divide_result INTEGER )
  LANGUAGE SQL
    BEGIN
       DECLARE overflow CONDITION FOR '22003';
       DECLARE CONTINUE HANDLER FOR overflow
           RESIGNAL SQLSTATE '22375';
       IF denominator = 0 THEN
           SIGNAL overflow;
       ELSE
           SET divide_result = numerator / denominator;
       END IF;
      END;
```

---

return-statement

The return-statement is used to return from the routine. For SQL functions, it returns the result of the function. For an SQL procedure, it optionally returns an integer status value.

Syntax

```
►►──RETURN──┬────────────┬──────────────────────────────────────────────────────►◄
            ├─expression─┤
            └─NULL───────┘
```

Description

expression
Specifies a value that is returned from the routine:

- If the routine is a function, *expression* must be specified. The value must be compatible with the data type that is specified on the RETURNS clause of the CREATE FUNCTION statement.
- If the routine is a procedure, the data type of *expression* must be INTEGER. If the expression is the null value, a value of 0 is returned.

NULL
The null value is returned from the SQL function. NULL is not allowed in SQL procedures.

Notes

If a RETURN statement was not used to return from a procedure or if a value is not specified on the RETURN statement,

- if the procedure returns with an SQLCODE that is greater or equal to zero, the return status will be set to a value of 0, or
- if the procedure returns with an SQLCODE that is less than zero, the return status will be set to a value of –1.

When a value is returned from a procedure, the caller may access the value using:

- the GET DIAGNOSTICS statement to retrieve the RETURN_STATUS when the SQL procedure was called from another SQL procedure or SQL function, or
- directly from the SQLCA returned from processing the CALL of an SQL procedure by retrieving the value of sqlerrd[0].

Example

Use a RETURN statement to return from an SQL stored procedure with a status value of zero if successful, and –200 if not.

```
BEGIN
  ...
  GOTO fail;
  ...
  success: RETURN 0
  failure: RETURN -200
```

---

signal-statement

The signal-statement is used to signal an error or warning condition. It causes an error or warning to be returned with the specified SQLSTATE and optional message text.

Syntax

```
►►──SIGNAL──┤ signal-value ├──┬────────────────────────────┬──────────────►◄
                              └──┤ signal-information ├──┘
```

signal-value::

signal-statement

```
                 ┌─VALUE─┐
├──┬─SQLSTATE────┴───────┴──sqlstate-string-constant─┬──────────────────────────────┤
   └─condition-name──────────────────────────────────┘
```

signal-information::

```
├──SET──MESSAGE_TEXT──=──┬─SQL-variable-name──────────┬──────────────────────────────┤
                         └─diagnostic-string-constant─┘
```

Description

SQLSTATE *sqlstate-string-constant*

Specifies the SQLSTATE error code that will be signalled. The string must be specified as 5 characters, that follow the rules for SQLSTATEs:

- Each character must be from the set of digits (Æ0Æ through Æ9Æ) or non-accented upper case letters (ÆAÆ through ÆZÆ).
- The SQLSTATE class (first two characters) cannot be Æ00Æ since this represents successful completion.

condition-name

Identifies a condition that will be signalled. The condition name must be declared within the compound statement.

MESSAGE_TEXT

Specifies a string that describes the error or warning. The string is returned in the SQLERRMC field of the SQLCA. If the actual length of the string is longer than 70 characters, it is truncated without a warning.

SQL-variable-name

Identifies an SQL variable that must be declared within the compound statement. The SQL variable must be defined as CHAR or VARCHAR.

diagnostic-string-constant

Specifies a string constant that contains the message text.

Notes

When a SIGNAL statement is issued, the SQLCODE returned in the SQLCA is set based on the SQLSTATE value.

- If the specified SQLSTATE class is either ’01’ or ’02’, a warning or not found is signalled and the SQLCODE is set to +438.
- Otherwise, an exception is signalled and the SQLCODE is set to –438.

If the SQLSTATE or condition indicates that an exception (SQLSTATE class other than ’01’ or ’02’) is signalled,

- If a handler exists in the same compound statement as the SIGNAL statement, and the compound statement contains a handler for SQLEXCEPTION or the specified SQLSTATE or condition; the exception is handled and control is transferred to that handler.
- Otherwise, the exception is not handled and control is immediately returned to the caller of the routine.

If the SQLSTATE or condition indicates that a warning (SQLSTATE class ’01’) or not found (SQLSTATE class ’02’) is signalled,

- If a handler exists in the same compound statement as the signal statement, and the compound statement contains a handler for SQLWARNING (if the SQLSTATE class is ′01′), NOT FOUND (if the SQLSTATE class is ′02′), or the specified SQLSTATE or condition; the warning or not found condition is handled and control is transferred to that handler.
- Otherwise, the warning is not handled and processing continues with the next statement.

SQLSTATE values are comprised of a two-character class code value, followed by a three-character subclass code value. Class code values represent classes of successful and unsuccessful execution conditions.

Any valid SQLSTATE value can be used in the SIGNAL statement. However, it is recommended that programmers define new SQLSTATEs based on ranges reserved for applications. This prevents the unintentional use of an SQLSTATE value that might be defined by the database manager in a future release.

- SQLSTATE classes that begin with the characters ′7′ through ′9′ or ′I′ through ′Z′ may be defined. Within these classes, any subclass may be defined.
- SQLSTATE classes that begin with the characters ′0′ through ′6′ or ′A′ through ′H′ are reserved for the database manager. Within these classes, subclasses that begin with the characters ′0′ through ′H′ are reserved for the database manager. Subclasses that begin with the characters ′I′ through ′Z′ may be defined.

For more information on SQLSTATEs, see Appendix B of the SQL Programming Concepts book.

Example

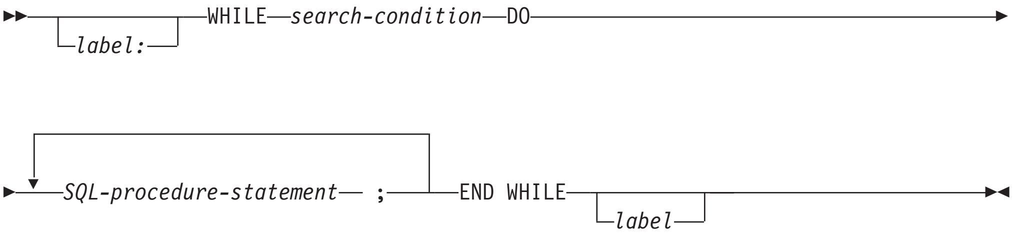
In the following compound statement, the parameter *rating* is passed in to the procedure. If the time in service with the company is less then 6 months, the exception II000 is immediately returned to the caller.

```
CREATE PROCEDURE raise ( IN rating INTEGER )
  LANGUAGE SQL
    BEGIN
       DECLARE new_salary DECIMAL(9,2);
       DECLARE service DECIMAL(8,0);
       DECLARE v_empno CHAR(6) DEFAULT '123456';
            SELECT salary, current_date - hiredate
               INTO new_salary, service
               FROM employee
               WHERE empno = v_empno;
            IF service < 600
              THEN SIGNAL SQLSTATE 'II001'
                     SET MESSAGE_TEXT = 'Insufficient time in service.';
            END IF;
            IF rating = 1
             THEN SET new_salary =
                          new_salary + (new_salary * .10);
             ELSEIF rating = 2
             THEN SET new_salary =
                          new_salary + (new_salary * .05);
            END IF;
            UPDATE employee
               SET salary = new_salary
               WHERE empno = v_empno;
     END;
```

while-statement

The while-statement repeats the execution of a statement while a specified condition is true.

Syntax



Description

label
Defines the label for the code block. If the beginning label is specified, it can be specified on a LEAVE statement. If the ending label is specified, it must be the same as the beginning label.

search-condition
The *search-condition* is evaluated before each execution of the loop. If the condition is true, the *SQL-procedure-statement* in the loop will be executed.

SQL-procedure-statement
Specifies the SQL statement to execute with the loop.

Example

This example uses a while-statement to loop on a FETCH statement. As long as the value of SQL variable *at_end* is 0, another FETCH is done. If the value of *at_end* is not zero, the while-statement is exited and cursor *c1* is closed. This example assumes that there is a handler that would get invoked for NOT FOUND and would set *at_end* to a value other than 0.

```
WHILE at_end = 0 DO
    FETCH c1 INTO
       v_firstnme, v_midinit,
       v_lastname, v_edlevel, v_salary;
END WHILE;
CLOSE c1;
```

Appendix A. SQL Limits

The following tables describe certain limits imposed by the DB2 UDB for AS/400 database manager.

Table 31. Identifier Length Limits

Identifier Limits	**DB2 UDB for AS/400 Limit**
Longest alias name	128
Longest authorization name	10
Longest column label	60
Longest correlation name	128
Longest cursor name	18
Longest host identifier	64
Longest server name	18
Longest SQL routine label	64
Longest statement name	18
Longest table, package, or alias label	50
Longest unqualified collection name	10
Longest unqualified column name	30
Longest unqualified constraint name	128
Longest unqualified data type name	128
Longest unqualified external program name[52]	10
Longest unqualified function name	128
Longest unqualified nodegroup name	10
Longest unqualified package name	10
Longest unqualified procedure name	128
Longest unqualified specific name	128
Longest unqualified SQL parameter name	30
Longest unqualified SQL variable name	30
Longest unqualified table, view, and index name	128
Unqualified system column name	10
Unqualified system table, view, and index name	10

Table 32. Numeric Limits

Numeric Limits	**DB2 UDB for AS/400 Limit**
Smallest BIGINT value	−9 223 372 036 854 775 808
Largest BIGINT value	+9 223 372 036 854 775 807
Smallest INTEGER value	−2 147 483 648

---

[52] For a service program entry point name, the limit is 279. For REXX procedures, the limit is 33.

Table 32. Numeric Limits (continued)

Numeric Limits	**DB2 UDB for AS/400 Limit**
Largest INTEGER value	+2 147 483 647
Smallest SMALLINT value	−32 768
Largest SMALLINT value	+32 767
Largest decimal precision	31
Smallest FLOAT value	$\approx -1.79\text{x}10^{308}$
Largest FLOAT value	$\approx +1.79\text{x}10^{308}$
Smallest positive FLOAT value	$\approx +2.23\text{x}10^{-308}$
Largest negative FLOAT value	$\approx -2.23\text{x}10^{-308}$
Smallest REAL value	$\approx -3.4\text{x}10^{38}$
Largest REAL value	$\approx +3.4\text{x}10^{38}$
Smallest positive REAL value	$\approx +1.17\text{x}10^{-38}$
Largest negative REAL value	$\approx -1.17\text{x}10^{-38}$

Table 33. String Limits

String Limits	**DB2 UDB for AS/400 Limit**
Maximum length of BLOB	15 728 640
Maximum length of CHAR	32766
Maximum length of VARCHAR	32740
Maximum length of CLOB	15 728 640
Maximum length of C NUL-terminated	32740
Maximum length of GRAPHIC	16383
Maximum length of VARGRAPHIC	16370
Maximum length of DBCLOB	7 864 320
Maximum length of C NUL-terminated graphic	16370
Maximum length of character constant	32740
Maximum length of a graphic constant	16370
Longest concatenated character string	32766
Longest concatenated graphic string	16370

Table 34. Datetime Limits

Datetime Limits	**DB2 UDB for AS/400 Limit**
Smallest DATE value	0001-01-01
Largest DATE value	9999-12-31
Smallest TIME value	00:00:00
Largest TIME value	24:00:00
Smallest TIMESTAMP value	0001-01-01-00.00.00.000000
Largest TIMESTAMP value	9999-12-31-24.00.00.000000

Table 35. DataLink Limits

Datalink Limits	DB2 UDB for AS/400 Limit
Maximum length of DATALINK	32718
Maximum length of DATALINK comment	254

Table 36. Database Manager Limits

Database Manager Limits	DB2 UDB for AS/400 Limit
Most columns in a table	8000
Most columns in a view	8000
Maximum number of parameters in a function	90
Maximum number of parameters in a procedure	254[55]
Maximum length of a row without LOBs including all overhead	32766
Maximum length of a row with LOBs including all overhead	15 728 640
Maximum size of a table	1/2 terabyte
Maximum size of an index	1 terabyte
Most rows in a table	4 294 967 288
Longest index key	2000
Most columns in an index key	120
Most indexes on a table	approximately 4000
Most tables referenced in an SQL statement	256
Most tables referenced in an SQL view	32
Most host variable declarations in a precompiled program[53]	storage
Most host variables in an SQL statement	storage[56]
Longest host variable used for insert or update	32766
Longest SQL statement	32767
Most elements in a select list[54]	approximately 8000
Most predicates in a WHERE or HAVING clause	4690
Maximum number of columns in a GROUP BY clause	120
Maximum total length of columns in a GROUP BY clause	2000
Maximum number of columns in an ORDER BY clause	10000
Maximum total length of columns in an ORDER BY clause	10000
Maximum size of an SQLDA	16 777 215
Maximum number of prepared statements	storage
Most declared cursors in a program	storage
Maximum number of cursors opened at one time	storage
Most tables in a relational database	storage
Maximum number of constraints on a table	300
Maximum levels allowed for a subselect	32
Maximum length of a comment	2000

Table 36. Database Manager Limits (continued)

Database Manager Limits	DB2 UDB for AS/400 Limit
Maximum length of a path	558
Maximum number of rows changed in a unit of work	500 000 000
Maximum number of triggers on a table	6
Maximum number of nested trigger invocations	200
Maximum procedures with result sets waiting to be fetched	100

---

53. In RPG/400 and PL/I programs when the old parameter passing technique is used, the limit is approximately 4000. The limit is based on the number of pointers allowed in the program. In all other cases, the limit is based on architectural constraints within the operating system.

54. The limit is based on the size of internal structures generated for the parsed SQL statement.

55. Procedures with PARAMETER STYLE SQL are limited to 90 parameters. SQL procedures with PARAMETER STYLE GENERAL are limited to 253. Procedures with PARAMETER STYLE GENERAL WITH NULLS are limited to 254. External procedures with PARAMETER STYLE GENERAL are limited to 255. The maximum number of parameters is also limited by the maximum number of parameters allowed by the licensed program used to compile the external program.

56. Limited by the length of the longest the SQL statement.

Appendix B. SQL Communication Area

An SQLCA is a set of variables that is updated at the end of the execution of every SQL statement. A program that contains executable SQL statements must provide exactly one SQLCA (unless a stand-alone SQLCODE or a stand-alone SQLSTATE variable is used instead).

The SQL INCLUDE statement can be used to provide the declaration of the SQLCA in all host languages except RPG or REXX. For information on the use of the SQLCA in a REXX procedure, see the SQL Programming with Host Languages book.

In C, COBOL, FORTRAN, and PL/I, the name of the storage area must be SQLCA. In PL/I, and C, the name of the structure must be SQLCA. Every SQL statement must be within the scope of its declaration.

When a stand-alone SQLCODE is specified in the program, the SQLCA must not be included. The precompiler will include an SQLCA with the name of the variable SQLCODE changed to SQLCADE (or SQLCOD changed to SQLCAD). The precompiler will add statements to the program to ensure that the stand-alone SQLCODE contains the correct values.

When a stand-alone SQLSTATE is specified in the program, the SQLCA must not be included. The precompiler will include an SQLCA with the name of the variable SQLSTATE changed to SQLSTATE. The precompiler will add statements to the program to ensure that the stand-alone SQLSTATE contains the correct values.

The stand-alone SQLCODE and stand-alone SQLSTATE must not be specified in RPG or REXX.

Field Descriptions

The names in the following table are those provided by the SQL INCLUDE statement. For the most part, C (and C++), COBOL, FORTRAN and PL/I use the same names. RPG names are different, because in RPG/400, they are limited to 6 characters. Note one instance where PL/I names differ from the COBOL names.

Table 37. Names Provided by the SQL INCLUDE Statement

C Name, COBOL & PL/I Name	FORTRAN[1] Name	RPG Name	Field Data Type	Field Value
SQLCAID sqlcaid	Not used SQLCAID	SQLAID	CHAR(8)	An “eye catcher” for storage dumps, containing 'SQLCA'.
SQLCABC sqlcabc	Not used SQLCABC	SQLABC	INTEGER	Contains the length of the SQLCA, 136.

Table 37. Names Provided by the SQL INCLUDE Statement (continued)

C Name, COBOL & PL/I Name	FORTRAN[1] Name	RPG Name	Field Data Type	Field Value
SQLCODE sqlcode	SQLCOD SQLCODE	SQLCOD	INTEGER	Contains an SQL return code. **Code** **Meaning** **0** Successful execution although SQLWARN indicators might have been set. **positive** Successful execution, but with a warning condition. **negative** Error condition.
SQLERRML[2] sqlerrml	SQLTXL SQLERRML	SQLERL	SMALLINT	Length indicator for SQLERRMC, in the range 0 through 70. 0 means that the value of SQLERRMC is not pertinent.
SQLERRMC[2] sqlerrmc	SQLTXT SQLERRMC	SQLERM	CHAR (70)	Contains message replacement text associated with the SQLCODE. For CONNECT and SET CONNECTION, the SQLERRMC field contains information about the connection, see Table 40 on page 546 for a description of the replacement text.
SQLERRP sqlerrp	SQLERP SQLERRP	SQLERP	CHAR(8)	Contains the name of the product and module returning the error. The first three characters identify the product: ARI for DB2 for VM and VSE DSN for DB2 UDB for OS/390 QSQ for DB2 UDB for AS/400 SQL for all other DB2 products See “CONNECT (Type 1)” on page 283 or “CONNECT (Type 2)” on page 287 for additional information.
SQLERRD sqlerrd	SQLERR SQLERRD	SQLERR[3]	Array	Contains six INTEGER variables that provide diagnostic information, see Table 39 on page 544 for a description of the diagnostic information.
SQLWARN sqlwarn	SQLWRN SQLWARN	SQLWRN[4]	CHAR(11)	A set of 11 CHAR(1) warning indicators, each containing blank or 'W' or 'N'.
SQLSTATE sqlstate	SQLSTT SQLSTATE	SQLSTT	CHAR(5)	A return code that indicates the outcome of the most recently executed SQL statement.

Table 37. Names Provided by the SQL INCLUDE Statement (continued)

C Name, COBOL & PL/I Name	FORTRAN[1] Name	RPG Name	Field Data Type	Field Value

Notes:

[1] The first name indicates the IBM SQL SQLCA names for the FORTRAN SQLCA. The second name indicates an alternative name that is available due to the DB2 UDB for AS/400 implementation of the SQLCA in FORTRAN.

[2] In COBOL, SQLERRM includes SQLERRML and SQLERRMC. In PL/I, the varying-length string SQLERRM is equivalent to SQLERRML prefixed to SQLERRMC.

[3] In RPG/400 and ILE RPG/400, SQLERR is defined as 24 characters (not an array) that are redefined by the fields SQLER1 through SQLER6. The fields are full-word binary. In ILE RPG/400, SQLERR is also redefined as an array. The name of the array is SQLERRD.

[4] Defined as 11 characters (not an array).

Table 38. SQLWARN Diagnostic Information

C Name COBOL & PL/I Name	FORTRAN[1] Name	RPG Name	Field Value

SQLWARN0
sqlwarn[0]
	SQLWRN(0)
	SQLWARN(1:1)
		SQLWN0	Blank if all other indicators are blank; contains 'W' if at least one other indicator contains 'W' or 'N'.

SQLWARN1
sqlwarn[1]
	SQLWRN(1)
	SQLWARN(2:2)
		SQLWN1	Contains 'W' if the value of a string column was truncated when assigned to a host variable. Contains ’N’ if *NOCNULRQD was specified an the CRTSQLCI or CRTSQLCPPI command (or CNULRQD(*NO) on the SET OPTION statement) and if the value of a string column was assigned to a C NUL-terminated host variable and if the host variable was large enough to contain the result but not large enough to contain the NUL-terminator.

SQLWARN2
sqlwarn[2]
	SQLWRN(2)
	SQLWARN(3:3)
		SQLWN2	Contains 'W' if the null values were eliminated from the argument of a function; not necessarily set to 'W' for the MIN function because its results are not dependent on the elimination of null values.

SQLWARN3
sqlwarn[3]
	SQLWRN(3)
	SQLWARN(4:4)
		SQLWN3	Contains 'W' if the number of columns is larger than the number of host variables.

SQLWARN4
sqlwarn[4]
	SQLWRN(4)
	SQLWARN(5:5)
		SQLWN4	Contains 'W' if a prepared UPDATE or DELETE statement does not include a WHERE clause.

SQLWARN5
sqlwarn[5]
	SQLWRN(5)
	SQLWARN(6:6)
		SQLWN5	Reserved

SQLWARN6
sqlwarn[6]
	SQLWRN(6)
	SQLWARN(7:7)
		SQLWN6	Contains ’W’ if date arithmetic results in an end-of-month adjustment.

SQLWARN7
sqlwarn[7]
	SQLWRN(7)
	SQLWARN(8:8)
		SQLWN7	Reserved

Table 38. SQLWARN Diagnostic Information (continued)

C Name COBOL & PL/I Name	FORTRAN^1 Name	RPG Name	Field Value

SQLWARN8
sqlwarn[8]
	SQLWRX(1)
	SQLWARN(9:9)
		SQLWN8	Contains 'W' if the result of a character conversion contains the substitution character.

SQLWARN9
sqlwarn[9]
	SQLWRX(2)
	SQLWARN(10:10)
		SQLWN9	Reserved

SQLWARNA
sqlwarn[10]
	SQLWRX(3)
	SQLWARN(11:11)
		SQLWNA	Reserved

Table 39. SQLERRD Diagnostic Information

C Name COBOL & PL/I Name	FORTRAN^1 Name	RPG Name	Field Value
SQLERRD(1) sqlerrd[0]	SQLERR(1)	SQLER1	Contains the last four characters of the CPF escape message if SQLCODE is less than 0. For example, if the message is CPF5715, X'F5F7F1F5' is placed in SQLERRD(1).[1] For a call to a procedure, contains the return status value specified on the RETURN statement. If a return status value is not specified on the RETURN statement, • 0 is returned if the call statement is successful, or • –200 is returned if the call statement is not successful.
SQLERRD(2) sqlerrd[1]	SQLERR(2)	SQLER2	Contains the last four characters of a CPD diagnostic message if the SQL code is less than 0.[1] For a CALL statement, SQLERRD(2) contains the number of result sets.
SQLERRD(3) sqlerrd[2]	SQLERR(3)	SQLER3	For a CONNECT for status statement, SQLERRD(3) contains information on the connection status. See "CONNECT (Type 2)" on page 287 for more information. For INSERT, UPDATE, and DELETE, shows the number of rows affected. For a FETCH statement, SQLERRD(3) contains the number of rows fetched. For the PREPARE statement, contains the estimated number of rows selected. If the number of rows is greater than 2 147 483 647, then 2 147 483 647 is returned.

Table 39. SQLERRD Diagnostic Information (continued)

C Name COBOL & PL/I Name	**FORTRAN^1 Name**	**RPG Name**	**Field Value**
SQLERRD(4) sqlerrd[3]	SQLERR(4)	SQLER4	For the PREPARE statement, contains a relative number estimate of the resources required for every execution. This number varies depending on the current availability of indexes, file sizes, CPU model, etc. It is an estimated cost for the access plan chosen by the DB2 UDB for AS/400 Query Optimizer. For a CONNECT and SET CONNECTION statement, SQLERRD(4) contains the type of conversation used and whether or not committable updates can be performed. See "CONNECT (Type 2)" on page 287 for more information. For a CALL statement, SQLERRD(4) contains the message key of the error that caused the procedure to fail. The QMHRTVPM API can be used to return the message description for the message key. For a trigger error in a DELETE, INSERT or UPDATE statement, SQLERRD(4) contains the message key of the error that was signaled from the trigger program. The QMHRTVPM API can be used to return the message description for the message key. For a FETCH statement, SQLERRD(4) contains the length of the row retrieved.
SQLERRD(5) sqlerrd[4]	SQLERR(5)	SQLER5	For a DELETE statement, shows the number of rows affected by referential constraints. For an EXECUTE IMMEDIATE or PREPARE statement, may contain the position of a syntax error. For a multiple-row FETCH statement, SQLERRD(5) contains +100 if the last row currently in the table has been fetched. For a CONNECT or SET CONNECTION statement, SQLERRD(5) contains: • -1 if the connection is unconnected • 0 if the connection is local • 1 if the connection is remote For a PREPARE statement, SQLERRD(5) contains the number of parameter markers in the prepared statement.
SQLERRD(6) sqlerrd[5]	SQLERR(6)	SQLER6	Contains the SQL completion message identifier when the SQLCODE is 0. In all other cases, it is undefined.

Table 39. SQLERRD Diagnostic Information (continued)

C Name COBOL & PL/I Name	FORTRAN[1] Name	RPG Name	Field Value
Note: [1] SQLERRD(1) and SQLERRD(2) are set only if appropriate and only if the current server is DB2 UDB for AS/400.			

Table 40. SQLERRMC Replacement Text for CONNECT and SET CONNECTION

Description		Data type
Relational Database Name		CHAR(18)
Product Identification (same as SQLERRP)		CHAR(8)
User ID of the server job		CHAR(10)
Connection method (*DUW or *RUW)		CHAR(10)
DDM server class name		CHAR(10)
QAS	DB2 UDB for AS/400	
QDB2	DB2 UDB for OS/390	
QDB2/2	DB2 for OS/2	
QDB2/6000	DB2 for AIX/6000	
QDB2/HPUX	DB2 for HP-UX**	
QDB2/NT	DB2 for NT	
QDB2/SUN	DB2 for SUN** Solaris**	
QSQLDS/VM	DB2 for VM and VSE	
QSQLDS/VSE	DB2 for VM and VSE	
Connection type (same as SQLERRD(4))		SMALLINT

INCLUDE SQLCA Declarations

In **C and C++**, INCLUDE SQLCA declarations are equivalent to the following:

```
#ifndef    SQLCODE
struct     sqlca
{
           unsigned char  sqlcaid[8];
           long           sqlcabc;
           long           sqlcode;
           short          sqlerrml;
           unsigned char  sqlerrmc[70];
           unsigned char  sqlerrp[8];
           long           sqlerrd[6];
           unsigned char  sqlwarn[11];
           unsigned char  sqlstate[5];
};
#define      SQLCODE   sqlca.sqlcode
```

```
#define      SQLWARN0  sqlca.sqlwarn[0]
#define      SQLWARN1  sqlca.sqlwarn[1]
#define      SQLWARN2  sqlca.sqlwarn[2]
#define      SQLWARN3  sqlca.sqlwarn[3]
#define      SQLWARN4  sqlca.sqlwarn[4]
#define      SQLWARN5  sqlca.sqlwarn[5]
#define      SQLWARN6  sqlca.sqlwarn[6]
#define      SQLWARN7  sqlca.sqlwarn[7]
#define      SQLWARN8  sqlca.sqlwarn[8]
#define      SQLWARN9  sqlca.sqlwarn[9]
#define      SQLWARNA  sqlca.sqlwarn[10]
#define      SQLSTATE  sqlca.sqlstate
#endif
struct sqlca sqlca;
```

In **COBOL**, INCLUDE SQLCA declarations are equivalent to the following:

```
01 SQLCA.
   05 SQLCAID      PIC X(8).
   05 SQLCABC      PIC S9(9) BINARY.
   05 SQLCODE      PIC S9(9) BINARY.
   05 SQLERRM.
      49 SQLERRML  PIC S9(4) BINARY.
      49 SQLERRMC  PIC X(70).
   05 SQLERRP      PIC X(8).
   05 SQLERRD      OCCURS 6 TIMES
                   PIC S9(9) BINARY.
   05 SQLWARN.
      10 SQLWARN0  PIC X(1).
      10 SQLWARN1  PIC X(1).
      10 SQLWARN2  PIC X(1).
      10 SQLWARN3  PIC X(1).
      10 SQLWARN4  PIC X(1).
      10 SQLWARN5  PIC X(1).
      10 SQLWARN6  PIC X(1).
      10 SQLWARN7  PIC X(1).
      10 SQLWARN8  PIC X(1).
      10 SQLWARN9  PIC X(1).
      10 SQLWARNA  PIC X(1).
   05 SQLSTATE     PIC X(5).
```

Note: In COBOL, INCLUDE SQLCA must not be specified outside the Working Storage Section.

In **FORTRAN**, INCLUDE SQLCA declarations are equivalent to the following:

```
 CHARACTER SQLCA(136)
 CHARACTER SQLCAID*8
 INTEGER*4 SQLCABC
 INTEGER*4 SQLCODE
 INTEGER*2 SQLERRML
 CHARACTER SQLERRMC*70
 CHARACTER SQLERRP*8
 INTEGER*4 SQLERRD(6)
 CHARACTER SQLWARN*11
 CHARACTER SQLSTOTE*5
 EQUIVALENCE (SQLCA(  1), SQLCAID)
 EQUIVALENCE (SQLCA(  9), SQLCABC)
 EQUIVALENCE (SQLCA( 13), SQLCODE)
 EQUIVALENCE (SQLCA( 17), SQLERRML)
 EQUIVALENCE (SQLCA( 19), SQLERRMC)
 EQUIVALENCE (SQLCA( 89), SQLERRP)
 EQUIVALENCE (SQLCA( 97), SQLERRD)
 EQUIVALENCE (SQLCA(121), SQLWARN)
 EQUIVALENCE (SQLCA(132), SQLSTOTE)

 INTEGER*4 SQLCOD,
C           SQLERR(6)
 INTEGER*2 SQLTXL
 CHARACTER  SQLERP*8,
C           SQLWRN(0:7)*1,
C           SQLWRX(1:3)*1,
C           SQLTXT*70,
C           SQLSTT*5,
C           SQLWRNWK*8,
C           SQLWRXWK*3,
C           SQLERRWK*24,
C           SQLERRDWK*24
 EQUIVALENCE (SQLWRN(1), SQLWRNWK)
 EQUIVALENCE (SQLWRX(1), SQLWRXWK)
 EQUIVALENCE (SQLCA(97), SQLERRDWK)
 EQUIVALENCE (SQLERR(1), SQLERRWK)
 COMMON /SQLCA1/SQLCOD,SQLERR,SQLTXL
 COMMON /SQLCA2/SQLERP,SQLWRN,SQLTXT,SQLWRX,SQLSTT
```

In **PL/I**; INCLUDE SQLCA declarations are equivalent to the following:

```
DCL 1 SQLCA,
      2 SQLCAID      CHAR(8),
      2 SQLCABC      BIN FIXED(31),
      2 SQLCODE      BIN FIXED(31),
      2 SQLERRM      CHAR(70) VAR,
      2 SQLERRP      CHAR(8),
      2 SQLERRD(6)   BIN FIXED(31),
      2 SQLWARN,
        3 SQLWARN0   CHAR(1),
        3 SQLWARN1   CHAR(1),
        3 SQLWARN2   CHAR(1),
        3 SQLWARN3   CHAR(1),
        3 SQLWARN4   CHAR(1),
        3 SQLWARN5   CHAR(1),
        3 SQLWARN6   CHAR(1),
        3 SQLWARN7   CHAR(1),
        3 SQLWARN8   CHAR(1),
        3 SQLWARN9   CHAR(1),
        3 SQLWARNA   CHAR(1),
      2 SQLSTATE     CHAR(5);
```

In **RPG/400**; SQLCA declarations are equivalent to the following:

```
ISQLCA          DS
I                                        1   8 SQLAID             SQL
I                                   B    9 120SQLABC             SQL
I                                   B   13 160SQLCOD             SQL
I                                   B   17 180SQLERL             SQL
I                                       19  88 SQLERM             SQL
I                                       89  96 SQLERP             SQL
I                                       97 120 SQLERR             SQL
I                                   B   97 1000SQLER1             SQL
I                                   B  101 1040SQLER2             SQL
I                                   B  105 1080SQLER3             SQL
I                                   B  109 1120SQLER4             SQL
I                                   B  113 1160SQLER5             SQL
I                                   B  117 1200SQLER6             SQL
I                                      121 131 SQLWRN             SQL
I                                      121 121 SQLWN0             SQL
I                                      122 122 SQLWN1             SQL
I                                      123 123 SQLWN2             SQL
I                                      124 124 SQLWN3             SQL
I                                      125 125 SQLWN4             SQL
I                                      126 126 SQLWN5             SQL
I                                      127 127 SQLWN6             SQL
I                                      128 128 SQLWN7             SQL
I                                      129 129 SQLWN8             SQL
```

```
I                                     130 130 SQLWN9             SQL
I                                     131 131 SQLWNA             SQL
I                                     132 136 SQLSTT             SQL
```

In **ILE RPG/400**; SQLCA declarations are equivalent to the following:

```
D*      SQL Communications area
D SQLCA           DS
D  SQLAID                 1      8A
D  SQLABC                 9     12B 0
D  SQLCOD                13     16B 0
D  SQLERL                17     18B 0
D  SQLERM                19     88A
D  SQLERP                89     96A
D  SQLERRD               97    120B 0 DIM(6)
D  SQLERR                97    120A
D   SQLER1               97    100B 0
D   SQLER2              101    104B 0
D   SQLER3              105    108B 0
D   SQLER4              109    112B 0
D   SQLER5              113    116B 0
D   SQLER6              117    120B 0
D  SQLWRN               121    131A
D   SQLWN0              121    121A
D   SQLWN1              122    122A
D   SQLWN2              123    123A
D   SQLWN3              124    124A
D   SQLWN4              125    125A
D   SQLWN5              126    126A
D   SQLWN6              127    127A
D   SQLWN7              128    128A
D   SQLWN8              129    129A
D   SQLWN9              130    130A
D   SQLWNA              131    131A
D  SQLSTT               132    136A
D*  End of SQLCA
```

Appendix C. SQL Descriptor Area (SQLDA)

An SQLDA is a set of variables that is required for execution of the SQL DESCRIBE statement, and it may optionally be used by the PREPARE, OPEN, CALL, FETCH, and EXECUTE statements. An SQLDA can be used in a DESCRIBE statement, altered with the addresses of host variables, and then used again in a FETCH statement.

SQLDAs are supported for all languages, but predefined declarations are provided only for C (and C++), COBOL, ILE RPG/400, PL/I, and REXX. In REXX, the SQLDA is somewhat different than in the other languages; for information on the use of SQLDAs in REXX, see the SQL Programming with Host Languages book.

The meaning of the information in an SQLDA depends on its use. In PREPARE and DESCRIBE, an SQLDA provides information to an application program about a prepared statement.In OPEN, CALL, EXECUTE, and FETCH, an SQLDA provides information to the database manager about host variables.

Field Descriptions

An SQLDA consists of four variables in a header structure followed by an arbitrary number of occurrences of a sequence of five variables collectively named SQLVAR. In OPEN, CALL, FETCH, and EXECUTE, each occurrence of SQLVAR describes a host variable. In PREPARE and DESCRIBE, each occurrence describes a column of a result table.

The SQL INCLUDE statement provides the following field names:

Table 41. Field Descriptions for an SQLDA Header

C Name [57] **PL/I Name COBOL Name**	**Field Data Type**	**Usage in DESCRIBE and PREPARE (set by the database manager except for SQLN)**	**Usage in FETCH, OPEN, CALL, or EXECUTE (set by the user prior to executing the statement)**
sqldaid SQLDAID	CHAR(8)	An 'eye catcher' for storage dumps, containing 'SQLDA '. The 7th byte of the SQLDAID can be used to determine whether more than one SQLVAR entry is needed for each column. For details, see “Determining How Many SQLVAR Occurrences are Needed” on page 554.	A ’2’ in the 7th byte indicates that two SQLVAR entries were allocated for each column. A ’3’ in the 7th byte indicates that three SQLVAR entries were allocated for each column. A ’4’ in the 7th byte indicates that four SQLVAR entries were allocated for each column.

---

[57] In this column, the lowercase name is the C Name. The uppercase name is the COBOL, PL/I, or RPG Name.

Table 41. Field Descriptions for an SQLDA Header (continued)

C Name [57] **PL/I Name** **COBOL Name**	**Field Data Type**	**Usage in DESCRIBE and PREPARE (set by the database manager except for SQLN)**	**Usage in FETCH, OPEN, CALL, or EXECUTE (set by the user prior to executing the statement)**
sqldabc SQLDABC	INTEGER	Length of the SQLDA.	Number of bytes of storage allocated for the SQLDA. Enough storage must be allocated to contain SQLN occurrences. SQLDABC must be set to a value greater than or equal to 16+SQLN*(80), where 80 is the length of an SQLVAR occurrence. If LOBs or distinct types are specified, there must be two SQLVAR entries for each parameter marker.
sqln SQLN	SMALLINT	Unchanged by the database manager. Must be set to a value greater than or equal to zero before the PREPARE or DESCRIBE statement is executed. It should be set to a value that is greater than or equal to the number of columns in the result or a multiple of the number of columns in the result when multiple sets of SQLVAR entries are necessary. Indicates the total number of occurrences of SQLVAR.	Total number of occurrences of SQLVAR provided in the SQLDA. SQLN must be set to a value greater than or equal to zero. If LOBs or distinct types are specified, there must be two SQLVAR entries for each parameter marker and SQLN must be set to two times the number of parameter markers.
sqld SQLD	SMALLINT	The number of columns described by occurrences of SQLVAR (zero if the statement being described is not a select-statement).	Number of host variables described by SQLVAR to be used in the SQLDA when executing this statement. SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN.

Field Descriptions in an Occurrence of SQLVAR

For each column or host variable described by the SQLDA, there are two types of SQLVAR entries:

Base SQLVAR entry

The base SQLVAR entry is always present. The fields of this entry contain the base information about the column or host variable such as data type code, length attribute (except for LOBs), column name (or label), CCSID, host variable address, and indicator variable address.

Extended SQLVAR entry

The extended SQLVAR entry is needed (for each column) if the result includes any LOB or distinct type columns. For distinct types, the extended SQLVAR contains the distinct type name. For LOBs, the extended SQLVAR contains the length attribute of the host variable and a pointer to the buffer that contains the actual length. If locators or file reference variables are used to represent LOBs, an extended SQLVAR is not necessary.

The extended SQLVAR entry is also needed for each column when:

- USING BOTH is specified, which indicates that column names and labels are returned.

- USING ALL is specified, which indicates that column names, labels, and system column names are returned.

The fields in the extended SQLVAR that return LOB and distinct type information do not overlap, and the fields that return LOB and label information do not overlap. Depending on the combination of labels, LOBs and distinct types, more than one extended SQLVAR entry per column may be required to return the information. See "Determining How Many SQLVAR Occurrences are Needed" on page 554.

Table 42, Table 43, and Table 44 on page 554 show how to map the base and extended SQLVAR entries. For an SQLDA that contains both base and extended SQLVAR entries, the base SQLVAR entries are in the first block, followed by a block of extended SQLVAR entries, which if necessary, are followed by a second or third block of extended SQLVAR entries. In each block, the number of occurrences of the SQLVAR entry is equal to the value in SQLD even though many of the extended SQLVAR entries might be unused.

Table 42. Contents of SQLVAR Arrays for USING NAMES, USING SYSTEM NAMES, USING LABELS or USING ANY

LOBs	DISTINCT types	7th byte of SQLDAID	SQLN Minimum	First Set (Base)	Second Set (Extended)	Third Set (Extended)	Fourth Set (Extended)
No	No	Blank	n	Column names, system column names, or labels	Not used	Not used	Not used
Yes	No	2	2n	Column names, system column names, or labels	LOBs	Not used	Not used
No	Yes	2	2n	Column names, system column names, or labels	Distinct types	Not used	Not used
Yes	Yes	2	2n	Column names, system column names, or labels	LOBs and distinct types	Not used	Not used

Table 43. Contents of SQLVAR Arrays for USING BOTH

LOBs	DISTINCT types	7th byte of SQLDAID	SQLN Minimum	First Set (Base)	Second Set (Extended)	Third Set (Extended)	Fourth Set (Extended)
No	No	2	2n	Column names	Labels	Not used	Not used
Yes	No	2	2n	Column names	LOBs and labels	Not used	Not used
No	Yes	3	3n	Column names	Distinct types	Labels	Not used
Yes	Yes	3	3n	Column names	LOBs and distinct types	Labels	Not used

Table 44. Contents of SQLVAR Arrays for USING ALL

LOBs	DISTINCT types	7th byte of SQLDAID	SQLN Minimum	First Set (Base)	Second Set (Extended)	Third Set (Extended)	Fourth Set (Extended)
No	No	3	3n	System column names	Labels	Column names	Not used
Yes	No	3	3n	System column names	LOBs and labels	Column names	Not used
No	Yes	4	4n	System column names	Distinct types	Labels	Column names
Yes	Yes	4	4n	System column names	LOBs and distinct types	Labels	Column names

Determining How Many SQLVAR Occurrences are Needed

The number of SQLVAR occurrences needed depends on the statement that the SQLDA was provided for and the data types of the columns or parameters being described. See the tables above for more information.

The 7th byte of SQLDAID is always set to the number of sets of SQLVARs necessary.

If SQLD is not set to a sufficient number of SQLVAR occurrences:

- SQLD is set to the total number of SQLVAR occurrences needed for all sets.
- A +237 warning is returned in the SQLCODE field of the SQLCA if at least enough SQLVARs were specified for the Base SQLVAR Entries. The Base SQLVAR entries are returned, but no extended SQLVARs are returned.
- A +239 warning is returned in the SQLCODE field of the SQLCA if enough SQLVARs were not specified for even the Base SQLVAR Entries. No SQLVAR entries are returned.

Table 45. Field Descriptions for an SQLVAR

C Name [58] COBOL Name PL/I Name RPG Name	Field Data Type	Usage in DESCRIBE and PREPARE (set by the database manager)	Usage in FETCH, OPEN, CALL, and EXECUTE (set by the user prior to executing the statement)
sqltype SQLTYPE	SMALLINT	Indicates the data type of the column and whether it can contain nulls. For a description of the type codes, see Table 47 on page 557. For a distinct type, the data type on which the distinct type is based is placed in this field. The base SQLVAR contains no indication that this is part of the description of a distinct type.	Indicates the data type of the host variable and whether an indicator variable is provided. For a description of the type codes, see Table 47 on page 557.

Table 45. Field Descriptions for an SQLVAR (continued)

C Name [58] **COBOL Name** **PL/I Name** **RPG Name**	**Field Data Type**	**Usage in DESCRIBE and PREPARE (set by the database manager)**	**Usage in FETCH, OPEN, CALL, and EXECUTE (set by the user prior to executing the statement)**
sqllen SQLLEN	SMALLINT	The length attribute of the column. For datetime columns, the length of the string representation of the values. See Table 47 on page 557. For a LOB, the value is 0 regardless of the length attribute of the LOB. Field SQLLONGLEN in the extended SQLVAR entry contains the length attribute of the LOB.	The length attribute of the host variable. See Table 47 on page 557. For a LOB, the value is 0 regardless of the length attribute of the LOB. Field SQLLONGLEN in the extended SQLVAR entry contains the length attribute of the LOB.
sqlres SQLRES	CHAR(12)	Reserved. Provides boundary alignment for SQLDATA.	Reserved. Provides boundary alignment for SQLDATA.
sqldata SQLDATA	pointer	The CCSID of a string column as described in Table 48 on page 559.	Contains the address of the host variable. For LOB host variables, if the SQLDATALEN field in the extended SQLVAR is null, this points to the four-byte LOB length, followed immediately by the LOB data. If the SQLDATALEN field in the extended SQLVAR is not null, this points to the LOB data and the SQLDATALEN field points to the four-byte LOB length.
sqlind SQLIND	pointer	Reserved	Contains the address of the indicator variable. Not used if there is no indicator variable (as indicated by an even value of SQLTYPE).
sqlname SQLNAME	VARCHAR (30)	The unqualified name of the column. If the column does not have a name, a string is constructed from the expression and returned.	Contains the CCSID of the host variable as described in Table 48 on page 559.

Table 46. Field Descriptions for an Extended SQLVAR

C Name [59] **COBOL Name** **PL/I Name** **RPG Name**	**Field Data Type**	**Usage in DESCRIBE and PREPARE (set by the database manager)**	**Usage in FETCH, OPEN, CALL, and EXECUTE (set by the user prior to executing the statement)**
len.sqllonglen SQLLONGL SQLLONGLEN	INTEGER	The length attribute of a LOB column.	The length attribute of a LOB host variable. The database manager ignores the SQLLEN field in the base SQLVAR for these data types. The length attribute indicates the number of bytes for a BLOB or CLOB, and the number of characters for a DBCLOB.
*	CHAR(12)	Reserved. Provides boundary alignment for SQLDATALEN.	Reserved. Provides boundary alignment for SQLDATALEN.
*	pointer	Reserved.	Reserved.
sqldatalen SQLDATAL SQLDATALEN	pointer	Not used.	Used only for LOB host variables. If the value of this field is null, the actual length of the LOB is stored in the first four bytes pointed to by the SQLDATA field in the matching base SQLVAR, and the LOB data immediately follows the four-byte length. The actual length indicates the number of bytes for a BLOB or CLOB and the number of double-byte characters for a DBCLOB. If the value of this field is not null, this field points to a four-byte long buffer that contains the actual length of the LOB in bytes (even for DBCLOBs). The SQLDATA field in the matching base SQLVAR then points to the LOB data. Regardless of whether this field is used, field SQLLONGLEN must be set.

---

[58] In this column, the lowercase name is the C Name. The uppercase name is the PL/I, COBOL, and RPG Name.

Table 46. Field Descriptions for an Extended SQLVAR (continued)

C Name [59] COBOL Name PL/I Name RPG Name	Field Data Type	Usage in DESCRIBE and PREPARE (set by the database manager)	Usage in FETCH, OPEN, CALL, and EXECUTE (set by the user prior to executing the statement)
sqldatatype_name SQLTNAME SQLDATATYPE-NAME	VARCHAR (30)	The SQLTNAME field of the extended SQLVAR is set to one of the following: • For a distinct type column, the database manager sets this to the fully qualified distinct type name. If the qualified name is longer than 30 bytes, it is truncated. • For a label, the database manager sets this to the first 20 bytes of the label. • For a column name, the database manager sets this to the column name.	Not used.

SQLTYPE and SQLLEN

The following table shows the values that may appear in the SQLTYPE and SQLLEN fields of the SQLDA. In PREPARE and DESCRIBE, an even value of SQLTYPE means the column does not allow nulls, and an odd value means the column does allow nulls.

Note: In PREPARE and DESCRIBE statements, an odd value is returned for an expression if one operand is nullable or if the expression may result in a -2 mapping-error null value.

In FETCH, OPEN, CALL, and EXECUTE, an even value of SQLTYPE means no indicator variable is provided, and an odd value means that SQLIND contains the address of an indicator variable.

Table 47. SQLTYPE and SQLLEN values for PREPARE, DESCRIBE, FETCH, OPEN, CALL, or EXECUTE

	For PREPARE and DESCRIBE		For FETCH, OPEN, CALL, and EXECUTE	
SQLTYPE	COLUMN DATA TYPE	SQLLEN	HOST VARIABLE DATA TYPE	SQLLEN
384/385	Date	10	Fixed-length character-string representation of a date	Length attribute of the host variable
388/389	Time	8	Fixed-length character-string representation of a time	Length attribute of the host variable
392/393	Timestamp	26	Fixed-length character-string representation of a time stamp	Length attribute of the host variable

---

[59] In this column, the lowercase name is the C Name. The first uppercase name is the PL/I and RPG Name. The second uppercase name is the COBOL Name.

Table 47. SQLTYPE and SQLLEN values for PREPARE, DESCRIBE, FETCH, OPEN, CALL, or EXECUTE (continued)

	For PREPARE and DESCRIBE		For FETCH, OPEN, CALL, and EXECUTE	
SQLTYPE	COLUMN DATA TYPE	SQLLEN	HOST VARIABLE DATA TYPE	SQLLEN
396/397	DataLink	Length attribute of the column	DataLink	Length attribute of the host variable
400/401	Not Applicable	Not Applicable	NUL-terminated graphic string	Length attribute of the host variable
404/405	BLOB	0 [61]	BLOB	Not used. [61]
408/409	CLOB	0 [61]	CLOB	Not used. [61]
412/413	DBCLOB	0 [61]	DBCLOB	Not used. [61]
448/449	Varying-length character string	Length attribute of the column	Varying-length character string	Length attribute of the host variable
452/453	Fixed-length character string	Length attribute of the column	Fixed-length character string	Length attribute of the host variable
456/457	Long varying-length character string	Length attribute of the column	Long varying-length character string	Length attribute of the host variable
460/461	Not Applicable	Not Applicable	NUL-terminated character string	Length attribute of the host variable
464/465	Varying-length graphic string	Length attribute of the column	Varying-length graphic string	Length attribute of the host variable
468/469	Fixed-length graphic string	Length attribute of the column	Fixed-length graphic string	Length attribute of the host variable
472/473	Long varying-length graphic string	Length attribute of the column	Long graphic string	Length attribute of the host variable
476/477	Not Applicable	Not Applicable	PASCAL L-string	Length attribute of the host variable
480/481	Floating point	4 for single precision, 8 for double precision	Floating point	4 for single precision, 8 for double precision
484/485	Packed decimal	Precision in byte 1; scale in byte 2	Packed decimal	Precision in byte 1; scale in byte 2
488/489	Zoned decimal	Precision in byte 1; scale in byte 2	Zoned decimal	Precision in byte 1; scale in byte 2
492/493	Big integer	8 [60]	Big integer	8
496/497	Large integer	4 [60]	Large integer	4
500/501	Small integer	2 [60]	Small integer	2
504/505	Not Applicable	Not Applicable	DISPLAY SIGN LEADING SEPARATE	Precision in byte 1; scale in byte 2
960/961	Not Applicable	Not Applicable	BLOB locator	4
964/965	Not Applicable	Not Applicable	CLOB locator	4
968/969	Not Applicable	Not Applicable	DBCLOB locator	4
916/917	Not Applicable	Not Applicable	BLOB file reference variable	267
920/921	Not Applicable	Not Applicable	CLOB file reference variable	267

Table 47. SQLTYPE and SQLLEN values for PREPARE, DESCRIBE, FETCH, OPEN, CALL, or EXECUTE (continued)

	For PREPARE and DESCRIBE		For FETCH, OPEN, CALL, and EXECUTE	
SQLTYPE	**COLUMN DATA TYPE**	**SQLLEN**	**HOST VARIABLE DATA TYPE**	**SQLLEN**
924/925	Not Applicable	Not Applicable	DBCLOB file reference variable	267

SQLDATA or SQLNAME

In the OPEN, FETCH, CALL, and EXECUTE statements, the SQLNAME field of the SQLVAR element can be used to specify a CCSID for string host variables. If the SQLNAME field is used to specify a CCSID, the SQLNAME length must be set to 8. In addition, the first 4 bytes of SQLNAME must be set as described in the table below. If no CCSID is specified, the job CCSID is used.

In the DESCRIBE, DESCRIBE TABLE, and PREPARE statements, the SQLDATA field of the SQLVAR element contains the CCSID of the column of the result table if that column is a string column. The CCSID is located in bytes 3 and 4 as described in Table 48.

Table 48. CCSID values for SQLDATA or SQLNAME

Data Type	Subtype	Bytes 1 & 2	Bytes 3 & 4
Character	SBCS data	X'0000'	ccsid
Character	Mixed data	X'0000'	ccsid
Character	Bit data	X'0000'	65535
Graphic	Not Applicable	X'0000'	ccsid
Any other data type	Not Applicable	Not Applicable	Not Applicable

Unrecognized and Unsupported SQLTYPES

The values that appear in the SQLTYPE field of the SQLDA are dependent on the level of data type support available at the sender as well as the receiver of the data. This is particularly important as new data types are added to the product.

New data types may or may not be supported by the sender or receiver of the data and may or may not even be recognized by the sender or receiver of the data. Depending on the situation, the new data type may be returned, or a compatible data type agreed upon by both the sender and receiver of the data may be returned or an error may result.

When the sender and receiver agree to use a compatible data type, the following indicates the mapping that will take place. This mapping will take place when at least one of the sender or receiver does not support the data type provided. The unsupported data type can be provided by either the application or the database manager.

---

60. Binary numbers can be represented in the SQLDA with a length of 2, 4, or 8, or with the precision in byte 1 and the scale in byte 2. If the first byte is greater than x'00', it indicates precision and scale.

61. Field SQLLONGLEN in the extended SQLVAR contains the length attribute of the column.

Table 49. Compatible Data Types for Unsupported Data Types

Data Type	Compatible Data Type
BIGINT	DECIMAL(19,0)
ROWID	VARCHAR(40) FOR BIT DATA

INCLUDE SQLDA Declarations

For C and C++

In C and C++, INCLUDE SQLDA declarations are equivalent to the following:

```
#ifndef SQLDASIZE
struct sqlda
{
       unsigned char  sqldaid[8];
       long           sqldabc;
       short          sqln;
       short          sqld;
       struct sqlvar
       {
              short          sqltype;
              short          sqllen;
              unsigned char *sqldata;
              short         *sqlind;
              struct sqlname
              {
                     short          length;
                     unsigned char  data[30];
              } sqlname;
       } sqlvar[1];
};

struct sqlvar2
       { struct
                {  long           sqllonglen;
                   char           reserve1[28];
                }  len;
                char *sqldatalen;
                struct sqldistinct_type
                       {  short          length;
                          unsigned char  data[30];
                       } sqldatatype_name;
       };

#define  SQLDASIZE(n) (sizeof(struct sqlda)+(n-1) * sizeof(struct sqlvar))
#endif
```

Figure 10. INCLUDE SQLDA Declarations for C and C++ (Part 1 of 3)

```
/*********************************************************************/
/* Macros for using the sqlvar2 fields.                              */
/*********************************************************************/

/*********************************************************************/
/*   '2' in the 7th byte of sqldaid indicates a doubled number of   */
/*       sqlvar entries.                                             */
/*   '3' in the 7th byte of sqldaid indicates a tripled number of   */
/*       sqlvar entries.                                             */
/*********************************************************************/
#define SQLDOUBLED '2'
#define SQLSINGLED ' '

/*********************************************************************/
/* GETSQLDOUBLED(daptr) returns 1 if the SQLDA pointed to by         */
/* daptr has been doubled, or 0 if it has not been doubled.          */
/*********************************************************************/
#define GETSQLDOUBLED(daptr) (((daptr)->sqldaid[6]==  \
 (char) SQLDOUBLED)  ?                                \
    (1)           :      \
    (0)             )

/*********************************************************************/
/* SETSQLDOUBLED(daptr, SQLDOUBLED) sets the 7th byte of sqldaid     */
/* to '2'.                                                           */
/* SETSQLDOUBLED(daptr, SQLSINGLED) sets the 7th byte of sqldaid     */
/* to be a ' '.                                                      */
/*********************************************************************/
#define SETSQLDOUBLED(daptr, newvalue)                \
  (((daptr)->sqldaid[6] =(newvalue)))

/*********************************************************************/
/* GETSQLDALONGLEN(daptr,n) returns the data length of the nth       */
/* entry in the sqlda pointed to by daptr. Use this only if the      */
/* sqlda was doubled or tripled and the nth SQLVAR entry has a       */
/* LOB datatype.                                                     */
/*********************************************************************/
#define GETSQLDALONGLEN(daptr,n) ((long) (((struct sqlvar2 *) \
&((daptr)->sqlvar[(n) +((daptr)->sqld)])) ->len.sqllonglen))

/*********************************************************************/
/* SETSQLDALONGLEN(daptr,n,len) sets the sqllonglen field of the     */
/* sqlda pointed to by daptr to len for the nth entry. Use this only */
/* if the sqlda was doubled or tripled and the nth SQLVAR entry has  */
/* a LOB datatype.                                                   */
/*********************************************************************/
#define SETSQLDALONGLEN(daptr,n,length) {             \
 struct sqlvar2 *var2ptr;                             \
 var2ptr = (struct sqlvar2 *) &((daptr)->sqlvar[(n)+  \
   ((daptr)->sqld)]);                                 \
 var2ptr->len.sqllonglen = (long) (length);               \
}

/*********************************************************************/
/* SETSQLDALENPTR(daptr,n,ptr) sets a pointer to the data length for */
/* the nth entry in the sqlda pointed to by daptr.                   */
/* Use this only if the sqlda has been doubled or tripled.           */
/*********************************************************************/
#define SETSQLDALENPTR(daptr,n,ptr) {                 \
 struct sqlvar2 *var2ptr;                             \
 var2ptr = (struct sqlvar2 *) &((daptr)->sqlvar[(n)+  \
   ((daptr)->sqld)]);                                 \
 var2ptr->sqldatalen = (char *) ptr;                  \
 }
```

Figure 10. INCLUDE SQLDA Declarations for C and C++ (Part 2 of 3)

```
/*********************************************************************/
/* GETSQLDALENPTR(daptr,n) returns a pointer to the data length for  */
/* the nth entry in the sqlda pointed to by daptr. Unlike the inline */
/* value (union sql8bytelen len), which is 8 bytes, the sqldatalen   */
/* pointer field returns a pointer to a long (4 byte) integer.       */
/* If the SQLDATALEN pointer is zero, a NULL pointer is be returned. */
/*                                                                   */
/* NOTE: Use this only if the sqlda has been doubled or tripled.     */
/*********************************************************************/
#define GETSQLDALENPTR(daptr,n) (                           \
  (((struct sqlvar2 *) &(daptr)->sqlvar[(n) +              \
    (daptr)->sqld])->sqldatalen == NULL) ?                  \
   ((long *) NULL ) : ((long *) ((struct sqlvar2 *)        \
  &(daptr)->sqlvar[(n) + (daptr) ->sqld])->sqldatalen))
```

Figure 10. INCLUDE SQLDA Declarations for C and C++ (Part 3 of 3)

For COBOL

In COBOL, INCLUDE SQLDA declarations are equivalent to the following:

```
1 SQLDA.
  05 SQLDAID     PIC X(8).
  05 SQLDABC     PIC S9(9) BINARY.
  05 SQLN        PIC S9(4) BINARY.
  05 SQLD        PIC S9(4) BINARY.
  05 SQLVAR OCCURS 0 TO 409 TIMES DEPENDING ON SQLD.
     10 SQLTYPE   PIC S9(4) BINARY.
     10 SQLLEN    PIC S9(4) BINARY.
     10 FILLER  REDEFINES SQLLEN.
        15 SQLPRECISION PIC X.
        15 SQLSCALE     PIC X.
     10 SQLRES    PIC X(12).
     10 SQLDATA   POINTER.
     10 SQLIND    POINTER.
     10 SQLNAME.
        49 SQLNAMEL PIC S9(4) BINARY.
        49 SQLNAMEC PIC X(30).
```

Figure 11. INCLUDE SQLDA Declarations for COBOL

For ILE COBOL

In ILE COBOL, INCLUDE SQLDA declarations are equivalent to the following:

```
1 SQLDA.
  05 SQLDAID     PIC X(8).
  05 SQLDABC     PIC S9(9) BINARY.
  05 SQLN        PIC S9(4) BINARY.
  05 SQLD        PIC S9(4) BINARY.
  05 SQLVAR OCCURS 0 TO 409 TIMES DEPENDING ON SQLD.
     10 SQLVAR1.
        15 SQLTYPE   PIC S9(4) BINARY.
        15 SQLLEN    PIC S9(4) BINARY.
        15 FILLER  REDEFINES SQLLEN.
           20 SQLPRECISION PIC X.
           20 SQLSCALE     PIC X.
        15 SQLRES    PIC X(12).
        15 SQLDATA   POINTER.
        15 SQLIND    POINTER.
        15 SQLNAME.
           49 SQLNAMEL PIC S9(4) BINARY.
           49 SQLNAMEC PIC X(30).
     10 SQLVAR2 REDEFINES SQLVAR1.
        15 SQLVAR2-RESERVED-1 PIC S9(9) BINARY.
        15 SQLLONGLEN         REDEFINES SQLVAR2-RESERVED-1
                              PIC S9(9) BINARY.
        15 SQLVAR2-RESERVED-2 PIC X(28).
        15 SQLDATALEN         POINTER.
        15 SQLDATATYPE-NAME.
           49 SQLDATATYPE-NAMEL PIC S9(4) BINARY.
           49 SQLDATATYPE-NAMEC PIC X(30).
```

Figure 12. INCLUDE SQLDA Declarations for ILE COBOL

For PL/I

In PL/I, INCLUDE SQLDA declarations are equivalent to the following:

```
DCL 1 SQLDA BASED(SQLDAPTR),
      2 SQLDAID     CHAR(8),
      2 SQLDABC     BIN FIXED(31),
      2 SQLN        BIN FIXED,
      2 SQLD        BIN FIXED,
      2 SQLVAR      (99),
        3 SQLTYPE   BIN FIXED,
        3 SQLLEN    BIN FIXED,
        3 SQLRES    CHAR(12),
        3 SQLDATA   PTR,
        3 SQLIND    PTR,
        3 SQLNAME   CHAR(30) VAR,

    1 SQLDA2 BASED(SQLDAPTR),
      2 SQLDAID2    CHAR(8),
      2 SQLDABC2    FIXED(31) BINARY,
      2 SQLN2       FIXED(15) BINARY,
      2 SQLD2       FIXED(15) BINARY,
      2 SQLVAR2     (99),
        3 SQLBIGLEN,
          4 SQLLONGL FIXED(31) BINARY,
          4 SQLRSVDL FIXED(31) BINARY,
        3 SQLDATAL  POINTER,
        3 SQLTNAME  CHAR(30) VAR;

    DECLARE SQLSIZE    FIXED(15) BINARY;
    DECLARE SQLDAPTR   PTR;
    DECLARE SQLDOUBLED CHAR(1)   INITIAL('2') STATIC;
    DECLARE SQLSINGLED CHAR(1)   INITIAL(' ') STATIC;
```

Figure 13. INCLUDE SQLDA Declarations for PL/I

For ILE RPG/400

In ILE RPG/400, INCLUDE SQLDA declarations are equivalent to the following:

```
D*      SQL Descriptor area
D SQLDA          DS
D  SQLDAID              1      8A
D  SQLDABC              9     12B 0
D  SQLN                13     14B 0
D  SQLD                15     16B 0
D  SQL_VAR                    80A   DIM(SQL_NUM)
D                      17     18B 0
D                      19     20B 0
D                      21     32A
D                      33     48*
D                      49     64*
D                      65     66B 0
D                      67     96A
D*
D SQLVAR         DS
D  SQLTYPE              1      2B 0
D  SQLLEN               3      4B 0
D  SQLRES               5     16A
D  SQLDATA             17     32*
D  SQLIND              33     48*
D  SQLNAMELEN          49     50B 0
D  SQLNAME             51     80A
D*
D SQLVAR2        DS
D  SQLLONGL             1      4B 0
D  SQLRSVDL             5     32A
D  SQLDATAL            33     48*
D  SQLTNAMELN          49     50B 0
D  SQLTNAME            51     80A
D*  End of SQLDA
```

Figure 14. INCLUDE SQLDA Declarations for ILE RPG/400

The user is responsible for the definition of SQL_NUM. SQL_NUM must be defined as a numeric constant with the dimension required for SQL_VAR.

Since RPG does not support structures within arrays, the SQLDA generates three data structures. The second and third data structures are used to setup/reference the part of the SQLDA which contains the field descriptions.

To set the field descriptions of the SQLDA the program sets up the field description in the subfields of SQLVAR (or SQLVAR2) and then does a MOVEA of SQLVAR (or SQLVAR2) to SQL_VAR,n where n is the number of the field in the SQLDA. This is repeated until all the field descriptions are set.

When the SQLDA field descriptions are to be referenced the user does a MOVEA of SQL_VAR,n to SQLVAR (or SQLVAR2) where n is the number of the field description to be processed.

Appendix D. Reserved Words

This is the list of currently reserved DB2 UDB for AS/400 words. Words may be added at any time. For a list of additional words that may become reserved in the future, see the IBM SQL and ANSI reserved words in the *IBM SQL Reference Version 1* SC26-3255.

Reserved Words

Table 50. SQL Reserved Words

ADD
ALIAS
ALL
ALLOCATE
ALLOW
ALTER
AND
ANY
AS
AUTHORIZATION

BEGIN
BETWEEN
BINARY
BY

CALL
CALLED
CASE
CAST
CCSID
CHAR
CHARACTER
CHECK
CLOSE
COLLECTION
COLUMN
COMMENT
COMMIT
CONCAT
CONDITION
CONNECT
CONNECTION
CONSTRAINT
CONTAINS
CONTINUE
COUNT
COUNT_BIG
CREATE
CROSS
CURRENT
CURRENT_DATE
CURRENT_PATH
CURRENT_SERVER
CURRENT_TIME
CURRENT_TIMESTAMP
CURRENT_TIMEZONE
CURRENT_USER
CURSOR

DATABASE
DAY
DAYS
DBINFO
DB2GENERAL
DB2SQL
DECLARE
DEFAULT
DELETE
DESCRIPTOR
DETERMINISTIC
DISALLOW
DISCONNECT
DISTINCT
DO
DOUBLE
DROP
DYNAMIC

ELSE
ELSEIF
END
END-EXEC[1]
ESCAPE
EXCEPTION
EXECUTE
EXISTS
EXIT
EXTERNAL

FENCED
FETCH
FILE
FINAL
FOR
FOREIGN
FREE
FROM
FUNCTION

GENERAL
GET
GO
GOTO
GRANT
GRAPHIC
GROUP

HANDLER
HAVING
HOUR
HOURS

IF
IMMEDIATE
IN
INDEX
INDICATOR
INNER
INOUT
INSENSITIVE
INSERT
INTEGRITY
INTO
IS
ISOLATION

JAVA
JOIN

KEY

LABEL
LANGUAGE
LEAVE
LEFT
LIKE
LINKTYPE
LOCK
LONG
LOOP

MICROSECOND
MICROSECONDS
MINUTE
MINUTES
MODIFIES
MONTH
MONTHS

NO
NODENAME
NODENUMBER
NOT
NULL

OF
ON
OPEN
OPTIMIZE
OPTION
OR
ORDER
OUT
OUTER

PACKAGE
PARAMETER
PARTITION
PATH
POSITION
PREPARE
PRIMARY
PRIVILEGES
PROCEDURE
PROGRAM

READ
READS
RECOVERY
REFERENCES
RELEASE
RENAME
REPEAT
RESET
RESULT
RETURN
RETURNS
REVOKE
ROLLBACK
ROUTINE
ROW
ROWS
RRN
RUN

SCHEMA
SCRATCHPAD
SECOND
SECONDS
SELECT
SET
SIMPLE
SOME
SOURCE
SPECIFIC
SQL
STATIC
SUBSTRING
SYNONYM

TABLE
THEN
TO
TRANSACTION
TRIM
TYPE

UNDO
UNION
UNIQUE
UNTIL
UPDATE
USAGE
USER
USING

VALUES
VARIABLE
VARIANT
VIEW

WHEN
WHERE
WHILE
WITH
WRITE

YEAR
YEARS

Note: [1] COBOL only

Appendix E. CCSID Values

The following tables describe the CCSIDs and conversions provided by the IBM relational database products.

- For DB2 UDB for OS/390 and SQL/DS, these tables represent the only CCSIDs and pairs of CCSID conversion tables that are initially supplied in the catalog. A user with administrative authority can add any SBCS CCSIDs and SBCS conversion tables at any time. It is also possible to provide user exit routines that perform SBCS or DBCS conversions.
- For DB2 UDB for AS/400 and DB2 UDB, these charts represent the only CCSIDs and conversion tables that are available. There is no way to add additional CCSIDs or conversion tables.

The following list defines the symbols used in the IBM relational database product column in the following tables:

X	Indicates that the conversion tables exist to convert from and to that CCSID.
C	Indicates that conversion tables exist to convert from that CCSID to another CCSID. This also implies that this CCSID cannot be used to tag local data, because the CCSID is in a foreign encoding scheme (for example, a PC-Data CCSID such as 850 cannot be used to tag local data in DB2 UDB for AS/400).
T	Indicates that while data may be tagged with this CCSID, conversion tables are not shipped with the product.

The information in this appendix refers to the following product versions:

- DB2 Universal Database for OS/390 Version 6
- DB2 for VM and VSE Version 6
- DB2 Universal Database for AS/400 Version 4 Release 5
- DB2 Universal Database for OS/2 Version 5.2
- DB2 Universal Database for AIX/6000 Version 5.2
- DB2 Universal Database for HP Version 5.2
- DB2 Universal Database for SUN Version 5.2
- DB2 Universal Database for NT and Windows 95 Version 5.2
- DB2 Universal Database for SCO Open Server Version 5.2

Table 51. Universal Character Set (UCS-2 and UTF-8)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
1208	UTF-8 Level 3			C						
13488	UCS-2 Level 1		T	X						

CCSID Values

Table 52. CCSIDs for EBCDIC Group 1 (Latin-1) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
37	USA, Canada (S/370), Netherlands, Portugal, Brazil, Australia, New Zealand	X	X	X	C	C	C	C	C	C
256	Word Processing, Netherlands	T	T	X						
273	Austria, Germany	X	X	X	C	C	C	C	C	C
277	Denmark, Norway	X	X	X	C	C	C	C	C	C
278	Finland, Sweden	X	X	X	C	C	C	C	C	C
280	Italy	X	X	X	C	C	C	C	C	C
284	Spain, Latin America (Spanish)	X	X	X	C	C	C	C	C	C
285	United Kingdom	X	X	X	C	C	C	C	C	C
297	France	X	X	X	C	C	C	C	C	C
500	Belgium, Canada (AS/400), Switzerland, International Latin-1	X	X	X	C	C	C	C	C	C
871	Iceland	X	X	X	C	C	C	C	C	C
924	Latin-0	T	T	X						
1140	USA, Canada (S/370), Netherlands, Portugal, Brazil, Australia, New Zealand	T	T	X						
1141	Austria, Germany	T	T	X						
1142	Denmark, Norway	T	T	X						
1143	Finland, Sweden	T	T	X						
1144	Italy	T	T	X						
1145	Spain, Latin America (Spanish)	T	T	X						
1146	United Kingdom	T	T	X						
1147	France	T	T	X						

Table 52. CCSIDs for EBCDIC Group 1 (Latin-1) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
1148	Belgium, Canada (AS/400), Switzerland, International Latin-1	T	T	X						
1149	Iceland	T	T	X						

Table 53. CCSIDs for PC-Data and ISO Group 1 (Latin-1) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
437	USA	X	C	C	X	C	C	C	C	C
819	Latin-1 countries (ISO 8859-1)	X	C	C	C	X	X	X	C	X
850	Latin Alphabet Number 1; Latin-1 countries	X	C	C	X	X	C	C	C	C
860	Portugal (850 subset)	C	C	C	X	C	C	C	C	C
861	Iceland	C		C						
863	Canada (850 subset)	C	C	C	X	C	C	C	C	C
865	Denmark, Norway, Finland, Sweden	C	C	C						
923	Latin-0			C						
1009	IRV 7-bit			C						
1010	France 7-bit			C						
1011	Germany 7-bit			C						
1012	Italy 7-bit			C						
1013	United Kingdom 7-bit			C						
1014	Spain 7-bit			C						
1015	Portugal 7-bit			C						
1016	Norway 7-bit			C						
1017	Denmark 7-bit			C						
1018	Finland and Sweden 7-bit			C						
1019	Belgium and Netherlands 7-bit			C						
1051	HP Emulation	X		C	C	C	X	C	C	
1252	Windows** Latin-1	X	C	C	C	C	C	C	X	C

Table 53. CCSIDs for PC-Data and ISO Group 1 (Latin-1) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
1275	Macintosh** Latin-1	X		C	C	C	C	C	C	C

Table 54. CCSIDs for EBCDIC Group 1a (Non-Latin-1 SBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
420	Arabic (Type 4)Visual LTR	X	X	X	C	C	C	C	C	C
423	Greek	X	X	X	C	C	C	C	C	C
424	Hebrew(Type 4)	X	X	X	C	C	C	C	C	C
870	Latin-2 Multilingual	X	X	X	C	C	C	C	C	C
875	Greek	X	X	X	C	C	C	C	C	C
880	Cyrillic Multilingual	T	T	X						
905	Turkey Latin-3 Multilingual	T	T	X						
918	Urdu	T	T	X						
1025	Cyrillic Multilingual	X	X	X	C	C	C	C	C	C
1026	Turkey Latin-5	X	T	X	C	C	C	C	C	C
1097	Farsi	T	T	X						
1112	Baltic Multilingual	X	X	X	C	C	C	C	C	C
1122	Estonia	T	X	X	C	C	C	C	C	C
1123	Ukraine	T	X	X	C	C	C	C	C	C
8612	Arabic (Type 5)			X						
8616	Hebrew (Type 6)			X						
12708	Arabic (Type 7)			X						
62211	Hebrew (Type 5)			X	C	C	C	C	C	C
62224	Arabic (Type 6)			X	C	C	C	C	C	C
62229	Hebrew (Type 8)				C	C	C	C	C	C
62233	Arabic (Type 8)				C	C	C	C	C	C
62234	Arabic (Type 9)				C	C	C	C	C	C
62235	Hebrew (Type 10)			X	C	C	C	C	C	C
62240	Hebrew (Type 11)				C	C	C	C	C	C

Table 54. CCSIDs for EBCDIC Group 1a (Non-Latin-1 SBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)

String Types:

4	Visual / Left-to-Right / Shaped
5	Implicit / Left-to-Right / Unshaped
6	Implicit / Right-to-Left / Unshaped
7	Visual / Contextual / Unshaped
8	Visual / Right-to-Left / Shaped
9	Visual / Right-to-Left / Shaped
10	Implicit / Contextual-Left
11	Implicit / Contextual-Right

Table 55. CCSIDs for PC-Data and ISO Group 1a (Non-Latin-1 SBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
720	Arabic (MS-Dos)			C						
737	Greek (MS-Dos)			C	C	C	C	C	C	C
775	Baltic (MS-Dos)			C						
813	Greek/Latin (ISO 8859-7)	C	C	C	X	X	X	C	C	X
851	Greek			C						
852	Latin-2 Multilingual	C	C	C	X	C	C	C	C	C
855	Cyrillic Multilingual		C	C	X	C	C	C	C	C
856	Arabic (Type 5)			C						
857	Turkey Latin-5	C		C	X	C	C	C	C	C
862	Hebrew (Type 10)	C	C	C	X	C	C	C	C	C
864	Arabic (Type 5)	C	C	C	X	C	C	C	C	C
866	Cyrillic		C	C	X	C	C	C	C	C
868	Urdu			C						
869	Greek	C	C	C	X	C	C	C	C	C
878	Russian Internet			C						
912	Latin-2 (ISO 8859-2)	C	C	C	C	X	X	C	C	X
914	Latin-4 (ISO 8859-4)			C						
915	Cyrillic Multilingual (ISO 8859-5)		C	C	X	X	X	C	C	X

Table 55. CCSIDs for PC-Data and ISO Group 1a (Non-Latin-1 SBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
916	Hebrew/Latin (ISO 8859-8) (Type 5)	C	C	C	C	X	C	C	C	C
920	Turkey Latin-5 (ISO 8859-9)	C		C	C	X	X	C	C	X
921	Baltic 8-bit	C		C	X	X	C	C	X	C
922	Estonia 8-bit			C	X	X	C	C	X	C
1008	Arabic 8-bit ISO			C						
1046	Arabic (Type 5)	C		C	C	X	C	C	C	C
1089	Arabic (ISO 8859-6) (Type 5)	C		C	C	X	X	C	C	C
1098	Farsi			C						
1125	Ukraine			C	X	C	C	C	C	C
1131	Belarus			C	X	C	C	C	C	C
1250	Windows Latin-2	C	C	C	C	C	C	C	X	C
1251	Windows Cyrillic	C	C	C	C	C	C	C	X	C
1253	Windows Greek	C	C	C	C	C	C	C	X	C
1254	Windows Turkey	C		C	C	C	C	C	X	C
1255	Windows Hebrew (Type 5)	C	C	C	C	C	C	C	X	C
1256	Windows Arabic (Type 5)	C	C	C	C	C	C	C	X	C
1257	Windows Baltic	C		C						
1280	Macintosh** Greek	C		C	C	C	C	C	C	C
1281	Macintosh** Turkish	C		C	C	C	C	C	C	C
1282	Macintosh** Latin-2	C		C	C	C	C	C	C	C
1283	Macintosh** Cyrillic	C		C	C	C	C	C	C	C
4948	Latin-2 Multilingual			C						
4951	Cyrillic Multilingual			C						
4952	Hebrew			C						
4953	Turkey Latin-5			C						
4960	Arabic			C						
4965	Greek			C						
9056	Arabic (Storage Interchange)			C						
62208	Hebrew (Type 4)				X	X	X	X	X	X

Table 55. CCSIDs for PC-Data and ISO Group 1a (Non-Latin-1 SBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
62209	Hebrew (Type 4)			C	X	C	C	C	C	C
62210	Hebrew/Latin (ISO 8859-8) (Type 4)			C	C	X	X	C	C	C
62213	Hebrew (Type 5)			C	X	C	C	C	C	C
62215	Windows Hebrew (Type 4)			C	C	C	C	C	X	C
62218	Arabic (Type 4)			C	X	C	C	C	C	C
62220	Hebrew (Type 6)				X	X	X	X	X	X
62221	Hebrew (Type 6)			C	X	C	C	C	C	C
62222	Hebrew/Latin (ISO 8859-8) (Type 6)			C	C	X	X	C	C	C
62223	Windows Hebrew (Type 6)			C	C	C	C	C	X	C
62225	Arabic (Type 6)				X	C	C	C	C	C
62226	Arabic (Type 6)				C	X	C	C	C	C
62227	Arabic (ISO 8859-6) (Type 6)				C	X	X	C	C	C
62228	Windows Arabic (Type 6)			C	C	C	C	C	X	C
62230	Hebrew (Type 8)				X	X	X	X	X	X
62231	Hebrew (Type 8)				X	C	C	C	C	C
62232	Hebrew/Latin (ISO 8859-8) (Type 8)				C	X	X	C	C	C
62236	Hebrew (Type 10)				X	X	X	X	X	X
62238	Hebrew/Latin (ISO 8859-8) (Type 10)			C	C	X	X	C	C	C
62239	Windows Hebrew (Type 10)			C	C	C	C	C	X	C
62241	Hebrew (Type 11)				X	X	X	X	X	X
62242	Hebrew (Type 11)				X	C	C	C	C	C
62243	Hebrew/Latin (ISO 8859-8) (Type 11)				C	X	X	C	C	C
62244	Windows Hebrew (Type 11)				C	C	C	C	X	C

Table 55. CCSIDs for PC-Data and ISO Group 1a (Non-Latin-1 SBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
String Types:										
4	Visual / Left-to-Right / Shaped									
5	Implicit / Left-to-Right / Unshaped									
6	Implicit / Right-to-Left / Unshaped									
7	Visual / Contextual / Unshaped									
8	Visual / Right-to-Left / Shaped									
9	Visual / Right-to-Left / Shaped									
10	Implicit / Contextual-Left									
11	Implicit / Contextual-Right									

Table 56. SBCS CCSIDs for EBCDIC Group 2 (DBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
290	Japan Katakana (extended)	X	X	X	C	C	C	C	C	C
833	Korea (extended)	X	X	X	C	C	C	C	C	C
836	Simplified Chinese (extended)	X	X	X	C	C	C	C	C	C
838	Thailand (extended)	X	X	X	C	C	C	C	C	C
1027	Japan English (extended)	X	X	X	C	C	C	C	C	C
1130	Vietnam	T	X	X						
1132	Lao	T	X	X						
9030	Thailand (extended)	T	T	X						
13121	Korea Windows	T	T	X						
13124	Traditional Chinese	T	T	X						
28709	Traditional Chinese (extended)	X	X	X	C	C	C	C	C	C

Table 57. SBCS CCSIDs for PC-Data Group 2 (DBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
367	Korea and Simplified Chinese EUC	X	C	C		X			C	

Table 57. SBCS CCSIDs for PC-Data Group 2 (DBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
874	Thailand (extended)	C	C	C	X	X			X	
891	Korea (non-extended)		C	C						
895	Japan EUC - JISX201 Roman Set	C	C							
896	Japan EUC - JISX201 Katakana Set		C							
897	Japan (non-extended)	X	C	C						
903	Simplified Chinese (non-extended)		C	C						
904	Traditional Chinese (non-extended)	C	C	C						
1040	Korea (extended)		C	C						
1041	Japan (extended)	X	C	C						
1042	Simplified Chinese (extended)		C	C						
1043	Traditional Chinese (extended)	C	C	C						
1088	Korea (KS Code 5601-89)	X	C	C						
1114	Traditional Chinese (Big-5)	C	C	C						
1115	Simplified Chinese GB-Code	C	C	C						
1126	Korea Windows		C	C						
1129	Vietnam			C						
1133	Lao ISO			C						
1258	Vietnam			C						
4970	Thailand (extended)			C	X	X			X	
5210	Traditional Chinese			C						
9066	Thailand (extended)			C						

CCSID Values

Table 58. DBCS CCSIDs for EBCDIC Group 2 (DBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
300	Japan - including 4370 user-defined characters (UDC)	X	X	X	C	C	C	C	C	C
834	Korea - including 1880 UDC	X	X	X	C	C	C	C	C	C
835	Traditional Chinese - including 6204 UDC	X	X	X	C	C	C	C	C	C
837	Simplified Chinese - including 1880 UDC	X	X	X	C	C	C	C	C	C
4396	Japan - including 1880 UDC	X	X	X	C	C	C	C	C	C
4930	Korea Windows			X	C	C	C	C	C	C
4933	Simplified Chinese			X	C	C	C	C	C	C

Table 59. DBCS CCSIDs for PC-Data Group 2 (DBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
301	Japan - including 1880 UDC	X	C	C	X	X	C	C	C	C
926	Korea - including 1880 UDC		C	C						
927	Traditional Chinese - including 6204 UDC	C	C	C	X	C	C	C	C	C
928	Simplified Chinese - including 1880 UDC		C	C						
941	Japan Windows	X	C	C	C	C	C	C	X	C
947	Traditional Chinese (Big-5)	C	C	C	X	X	C	C	X	C
951	Korea (KS Code 5601-89) - including 1880 UDC	X	C	C	X	C	C	C	X	C
952	Japan (EUC) X208-1990 set		C							

Table 59. DBCS CCSIDs for PC-Data Group 2 (DBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
953	Japan (EUC) X212-1990 set		C							
971	Korea (EUC) - including 188 UDC	X	C	C	C	X	X	X	C	C
1351	Japan HP-UX (J15)	X		C	C	C	X	C	C	C
1362	Korea Windows		C	C	C	C	C	C	X	C
1380	Simplified Chinese (GB-Code) - including 1880 UDC	C	C	C	X	C	C	C	X	X
1382	Simplified Chinese (EUC) - including 1360 UDC	C	C	C	C	X	X	X	C	X
1385	Traditional Chinese			C	C	C	C	C	X	C

Table 60. Mixed CCSIDs for EBCDIC Group 2 (DBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
930	Japan Katakana/Kanji (extended) - including 4370 UDC	X	X	X	C	C	C	C	C	C
933	Korea (extended) - including 1880 UDC	X	X	X	C	C	C	C	C	C
935	Simplified Chinese (extended) - including 1880 UDC	X	X	X	C	C	C	C	C	C
937	Traditional Chinese (extended) - including 4370 UDC	X	X	X	C	C	C	C	C	C
939	Japan English/Kanji (extended) - including 4370 UDC	X	X	X	C	C	C	C	C	C
1364	Korea (extended)			X	C	C	C	C	C	C

Table 60. Mixed CCSIDs for EBCDIC Group 2 (DBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
1388	Traditional Chinese			X	C	C	C	C	C	C
5026	Japan Katakana/Kanji (extended) - including 1880 UDC)	X	X	X	C	C	C	C	C	C
5035	Japan English/Kanji (extended) - including 1880 UDC	X	X	X	C	C	C	C	C	C

Table 61. Mixed CCSIDs for PC-Data Group 2 (DBCS) Countries

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
932	Japan (non-extended) - including 1880 UDC	X	C	C	X	X	C	C	C	C
934	Korea (non-extended) including 1880 UDC		C	C						
936	Simplified Chinese (non-extended) - including 1880 UDC		C	C						
938	Traditional Chinese (non-extended) - including 6204 UDC)	C	C	C	X	C	C	C	C	C
942	Japan (extended) - including 1880 UDC	X	C	C	X	C	C	C	C	C
943	Japan NT	X	C	C	X	C	C	C	X	C
944	Korea (extended) - including 1880 UDC	C	C	C						
946	Simplified Chinese (extended) - including 1880 UDC		C	C						

Table 61. Mixed CCSIDs for PC-Data Group 2 (DBCS) Countries (continued)

CCSID	Description	DB2 UDB (OS/390)	DB2 for VM and VSE	DB2 UDB (AS/400)	DB2 UDB (OS/2)	DB2 UDB (AIX/6000)	DB2 UDB (HP)	DB2 UDB (SUN)	DB2 UDB (NT)	DB2 UDB (SCO)
948	Traditional Chinese (extended) - including 6204 UDC	C	C	C	X	C	C	C	C	C
949	Korea (KS Code 5601-89) - including 1880 UDC	X	C	C	X	C	C	C	C	C
950	Traditional Chinese (Big-5)	C	C	C	X	X	X	X	X	C
954	Japan (EUC)	C	C	C	C	X	X	X	C	X
956	Japan 2022 TCP			C						
957	Japan 2022 TCP			C						
958	Japan 2022 TCP			C						
959	Japan 2022 TCP			C						
964	Traditional Chinese (EUC)	C	C	C	C	X	X	X	C	C
965	Traditional Chinese 2022 TCP			C						
970	Korea EUC	X	C	C	C	X	X	X	C	C
1363	Korea Windows		C	C	C	C	C	C	X	C
1381	Simplified Chinese GB-Code	C	C	C	X	C	C	C	X	C
1383	Simplified Chinese EUC	C	C	C	C	X	X	X	C	X
1386	Traditional Chinese			C	X	X	C	C	X	C
5039	Japan HP-UX (J15)	C			C	C	X	C	C	C
5050	Japan (EUC)			C						
5052	Japan 2022 TCP			C						
5053	Japan 2022 TCP			C						
5054	Japan 2022 TCP			C						
5055	Japan 2022 TCP			C						
17354	Korea 2022 TCP			C						
25546	Korea 2022 TCP			C						
33722	Japan EUC			C						

Appendix F. Considerations for Using Distributed Relational Database

This appendix contains information that may be useful in developing applications that use application servers which are not the same product as their application requesters.

All IBM relational database products support extensions to IBM SQL. Some of these extensions are product-specific, and some are shared by more than one product.

For the most part, an application can use the statements and clauses that are supported by the database manager of the current server, even though that application might be running through the application requester of a database manager that does not support some of those statements and clauses. Restrictions to this general rule are identified in Table 62, Table 63 on page 585, Table 64 on page 586, and Table 65 on page 587.

Note that an 'R' in the table indicates that this SQL function is not supported in the specified environment. An 'R' in every column of the same row means that the function is available only if the current server and requester are the same product.

Note that DB2 UDB in the following table refers to any of the DB2 products other than DB2 UDB for OS/390, DB2 for VM and VSE, or DB2 UDB for AS/400.

The information in this appendix refers to the following product versions:
- DB2 UDB for OS/390 Version 6
- DB2 for VM and VSE Version 6
- DB2 UDB for AS/400 Version 4 Release 4
- DB2 UDB for OS/2 Version 5.2
- DB2 UDB for AIX/6000 Version 5.2
- DB2 UDB for HP Version 5.2
- DB2 UDB for NT Version 5.2
- DB2 UDB for SUN Version 5.2
- DB2 UDB for SCO Open Server Version 5.2

Table 62. DB2 UDB for OS/390 Application Requester

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server
CALL				
CALL with result sets		R	R	R
COMMIT HOLD	R	R	R	R
COMMIT RELEASE	R	R	R	R
CONNECT (Type 2)		Note 1	Note 1	Note 1
DECLARE CURSOR WITH HOLD		R		
DECLARE STATEMENT				

Table 62. DB2 UDB for OS/390 Application Requester (continued)

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server
DECLARE TABLE				
DECLARE VARIABLE	R	R	R	R
Deferred Existence (Note 3)				R
DESCRIBE TABLE		R		R
DESCRIBE with USING clause				R
DISCONNECT	R	R	R	R
Extended Dynamic Statements	R	R	R	R
Host Structures				
Host Variables - optional colon		R	R	R
Large Object (LOB) Data Types		R		R
DATALINK Data Types	R	R	R	R
Distinct Data Types		R		R
Non-IBM SQL host declarations		Note 2	Note 2	Note 2
PREPARE with INTO clause				
PREPARE with USING clause				R
PUT	R	R	R	R
RELEASE				
ROLLBACK HOLD	R	R	R	R
ROLLBACK RELEASE	R	R	R	R
SET CONNECTION				
SET CURRENT PACKAGESET				
SET host variable		R	R	R
SET TRANSACTION	R	R	R	R
Scrollable Cursor statements	R	R	R	R
UPDATE cursor - FOR UPDATE OF clause not specified				
WHENEVER with STOP	R	R	R	R

Notes:

1 The application server will only be allowed read-only operations unless all the other connections are already read-only. If the application server is DB2 UDB for AS/400 or DB2 UDB this is only a restriction if a TCP/IP connection is used.

2 The statement is supported if the application requester understands it.

3 Objects need not exist at bind time when they are referred to in a data manipulation statement.

Table 63. DB2 for VM and VSE Application Requester

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server
CALL	Note 4		Note 4	Note 4
CALL with result sets	R	R	R	R
COMMIT HOLD	R	R	R	R
COMMIT RELEASE				
CONNECT (Type 2)	R	R	R	R
DECLARE CURSOR WITH HOLD		R		
DECLARE STATEMENT	R	R	R	R
DECLARE TABLE	R	R	R	R
DECLARE VARIABLE	R	R	R	R
Deferred Existence (Note 2)			R	
DESCRIBE TABLE	R	R	R	R
DESCRIBE with USING clause			R	
DISCONNECT	R	R	R	R
Extended Dynamic Statements	R Note 3		R Note 3	R Note 3
Host Variables - optional colon	R	R	R	R
Host Structures				
Large Object (LOB) Data Types	R	R	R	R
DATALINK Data Types	R	R	R	R
Distinct Data Types	R	R	R	R
Non-IBM SQL host declarations	Note 1		Note 1	Note 1
PREPARE with INTO clause	R	R	R	R
PREPARE with USING clause	R	R	R	R
PUT				
RELEASE	R	R	R	R
ROLLBACK HOLD	R	R	R	R
ROLLBACK RELEASE				
SET CONNECTION	R	R	R	R
SET CURRENT PACKAGESET	R	R	R	R
SET host variable	R	R	R	R
SET TRANSACTION	R	R	R	R
Scrollable Cursor statements	R	R	R	R
UPDATE cursor - FOR UPDATE OF clause not specified				
WHENEVER with STOP				

Table 63. DB2 for VM and VSE Application Requester (continued)

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server

Notes:

1 The statement is supported if the application requester understands it.

2 Objects need not exist at bind time when they are referred to in a data manipulation statement.

3 Most of the extended dynamic statements involving non-modifiable packages will work. See the SQL/DS product library for more information.

4 The CALL statement will only work from an SQL/DS application requester if all parameters are IN.

Table 64. DB2 UDB for AS/400 Application Requester

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server
CALL				
CALL with result sets	R	R	R	R
COMMIT HOLD	R	R		R
COMMIT RELEASE	R	R	R	R
CONNECT (Type 2)		Note 1	Note 1	Note 1
DECLARE CURSOR WITH HOLD		R		
DECLARE PROCEDURE				
DECLARE STATEMENT				
DECLARE TABLE				
DECLARE VARIABLE				
Deferred Existence (Note 3)				R
DESCRIBE TABLE		R		R
DESCRIBE with USING clause				R
DISCONNECT				
Extended Dynamic Statements	R	R	R	R
Host Variables - optional colon	R	R	R	R
Host Structures				
Large Object (LOB) Data Types		R		R
DATALINK Data Types	R	R		R
Distinct Data Types		R		R
Non-IBM SQL host declarations	Note 2	Note 2		Note 2
PREPARE with INTO clause				
PREPARE with USING clause				R
PUT	R	R	R	R
RELEASE				
ROLLBACK HOLD	R	R		R

Table 64. DB2 UDB for AS/400 Application Requester (continued)

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server
ROLLBACK RELEASE	R	R	R	R
SET CONNECTION				
SET CURRENT PACKAGESET	R	R	R	R
SET host variable	R	R	R	R
SET TRANSACTION	R	R		R
Scrollable Cursor statements	R	R		R
UPDATE cursor - FOR UPDATE OF clause not specified	R	R		
WHENEVER with STOP	R	R	R	R

Notes:

1 The application server will only be allowed read-only operations unless all the other connections are already read-only. If the application server is DB2 UDB for AS/400, this is only a restriction if a TCP/IP connection is used.

2 The statement is supported if the application requester understands it.

3 Objects need not exist at bind time when they are referred to in a data manipulation statement.

Table 65. DB2 UDB Application Requester

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server
CALL				
CALL with result sets			R	
COMMIT HOLD	R	R	R	R
COMMIT RELEASE	R	R	R	R
CONNECT (Type 2)		Note 1	Note 1	Note 1
DECLARE CURSOR WITH HOLD		R		
DECLARE STATEMENT	R	R	R	R
DECLARE TABLE	R	R	R	R
DECLARE VARIABLE	R	R	R	R
Deferred Existence (Note 3)				R
DESCRIBE TABLE	R	R	R	R
DESCRIBE with USING clause	R	R	R	R
DISCONNECT				
Extended Dynamic Statements	R	R	R	R
Host Variables - optional colon	R	R	R	R
Host Structures	Note 4	Note 4	Note 4	Note 4
Large Object (LOB) Data Types		R		
DATALINK Data Types	R	R	R	R

Table 65. DB2 UDB Application Requester (continued)

SQL Statement or Function	DB2 UDB for OS/390 Application Server	DB2 for VM and VSE Application Server	DB2 UDB for AS/400 Application Server	DB2 UDB Application Server
Distinct Data Types		R		
Non-IBM SQL host declarations	Note 2	Note 2	Note 2	
PREPARE with INTO clause				
PREPARE with USING clause	R	R	R	R
PUT	R	R	R	R
RELEASE				
ROLLBACK HOLD	R	R	R	R
ROLLBACK RELEASE	R	R	R	R
SET CONNECTION				
SET CURRENT PACKAGESET				
SET host variable	R	R	R	R
SET TRANSACTION	R	R	R	R
Scrollable Cursor statements	R	R	R	R
UPDATE cursor - FOR UPDATE OF clause not specified	R	R		
WHENEVER with STOP	R	R	R	R

Notes:

1 The application server will only be allowed read-only operations unless all the other connections are already read-only. If the application server is DB2 UDB for AS/400, this is only a restriction if a TCP/IP connection is used.

2 The statement is supported if the application requester understands it.

3 Objects need not exist at bind time when they are referred to in a data manipulation statement.

4 In DB2 UDB host structures are only supported in COBOL.

CONNECT (Type 1) and CONNECT (Type 2) Differences

There are two types of CONNECT statements. They have the same syntax, but they have different semantics:

- CONNECT (Type 1) is used for remote unit of work. See “Remote Unit of Work” on page 22.
- CONNECT (Type 2) is used for distributed unit of work. See “CONNECT (Type 2)” on page 287.

The following table summarizes the differences between CONNECT (Type 1) and CONNECT (Type 2) rules:

Table 66. CONNECT (Type 1) and CONNECT (Type 2) Differences

Type 1 Rules	Type 2 Rules
CONNECT statements can only be executed when the activation group is in the connectable state. No more than one CONNECT statement can be executed within the same unit of work.	There are no rules about the connectable state. More than one CONNECT statement can be executed within the same unit of work.
If the CONNECT statement fails because the server name is not listed in the local directory, the connection state of the activation group is unchanged. If a CONNECT statement fails because the activation group is not in the connectable state, the SQL connection status of the activation group is unchanged. If a CONNECT statement fails for any other reason, the activation group is placed in the unconnected state.	If a CONNECT statement fails, the current SQL connection is unchanged and any subsequent SQL statements are executed by the current server.
CONNECT ends all existing connections of the activation group. Accordingly, CONNECT also closes any open cursors for that activation group.	CONNECT does not end connections and does not close cursors.
A CONNECT to the current server will succeed if the application group is the connectable state.	A CONNECT to an existing SQL connection of the activation group is an error. Thus, a CONNECT to the current server is an error.

Determining the CONNECT rules that apply

A program preparation option is used to specify the type of CONNECT that will be performed by a program. The program preparation option is specified using the RDBCNNMTH parameter on the CRTSQLxxx command.

Connecting to Application Servers That Only Support Remote Unit of Work

CONNECT (Type 2) connections to application servers that only support remote unit of work might result in connections that are read-only.

If a CONNECT (Type 2) is performed to an application server that only supports remote unit of work[62]:

- The connection allows read-only operations if, at the time of the connect, there are any dormant connections that allow updates. In this case, the connection does not allow updates.
- Otherwise, the connection allows updates.

If a CONNECT (Type 2) is performed to an application server that supports distributed unit of work:

---

[62] DB2 UDB for AS/400 using the initial DRDA support for native TCP/IP is an example of an application server that supports only remote unit of work.

- The connection allows read-only operations when there are dormant connections that allow updates to application servers that only support remote unit of work. In this case, the connection allows updates as soon as the dormant connection is ended.
- Otherwise, the connection allows updates.

Appendix G. DB2 UDB for AS/400 Catalog Views

The views contained in a DB2 UDB for AS/400 catalog are described in this section. The database manager maintains a set of tables containing information about the data in the database. These tables are collectively known as the *catalog*. The *catalog tables* contain information about tables, user-defined functions, user-defined types, parameters, procedures, packages, views, indexes, aliases, constraints and languages supported by DB2 UDB for AS/400. The catalog tables include the following files in the QSYS library:

- QADBXREF
- QADBPKG
- QADBFDEP
- QADBXRDBD
- QADBFCST
- QADBCCST
- QADBIFLD
- QADBKFLD

The catalog tables also include the following files in the QSYS2 library:

- SQL_LANGUAGES
- SYSPARMS
- SYSROUTINES[63]
- SYSTYPES

The database manager provides views over the catalog tables. The views provide more consistency with the catalog views of other IBM SQL products and with the catalog views of the ANSI and ISO standard (called Information Schema in the standard).

With the exception of SYSINDEXES, SYSKEYS, and SYSPACKAGES; each of the following catalog views has a corresponding view defined in the Information Schema.

The catalog includes the following views and tables in the QSYS2 library:

DB2 UDB for AS/400 name	ANSI/ISO name	Description
SQL_LANGUAGES	SQL_LANGUAGES	Information about the supported languages
SYSCHKCST	CHECK_CONSTRAINTS	Information about check constraints
SYSCOLUMNS	COLUMNS	Information about column attributes
SYSCST	TABLE_CONSTRAINTS	Information about all constraints

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[63] SYSPARMS and SYSROUTINES may contain references to external non-ILE programs. Since restores of non-ILE programs do not repopulate these catalog tables, you may wish to regularly save these tables.

DB2 UDB for AS/400 name	ANSI/ISO name	Description
SYSCSTCOL	CONSTRAINT_COLUMN_USAGE	Information about the columns referenced in a constraint
SYSCSTDEP	CONSTRAINT_TABLE_USAGE	Information about constraint dependencies on tables
SYSFUNCS	ROUTINES	Information about user-defined functions
SYSINDEXES		Information about indexes
SYSKEYCST	KEY_COLUMN_USAGE	Information about unique, primary, and foreign keys
SYSKEYS		Information about index keys
SYSPACKAGE		Information about packages
SYSPARMS	PARAMETERS	Information about routine parameters
SYSPROCS	ROUTINES	Information about procedures
SYSREFCST	REFERENTIAL_CONSTRAINTS	Information about referential constraints
SYSROUTINES	ROUTINES	Information about functions and procedures
SYSTABLES	TABLES	Information about tables and views
SYSTYPES	USER_DEFINED_TYPES	Information about user-defined types
SYSVIEWDEP	VIEW_TABLE_USAGE	Information about view dependencies on tables
SYSVIEWS	VIEWS	Information about definition of a view

The catalog views in the QSYS2 library contain information about all tables, parameters, procedures, functions, user-defined types, packages, views, indexes, and constraints on the AS/400 system. Additionally, an SQL collection will contain a set of these views (except SQL_LANGUAGES, SYSPARMS, SYSPROCS, SYSFUNCS, SYSROUTINES, and SYSTYPES) that only contain information about tables, packages, views, indexes, and constraints in the collection.

Tables and views in the catalog are like any other database tables and views. If you have authorization, you can use SQL statements to look at data in the catalog views in the same way that you retrieve data from any other table in the AS/400 system. The database manager ensures that the catalog contains accurate descriptions of the objects in the database at all times.

Notes

- Collections that were created prior to Version 2 Release 1.1 do not have the SYSPACKAGE catalog view unless an SQL package was created into the collection.
- Collections that were created prior to Version 3 Release 1 do not have the SYSCST, SYSCSTCOL, SYSCSTDEP, SYSKEYCST, and SYSREFCST catalog views unless a constraint has been added to a table or a table with a constraint was created in the collection using SQL.

- Additional columns were added to the SYSCOLUMNS, SYSINDEXES, SYSKEYS, SYSPACKAGE, SYSTABLES, SYSVIEWDEP, and SYSVIEWS catalog views in Version 3 Release 1. If the collection was created prior to this release, not all of the columns described below are in the catalog views.
- Additional columns were added to the SYSCOLUMNS catalog views in Version 4 Release 4. If the collection was created prior to this release, not all of the columns described below are in the catalog views.
- The format of some of the columns changed in Version 3 Release 1. Some of the changes are as follows:
  - Columns were added which show the mapping between the SQL names and the system names.
  - All name (identifier) columns are VARCHAR(128). This complies with the ANS/ISO information schema.
  - Delimited names do not contain the delimiters with exception of the system name columns. For example, if the following table was created:

```
CREATE TABLE "colname"/"long_table_name"
                        ("long_column_name" CHAR(10),
                         INTCOL INTEGER)
```

  To return information about the mapping between SQL names and system names, the following select statement would be used:

```
SELECT TABLE_NAME, SYSTEM_TABLE_NAME, COLUMN_NAME, SYSTEM_COLUMN_NAME
    FROM QSYS2/SYSCOLUMNS
    WHERE TABLE_NAME = 'long_table_name' AND
          TABLE_SCHEMA = 'colname'
```

  The following rows would be returned:

TABLE_NAME	SYSTEM_TABLE_NAME	COLUMN_NAME	SYSTEM_COLUMN_NAME
long_table_name	″long0001″	long_column_name	LONG_00001
long_table_name	″long0001″	INTCOL	INTCOL

- If the information in the column is not applicable, the null value is returned.

  Using the table created above, the following select statement, which queries the NUMERIC_SCALE and the CHARACTER_MAXIMUM_LENGTH, would return the null value when the data was not applicable to the data type of the column.

```
SELECT COLUMN_NAME, NUMERIC_SCALE, CHARACTER_MAXIMUM_LENGTH
  FROM QSYS2/SYSCOLUMNS
  WHERE TABLE_NAME = 'long_table_name'    AND
        TABLE_SCHEMA = 'colname'
```

  The following rows would be returned:

COLUMN_NAME	NUMERIC_SCALE	CHARACTER_MAXIMUM_LENGTH
long_column_name	?	10
INTCOL	0	?

  Because numeric scale is not valid for a character column, the null value is returned for NUMERIC_SCALE for the ″long_column_name″ column. Because character length is not valid for a numeric column, the null value is returned for CHARACTER_MAXIMUM_LENGTH for the INTCOL column.
- CREATE VIEW text is stored using SQL naming. Only the select-statement portion of the view is stored.

The system catalog views in the QSYS2 library are system objects. This means that any user views created over the catalog views in the QSYS2 library must be deleted when the operating system is installed. All dependent objects must be deleted as well. To avoid this requirement, you can save views before installation and then restore them afterwards. Views can be built over the same files in the QSYS library that the catalog views are built over. These cross reference files in the QSYS library are not deleted during installation. Therefore, any views built over them are maintained throughout the installation process.

SQL_LANGUAGES

The SQL_LANGUAGES (system name SYSLANGS) table contains one row for every SQL language binding and programming language for which conformance is claimed. The following table describes the columns in the SQL_LANGUAGES view:

Table 67. SQL_LANGUAGES view

Column Name	System Column Name	Data Type	Description
SQL_LANGUAGE_SOURCE	SOURCE	VARCHAR(254)	Name of the standard.
SQL_LANGUAGE_YEAR	SOURCEYEAR	VARCHAR(254) Nullable	Year in which the standard was approved.
SQL_LANGUAGE_ CONFORMANCE	CONFORM	VARCHAR(254) Nullable	Level of conformance. If conformance is not claimed, the value for this column is null. **YES** conformance is claimed **NO** conformance is not claimed **null** Language does not require or define conformance
SQL_LANGUAGE_INTEGRITY	INTEGRITY	VARCHAR(254) Nullable	Support of the integrity feature. Level of conformance. If conformance is not claimed, the value for this column is null. **YES** conformance is claimed to the integrity feature **NO** conformance is not claimed to the integrity feature **null** Language does not support the integrity feature
SQL_LANGUAGE_ IMPLEMENTATION	IMPLEMENT	VARCHAR(254) Nullable	Will always be the null value.

Table 67. SQL_LANGUAGES view (continued)

Column Name	System Column Name	Data Type	Description
SQL_LANGUAGE_ BINDING_STYLE	BINDSTYLE	VARCHAR(254) Nullable	The style of binding of the SQL language **EMBEDDED** support for embedded SQL for the language in SQL_LANGUAGE_ PROGRAMMING_LANG **DIRECT** DIRECT SQL is supported (for example Interactive SQL) **CLI** Support for CLI for the language in SQL_LANGUAGE_ PROGRAMMING_LANG
SQL_LANGUAGE_ PROGRAMMING_LANG	LANG	VARCHAR(254) Nullable	The language supported by EMBEDDED or CLI. The supported languages are C, COBOL, FORTRAN, and PLI.

SYSCHKCST

The SYSCHKCST view contains one row for each check constraint in the SQL collection. The following table describes the columns in the SYSCHKCST view.

Table 68. SYSCHKCST view

ANS Column Name	Column Name	Data Type	Description
CONSTRAINT_CATALOG	N/A	VARCHAR(128)	Catalog of the constraint.
CONSTRAINT_SCHEMA	DBNAME	VARCHAR(128)	Name of the collection containing the constraint.
CONSTRAINT_NAME	NAME	VARCHAR(128)	Name of the constraint
CHECK_CLAUSE	CHECK	VARCHAR(2000) Nullable	Text of the check constraint clause nullable

SYSCOLUMNS

The SYSCOLUMNS view contains one row for every column of each table and view in the SQL collection (including the columns of the SQL catalog). The following table describes the columns in the SYSCOLUMNS view:

Table 69. SYSCOLUMNS view

Column name	System Column Name	Data Type	Description
COLUMN_NAME	NAME	VARCHAR(128)	Name of the column. This will be the SQL column name if one exists; otherwise, it will be the system column name.

Table 69. SYSCOLUMNS view (continued)

Column name	System Column Name	Data Type	Description
TABLE_NAME	TBNAME	VARCHAR(128)	Name of the table or view that contains the column. This will be the SQL table or view name if one exists; otherwise, it will be the system table or view name.
TABLE_OWNER	TBCREATOR	VARCHAR(128)	The owner of the table or view.
ORDINAL_POSITION	COLNO	INTEGER	Numeric place of the column in the table or view, ordered from left to right.
DATA_TYPE	COLTYPE	CHAR(8)	Type of column: **BIGINT** Big number **INTEGER** Large number **SMALLINT** Small number **DECIMAL** Packed decimal **NUMERIC** Zoned decimal **FLOAT** Floating point; FLOAT, REAL, or DOUBLE PRECISION **BLOB** Binary large object string **CHAR** Fixed-length character string **VARCHAR** Varying-length character string **CLOB** Character large object string **GRAPHIC** Fixed-length graphic string **VARG** Varying-length graphic string **DBCLOB** Double-byte character large object string **DATE** Date **TIME** Time **TIMESTMP** Timestamp **DATALINK** Datalink **DISTINCT** Distinct type

Table 69. SYSCOLUMNS view (continued)

Column name	System Column Name	Data Type	Description
LENGTH	LENGTH	INTEGER	The length attribute of the column; or, in the case of a decimal, numeric, or nonzero precision binary column, its precision: **8 bytes** BIGINT **4 bytes** INTEGER **2 bytes** SMALLINT **Precision of number** DECIMAL **Precision of number** NUMERIC **8 bytes** FLOAT, FLOAT(n) where n = 25 to 53, or DOUBLE PRECISION **4 bytes** FLOAT(n) where n = 1 to 24, or REAL **Maximum length of binary string** BLOB **Length of string** CHAR **Maximum length of string** VARCHAR or CLOB **Length of graphic string** GRAPHIC **Maximum length of graphic string** VARGRAPHIC or DBCLOB **4 bytes** DATE **3 bytes** TIME **10 bytes** TIMESTAMP **Maximum length of datalink URL and comment** DATALINK **Same value as the source type** DISTINCT
NUMERIC_SCALE	SCALE	INTEGER Nullable	Scale of numeric data. Contains the null value if not decimal, numeric, or binary column.
IS_NULLABLE	NULLS	CHAR(1)	If the column can contain null values: **N** No **Y** Yes

Table 69. SYSCOLUMNS view (continued)

Column name	System Column Name	Data Type	Description
IS_UPDATABLE	UPDATES	CHAR(1)	If the column can be updated: **N** No **Y** Yes
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. Contains the null value if there is no long comment.
HAS_DEFAULT	DEFAULT	CHAR(1)	If the column has a default value (DEFAULT clause or null capable): **N** No **Y** Yes
COLUMN_HEADING	LABEL	VARCHAR(60) Nullable	A character string you supply with the LABEL ON statement (column headings) Contains the null value if there is no column heading.

Table 69. SYSCOLUMNS view (continued)

Column name	System Column Name	Data Type	Description
STORAGE	STORAGE	INTEGER	The storage requirements for the column: **8 bytes** BIGINT **4 bytes** INTEGER **2 bytes** SMALLINT **(Precision/2) + 1** DECIMAL **Precision of number** NUMERIC **8 bytes** FLOAT, FLOAT(n) where n = 25 to 53, or DOUBLE PRECISION **4 bytes** FLOAT(n) where n = 1 to 24, or REAL **Length of string** CHAR **Maximum length of string + 2** VARCHAR **Maximum length of string + 29** CLOB **Length of string * 2** GRAPHIC **Maximum length of string * 2 + 2** VARGRAPHIC **Maximum length of string * 2 + 29** DBCLOB **4 bytes** DATE **3 bytes** TIME **10 bytes** TIMESTAMP **Maximum length of datalink URL and comment + 24** DATALINK **Same value as the source type** DISTINCT **Note:** This column supplies the storage requirements for all data types.
NUMERIC_ PRECISION	PRECISION	INTEGER Nullable	The precision of all numeric columns. Contains the null value if the column is not numeric. **Note:** This column supplies the precision of all numeric data types, including single-and double-precision floating point. The NUMERIC_PRECISION_RADIX column indicates if the value in this column is in binary or decimal digits.

Table 69. SYSCOLUMNS view (continued)

Column name	System Column Name	Data Type	Description
CCSID	CCSID	INTEGER Nullable	The CCSID value for CHAR, VARCHAR, CLOB, DATE, TIME, TIMESTAMP, GRAPHIC, VARGRAPHIC, DBCLOB, and DATALINK columns. Contains the null value if the column is numeric.
TABLE_SCHEMA	DBNAME	VARCHAR(128)	The name of the SQL collection containing the table or view.
COLUMN_DEFAULT	DFTVALUE	VARCHAR(2000) Nullable	The default value of a column, if one exists. If the default value of the column cannot be represented without truncation, then the value of the column is the string 'TRUNCATED'. Contains the null value if the column has no default value.
CHARACTER_ MAXIMUM_LENGTH	CHARLEN	INTEGER Nullable	Maximum length of the string for binary, character and graphic string data types. Contains the null value if the column is numeric.
CHARACTER_ OCTET_LENGTH	CHARBYTE	INTEGER Nullable	Number of bytes for binary, character and graphic string data types. Contains the null value if the column is not character or graphic.
NUMERIC_ PRECISION_RADIX	RADIX	INTEGER Nullable	Indicates if the precision specified in column NUMERIC_PRECISION is specified as a number of binary or decimal digits **2** Binary; floating-point precision is specified in binary digits. **10** Decimal; all other numeric types are specified in decimal digits. Contains the null value if the column is not numeric.
DATETIME_ PRECISION	DATPRC	INTEGER Nullable	The fractional part of a date, time, or timestamp. **0** For DATE and TIME data types **6** For TIMESTAMP data types (number of microseconds). Contains the null value if the column is not date, time, or timestamp.
COLUMN_TEXT	LABELTEXT	VARCHAR(50) Nullable	A character string you supply with the LABEL ON statement (column text) Contains the null value if the column has no column text.
SYSTEM_ COLUMN_NAME	SYS_CNAME	CHAR(10)	The system name of the column

Table 69. SYSCOLUMNS view (continued)

Column name	System Column Name	Data Type	Description
SYSTEM_ TABLE_NAME	SYS_TNAME	CHAR(10)	The system name of the table or view
SYSTEM_ TABLE_SCHEMA	SYS_DNAME	CHAR(10)	The system name of the collection
USER_DEFINED_ TYPE_SCHEMA	TYPESCHEMA	VARCHAR(128)	The name of the collection if this is a the user-defined type. Contains the null value if this is not a user-defined type.
USER_DEFINED_ TYPE_NAME	TYPENAME	VARCHAR(128)	The name of the user-defined type. Contains the null value if this is not a user-defined type.

SYSCST

The SYSCST view contains one row for each constraint in the SQL collection. The following table describes the columns in the SYSCST view:

Table 70. SYSCST view

Column Name	System Column Name	Data Type	Description
CONSTRAINT_SCHEMA	CDBNAME	VARCHAR(128)	Name of the collection containing the constraint.
CONSTRAINT_NAME	RELNAME	VARCHAR(128)	Name of the constraint.
CONSTRAINT_TYPE	TYPE	VARCHAR(11)	Constraint Type UNIQUE PRIMARY KEY FOREIGN KEY
TABLE_SCHEMA	TDBNAME	VARCHAR(128)	Name of the collection containing the table.
TABLE_NAME	TBNAME	VARCHAR(128)	Name of the table which the constraint is created over. This will be the SQL table name if it exists; otherwise, it will be the system table name.
IS_DEFERRABLE	ISDEFER	VARCHAR(3)	Whether the constraint checking can be deferred. Will always be NO.
INITIALLY_DEFERRED	INITDEFER	VARCHAR(3)	Whether the constraint was defined as initially deferred. Will always be NO.
SYSTEM_TABLE_NAME	SYS_TNAME	CHAR(10)	System name of the table.
SYSTEM_TABLE_SCHEMA	SYS_DNAME	CHAR(10)	System name of the collection containing the table.

SYSCSTCOL

The SYSCSTCOL view records the columns on which constraints are defined. There is one row for every column in a unique or primary key constraint and the referencing columns of a referential constraint. The following table describes the columns in the SYSCSTCOL view:

Table 71. SYSCSTCOL view

Column Name	System Column Name	Data Type	Description
TABLE_SCHEMA	TDBNAME	VARCHAR(128)	Name of the SQL collection that contains the table the constraint is dependent on.
TABLE_NAME	TBNAME	VARCHAR(128)	Name of the table the constraint is dependent on. This is the SQL table name if it exists; otherwise, it is the system table name.
COLUMN_NAME	COLUMN	VARCHAR(128)	Column that the constraint was created over. This is the SQL column name if it exists; otherwise, it is the system column name.
CONSTRAINT_SCHEMA	CDBNAME	VARCHAR(128)	Name of the collection of the constraint.
CONSTRAINT_NAME	RELNAME	VARCHAR(128)	Name of the constraint.
SYSTEM_COLUMN_NAME	SYS_CNAME	CHAR(10)	System name of the column.
SYSTEM_TABLE_NAME	SYS_TNAME	CHAR(10)	System name of the table.
SYSTEM_TABLE_SCHEMA	SYS_DNAME	CHAR(10)	System name of the collection containing the table.

SYSCSTDEP

The SYSCSTDEP view records the tables on which constraints are defined. The following table describes the columns in the SYSCSTDEP view:

Table 72. SYSCSTDEP view

Column Name	System Column Name	Data Type	Description
TABLE_SCHEMA	TDBNAME	VARCHAR(128)	Name of the SQL collection that contains the table on which the constraint is dependent
TABLE_NAME	TBNAME	VARCHAR(128)	Name of the table on which the constraint is dependent. This is the SQL table name if it exists otherwise it is the system table name.
CONSTRAINT_SCHEMA	CDBNAME	VARCHAR(128)	Name of the collection of the constraint.
CONSTRAINT_NAME	RELNAME	VARCHAR(128)	Name of the constraint.
SYSTEM_TABLE_NAME	SYS_TNAME	CHAR(10)	System name of the table.
SYSTEM_TABLE_SCHEMA	SYS_DNAME	CHAR(10)	System name of the collection containing the table.

SYSFUNCS

The SYSFUNCS view contains one row for each function created by the CREATE FUNCTION statement. The following table describes the columns in the SYSFUNCS view:

Table 73. SYSFUNCS view

Column Name	System Column Name	Data Type	Description
SPECIFIC_SCHEMA	SPECSCHEMA	VARCHAR(128)	Schema name of the routine (function) instance.
SPECIFIC_NAME	SPECNAME	VARCHAR(128)	Name of the routine instance.
ROUTINE_SCHEMA	FUNCSCHEMA	VARCHAR(128)	Name of the SQL schema (collection) that contains the routine.
ROUTINE_NAME	FUNCNAME	VARCHAR(128)	Name of the routine.
ROUTINE_CREATED	FUNCCREATE	TIMESTAMP	Identifies the timestamp when the routine was created.
ROUTINE_DEFINER	DEFINER	VARCHAR(128)	Name of the user that defined the routine.
ROUTINE_BODY	BODY	VARCHAR(8)	The type of the routine body: **EXTERNAL** This is an external routine. **SQL** This is an SQL routine.
EXTERNAL_NAME	EXTNAME	VARCHAR(279) Nullable	If this is an external routine, this column identifies the external program name. If this is an SQL routine, this column is null. • For ILE service programs, the external program name is *collection-name/service-program-name(entry-point-name)*. • For all other languages, the external program name is *collection-name/program-name*.
EXTERNAL_LANGUAGE	LANGUAGE	VARCHAR(8) Nullable	If this is an external routine, this column identifies the external program name. If this is an SQL routine, this column contains the null value. **C** The external program is written in C. **C++** The external program is written in C++. **CL** The external program is written in CL. **COBOL** The external program is written in COBOL. **COBOLLE** The external program is written in ILE COBOL/400. **PLI** The external program is written in PL/I. **RPG** The external program is written in RPG. **RPGLE** The external program is written in ILE RPG/400.

Table 73. SYSFUNCS view (continued)

Column Name	System Column Name	Data Type	Description
PARAMETER_STYLE	PARM_STYLE	VARCHAR(7) Nullable	If this is an external routine, this column identifies the parameter style (calling convention). If this is an SQL routine, this column is null. **DB2SQL** This is the DB2SQL calling convention. **GENERAL** This is the GENERAL calling convention. **NULLS** This is the GENERAL WITH NULLS calling convention. **SQL** This is the SQL standard calling convention.
IS_DETERMINISTIC	DETERMINE	VARCHAR(3) Nullable	This column identifies whether the routine is deterministic. That is, whether a call to the routine with the same arguments will always return the same result. **NO** The routine is not deterministic. **YES** The routine is deterministic.
SQL_DATA_ACCESS	DATAACCESS	VARCHAR(8)	This column identifies whether a routine contains SQL and whether it reads or modifies data. **NONE** The routine does not contain any SQL statements. **CONTAINS** The routine contains SQL statements. **READS** The routine possibly reads data from a table or view. **MODIFIES** The routine possibly modifies data in a table or view or issues SQL DDL statements.
SQL_PATH	SQL_PATH	VARCHAR(558) Nullable	If this is an SQL routine, this column identifies the path. If this is an external routine, this column is null.
PARM_SIGNATURE	SIGNATURE	VARCHAR(510)	This column identifies the routine signature.
NUMBER_OF_RESULTS	NUMRESULTS	SMALLINT	Identifies the number of results.
IN_PARMS	IN_PARMS	SMALLINT	Identifies the number of input parameters. 0 indicates that there are no input parameters.
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. It contains the null value if there is no comment.

Table 73. SYSFUNCS view (continued)

Column Name	System Column Name	Data Type	Description
ROUTINE_DEFINITION	ROUTINEDEF	VARCHAR(18432) Nullable	If this is an SQL routine, this column contains the SQL routine body. It contains null if the routine body is longer than the length attribute of this column or if this is an external routine.
FUNCTION_ORIGIN	ORIGIN	CHAR(1)	Identifies the type of function. If this is a procedure, this column contains a blank. **B** This is a built-in function (defined by DB2 UDB for AS/400). **E** This is a user-defined function. **U** This is a user-defined function that is based on another function. **S** This is a system-generated function.
FUNCTION_TYPE	TYPE	CHAR(1)	Identifies the form of the function. If this is a procedure, this column contains a blank. **S** This is a scalar function. **C** This is a column function.
EXTERNAL_ACTION	EXTACTION	CHAR(1) Nullable	Identifies the whether the invocation of the function has external effects. **E** This function has external side effects. **N** This function does not have any external side effects.
IS_NULL_CALL	NULL_CALL	VARCHAR(3) Nullable	Identifies whether the function needs to be called if an input parameter is the null value. **NO** This function need not be called if an input parameter is the null value. The result of the function is implicitly null if any of the operands are null. **YES** This function must be called even if an input operand is null.
SCRATCH_PAD	SCRATCHPAD	INTEGER Nullable	Identifies whether the address of a static memory area (scratch pad) is passed to the function. **0** The function does not have a scratch pad. **integer** Indicates the size of the scratch pad passed to the function.

Table 73. SYSFUNCS view (continued)

Column Name	System Column Name	Data Type	Description
FINAL_CALL	FINAL_CALL	VARCHAR(3) Nullable	Indicates whether a final call to the function should be made to allow the function to clean up its work areas (scratch pads). **NO** No final call is made. **YES** A final call to the function is made when the statement is complete.
PARALLELIZABLE	PARALLEL	VARCHAR(3) Nullable	Identifies whether the function can be run in parallel. **NO** The function must be synchronous. **YES** The function can be run in parallel.
DBINFO	DBINFO	VARCHAR(3) Nullable	Identifies whether information about the database is passed to the function. **NO** No database information is passed to the function. **YES** Information about the database is passed to the function.
SOURCE_ SPECIFIC_ SCHEMA	SRCSCHEMA	VARCHAR(128) Nullable	If this is sourced function and the source is user-defined, this column contains the name of the source schema. If this is a sourced function and the source is built-in, this column contains ’QSYS2’. Otherwise, this column contains the null value.
SOURCE_SPECIFIC_NAME	SRCNAME	VARCHAR(128) Nullable	If this is sourced function and the source is user-defined, this column contains the name of the source function name. If this is a sourced function and the source is built-in, this column contains ’N/A for built-in’. Otherwise, this column contains the null value.
IS_USER_DEFINED_CAST	CAST_FUNC	VARCHAR(3) Nullable	Identifies whether this function is a cast function created when a user-defined type was created. **NO** This function is not a cast function. **YES** This function is a cast function.

SYSINDEXES

The SYSINDEXES view contains one row for every index in the SQL collection created using the SQL CREATE INDEX statement, including indexes on the SQL catalog. The following table describes the columns in the SYSINDEXES view:

Table 74. SYSINDEXES view

Column Name	System Column Name	Data Type	Description
INDEX_NAME	NAME	VARCHAR(128)	Name of the index. This will be the SQL index name if one exists; otherwise, it will be the system index name.
INDEX_OWNER	CREATOR	VARCHAR(128)	Owner of the index
TABLE_NAME	TBNAME	VARCHAR(128)	Name of the table on which the index is defined. This will be the SQL table name if one exists; otherwise, it will be the system table name.
TABLE_OWNER	TBCREATOR	VARCHAR(128)	Owner of the table
TABLE_SCHEMA	TBDBNAME	VARCHAR(128)	Name of the SQL collection that contains the table on which the index is defined
IS_UNIQUE	UNIQUERULE	CHAR(1)	If the index is unique: **D** No (duplicates are allowed) **V** Yes (duplicate NULL values are allowed) **U** Yes
COLUMN_COUNT	COLCOUNT	INTEGER	Number of columns in the key
INDEX_SCHEMA	DBNAME	VARCHAR(128)	Name of the SQL collection that contains the index
SYSTEM_INDEX_NAME	SYS_IXNAME	CHAR(10)	System index name
SYSTEM_INDEX_SCHEMA	SYS_IDNAME	CHAR(10)	System index collection name
SYSTEM_TABLE_NAME	SYS_TNAME	CHAR(10)	System table name
SYSTEM_TABLE_SCHEMA	SYS_DNAME	CHAR(10)	System table collection name
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. It contains the null value if there is no comment.

SYSKEYCST

The SYSKEYCST view contains one or more rows for each UNIQUE KEY, PRIMARY KEY, or FOREIGN KEY in the SQL collection. There is one row for each column in every unique or primary key constraint and the referencing columns of a referential constraint. The following table describes the columns in the SYSKEYCST view:

Table 75. SYSKEYCST view

Column Name	System Column Name	Data Type	Description
CONSTRAINT_SCHEMA	CDBNAME	VARCHAR(128)	Name of the collection containing the constraint.
CONSTRAINT_NAME	RELNAME	VARCHAR(128)	Name of the constraint.
TABLE_SCHEMA	TDBNAME	VARCHAR(128)	Name of the collection containing the table.

Table 75. SYSKEYCST view (continued)

Column Name	System Column Name	Data Type	Description
TABLE_NAME	TBNAME	VARCHAR(128)	Name of the table.
COLUMN_NAME	COLNAME	VARCHAR(128)	The name of the column.
ORDINAL_POSITION	COLSEQ	INTEGER	The position of the column within the key
COLUMN_POSITION	COLNO	INTEGER	The position of the column within the row
TABLE_OWNER	CREATOR	VARCHAR(128)	Owner of the table.
SYSTEM_COLUMN_NAME	SYS_CNAME	CHAR(10)	System name of the column.
SYSTEM_TABLE_NAME	SYS_TNAME	CHAR(10)	System name of the table.
SYSTEM_TABLE_SCHEMA	SYS_DNAME	CHAR(10)	System name of the collection containing the schema table.

SYSKEYS

The SYSKEYS view contains one row for every column of an index in the SQL collection, including the keys for the indexes on the SQL catalog. The following table describes the columns in the SYSKEYS view:

Table 76. SYSKEYS view

Column Name	System Column Name	Data Type	Description
INDEX_NAME	IXNAME	VARCHAR(128)	Name of the index. This will be the SQL index name if one exists; otherwise, it will be the system index name.
INDEX_OWNER	IXCREATOR	VARCHAR(128)	Owner of the index
COLUMN_NAME	COLNAME	VARCHAR(128)	Name of the column of the key. This will be the SQL column name if one exists; otherwise, it will be the system column name.
COLUMN_POSITION	COLNO	INTEGER	Numeric position of the column in the row
ORDINAL_POSITION	COLSEQ	INTEGER	Numeric position of the column in the key
ORDERING	ORDERING	CHAR(1)	Order of the column in the key: **A** Ascending **D** Descending
INDEX_SCHEMA	IXDBNAME	VARCHAR(128)	Name of the collection containing the index.
SYSTEM_COLUMN_NAME	SYS_CNAME	CHAR(10)	System name of the column
SYSTEM_INDEX_NAME	SYS_IXNAME	CHAR(10)	System name of the index
SYSTEM_INDEX_SCHEMA	SYS_IDNAME	CHAR(10)	System name of the collection containing the index

SYSPACKAGE

The SYSPACKAGE view contains one row for each SQL package in the SQL collection. The following table describes the columns in the SYSPACKAGE view:

Table 77. SYSPACKAGE view

Column Name	System Column Name	Data Type	Description
PACKAGE_CATALOG	LOCATION	VARCHAR(128)	Location of the SQL package
PACKAGE_SCHEMA	COLLID	VARCHAR(128)	Name of the collection
PACKAGE_NAME	NAME	VARCHAR(128)	Name of the SQL package
PACKAGE_OWNER	OWNER	VARCHAR(128)	Owner of the SQL package
PACKAGE_CREATOR	CREATOR	VARCHAR(128)	Creator of the SQL package
CREATION_TIMESTAMP	TIMESTAMP	CHAR(26)	Timestamp of when the SQL package was created
DEFAULT_SCHEMA	QUALIFIER	VARCHAR(128)	Implicit name for unqualified tables, views, and indexes
PROGRAM_NAME	PROGNAME	VARCHAR(128)	Name of program the package was created from
PROGRAM_SCHEMA	LIBRARY	VARCHAR(128)	Name of collection containing the program
PROGRAM_CATALOG	RDB	VARCHAR(128)	Name of the relational database where the program resides
ISOLATION	ISOLATION	CHAR(2)	Isolation option specification: RR Repeatable Read RS Read Stability (*ALL) CS Cursor Stability (*CS) UR Uncommitted Read (*CHG) NO None (*NONE)

QUOTE	QUOTE	CHAR(1)	Escape character specification (Y/N):
			Y = Quotation mark
			N = Apostrophe

COMMA	COMMA	CHAR(1)	Comma option specification (Y/N):
			Y = Comma
			N = Period

PACKAGE_TEXT	LABEL	VARCHAR(50)	A character string you supply with the LABEL ON statement.
LONG_COMMENT	REMARKS	VARCHAR(2000)	A character string you supply with the COMMENT ON statement.
CONSISTENCY_TOKEN	CONTOKEN	CHAR(8) FOR BIT DATA	Consistency token of package
SYSTEM_ PACKAGE_NAME	SYS_NAME	CHAR(10)	System name of the package.
SYSTEM_ PACKAGE_SCHEMA	SYS_DNAME	CHAR(10)	System name of the collection containing the package.
SYSTEM_ DEFAULT_SCHEMA	SYS_DDNAME	CHAR(10)	System name of the implicit qualifier for unqualified table, views, indexes, and packages.
SYSTEM_ PROGRAM_NAME	SYS_PNAME	CHAR(10)	System name of the program.

Table 77. SYSPACKAGE view (continued)

Column Name	System Column Name	Data Type	Description
SYSTEM_ PROGRAM_SCHEMA	SYS_PDNAME	CHAR(10)	System name of the collection containing the program

SYSPARMS

The SYSPARMS table contains one row for each parameter of a procedure created by the CREATE PROCEDURE statement or function created by the CREATE FUNCTION statement. The following table describes the columns in the SYSPARMS table:

Table 78. SYSPARMS table

Column Name	System Column Name	Data Type	Description
SPECIFIC_SCHEMA	SPECSCHEMA	VARCHAR(128)	Schema name of the routine instance.
SPECIFIC_NAME	SPECNAME	VARCHAR(128)	Name of the routine instance.
ORDINAL_POSITION	PARMNO	INTEGER	Numeric place of the parameter in the parameter list, ordered from left to right.
PARAMETER_MODE	PARMMODE	VARCHAR(5)	The type of the parameter: **IN** This is an input parameter. **OUT** This is an output parameter. **INOUT** This is an input/output parameter.
PARAMETER_NAME	PARMNAME	VARCHAR(128) Nullable	The name of the parameter.

Table 78. SYSPARMS table (continued)

Column Name	System Column Name	Data Type	Description
DATA_TYPE	DATA_TYPE	VARCHAR(128)	Type of column: **BIGINT** Big number **INTEGER** Large number **SMALLINT** Small number **DECIMAL** Packed decimal **NUMERIC** Zoned decimal **DOUBLE PRECISION** Floating point; DOUBLE PRECISION **REAL** Floating point; REAL **BINARY LARGE OBJECT** Binary large object string **CHARACTER** Fixed-length character string **CHARACTER VARYING** Varying-length character string **CHARACTER LARGE OBJECT** Character large object string **GRAPHIC** Fixed-length graphic string **GRAPHIC VARYING** Varying-length graphic string **DOUBLE-BYTE CHARACTER LARGE OBJECT** Double-byte character large object string **DATE** Date **TIME** Time **TIMESTAMP** Timestamp **DATALINK** Datalink **DISTINCT** Distinct type
NUMERIC_SCALE	SCALE	INTEGER Nullable	Scale of numeric data. Contains the null value if not decimal, numeric, or binary parameter.

Table 78. SYSPARMS table (continued)

Column Name	System Column Name	Data Type	Description
NUMERIC_PRECISION	PRECISION	INTEGER Nullable	The precision of all numeric parameters. Contains the null value if the parameter is not numeric. **Note:** This column supplies the precision of all numeric data types, including single-and double-precision floating point. The NUMERIC_PRECISION_RADIX column indicates if the value in this column is in binary or decimal digits.
CCSID	CCSID	INTEGER Nullable	The CCSID value for CHAR, VARCHAR, CLOB, DATE, TIME, TIMESTAMP, GRAPHIC, VARGRAPHIC, DBCLOB and DATALINK parameters. Contains the null value if the parameter is numeric.
CHARACTER_ MAXIMUM_LENGTH	CHARLEN	INTEGER Nullable	Maximum length of the string for binary, character, and graphic string data types. Contains the null value if the parameter is numeric.
CHARACTER_ OCTET_LENGTH	CHARBYTE	INTEGER Nullable	Number of bytes for binary, character, and graphic string data types. Contains the null value if the parameter is not binary, character, or graphic.
NUMERIC_ PRECISION_RADIX	RADIX	INTEGER Nullable	Indicates if the precision specified in column NUMERIC_PRECISION is specified as a number of binary or decimal digits: **2** Binary; floating-point precision is specified in binary digits. **10** Decimal; all other numeric types are specified in decimal digits. Contains the null value if the parameter is not numeric.
DATETIME_PRECISION	DATPRC	INTEGER Nullable	The fractional part of a date, time, or timestamp. **0** For DATE and TIME data types **6** For TIMESTAMP data types (number of microseconds). Contains the null value if the parameter is not date, time, or timestamp.
IS_NULLABLE	NULLS	VARCHAR(3)	Indicates whether the parameter is nullable. **NO** The parameter does not allow nulls. **YES** The parameter does allow nulls.

Table 78. SYSPARMS table (continued)

Column Name	System Column Name	Data Type	Description
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. It contains the null value if there is no comment.
ROW_TYPE	ROWTYPE	CHAR(1)	Indicates the type of row. If this is a parameter to a procedure, this column contains the null value. **P** Parameter. **R** Result before casting. **C** Result after casting.
DATA_TYPE_SCHEMA	TYPESCHEMA	VARCHAR(128) Nullable	Schema of the data type if this is a user-defined type. If this is not a user-defined type, this column contains the null value.
DATA_TYPE_NAME	TYPENAME	VARCHAR(128) Nullable	Name of the data type if this is a user-defined type. If this is not a user-defined type, this column contains the null value.
AS_LOCATOR	ASLOCATOR	VARCHAR(3)	Indicates whether the parameter was specified as a locator. **NO** The parameter was not specified as a locator. **YES** The parameter was specified as a locator.

SYSPROCS

The SYSPROCS view contains one row for each procedure created by the CREATE PROCEDURE statement. The following table describes the columns in the SYSPROCS view:

Table 79. SYSPROCS view

Column Name	System Column Name	Data Type	Description
SPECIFIC_SCHEMA	SPECSCHEMA	VARCHAR(128)	Schema name of the routine (procedure) instance.
SPECIFIC_NAME	SPECNAME	VARCHAR(128)	Name of the routine instance.
ROUTINE_SCHEMA	PROCSCHEMA	VARCHAR(128)	Name of the SQL schema (collection) that contains the routine.
ROUTINE_NAME	PROCNAME	VARCHAR(128)	Name of the routine.
ROUTINE_CREATED	RTNCREATE	TIMESTAMP	Identifies the timestamp when the routine was created.
ROUTINE_DEFINER	DEFINER	VARCHAR(128)	Name of the user that defined the routine.

Table 79. SYSPROCS view (continued)

Column Name	System Column Name	Data Type	Description
ROUTINE_BODY	BODY	VARCHAR(8)	The type of the routine body: **EXTERNAL** This is an external routine. **SQL** This is an SQL routine.
EXTERNAL_NAME	EXTNAME	VARCHAR(279) Nullable	If this is an external routine, this column identifies the external program name. If this is an SQL routine, this column is null. • For REXX, the external program name is *collection-name/source-file-name(member-name)*. • For Java programs, the external program name is *fully-qualified-class-name!method-name* or *fully-qualified-class-name.method-name*. • For all other languages, the external program name is *collection-name/program-name*.
EXTERNAL_LANGUAGE	LANGUAGE	VARCHAR(8) Nullable	If this is an external routine, this column identifies the external program name. If this is an SQL routine, this column contains the null value. **C** The external program is written in C. **C++** The external program is written in C++. **CL** The external program is written in CL. **COBOL** The external program is written in COBOL. **COBOLLE** The external program is written in ILE COBOL/400. **FORTRAN** The external program is written in FORTRAN. **JAVA** The external program is written in JAVA. **PLI** The external program is written in PL/I. **REXX** The external program is a REXX procedure. **RPG** The external program is written in RPG. **RPGLE** The external program is written in ILE RPG/400.

Table 79. SYSPROCS view (continued)

Column Name	System Column Name	Data Type	Description
PARAMETER_STYLE	PARM_STYLE	VARCHAR(7) Nullable	If this is an external routine, this column identifies the parameter style (calling convention). If this is an SQL routine, this column is null. **DB2GNRL** This is the DB2GENERAL calling convention. **DB2SQL** This is the DB2SQL calling convention. **GENERAL** This is the GENERAL calling convention. **JAVA** This is the JAVA calling convention. **NULLS** This is the GENERAL WITH NULLS calling convention. **SQL** This is the SQL standard calling convention.
IS_DETERMINISTIC	DETERMINE	VARCHAR(3) Nullable	This column identifies whether the routine is deterministic. That is, whether a call to the routine with the same arguments will always return the same result. **NO** The routine is not deterministic. **YES** The routine is deterministic.
SQL_DATA_ACCESS	DATAACCESS	VARCHAR(8)	This column identifies whether a routine contains SQL and whether it reads or modifies data. **NONE** The routine does not contain any SQL statements. **CONTAINS** The routine contains SQL statements. **READS** The routine possibly reads data from a table or view. **MODIFIES** The routine possibly modifies data in a table or view or issues SQL DDL statements.
SQL_PATH	SQL_PATH	VARCHAR(558) Nullable	If this is an SQL routine, this column identifies the path. If this is an external routine, this column is null.
PARM_SIGNATURE	SIGNATURE	VARCHAR(510)	This column identifies the routine signature.
RESULT_SETS	RESULTS	SMALLINT	Identifies the maximum number of result sets returned. 0 indicates that there are no result sets.

Table 79. SYSPROCS view (continued)

Column Name	System Column Name	Data Type	Description
IN_PARMS	IN_PARMS	SMALLINT	Identifies the number of input parameters. 0 indicates that there are no input parameters.
OUT_PARMS	OUT_PARMS	SMALLINT	Identifies the number of output parameters. 0 indicates that there are no output parameters.
INOUT_PARMS	INOUT_PARM	SMALLINT	Identifies the number of input/output parameters. 0 indicates that there are no input/output parameters.
PARSE_TREE	PARSE_TREE	VARCHAR(350) FOR BIT DATA	If this is an external routine, this column identifies the parse tree of the CREATE PROCEDURE statement. It is only used internally.
PARM_ARRAY	PARM_ARRAY	VARCHAR(6600) FOR BIT DATA	If this is an external routine, this column identifies the parameter array built from the CREATE PROCEDURE statement. It is only used internally.
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. It contains the null value if there is no comment.
ROUTINE_DEFINITION	ROUTINEDEF	VARCHAR(18432) Nullable	If this is an SQL routine, this column contains the SQL routine body. It contains null if the routine body is longer than the length attribute of this column or if this is an external routine.

SYSREFCST

The SYSREFCST view contains one row for each foreign key in the SQL collection. The following table describes the columns in the SYSREFCST view:

Table 80. SYSREFCST view

Column Name	System Column Name	Data Type	Description
CONSTRAINT_SCHEMA	CDBNAME	VARCHAR(128)	Name of the collection containing the constraint.
CONSTRAINT_NAME	RELNAME	VARCHAR(128)	Name of the constraint.
UNIQUE_ CONSTRAINT_SCHEMA	UNQDBNAME	VARCHAR(128)	Name of the SQL collection containing the unique constraint referenced by the referential constraint.
UNIQUE_ CONSTRAINT_NAME	UNQNAME	VARCHAR(128)	Name of the unique constraint referenced by the referential constraint.
MATCH_OPTION	MATCH	VARCHAR(7)	Match option. Will always be NONE.
UPDATE_RULE	UPDATE	VARCHAR(11)	Update Rule. • NO ACTION • RESTRICT

Table 80. SYSREFCST view (continued)

Column Name	System Column Name	Data Type	Description
DELETE_RULE	DELETE	VARCHAR(11)	Delete Rule • NO ACTION • CASCADE • SET NULL • SET DEFAULT • RESTRICT
COLUMN_COUNT	COLCOUNT	INTEGER	Number of columns in the foreign key.

SYSROUTINES

The SYSROUTINES table contains one row for each procedure created by the CREATE PROCEDURE statement and each function created by the CREATE FUNCTION statement. The following table describes the columns in the SYSROUTINES view:

Table 81. SYSROUTINES view

Column Name	System Column Name	Data Type	Description
SPECIFIC_SCHEMA	SPECSCHEMA	VARCHAR(128)	Schema name of the routine instance.
SPECIFIC_NAME	SPECNAME	VARCHAR(128)	Name of the routine instance.
ROUTINE_SCHEMA	RTNSCHEMA	VARCHAR(128)	Name of the SQL schema (collection) that contains the routine.
ROUTINE_NAME	RTNNAME	VARCHAR(128)	Name of the routine.
ROUTINE_TYPE	RTNTYPE	VARCHAR(9)	Type of the routine. **PROCEDURE** This is a procedure. **FUNCTION** This is a function.
ROUTINE_CREATED	RTNCREATE	TIMESTAMP	Identifies the timestamp when the routine was created.
ROUTINE_DEFINER	DEFINER	VARCHAR(128)	Name of the user that defined the routine.
ROUTINE_BODY	BODY	VARCHAR(8)	The type of the routine body: **EXTERNAL** This is an external routine. **SQL** This is an SQL routine.

Table 81. SYSROUTINES view (continued)

Column Name	System Column Name	Data Type	Description
EXTERNAL_NAME	EXTNAME	VARCHAR(279) Nullable	If this is an external routine, this column identifies the external program name. If this is an SQL routine, this column is null. • For REXX, the external program name is *collection-name/source-file-name(member-name)*. • For ILE service programs, the external program name is *collection-name/service-program-name(entry-point-name)*. • For Java programs, the external program name is *fully-qualified-class-name!method-name* or *fully-qualified-class-name.method-name*. • For all other languages, the external program name is *collection-name/program-name*.
EXTERNAL_LANGUAGE	LANGUAGE	VARCHAR(8) Nullable	If this is an external routine, this column identifies the external program name. If this is an SQL routine, this column contains the null value. **C** The external program is written in C. **C++** The external program is written in C++. **CL** The external program is written in CL. **COBOL** The external program is written in COBOL. **COBOLLE** The external program is written in ILE COBOL/400. **FORTRAN** The external program is written in FORTRAN. **JAVA** The external program is written in JAVA. **PLI** The external program is written in PL/I. **REXX** The external program is a REXX procedure. **RPG** The external program is written in RPG. **RPGLE** The external program is written in ILE RPG/400.

Table 81. SYSROUTINES view (continued)

Column Name	System Column Name	Data Type	Description
PARAMETER_STYLE	PARM_STYLE	VARCHAR(7) Nullable	If this is an external routine, this column identifies the parameter style (calling convention). If this is an SQL routine, this column is null. **DB2GNRL** This is the DB2GENERAL calling convention. **DB2SQL** This is the DB2SQL calling convention. **GENERAL** This is the GENERAL calling convention. **JAVA** This is the JAVA calling convention. **NULLS** This is the GENERAL WITH NULLS calling convention. **SQL** This is the SQL standard calling convention.
IS_DETERMINISTIC	DETERMINE	VARCHAR(3) Nullable	This column identifies whether the routine is deterministic. That is, whether a call to the routine with the same arguments will always return the same result. **NO** The routine is not deterministic. **YES** The routine is detervariant.
SQL_DATA_ACCESS	DATAACCESS	VARCHAR(8)	This column identifies whether a routine contains SQL and whether it reads or modifies data. **NONE** The routine does not contain any SQL statements. **CONTAINS** The routine contains SQL statements. **READS** The routine possibly reads data from a table or view. **MODIFIES** The routine possibly modifies data in a table or view or issues SQL DDL statements.
SQL_PATH	SQL_PATH	VARCHAR(558) Nullable	If this is an SQL routine, this column identifies the path. If this is an external routine, this column is null.
PARM_SIGNATURE	SIGNATURE	VARCHAR(510)	This column identifies the routine signature.
NUMBER_OF_RESULTS	NUMRESULTS	SMALLINT	Identifies the number of results.

Table 81. SYSROUTINES view (continued)

Column Name	System Column Name	Data Type	Description
MAX_DYNAMIC_ RESULT_SETS	RESULTS	SMALLINT	Identifies the maximum number of result sets returned. 0 indicates that there are no result sets.
IN_PARMS	IN_PARMS	SMALLINT	Identifies the number of input parameters. 0 indicates that there are no input parameters.
OUT_PARMS	OUT_PARMS	SMALLINT	Identifies the number of output parameters. 0 indicates that there are no output parameters.
INOUT_PARMS	INOUT_PARM	SMALLINT	Identifies the number of input/output parameters. 0 indicates that there are no input/output parameters.
PARSE_TREE	PARSE_TREE	VARCHAR(350) FOR BIT DATA	If this is an external routine, this column identifies the parse tree of the CREATE FUNCTION or CREATE PROCEDURE statement. It is only used internally.
PARM_ARRAY	PARM_ARRAY	VARCHAR(6600) FOR BIT DATA	If this is an external routine, this column identifies the parameter array built from the CREATE FUNCTION or CREATE PROCEDURE statement. It is only used internally.
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. It contains the null value if there is no comment.
ROUTINE_DEFINITION	ROUTINEDEF	VARCHAR(18432) Nullable	If this is an SQL routine, this column contains the SQL routine body. It contains null if the routine body is longer than the length attribute of this column or if this is an external routine.
FUNCTION_ORIGIN	ORIGIN	CHAR(1)	Identifies the type of function. If this is a procedure, this column contains a blank. **B** This is a built-in function (defined by DB2 UDB for AS/400). **E** This is a user-defined function. **U** This is a user-defined function that is sourced on another function. **S** This is a system-generated function.
FUNCTION_TYPE	TYPE	CHAR(1)	Identifies the form of the function. If this is a procedure, this column contains a blank. **S** This is a scalar function. **C** This is a column function.

Table 81. SYSROUTINES view (continued)

Column Name	System Column Name	Data Type	Description
EXTERNAL_ACTION	EXTACTION	CHAR(1) Nullable	Identifies whether the invocation of the function has external effects. If the routine is a procedure, this column contains the null value. **E** This function has external side effects. **N** This function does not have any external side effects.
IS_NULL_CALL	NULL_CALL	VARCHAR(3) Nullable	Identifies whether the function needs to be called if an input parameter is the null value. If the routine is a procedure, this column contains the null value. **NO** This function need not be called if an input parameter is the null value. The result of the function is implicitly null if any of the operands are null. **YES** This function must be called even if an input operand is null.
SCRATCH_PAD	SCRATCHPAD	INTEGER Nullable	Identifies whether the address of a static memory area (scratch pad) is passed to the function. If the routine is a procedure, this column contains the null value. **0** The function does not have a scratch pad. **integer** Indicates the size of the scratch pad passed to the function.
FINAL_CALL	FINAL_CALL	VARCHAR(3) Nullable	Indicates whether a final call to the function should be made to allow the function to clean up its work areas (scratch pads). If the routine is a procedure, this column contains the null value. **NO** No final call is made. **YES** A final call to the function is made when the statement is complete.
PARALLELIZABLE	PARALLEL	VARCHAR(3) Nullable	Identifies whether the function can be run in parallel. **NO** The function must be synchronous. **YES** The function can be run in parallel.

Table 81. SYSROUTINES view (continued)

Column Name	System Column Name	Data Type	Description
DBINFO	DBINFO	VARCHAR(3) Nullable	Identifies whether information about the database is passed to the function or procedure.. **NO** No database information is passed to the function. **YES** Information about the database is passed to the function.
SOURCE_SPECIFIC_ SCHEMA	SRCSCHEMA	VARCHAR(128) Nullable	If this is sourced function and the source is user-defined, this column contains the name of the source schema. If this is a sourced function and the source is built-in, this column contains 'QSYS2'. Otherwise, this column contains the null value.
SOURCE_SPECIFIC_NAME	SRCNAME	VARCHAR(128) Nullable	If this is sourced function and the source is user-defined, this column contains the name of the source function name. If this is a sourced function and the source is built-in, this column contains 'N/A for built-in'. Otherwise, this column contains the null value.
IS_USER_ DEFINED_CAST	CAST_FUNC	VARCHAR(3) Nullable	Identifies whether the this function is a cast function created when a user-defined type was created. If the routine is a procedure, this column contains the null value. **NO** This function is not a cast function. **YES** This function is a cast function.

SYSTABLES

The SYSTABLES view contains one row for every table, view or alias in the SQL collection, including the tables and views of the SQL catalog. The following table describes the columns in the SYSTABLES view:

Table 82. SYSTABLES view

Column name	System Column Name	Data Type	Description
TABLE_NAME	NAME	VARCHAR(128)	Name of the table, view or alias. This is the SQL table, view or alias name if it exists; otherwise, it is the system table, view or alias name.
TABLE_OWNER	CREATOR	VARCHAR(128)	Owner of the table, view or alias

Table 82. SYSTABLES view (continued)

Column name	System Column Name	Data Type	Description
TABLE_TYPE	TYPE	CHAR(1)	If the row describes a table, view, or alias: **A** Alias **L** Logical file **P** Physical file **T** Table **V** View
COLUMN_COUNT	COLCOUNT	INTEGER	Number of columns in the table or view. Zero for an alias.
ROW_LENGTH	RECLENGTH [64]	INTEGER	Maximum length of any record in the table. Zero for an alias.
TABLE_TEXT	LABEL	VARCHAR(50)	A character string you supply with the LABEL ON statement.
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. It contains the null value if there is no comment.
TABLE_SCHEMA	DBNAME	VARCHAR(128)	Name of the SQL collection that contains the table, view or alias
LAST_ ALTERED_TIMESTAMP	ALTEREDTS	TIMESTAMP	Table last changed timestamp
SYSTEM_TABLE_NAME	SYS_TNAME	CHAR(10)	System table name.
SYSTEM_TABLE_SCHEMA	SYS_DNAME	CHAR(10)	System collection name
FILE_TYPE	FILETYPE	CHAR(1)	File type **D** Data file or alias **S** Source file
BASE_TABLE_SCHEMA	TBDBNAME	VARCHAR(128) Nullable	For an alias, this is the name of the SQL collection that contains the table or view the alias is based on. It contains the null value if this is not an alias.
BASE_TABLE_NAME	TBNAME	VARCHAR(128) Nullable	For an alias, this is the name of the table or view the alias is based on. It contains the null value if this is not an alias.
BASE_TABLE_MEMBER	TBMEMBER	VARCHAR(10) Nullable	For an alias, this is the name of the file member the alias is based on. It contains the null value if this is not an alias. It contains *FIRST if this is an alias, but a member name was not specified.

SYSTYPES

The SYSTYPES table contains one row for each user-defined type created by the CREATE DISTINCT TYPE statement The following table describes the columns in the SYSTYPES table:

Table 83. SYSTYPES table

Column Name	System Column Name	Data Type	Description
USER_DEFINED_ TYPE_SCHEMA	TYPESCHEMA	VARCHAR(128)	Schema name of the user-defined type.
USER_DEFINED_ TYPE_NAME	TYPENAME	VARCHAR(128)	Name of the user-defined type.
USER_DEFINED_ TYPE_DEFINER	DEFINER	VARCHAR(128)	Name of the user that created the user-defined type.
SOURCE_SCHEMA	SRCSCHEMA	VARCHAR(128) Nullable	The schema for the source data type of this user-defined type. If this is a system predefined type, the column contains the null value.
SOURCE_TYPE	SRCTYPE	VARCHAR(128) Nullable	The name of the source data type of this user-defined type. If this is a system predefined type, the column contains the null value.
SYSTEM_TYPE_ SCHEMA	SYSTSCHEMA	CHAR(10)	System schema name of the user-defined type.
SYSTEM_TYPE_ NAME	SYSTNAME	CHAR(10)	System name of the user-defined type.
METATYPE	METATYPE	CHAR(1)	Indicates the type of data type. **S** System predefined data type. **T** User-defined distinct type.

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64. The length is the number of bytes passed in database buffers, not the internal storage length.

Table 83. SYSTYPES table (continued)

Column Name	System Column Name	Data Type	Description
LENGTH	LENGTH	INTEGER	The length attribute of the user-defined type; or, in the case of a decimal, numeric, or nonzero precision binary column, its precision: **8 bytes** BIGINT **4 bytes** INTEGER **2 bytes** SMALLINT **Precision of number** DECIMAL **Precision of number** NUMERIC **8 bytes** FLOAT, FLOAT(n) where n = 25 to 53, or DOUBLE PRECISION **4 bytes** FLOAT(n) where n = 1 to 24, or REAL **Maximum length of binary string** BLOB **Length of string** CHARACTER **Maximum length of string** VARCHAR or CLOB **Length of graphic string** GRAPHIC **Maximum length of graphic string** VARGRAPHIC or DBCLOB **4 bytes** DATE **3 bytes** TIME **10 bytes** TIMESTAMP **Maximum length of datalink URL and comment** DATALINK **Same value as the source type** DISTINCT
NUMERIC_SCALE	SCALE	INTEGER Nullable	Scale of numeric data. Contains the null value if not decimal, numeric, or binary user-defined type.
CCSID	CCSID	INTEGER Nullable	The CCSID value for CHAR, VARCHAR, CLOB, DATE, TIME, TIMESTAMP, GRAPHIC, VARGRAPHIC, DBCLOB and DATALINK user-defined types. Contains the null value if the user-defined type is numeric.

Table 83. SYSTYPES table (continued)

Column Name	System Column Name	Data Type	Description
STORAGE	STORAGE	INTEGER	The storage requirements for the column: **8 bytes** BIGINT **4 bytes** INTEGER **2 bytes** SMALLINT **(Precision/2) + 1** DECIMAL **Precision of number** NUMERIC **8 bytes** FLOAT, FLOAT(n) where n = 25 to 53, or DOUBLE PRECISION **4 bytes** FLOAT(n) where n = 1 to 24, or REAL **Length of string** CHAR **Maximum length of string + 2** VARCHAR **Maximum length of string + 29** CLOB **Length of string * 2** GRAPHIC **Maximum length of string * 2 + 2** VARGRAPHIC **Maximum length of string * 2 + 29** DBCLOB **4 bytes** DATE **3 bytes** TIME **10 bytes** TIMESTAMP **Maximum length of datalink URL and comment + 24** DATALINK **Same value as the source type** DISTINCT **Note:** This column supplies the storage requirements for all data types.
NUMERIC_ PRECISION	PRECISION	INTEGER Nullable	The precision of all numeric user-defined types. Contains the null value if the user-defined type is not numeric. **Note:** This column supplies the precision of all numeric data types, including single-and double-precision floating point. The NUMERIC_PRECISION_RADIX column indicates if the value in this column is in binary or decimal digits.

Table 83. SYSTYPES table (continued)

Column Name	System Column Name	Data Type	Description
CHARACTER_ MAXIMUM_LENGTH	CHARLEN	INTEGER Nullable	Maximum length of the string for binary, character, and graphic string data types. Contains the null value if the user-defined type is numeric.
CHARACTER_ OCTET_LENGTH	CHARBYTE	INTEGER Nullable	Number of bytes for binary, character, and graphic string data types. Contains the null value if the user-defined type is not binary, character, or graphic.
ALLOCATE	ALLOCATE	INTEGER Nullable	Allocated length of the string for binary, varying-length character, and varying-length graphic string data types. Contains the null value if the user-defined type is numeric or fixed-length.
NUMERIC_ PRECISION_RADIX	RADIX	INTEGER Nullable	Indicates if the precision specified in column NUMERIC_PRECISION is specified as a number of binary or decimal digits: **2** Binary; floating-point precision is specified in binary digits. **10** Decimal; all other numeric types are specified in decimal digits. Contains the null value if the user-defined type is not numeric.
DATETIME_ PRECISION	DATPRC	INTEGER Nullable	The fractional part of a date, time, or timestamp. **0** For DATE and TIME data types **6** For TIMESTAMP data types (number of microseconds). Contains the null value if the user-defined type is not date, time, or timestamp.
CREATE_TIME	CRTTIME	TIMESTAMP	Identifies the timestamp when the user-defined type was created.
LONG_COMMENT	REMARKS	VARCHAR(2000) Nullable	A character string you supply with the COMMENT ON statement. It contains the null value if there is no comment.

SYSVIEWDEP

The SYSVIEWDEP view records the dependencies of views on tables, including the views of the SQL catalog. The following table describes the columns in the SYSVIEWDEP view:

Table 84. SYSVIEWDEP view

Column name	System Column Name	Data Type	Description
VIEW_NAME	DNAME	VARCHAR(128)	Name of the view. This is the SQL view name if it exists; otherwise, it is the system view name.
VIEW_OWNER	DCREATOR	VARCHAR(128)	Owner of the view
TABLE_NAME	BNAME	VARCHAR(128)	Name of the table or view the view is dependent on. This is the SQL view name if it exists; otherwise, it is the system view name.
TABLE_OWNER	BCREATOR	VARCHAR(128)	Owner of the table or view the view is dependent on
TABLE_SCHEMA	BDBNAME	VARCHAR(128)	Name of the SQL collection that contains the table or view the view is dependent on
TABLE_TYPE	BTYPE	CHAR(1)	Type of object the view was based on: **T** Table **P** Physical file **V** View **L** Logical file
VIEW_SCHEMA	DDBNAME	VARCHAR(128)	Name of the collection of the view.
SYSTEM_VIEW_NAME	SYS_VNAME	CHAR(10)	System View name
SYSTEM_VIEW_SCHEMA	SYS_VDNAME	CHAR(10)	System View collection
SYSTEM_TABLE_NAME	SYS_TNAME	CHAR(10)	System Table name
SYSTEM_TABLE_SCHEMA	SYS_DNAME	CHAR(10)	System Table collection

SYSVIEWS

The SYSVIEWS view contains one row for each view in the SQL collection, including the views of the SQL catalog. The following table describes the columns in the SYSVIEWS view:

Table 85. SYSVIEWS view

Column Name	System Column Name	Data Type	Description
TABLE_NAME	NAME	VARCHAR(128)	Name of the view. This is the SQL view name if it exists; otherwise, it is the system view name.
VIEW_OWNER	CREATOR	VARCHAR(128)	Owner of the view
SEQNO	SEQNO	INTEGER	Sequence number of this row; will always be 1.

Table 85. SYSVIEWS view (continued)

Column Name	System Column Name	Data Type	Description
CHECK_OPTION	CHECK	CHAR(1)	The check option used on the view **N** No check option was specified **Y** The local option was specified **C** The cascaded option was specified
VIEW_DEFINITION	TEXT	VARCHAR(10000) Nullable	The query expression portion of the CREATE VIEW statement. If the string cannot be contained, then the value is null.
IS_UPDATABLE	UPDATES	CHAR(1)	Specifies if the view is updatable: **Y** The view is updatable **N** The view is read-only
TABLE_SCHEMA	DBNAME	VARCHAR(128)	Name of the SQL collection that contains the view.
SYSTEM_VIEW_NAME	SYS_VNAME	CHAR(10)	System View name
SYSTEM_VIEW_SCHEMA	SYS_VDNAME	CHAR(10)	System View collection name

Bibliography

The publications listed here provide additional information about topics described or referred to in this guide. These manuals are listed with their full titles and order numbers. When these manuals are referred to in this guide, a shortened version of the title is used.

- *Backup and Recovery*, SC41-5304-04

  This guide contains a subset of the information found in the *Backup and Recovery*, SC41-5304-04 book. The manual contains information about planning a backup and recovery strategy, the different types of media available to save and restore procedures, and disk recovery procedures. It also describes how to install the system again from backup.
- *ILE COBOL for AS/400 Programmer's Guide*, SC09-2540-01

  This guide provides information needed to design, write, test, and maintain COBOL/400 programs on the AS/400 system.
- *ILE RPG for AS/400 Programmer's Guide*, SC09-2507-02

  This guide provides information you need to design, write, test, and maintain ILE RPG/400 programs on the AS/400 system.
- *REXX/400 Programmer's Guide*, SC41-5728-00

  This guide provides information you need to design, write, test, and maintain REXX/400 programs on the AS/400 system.
- *PL/I User's Guide and Reference* book, SC09-1825

  This guide provides information about using AS/400 PL/I in the System/38 environment. Differences between the System/38 environment and the AS/400 environment are identified as well as the enhancements available in the AS/400 environment.
- *CL Programming*, SC41-5721-03

  This guide provides a wide-ranging discussion of the AS/400 programming topics, including a general discussion of objects and libraries, CL programming, controlling flow and communicating between programs, working with objects in CL programs, and creating CL programs. Other topics include predefined and impromptu messages and handling, defining and creating user-defined commands and menus, application testing, including debug mode, breakpoints, traces, and display functions.
- File Management

  This book provides information about using files in application programs.
- Database Programming

  This book provides a detailed description of the AS/400 database organization, including information on how to create, describe, and update database files on the system.
- Distributed Database Programming

  Provides information on preparing and managing an AS/400 system in a distributed relational database using the Distributed Relational Database Architecture (DRDA). Describes planning, setting up, programming, administering, and operating a distributed relational database on more than one AS/400 system in a like-system environment.
- *Security - Reference*, SC41-5302-04

  This guide provides information about system security concepts, planning for security, and setting up security on the system. It also gives information about protecting the system and data from being used by people who do not have the proper authorization, protecting the data from intentional or unintentional damage or destruction, keeping security up-to-date, and setting up security on the system.
- SQL Programming Concepts

  This book provides an overview of how to design, write, run, and test DB2 UDB for AS/400 statements. It also describes interactive Structured Query Language (SQL).
- SQL Programming with Host Languages

  This book provides examples of how to write SQL statements in COBOL, ILE COBOL/400, ILE RPG/400, ILE C/400, and PL/I programs.
- Database Performance and Query Optimization

  This book provides information on optimizing the performance of your queries using available tools and techniques.
- *IDDU Use*, SC41-5704-00

This book describes how to use AS/400 interactive data definition utility (IDDU) to describe data dictionaries, files, and records to the system.

- SQL Call Level Interfaces (ODBC)

  This book describes how to use X/Open SQL Call Level Interface to access SQL functions directly through procedure calls to a service program provided by DB2 UDB for AS/400.
- *DB2 UDB for AS/400 Advanced Database Functions*, GG24-4249

  This book provides suggestions, guidelines, and practical examples of when and how functions offered by DB2 UDB for AS/400 such as triggers, referential integrity, DRDA-2, 2-phase commit, and stored procedures, can be effectively used. The book reports examples developed in several programming languages (RPG, COBOL, C), using native and SQL data access interface, both in the Integrated Language Environment and with the Original Program Model.
- Client Access Express category in the AS/400 Information Center

  This information describes how to set up and run ODBC applications on a client using Client Access ODBC. Included in this document are chapters on performance, examples, and configuring specific applications to run with Client Access ODBC.
- *AS/400 Toolbox for Java Setup Guide*, SC41-5438-03

  This book describes how to set up and run JDBC applications on a client using AS/400 Toolbox for Java. Included in this document are chapters on performance, examples, and configuring specific applications to run with AS/400 Toolbox for Java.
- AS/400 Developer Kit for Java

  This information provides the details you need to design, write, test, and maintain JAVA programs on the AS/400 system. The book also contains information on the AS/400 Developer Kit for Java JDBC driver.
- DB2 Multisystem

  This book describes the fundamental concepts of distributed relational database files, nodegroups, and partitioning. The book provides the information you need to create and use database files that are partitioned across multiple AS/400 systems. Information is provided on how to configure the systems, how to create the files, and how the files can be used in applications.

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