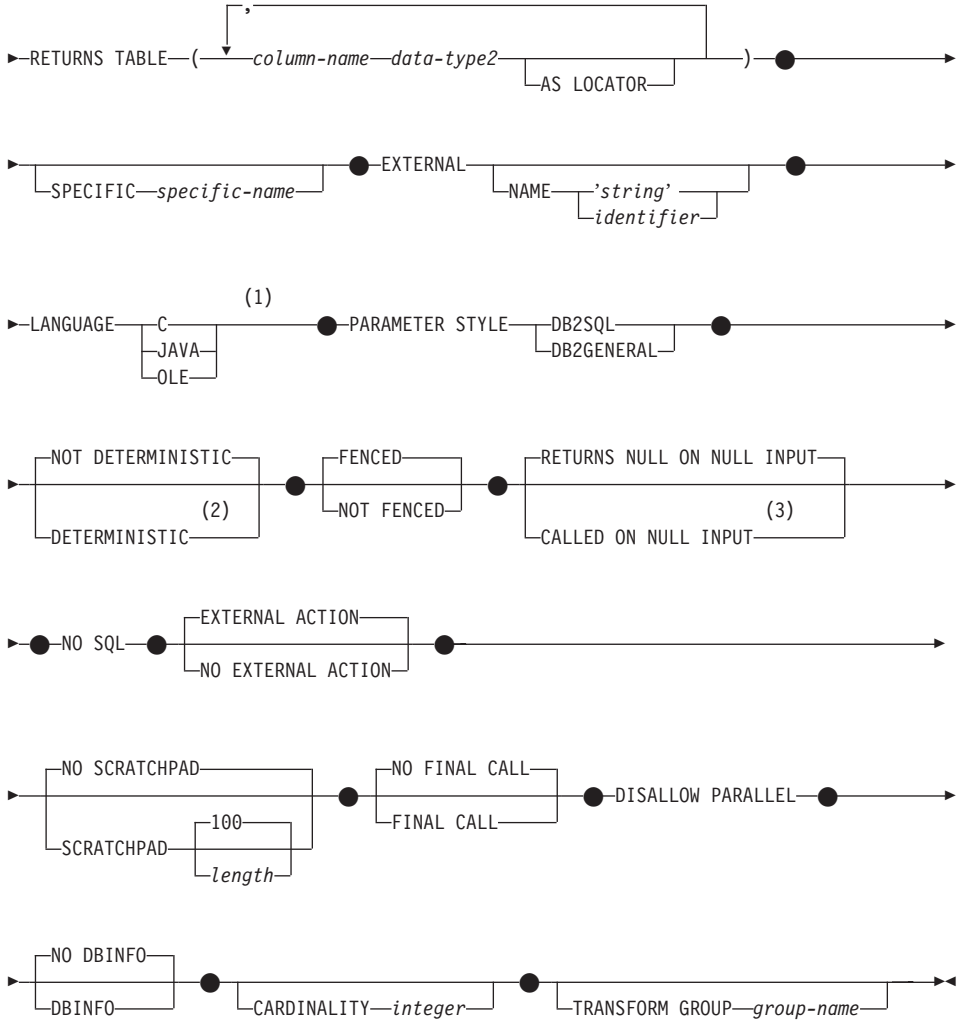


Notes:

1 See "CREATE FUNCTION (OLE DB External Table)" on page 631 for information on creating LANGUAGE OLE DB external table functions. See "CREATE FUNCTION (SQL Scalar, Table or Row)" on page 649 for information on creating LANGUAGE SQL table functions.

2 NOT VARIANT may be specified in place of DETERMINISTIC and VARIANT may be specified in place of NOT DETERMINISTIC.

3 NULL CALL may be specified in place of CALLED ON NULL INPUT and NOT NULL CALL may be specified in place of RETURNS NULL ON NULL INPUT.

Description

function-name
Names the function being defined. It is a qualified or unqualified name that designates a function. The unqualified form of *function-name* is an SQL identifier (with a maximum length of 18). In dynamic SQL statements, the CURRENT SCHEMA special register is used as a qualifier for an unqualified object name. In static SQL statements the QUALIFIER precompile/bind option implicitly specifies the qualifier for unqualified object names. The qualified form is a *schema-name* followed by a period and an SQL identifier. The qualified name must not be the same as the data type of the first parameter, if that first parameter is a structured type.

The name, including the implicit or explicit qualifiers, together with the number of parameters and the data type of each parameter (without regard for any length, precision or scale attributes of the data type) must not identify a function described in the catalog (SQLSTATE 42723). The unqualified name, together with the number and data types of the parameters, while of course unique within its schema, need not be unique across schemas.

If a two-part name is specified, the *schema-name* cannot begin with "SYS" (SQLSTATE 42939).

A number of names used as keywords in predicates are reserved for system use, and may not be used as a *function-name* (SQLSTATE 42939). The names are SOME, ANY, ALL, NOT, AND, OR, BETWEEN, NULL, LIKE, EXISTS, IN, UNIQUE, OVERLAPS, SIMILAR, MATCH and the comparison operators as described in "Basic Predicate" on page 187.

The same name can be used for more than one function if there is some difference in the signature of the functions. Although there is no prohibition against it, an external user-defined table function should not be given the same name as a built-in function.

parameter-name
Specifies an optional name for the parameter that is distinct from the names of all other parameters in this function.

(data-type1,...)
Identifies the number of input parameters of the function, and specifies the data type of each parameter. One entry in the list must be specified for each parameter that the function will expect to receive. No more than 90 parameters are allowed. If this limit is exceeded, an error (SQLSTATE 54023) is raised.

It is possible to register a function that has no parameters. In this case, the parentheses must still be coded, with no intervening data types. For example,

```
CREATE FUNCTION WOOFER() ...
```

No two identically-named functions within a schema are permitted to have exactly the same type for all corresponding parameters. Lengths, precisions and scales are not considered in this type comparison. Therefore CHAR(8) and CHAR(35) are considered to be the same type, as are DECIMAL(11,2) and DECIMAL (4,3). There is some further bundling of types that causes them to be treated as the same type for this purpose, such as DECIMAL and NUMERIC. A duplicate signature raises an SQL error (SQLSTATE 42723).

For example, given the statements:

```
CREATE FUNCTION PART (INT, CHAR(15)) ...
CREATE FUNCTION PART (INTEGER, CHAR(40)) ...

CREATE FUNCTION ANGLE (DECIMAL(12,2)) ...
CREATE FUNCTION ANGLE (DEC(10,7)) ...
```

the second and fourth statements would fail because they are considered to be a duplicate functions.

data-type1
Specifies the data type of the parameter.

- SQL data type specifications and abbreviations which may be specified in the *data-type* definition of a CREATE TABLE statement and have a correspondence in the language that is being used to write the function may be specified. See the language-specific sections of the *Application Development Guide* for details on the mapping between the SQL data types and host language data types with respect to user-defined functions.
- DECIMAL (and NUMERIC) are invalid with LANGUAGE C and OLE (SQLSTATE 42815). For alternatives to using DECIMAL refer to *Application Development Guide*.
- REF(*type-name*) may be specified as the data type of a parameter. However, such a parameter must be unscoped (SQLSTATE 42997).
- Structured types may be specified, provided that appropriate transform functions exist in the associated transform group.

AS LOCATOR
For the LOB types or distinct types which are based on a LOB type, the AS LOCATOR clause can be added. This indicates that a LOB locator is to be passed to the UDF instead of the actual value. This saves greatly in the number of bytes passed to the UDF, and may save as well in performance, particularly in the case where only a few bytes of the value are actually of interest to the UDF. Use of LOB locators in UDFs are described in *Application Development Guide*.

Here is an example which illustrates the use of the AS LOCATOR clause in parameter definitions:

```
CREATE FUNCTION foo ( CLOB(10M) AS LOCATOR, IMAGE AS LOCATOR)
                    ...
```

which assumes that IMAGE is a distinct type based on one of the LOB types.

Note also that for argument promotion purposes, the AS LOCATOR clause has no effect. In the example the types are considered to be CLOB and IMAGE respectively, which would mean that a CHAR or VARCHAR argument could be passed to the function as the first argument. Likewise, the AS LOCATOR has no effect on the function signature, which is used in matching the function (a) when referenced in DML, by a process called "function resolution", and (b) when referenced in a DDL statement such as COMMENT ON or DROP. In fact the clause may or may not be used in COMMENT ON or DROP with no significance.

An error (SQLSTATE 42601) is raised if AS LOCATOR is specified for a type other than a LOB or a distinct type based on a LOB.

If the function is FENCED, the AS LOCATOR clause cannot be specified (SQLSTATE 42613).

RETURNS TABLE

Specifies that the output of the function is a table. The parentheses that follow this keyword delimit a list of the names and types of the columns of the table, resembling the style of a simple CREATE TABLE statement which has no additional specifications (constraints, for example). No more than 255 columns are allowed (SQLSTATE 54011).

column-name

Specifies the name of this column. The name cannot be qualified and the same name cannot be used for more than one column of the table.

data-type2

Specifies the data type of the column, and can be any data type supported for a parameter of a UDF written in the particular language, except for structured types (SQLSTATE 42997).

AS LOCATOR

When *data-type2* is a LOB type or distinct type based on a LOB type, the use of this option indicates that the function is returning a locator for the LOB value that is instantiated in the result table.

The valid types for use with this clause are discussed on page 593.

SPECIFIC *specific-name*
Provides a unique name for the instance of the function that is being defined. This specific name can be used when sourcing on this function, dropping the function, or commenting on the function. It can never be used to invoke the function. The unqualified form of *specific-name* is an SQL identifier (with a maximum length of 18). The qualified form is a *schema-name* followed by a period and an SQL identifier. The name, including the implicit or explicit qualifier, must not identify another function instance that exists at the application server; otherwise an error (SQLSTATE 42710) is raised.

The *specific-name* may be the same as an existing *function-name*.

If no qualifier is specified, the qualifier that was used for *function-name* is used. If a qualifier is specified, it must be the same as the explicit or implicit qualifier of *function-name* or an error (SQLSTATE 42882) is raised.

If *specific-name* is not specified, a unique name is generated by the database manager. The unique name is SQL followed by a character timestamp, SQLyymmddhhmmssxxx.

EXTERNAL
This clause indicates that the CREATE FUNCTION statement is being used to register a new function based on code written in an external programming language and adhering to the documented linkage conventions and interface.

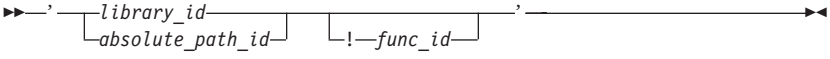
If NAME clause is not specified "NAME *function-name*" is assumed.

NAME *'string'*
This clause identifies the user-written code which implements the function being defined.

The 'string' option is a string constant with a maximum of 254 characters. The format used for the string is dependent on the LANGUAGE specified.

- For LANGUAGE C:

  The *string* specified is the library name and function within library, which the database manager invokes to execute the user-defined function being CREATEd. The library (and the function within the library) do not need to exist when the CREATE FUNCTION statement is performed. However, when the function is used in an SQL statement, the library and function within the library must exist and be accessible from the database server machine.



Extraneous blanks are not permitted within the single quotes.

library_id
Identifies the library name containing the function. The database manager will look for the library in the .../sqllib/function directory (UNIX-based systems), or ...*instance_name*\function directory (OS/2, and Windows 32-bit operating systems as specified by the DB2INSTPROF registry variable), where the database manager will locate the controlling sqllib directory which is being used to run the database manager. For example, the controlling sqllib directory in UNIX-based systems is /u/$DB2INSTANCE/sqllib.

If 'myfunc' were the *library_id* in a UNIX-based system it would cause the database manager to look for the function in library /u/production/sqllib/function/myfunc, provided the database manager is being run from /u/production.

For OS/2, and Windows 32-bit operating systems, the database manager will look in the LIBPATH or PATH if the *library_id* is not located in the function directory.

In OS/2 the library_id should not contain more than 8 characters.

absolute_path_id
Identifies the full path name of the function.

In a UNIX-based system, for example, '/u/jchui/mylib/myfunc' would cause the database manager to look in /u/jchui/mylib for the myfunc function.

In OS/2, and Windows 32-bit operating systems 'd:\mylib\myfunc' would cause the database manager to load the myfunc.dll file from the d:\mylib directory.

In OS/2 the last part of this specification (i.e. the name of the dll), should not contain more than 8 characters.

! func_id
Identifies the entry point name of the function to be invoked. The ! serves as a delimiter between the library id and the function id. If *! func_id* is omitted, the database manager will use the default entry point established when the library was linked.

In a UNIX-based system, for example, 'mymod!func8' would direct the database manager to look for the library $inst_home_dir/sqllib/function/mymod and to use entry point func8 within that library.

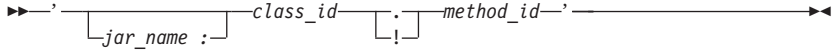
In OS/2, and Windows 32-bit operating systems, 'mymod!func8' would direct the database manager to load the mymod.dll file and call the func8() function in the dynamic link library (DLL).

If the string is not properly formed, an error (SQLSTATE 42878) is raised.

In any case, the body of every external function should be in a directory that is available on every partition of the database.

- For LANGUAGE JAVA:

  The *string* specified contains the optional jar file identifier, class identifier and method identifier, which the database manager invokes to execute the user-defined function being CREATEd. The class identifier and method identifier do not need to exist when the CREATE FUNCTION statement is performed. If a *jar_id* is specified, it must exist when the CREATE FUNCTION statement is executed. However, when the function is used in an SQL statement, the method identifier must exist and be accessible from the database server machine.



  Extraneous blanks are not permitted within the single quotes.

  jar_name
  Identifies the jar identifier given to the jar collection when it was installed in the database. It can be either a simple identifier, or a schema qualified identifier. Examples are 'myJar' and 'mySchema.myJar'

  class_id
  Identifies the class identifier of the Java object. If the class is part of a package, the class identifier part must include the complete package prefix, for example, 'myPacks.UserFuncs'. The Java virtual machine will look in directory '.../myPacks/UserFuncs/' for the classes. In OS/2 and Windows 32-bit operating systems, the Java virtual machine will look in directory '...\myPacks\UserFuncs\'.

  method_id
  Identifies the method name of the Java object to be invoked.

- For LANGUAGE OLE:

  The *string* specified is the OLE programmatic identifier (progid) or class identifier (clsid), and method identifier, which the database

manager invokes to execute the user-defined function being CREATEd. The programmatic identifier or class identifier, and method identifier do not need to exist when the CREATE FUNCTION statement is performed. However, when the function is used in an SQL statement, the method identifier must exist and be accessible from the database server machine, otherwise an error (SQLSTATE 42724) is raised.

Extraneous blanks are not permitted within the single quotes.

progid
Identifies the programmatic identifier of the OLE object.

progid is not interpreted by the database manager but only forwarded to the OLE APIs at run time. The specified OLE object must be creatable and support late binding (also called IDispatch-based binding).

clsid
Identifies the class identifier of the OLE object to create. It can be used as an alternative for specifying a *progid* in the case that an OLE object is not registered with a progid. The *clsid* has the form:

{nnnnnnnn-nnnn-nnnn-nnnn-nnnnnnnnnnnn}

where 'n' is an alphanumeric character. *clsid* is not interpreted by the database manager but only forwarded to the OLE APIs at run time.

method_id
Identifies the method name of the OLE object to be invoked.

NAME *identifier*
This clause identifies the name of the user-written code which implements the function being defined. The *identifier* specified is an SQL identifier. The SQL identifier is used as the *library-id* in the string. Unless it is a delimited identifier, the identifier is folded to upper case. If the identifier is qualified with a schema name, the schema name portion is ignored. This form of NAME can only be used with LANGUAGE C.

LANGUAGE
This mandatory clause is used to specify the language interface convention to which the user-defined function body is written.

C This means the database manager will call the user-defined

function as if it were a C function. The user-defined function must conform to the C language calling and linkage convention as defined by the standard ANSI C prototype.

JAVA This means the database manager will call the user-defined function as a method in a Java class.

OLE This means the database manager will call the user-defined function as if it were a method exposed by an OLE automation object. The user-defined function must conform with the OLE automation data types and invocation mechanism as described in the *OLE Automation Programmer's Reference*.

LANGUAGE OLE is only supported for user-defined functions stored in DB2 for Windows 32-bit operating systems.

Refer to "CREATE FUNCTION (OLE DB External Table)" on page 631 for creating LANGUAGE OLEDB external table functions.

PARAMETER STYLE

This clause is used to specify the conventions used for passing parameters to and returning the value from functions.

DB2SQL

Used to specify the conventions for passing parameters to and returning the value from external functions that conform to C language calling and linkage conventions. This must be specified when LANGUAGE C or LANGUAGE OLE is used.

DB2GENERAL

Used to specify the conventions for passing parameters to and returning the value from external functions that are defined as a method in a Java class. This can only be specified when LANGUAGE JAVA is used.

The value DB2GENRL may be used as a synonym for DB2GENERAL.

DETERMINISTIC or **NOT DETERMINISTIC**

This optional clause specifies whether the function always returns the same results for given argument values (DETERMINISTIC) or whether the function depends on some state values that affect the results (NOT DETERMINISTIC). That is, a DETERMINISTIC function must always return the same table from successive invocations with identical inputs. Optimizations taking advantage of the fact that identical inputs always produce the same results are prevented by specifying NOT DETERMINISTIC. An example of a NOT DETERMINISTIC table function would be a function that retrieves data from a data source such as a file.

FENCED or **NOT FENCED**
This clause specifies whether or not the function is considered "safe" to run in the database manager operating environment's process or address space (NOT FENCED), or not (FENCED).

If a function is registered as FENCED, the database manager insulates its internal resources (e.g. data buffers) from access by the function. Most functions will have the option of running as FENCED or NOT FENCED. In general, a function running as FENCED will not perform as well as a similar one running as NOT FENCED.

Warning: Use of NOT FENCED for functions not adequately coded, reviewed and tested can compromise the integrity of DB2. DB2 takes some precautions against many of the common types of inadvertent failures that might occur, but cannot guarantee complete integrity when NOT FENCED user defined functions are used.

Note that, while the use of FENCED does offer a greater degree of protection for database integrity, a FENCED UDF that has not been adequately coded, reviewed and tested can cause an inadvertent failure of DB2.

Most user-defined functions should be able to run either as FENCED or NOT FENCED. Only FENCED can be specified for a function with LANGUAGE OLE (SQLSTATE 42613).

To change from FENCED to NOT FENCED, the function must be re-registered (by first dropping it and then re-creating it). Either SYSADM authority, DBADM authority or a special authority (CREATE_NOT_FENCED) is required to register a user-defined function as NOT FENCED.

If the function is FENCED, the AS LOCATOR clause cannot be specified (SQLSTATE 42613).

RETURNS NULL ON NULL INPUT or CALLED ON NULL INPUT
This optional clause may be used to avoid a call to the external function if any of the arguments is null. If the user-defined function is defined to have no parameters, then of course this null argument condition cannot arise, and it does not matter how this specification is coded.

If RETURNS NULL ON NULL INPUT is specified, and if, at table function OPEN time, any of the function's arguments are null, then the user-defined function is not called. The result of the attempted table function scan is the empty table (a table with no rows).

If CALLED ON NULL INPUT is specified, then regardless of whether any arguments are null, the user-defined function is called. It can return a null value or a normal (non-null) value. But responsibility for testing for null argument values lies with the UDF.

The value NULL CALL may be used as a synonym for CALLED ON NULL INPUT for backwards and family compatibility. Similarly, NOT NULL CALL may be used as a synonym for RETURNS NULL ON NULL INPUT.

NO SQL
This mandatory clauses indicates that the function cannot issue any SQL statements. If it does, an error (SQLSTATE 38502) is raised at run time.

NO EXTERNAL ACTION or **EXTERNAL ACTION**
This optional clause specifies whether or not the function takes some action that changes the state of an object not managed by the database manager. Optimizations that assume functions have no external impacts are prevented by specifying EXTERNAL ACTION. For example: sending a message, ringing a bell, or writing a record to a file.

NO SCRATCHPAD or **SCRATCHPAD** *length*
This optional clause may be used to specify whether a scratchpad is to be provided for an external function. (It is strongly recommended that user-defined functions be re-entrant, so a scratchpad provides a means for the function to "save state" from one call to the next.)

If SCRATCHPAD is specified, then at first invocation of the user-defined function, memory is allocated for a scratchpad to be used by the external function. This scratchpad has the following characteristics:

- *length*, if specified, sets the size of the scratchpad in bytes and must be between 1 and 32 767 (SQLSTATE 42820). The default value is 100.
- It is initialized to all X'00''s.
- Its scope is the SQL statement. There is one scratchpad per reference to the external function in the SQL statement. So if the UDFX function in the following statement is defined with the SCRATCHPAD keyword, two scratchpads would be assigned.

```
SELECT A.C1, B.C2
   FROM TABLE (UDFX(:hv1)) AS A,
        TABLE (UDFX(:hv1)) AS B
       WHERE ...
```

- It is persistent. It is initialized at the beginning of the execution of the statement, and can be used by the external table function to preserve the state of the scratchpad from one call to the next. If the FINAL CALL keyword is also specified for the UDF, then the scratchpad is NEVER altered by DB2, and any resources anchored in the scratchpad should be released when the special FINAL call is made.

If NO FINAL CALL is specified or defaulted, then the external table function should clean up any such resources on the CLOSE call, as DB2 will re-initialize the scratchpad on each OPEN call. This determination of FINAL CALL or NO FINAL CALL and the associated behavior of the scratchpad could be an important consideration, particularly if the table function will be used in a subquery or join, since that is when multiple OPEN calls can occur during the execution of a statement.

- It can be used as a central point for system resources (for example, memory) which the external function might acquire. The function could acquire the memory on the first call, keep its address in the scratchpad, and refer to it in subsequent calls.

  (As outlined above, the FINAL CALL/NO FINAL CALL keyword is used to control the re-initialization of the scratchpad, and also dictates when the external table function should release resources anchored in the scratchpad.)

If SCRATCHPAD is specified, then on each invocation of the user-defined function an additional argument is passed to the external function which addresses the scratchpad.

If NO SCRATCHPAD is specified then no scratchpad is allocated or passed to the external function.

NO FINAL CALL or FINAL CALL

This optional clause specifies whether a final call (and a separate first call) is to be made to an external function. It also controls when the scratchpad is re-initalized. If NO FINAL CALL is specified, then DB2 can only make three types of calls to the table function: open, fetch and close. However, if FINAL CALL is specified, then in addition to open, fetch and close, a first call and a final call can be made to the table function.

For external table functions, the call-type argument is ALWAYS present, regardless of which option is chosen. See *Application Development Guide* for more information about this argument and its values.

A description of the table UDF processing of these calls when errors occur is included in the *Application Development Guide*.

DISALLOW PARALLEL

This clause specifies that, for a single reference to the function, the invocation of the function can not be parallelized. Table functions are always run on a single partition.

NO DBINFO or **DBINFO**

This optional clause specifies whether certain specific information known by DB2 will be passed to the UDF as an additional invocation-time argument (DBINFO) or not (NO DBINFO). NO DBINFO is the default. DBINFO is not supported for LANGUAGE OLE (SQLSTATE 42613).

If DBINFO is specified, then a structure is passed to the UDF which contains the following information:

- Data base name - the name of the currently connected database.
- Application ID - unique application ID which is established for each connection to the database.
- Application Authorization ID - the application run-time authorization ID, regardless of the nested UDFs in between this UDF and the application.
- Code page - identifies the database code page.
- Schema name - not applicable to external table functions.
- Table name - not applicable to external table functions.
- Column name - not applicable to external table functions.
- Database version/release- identifies the version, release and modification level of the database server invoking the UDF.
- Platform - contains the server's platform type.
- Table function result column numbers - an array of the numbers of the table function result columns actually needed for the particular statement referencing the function. Only provided for table functions, it enables the UDF to optimize by only returning the required column values instead of all column values.

Please see the *Application Development Guide* for detailed information on the structure and how it is passed to the UDF.

CARDINALITY *integer*

This optional clause provides an estimate of the expected number of rows to be returned by the function for optimization purposes. Valid values for *integer* range from 0 to 2 147 483 647 inclusive.

If the CARDINALITY clause is not specified for a table function, DB2 will assume a finite value as a default- the same value assumed for tables for which the RUNSTATS utility has not gathered statistics.

Warning: if a function does in fact have infinite cardinality, i.e. it returns a row every time it is called to do so, never returning the ″end-of-table″ condition, then queries which require the ″end-of-table″ condition to correctly function will be infinite, and will have to be interrupted. Examples of such queries are those involving GROUP BY and ORDER BY. The user is advised to not write such UDFs.

TRANSFORM GROUP *group-name*

Indicates the transform group to be used for user-defined structured type transformations when invoking the function. A transform is required if the function definition includes a user-defined structured type as a parameter data type. If this clause is not specified, the default group name DB2_FUNCTION is used. If the specified (or default) *group-name* is not

defined for a referenced structured type, an error results (SQLSTATE 42741). If a required FROM SQL transform function is not defined for the given group-name and structured type, an error results (SQLSTATE 42744).

Notes

- When choosing the data types for the parameters of a user-defined function, consider the rules for promotion that will affect its input values (see "Promotion of Data Types" on page 90). For example, a constant which may be used as an input value could have a built-in data type different from the one expected and, more significantly, may not be promoted to the data type expected. Based on the rules for promotion, it is generally recommended to use 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 UDFs across platforms the following data types should not be used:
  - FLOAT- use DOUBLE or REAL instead.
  - NUMERIC- use DECIMAL instead.
  - LONG VARCHAR- use CLOB (or BLOB) instead.
- For information on writing, compiling, and linking an external user-defined function, see the *Application Development Guide*.
- Creating a function with a schema name that does not already exist will result in the implicit creation of that schema provided the authorization ID of the statement has IMPLICIT_SCHEMA authority. The schema owner is SYSIBM. The CREATEIN privilege on the schema is granted to PUBLIC.

Examples

Example 1: The following registers a table function written to return a row consisting of a single document identifier column for each known document in a text management system. The first parameter matches a given subject area and the second parameter contains a given string.

Within the context of a single session, the UDF will always return the same table, and therefore it is defined as DETERMINISTIC. Note the RETURNS clause which defines the output from DOCMATCH. FINAL CALL must be specified for each table function. In addition, the DISALLOW PARALLEL keyword is added as table functions cannot operate in parallel. Although the size of the output for DOCMATCH is highly variable, CARDINALITY 20 is a representative value, and is specified to help the DB2 optimizer.

```
CREATE FUNCTION DOCMATCH (VARCHAR(30), VARCHAR(255))
    RETURNS TABLE (DOC_ID CHAR(16))
    EXTERNAL NAME '/common/docfuncs/rajiv/udfmatch'
    LANGUAGE C
    PARAMETER STYLE DB2SQL
    NO SQL
    DETERMINISTIC
    NO EXTERNAL ACTION
    NOT FENCED
    SCRATCHPAD
    FINAL CALL
    DISALLOW PARALLEL
    CARDINALITY 20
```

Example 2: The following registers an OLE table function that is used to retrieve message header information and the partial message text of messages in Microsoft Exchange. For an example of the code that implements this table function, see the *Application Development Guide*.

```
CREATE FUNCTION MAIL()
    RETURNS TABLE (TIMERECIEVED DATE,
                   SUBJECT VARCHAR(15),
                   SIZE INTEGER,
                   TEXT VARCHAR(30))
    EXTERNAL NAME 'tfmail.header!list'
    LANGUAGE OLE
    PARAMETER STYLE DB2SQL
    NOT DETERMINISTIC
    FENCED
    CALLED ON NULL INPUT
    SCRATCHPAD
    FINAL CALL
    NO SQL
    EXTERNAL ACTION
    DISALLOW PARALLEL
```

CREATE FUNCTION (OLE DB External Table)

This statement is used to register a user-defined OLE DB external table function to access data from an OLE DB provider.

A *table function* may be used in the FROM clause of a SELECT.

Invocation

This statement can be embedded in an application program or issued through the use of dynamic SQL statements. It is an executable statement that can be dynamically prepared. However, if the bind option DYNAMICRULES BIND applies, the statement cannot be dynamically prepared (SQLSTATE 42509).

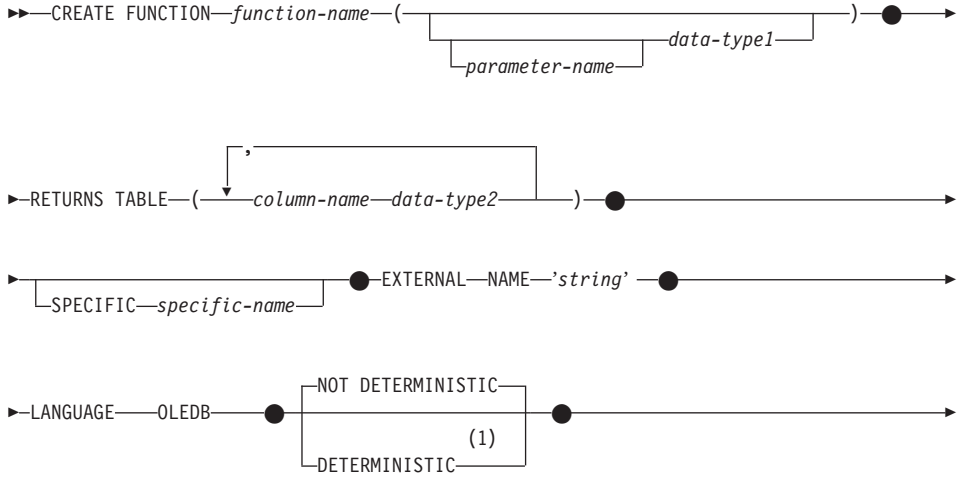
Authorization

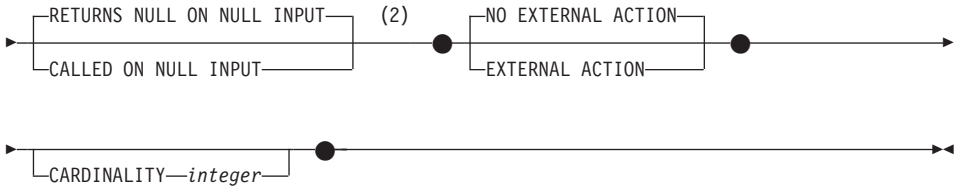
The privileges held by the authorization ID of the statement must include at least one of the following:

- SYSADM or DBADM authority
- IMPLICIT_SCHEMA authority on the database, if the implicit or explicit schema name of the function does not exist
- CREATEIN privilege on the schema, if the schema name of the function exists.

If the authorization ID has insufficient authority to perform the operation, an error (SQLSTATE 42502) is raised.

Syntax





Notes:

1 NOT VARIANT may be specified in place of DETERMINISTIC and VARIANT may be specified in place of NOT DETERMINISTIC.

2 NULL CALL may be specified in place of CALLED ON NULL INPUT and NOT NULL CALL may be specified in place of RETURNS NULL ON NULL INPUT.

Description

function-name

Names the function being defined. It is a qualified or unqualified name that designates a function. The unqualified form of *function-name* is an SQL identifier (with a maximum length of 18). In dynamic SQL statements, the CURRENT SCHEMA special register is used as a qualifier for an unqualified object name. In static SQL statements the QUALIFIER precompile/bind option implicitly specifies the qualifier for unqualified object names. The qualified form is a *schema-name* followed by a period and an SQL identifier.

The name, including the implicit or explicit qualifiers, together with the number of parameters and the data type of each parameter (without regard for any length, precision or scale attributes of the data type) must not identify a function described in the catalog (SQLSTATE 42723). The unqualified name, together with the number and data types of the parameters, while of course unique within its schema, need not be unique across schemas.

If a two-part name is specified, the *schema-name* cannot begin with "SYS" (SQLSTATE 42939).

A number of names used as keywords in predicates are reserved for system use, and may not be used as a *function-name* (SQLSTATE 42939). The names are SOME, ANY, ALL, NOT, AND, OR, BETWEEN, NULL, LIKE, EXISTS, IN, UNIQUE, OVERLAPS, SIMILAR, MATCH and the comparison operators as described in "Basic Predicate" on page 187.

The same name can be used for more than one function if there is some difference in the signature of the functions. Although there is no prohibition against it, an external user-defined table function should not be given the same name as a built-in function.

parameter-name
Specifies an optional name for the parameter.

data-type1
Identifies the input parameter of the function, and specifies the data type of the parameter. If no input parameter is specified, then data is retrieved from the external source possibly subsetted through query optimization. The input parameter can be any character or graphic string data type and it passes command text to an OLE DB provider.

It is possible to register a function that has no parameters. In this case, the parentheses must still be coded, with no intervening data types. For example,

```
CREATE FUNCTION WOOFER() ...
```

No two identically-named functions within a schema are permitted to have exactly the same type for all corresponding parameters. Length is not considered in this type comparison. Therefore CHAR(8) and CHAR(35) are considered to be the same type. A duplicate signature raises an SQL error (SQLSTATE 42723).

RETURNS TABLE
Specifies that the output of the function is a table. The parentheses that follow this keyword delimit a list of the names and types of the columns of the table, resembling the style of a simple CREATE TABLE statement which has no additional specifications (constraints, for example).

column-name
Specifies the name of the column which must be the same as the corresponding rowset column name. The name cannot be qualified and the same name cannot be used for more than one column of the table.

data-type2
Specifies the data type of the column (see language-specific sections of *Application Development Guide* for details on the mapping between the SQL data types and OLE DB data types).

SPECIFIC *specific-name*
Provides a unique name for the instance of the function that is being defined. This specific name can be used when sourcing on this function, dropping the function, or commenting on the function. It can never be used to invoke the function. The unqualified form of *specific-name* is an SQL identifier (with a maximum length of 18). The qualified form is a *schema-name* followed by a period and an SQL identifier. The name, including the implicit or explicit qualifier, must not identify another function instance that exists at the application server; otherwise an error (SQLSTATE 42710) is raised.

The *specific-name* may be the same as an existing *function-name*.

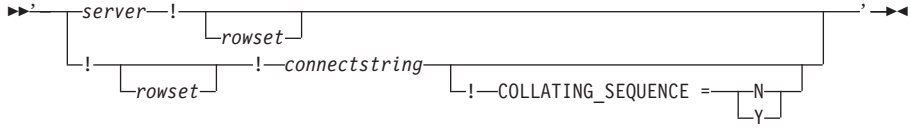
If no qualifier is specified, the qualifier that was used for *function-name* is used. If a qualifier is specified, it must be the same as the explicit or implicit qualifier of *function-name* or an error (SQLSTATE 42882) is raised.

If *specific-name* is not specified, a unique name is generated by the database manager. The unique name is SQL followed by a character timestamp, SQLyymmddhhmmssxxx.

EXTERNAL NAME *'string'*
This clause identifies the external table and an OLE DB provider.

The 'string' option is a string constant with a maximum of 254 characters.

The string specified is used to establish a connection and session with a OLE DB provider, and retrieve data from a rowset. The OLE DB provider and data source do not need to exist when the CREATE FUNCTION statement is performed. See OLE DB Table Functions in *Application Development Guide* for more details.



server
Identifies the local name of a data source as defined by "CREATE SERVER" on page 708.

rowset
Identifies the rowset (table) exposed by the OLE DB provider. Fully qualified table names must be provided for OLE DB providers that support catalog or schema names.

connectstring
String version of the initialization properties needed to connect to a data source. The basic format of a connection string is based on the ODBC connection string. The string contains a series of keyword/value pairs separated by semicolons. The equal sign (=) separates each keyword and its value. Keywords are the descriptions of the OLE DB initialization properties (property set DBPROPSET_DBINIT) or provider-specific keywords. Refer to the language-specific sections of *Application Development Guide* for details.

COLLATING_SEQUENCE
Specifies whether the data source uses the same collating sequence as DB2 Universal Database. See "CREATE SERVER" on page 708 for details. Valid values are as follows:

Y = Same collating sequence

N = Different collating sequence

If COLLATING_SEQUENCE is not specified, then the data source is assumed to have a different collating sequence from DB2 Universal Database.

If *server* is provided, *connectstring* or COLLATING_SEQUENCE are not allowed in the external name. They are defined as server options CONNECTSTRING and COLLATING_SEQUENCE. If no *server* is provided, a *connectstring* must be provided. If *rowset* is not provided, the table function must have an input parameter to pass through command text to the OLE DB provider.

LANGUAGE OLEDB

This means the database manager will deploy a built-in generic OLE DB consumer to retrieve data from the OLE DB provider. No table function implementation is required by the developer.

LANGUAGE OLEDB table functions can be created on any platform, but only executed on platforms supported by Microsoft OLE DB.

DETERMINISTIC or **NOT DETERMINISTIC**

This optional clause specifies whether the function always returns the same results for given argument values (DETERMINISTIC) or whether the function depends on some state values that affect the results (NOT DETERMINISTIC). That is, a DETERMINISTIC function must always return the same table from successive invocations with identical inputs. Optimizations taking advantage of the fact that identical inputs always produce the same results are prevented by specifying NOT DETERMINISTIC.

RETURNS NULL ON NULL INPUT or CALLED ON NULL INPUT

This optional clause may be used to avoid a call to the external function if any of the arguments is null. If the user-defined function is defined to have no parameters, then of course this null argument condition cannot arise.

If RETURNS NULL ON NULL INPUT is specified and if at execution time any one of the function's arguments is null, the user-defined function is not called and the result is the empty table, i.e. a table with no rows.

If CALLED ON NULL INPUT is specified, then at execution time regardless of whether any arguments are null, the user-defined function is called. It can return an empty table or not, depending on its logic. But responsibility for testing for null argument values lies with the UDF.

The value NULL CALL may be used as a synonym for CALLED ON NULL INPUT for backwards and family compatibility. Similarly, NOT NULL CALL may be used as a synonym for RETURNS NULL ON NULL INPUT.

NO EXTERNAL ACTION or **EXTERNAL ACTION**
This optional clause specifies whether or not the function takes some action that changes the state of an object not managed by the database manager. Optimizations that assume functions with no external impacts are prevented by specifying EXTERNAL ACTION. For example: sending a message, ringing a bell, or writing a record to a file.

CARDINALITY *integer*
This optional clause provides an estimate of the expected number of rows to be returned by the function for optimization purposes. Valid values for *integer* range from 0 to 2 147 483 647 inclusive.

If the CARDINALITY clause is not specified for a table function, DB2 will assume a finite value as a default- the same value assumed for tables for which the RUNSTATS utility has not gathered statistics.

Warning: if a function does in fact have infinite cardinality, i.e. it returns a row every time it is called to do so, never returning the ″end-of-table″ condition, then queries which require the ″end-of-table″ condition to correctly function will be infinite, and will have to be interrupted. Examples of such queries are those involving GROUP BY and ORDER BY. The user is advised to not write such UDFs.

Notes

- FENCED, FINAL CALL, SCRATCHPAD, PARAMETER STYLE DB2SQL, DISALLOW PARALLEL, NO DBINFO, and NO SQL are implicit in the statement and can be specified. Refer to “CREATE FUNCTION (External Table)” on page 615 for specific descriptions.
- When choosing the data types for the parameters of a user-defined function, consider the rules for promotion that will affect its input values (see “Promotion of Data Types” on page 90). For example, a constant which may be used as an input value could have a built-in data type different from the one expected and, more significantly, may not be promoted to the data type expected. Based on the rules for promotion, it is generally recommended to use the following data types for parameters:
  - VARCHAR instead of CHAR
  - VARGRAPHIC instead of GRAPHIC
- For portability of UDFs across platforms the following data types should not be used:
  - FLOAT- use DOUBLE or REAL instead.
  - NUMERIC- use DECIMAL instead.

– LONG VARCHAR- use CLOB (or BLOB) instead.

- For information on creating a user-defined OLE DB external table function, see the *Application Development Guide*.
- Creating a function with a schema name that does not already exist will result in the implicit creation of that schema provided the authorization ID of the statement has IMPLICIT_SCHEMA authority. The schema owner is SYSIBM. The CREATEIN privilege on the schema is granted to PUBLIC.

Examples

Example 1: The following registers an OLE DB table function, which retrieves order information from a Microsoft Access database. The connection string is defined in the external name.

```
CREATE FUNCTION orders ()
  RETURNS TABLE (orderid INTEGER,
                 customerid CHAR(5),
                 employeeid INTEGER,
                 orderdate TIMESTAMP,
                 requireddate TIMESTAMP,
                 shippeddate TIMESTAMP,
                 shipvia INTEGER,
                 freight dec(19,4))
  LANGUAGE OLEDB
  EXTERNAL NAME '!orders!Provider=Microsoft.Jet.OLEDB.3.51;
                         Data Source=c:\sqllib\samples\oledb\nwind.mdb
  !COLLATING_SEQUENCE=Y';
```

Example 2: The following registers an OLE DB table function, which retrieves customer information from an Oracle database. The connection string is provided through a server definition. The table name is fully qualified in the external name. The local user john is mapped to the remote user dave. Other users will use the guest userid in the connection string. Refer to "CREATE SERVER" on page 708, "CREATE WRAPPER" on page 839 and "CREATE USER MAPPING" on page 821 for details on the statements.

```
CREATE SERVER spirit
  WRAPPER OLEDB
  OPTIONS (CONNECTSTRING 'Provider=MSDAORA;Persist Security Info=False;
                         User ID=guest;password=pwd;Locale Identifier=1033;
                         OLE DB Services=CLIENTCURSOR;Data Source=spirit');

CREATE USER MAPPING FOR john
  SERVER spirit
  OPTIONS (REMOTE_AUTHID 'dave', REMOTE_PASSWORD 'mypwd');

CREATE FUNCTION customers ()
  RETURNS TABLE (customer_id INTEGER,
                 name  VARCHAR(20),
                 address VARCHAR(20),
                 city VARCHAR(20),
                 state VARCHAR(5),
```

```
                zip_code INTEGER)
  LANGUAGE OLEDB
  EXTERNAL NAME 'spirit!demo.customer';
```

Example 3: The following registers an OLE DB table function, which retrieves information about stores from a MS SQL Server 7.0 database. The connection string is provided in the external name. The table function has an input parameter to pass through command text to the OLE DB provider. The rowset name does not need to be specified in the external name. The query example passes in a SQL command text to retrieve the top 3 stores.

```
CREATE FUNCTION favorites (varchar(600))
  RETURNS TABLE (store_id CHAR (4),
                 name  VARCHAR (41),
                 sales INTEGER)
  SPECIFIC favorites
  LANGUAGE OLEDB
  EXTERNAL NAME '!!Provider=SQLOLEDB.1;Persist Security Info=False;
                 User ID=sa;Initial Catalog=pubs;Data Source=WALTZ;
                 Locale Identifier=1033;Use Procedure for Prepare=1;
                 Auto Translate=False;Packet Size=4096;Workstation ID=WALTZ;
                 OLE DB Services=CLIENTCURSOR;';

SELECT *
  FROM TABLE (favorites
             (' select top 3 sales.stor_id as store_id, ' || '
                  stores.stor_name as name, ' || '
                  sum(sales. qty) as sales  ' || '
               from sales, stores ' || '
               where sales.stor_id = stores.stor_id ' || '
               group by sales.stor_id, stores.stor_name' || '
               order by sum(sales.qty) desc')) as f;
```

CREATE FUNCTION (Source or Template)

This statement is used to:

- Register a user-defined function, based on another existing scalar or column function, with an application server.
- Register a function template with an application server that is designated as a federated server. A *function template* is a partial function that contains no executable code. The user creates it for the purpose of mapping it to a data source function. After the mapping is created, the user can specify the function template in queries submitted to the federated server. When such a query is processed, the federated server will invoke the data source function to which the template is mapped, and return values whose data types correspond to those in the RETURNS portion of the template's definition. Refer to "Function Mappings, Function Templates, and Function Mapping Options" on page 48 for more information.

Invocation

This statement can be embedded in an application program or issued through the use of dynamic SQL statements. It is an executable statement that can be dynamically prepared. However, if the bind option DYNAMICRULES BIND applies, the statement cannot be dynamically prepared (SQLSTATE 42509).

Authorization

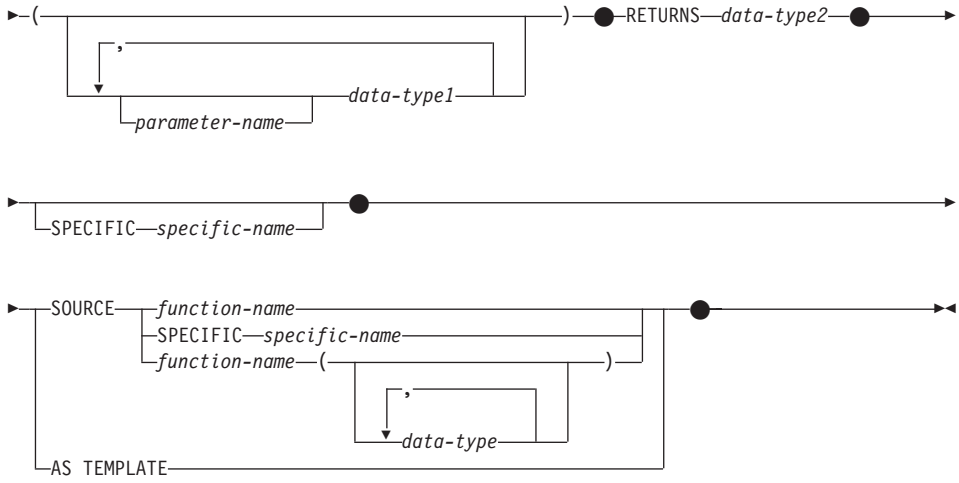
The privileges held by the authorization ID of the statement must include at least one of the following:

- SYSADM or DBADM authority
- IMPLICIT_SCHEMA authority on the database, if the implicit or explicit schema name of the function does not exist
- CREATEIN privilege on the schema, if the schema name of the function exists.

If the authorization ID has insufficient authority to perform the operation, an error (SQLSTATE 42502) is raised.

No authority is required on a function referenced in the SOURCE clause.

Syntax



Description

function-name

Names the function or function template being defined. It is a qualified or unqualified name that designates a function. The unqualified form of *function-name* is an SQL identifier (with a maximum length of 18). In dynamic SQL statements, the CURRENT SCHEMA special register is used as a qualifier for an unqualified object name. In static SQL statements the QUALIFIER precompile/bind option implicitly specifies the qualifier for unqualified object names. The qualified form is a *schema-name* followed by a period and an SQL identifier.

The name, including the implicit or explicit qualifiers, together with the number of parameters and the data type of each parameter (without regard for any length, precision or scale attributes of the data type) must not identify a function or function template described in the catalog (SQLSTATE 42723). The unqualified name, together with the number and data types of the parameters, while of course unique within its schema, need not be unique across schemas.

If a two-part name is specified, the *schema-name* cannot begin with "SYS". Otherwise, an error (SQLSTATE 42939) is raised.

A number of names used as keywords in predicates are reserved for system use, and may not be used as a *function-name* (SQLSTATE 42939). The names are SOME, ANY, ALL, NOT, AND, OR, BETWEEN, NULL, LIKE, EXISTS, IN, UNIQUE, OVERLAPS, SIMILAR, MATCH and the comparison operators as described in "Basic Predicate" on page 187.

When naming a user-defined function that is sourced on an existing function with the purpose of supporting the same function with a

user-defined distinct type, the same name as the sourced function may be used. This allows users to use the same function with a user-defined distinct type without realizing that an additional definition was required. In general, the same name can be used for more than one function if there is some difference in the signature of the functions.

(data-type,...)
Identifies the number of input parameters of the function or function template, and specifies the data type of each parameter. One entry in the list must be specified for each parameter that the function or function template will expect to receive. No more than 90 parameters are allowed. If this limit is exceeded, an error (SQLSTATE 54023) is raised.

It is possible to register a function or function template that has no parameters. In this case, the parentheses must still be coded, with no intervening data types. For example,

```
CREATE FUNCTION WOOFER() ...
```

No two identically-named functions or function templates within a schema are permitted to have exactly the same type for all corresponding parameters. (This restriction applies also to a function and function template within a schema that have the same name.) Lengths, precisions and scales are not considered in this type comparison. Therefore CHAR(8) and CHAR(35) are considered to be the same type, as are DECIMAL(11,2) and DECIMAL (4,3). There is some further bundling of types that causes them to be treated as the same type for this purpose, such as DECIMAL and NUMERIC. A duplicate signature raises an SQL error (SQLSTATE 42723).

For example, given the statements:

```
CREATE FUNCTION PART (INT, CHAR(15)) ...
CREATE FUNCTION PART (INTEGER, CHAR(40)) ...

CREATE FUNCTION ANGLE (DECIMAL(12,2)) ...
CREATE FUNCTION ANGLE (DEC(10,7)) ...
```

the second and fourth statements would fail because they are considered to be a duplicate functions.

parameter-name
Specifies an optional name for the parameter that is distinct from the names of all other parameters in this function.

data-type1
Specifies the data type of the parameter.

With a sourced scalar function any valid SQL data type may be used provided it is castable to the type of the corresponding parameter of the function identified in the SOURCE clause (for the definition of

castable, see "Casting Between Data Types" on page 91). A REF(*type-name*) data type cannot be specified as the data type of a parameter (SQLSTATE 42997).

Since the function is sourced, it is not necessary (but still permitted) to specify length, precision, or scale for the parameterized data types. Instead, empty parentheses may be used (for example CHAR() may be used). A *parameterized data type* is any one of the data types that can be defined with a specific length, scale, or precision. The parameterized data types are the string data types and the decimal data types.

RETURNS

This mandatory clause identifies the output of the function or function template.

data-type2

Specifies the data type of the output.

Any valid SQL data type is valid, as is a distinct type, provided it is castable from the result type of the source function (for the definition of castable, see "Casting Between Data Types" on page 91).

The parameter of a parameterized type need not be specified, as above for parameters of a sourced function. Instead, empty parentheses may be used, for example, VARCHAR().

Also see page 644 for additional considerations and rules that apply to the specification of the data type in the RETURNS clause when the function is sourced on another.

SPECIFIC *specific-name*

Provides a unique name for the instance of the function that is being defined. This specific name can be used when sourcing on this function, dropping the function, or commenting on the function. It can never be used to invoke the function. The unqualified form of *specific-name* is an SQL identifier (with a maximum length of 18). The qualified form is a *schema-name* followed by a period and an SQL identifier. The name, including the implicit or explicit qualifier, must not identify another function instance that exists at the application server; otherwise an error (SQLSTATE 42710) is raised.

The *specific-name* may be the same as an existing *function-name*.

If no qualifier is specified, the qualifier that was used for *function-name* is used. If a qualifier is specified, it must be the same as the explicit or implicit qualifier of *function-name* or an error (SQLSTATE 42882) is raised.

If *specific-name* is not specified, a unique name is generated by the database manager. The unique name is SQL followed by a character timestamp, SQLyymmddhhmmssxxx.

SOURCE
Specifies that the function being created is to be implemented by another function (the source function) already known to the database manager. The source function can be either a built-in function[71] or a previously created user-defined scalar function.

The SOURCE clause may be specified only for scalar or column functions; it may not be specified for table functions.

The SOURCE clause provides the identity of the other function.

function-name
Identifies the particular function that is to be used as the source and is valid only if there is exactly one specific function in the schema with this *function-name*. This syntax variant is not valid for a source function that is a built-in function.

If an unqualified name is provided, then the authorization ID's current SQL path (the value of the CURRENT PATH special register) is used to locate the function. The first schema in the function path that has a function with this name is selected.

If no function by this name exists in the named schema or if the name is not qualified and there is no function with this name in the function path, an error (SQLSTATE 42704) is raised. If there is more than one specific instance of the function in the named or located schema, an error (SQLSTATE 42725) is raised.

SPECIFIC *specific-name*
Identifies the particular user-defined function that is to be used as the source, by the *specific-name* either specified or defaulted to at function creation time. This syntax variant is not valid for a source function that is a built-in function.

If an unqualified name is provided, then the authorization ID's current SQL path is used to locate the function. The first schema in the function path that has a function with this specific name is selected.

If no function by this *specific-name* exists in the named schema or if the name is not qualified and there is no function with this *specific-name* in the SQL path, an error (SQLSTATE 42704) is raised.

function-name (data-type,...)
Provides the function signature, which uniquely identifies the source function. This is the only valid syntax variant for a source function that is a built-in function.

71. With the exception of COALESCE, NODENUMBER, NULLIF, PARTITION, TYPE_ID, TYPE_NAME, TYPE_SCHEMA and VALUE.

The rules for function resolution (as described in "Function Resolution" on page 144) are applied to select one function from the functions with the same function name, given the data types specified in the SOURCE clause. However, the data type of each parameter in the function selected must have the exact same type as the corresponding data type specified in the source function.

function-name
Gives the function name of the source function. If an unqualified name is provided, then the schemas of the user's SQL path are considered.

data-type
Must match the data type that was specified on the CREATE FUNCTION statement in the corresponding position (comma separated).

It is not necessary to specify the length, precision or scale for the parameterized data types. Instead an empty set of parentheses may be coded to indicate that these attributes are to be ignored when looking for a data type match. For example, DECIMAL() will match a parameter whose data type was defined as DECIMAL(7,2)).

FLOAT() cannot be used (SQLSTATE 42601) since the parameter value indicates different data types (REAL or DOUBLE).

However, if length, precision, or scale is coded, the value must exactly match that specified in the CREATE FUNCTION statement. This can be useful in assuring that the exact intended function will be used. Also note that synonyms for data types will be considered a match (for example DEC and NUMERIC will match).

A type of FLOAT(n) does not need to match the defined value for n since 0<n<25 means REAL and 24<n<54 means DOUBLE. Matching occurs based on whether the type is REAL or DOUBLE.

If no function with the specified signature exists in the named or implied schema, an error (SQLSTATE 42883) is raised.

AS TEMPLATE
Indicates that this statement will be used to create a function template, not a function with executable code.

Rules

- For convenience, in this section we will call the function being created CF and the function identified in the SOURCE clause SF, no matter which of the three allowable syntaxes was used to identify SF.

  - The unqualified name of CF and the unqualified name of SF can be different.
  - A function named as the source of another function can, itself, use another function as its source. Extreme care should be exercised when exploiting this facility because it could be very difficult to debug an application if an indirectly invoked function raises an error.
  - The following clauses are invalid if specified in conjunction with the SOURCE clause (because CF will inherit these attributes from SF):
    - CAST FROM ...,
    - EXTERNAL ...,
    - LANGUAGE ...,
    - PARAMETER STYLE ...,
    - DETERMINISTIC / NOT DETERMINISTIC,
    - FENCED / NOT FENCED,
    - RETURNS NULL ON NULL INPUT / CALLED ON NULL INPUT
    - EXTERNAL ACTION / NO EXTERNAL ACTION
    - NO SQL
    - SCRATCHPAD / NO SCRATCHPAD
    - FINAL CALL / NO FINAL CALL
    - RETURNS TABLE (...)
    - CARDINALITY ...
    - ALLOW PARALLEL / DISALLOW PARALLEL
    - DBINFO / NO DBINFO

  An error (SQLSTATE 42613) will result from violation of these rules.
- The number of input parameters in CF must be the same as those in SF; otherwise an error (SQLSTATE 42624) is raised.
- It is not necessary for CF to specify length, precision, or scale for a parameterized data type in the case of:
  - The function's input parameters,
  - Its RETURNS parameter

  Instead, empty parentheses may be specified as part of the data type (for example: VARCHAR()) in order to indicate that the length/precision/scale will be the same as those of the source function, or determined by the casting.

  However, if length, precision, or scale is specified then the value in CF is checked against the corresponding value in SF as outlined below for input parameters and returns value.

- The specification of the input parameters of CF are checked against those of SF. The data type of each parameter of CF must either be the same as or be *castable* to the data type of the corresponding parameter of SF. For the definition of castable, see "Casting Between Data Types" on page 91. If any parameter is not the same type or castable, an error (SQLSTATE 42879) is raised.

  Note that this rule provides no guarantee against an error occurring when CF is used. An argument that matches the data type and length or precision attributes of a CF parameter may not be assignable if the corresponding SF parameter has a shorter length or less precision. In general, parameters of CF should not have length or precision attributes that are greater than the attributes of the corresponding SF parameters.
- The specifications for the RETURNS data type of CF are checked against that of SF. The final RETURNS data type of SF, after any casting, must either be the same as or castable to the RETURNS data type of CF. Otherwise an error (SQLSTATE 42866) is raised.

  Note that this rule provides no guarantee against an error occurring when CF is used. A result value that matches the data type and length or precision attributes of the SF RETURNS data type may not be assignable if the CF RETURNS data type has a shorter length or less precision. Caution should be used when choosing to specify the RETURNS data type of CF as having length or precision attributes that are less than the attributes of the SF RETURNS data type.

Notes

- Determining whether one data type is castable to another data type does not consider length or precision and scale for parameterized data types such as CHAR and DECIMAL. Therefore, errors may occur when using a function as a result of attempting to cast a value of the source data type to a value of the target data type. For example, VARCHAR is castable to DATE but if the source type is actually defined as VARCHAR(5), an error will occur when using the function.
- When choosing the data types for the parameters of a user-defined function, consider the rules for promotion that will affect its input values (see "Promotion of Data Types" on page 90). For example, a constant which may be used as an input value could have a built-in data type different from the one expected and, more significantly, may not be promoted to the data type expected. Based on the rules for promotion, it is generally recommended to use the following data types for parameters:
  - INTEGER instead of SMALLINT
  - DOUBLE instead of REAL
  - VARCHAR instead of CHAR
  - VARGRAPHIC instead of GRAPHIC

- Creating a function with a schema name that does not already exist will result in the implicit creation of that schema provided the authorization ID of the statement has IMPLICIT_SCHEMA authority. The schema owner is SYSIBM. The CREATEIN privilege on the schema is granted to PUBLIC.
- For a federated server to recognize a data source function, the function must map to a counterpart at the federated database. If the database contains no counterpart, the user must create the counterpart and then the mapping.

  The counterpart can be a function (scalar or source) or a function template. If the user creates a function and the required mapping, then, each time a query that specifies the function is processed, DB2 (1) compares strategies for invoking it with strategies for invoking the data source function, and (2) invokes the function that is expected to require less overhead.

  If the user creates a function template and the mapping, then, each time a query that specifies the template is processed, DB2 invokes the data source function that it maps to, provided that an access plan for invoking this function exists. Refer to the *Application Development Guide* for more information about controlling the overhead of invoking functions in a federated system.

Examples

Example 1: Some time after the creation of Pellow's original CENTRE external scalar function, another user wants to create a function based on it, except this function is intended to accept only integer arguments.

```
CREATE FUNCTION MYCENTRE (INTEGER, INTEGER)
    RETURNS FLOAT
    SOURCE PELLOW.CENTRE (INTEGER, FLOAT)
```

Example 2: You have created a distinct type HATSIZE which is based on the built-in INTEGER data type, and now would find it useful to have an AVG function to compute the average hat size of different departments. This is easily done as follows:

```
CREATE FUNCTION AVG (HATSIZE) RETURNS (HATSIZE)
    SOURCE SYSIBM.AVG (INTEGER)
```

The creation of the distinct type has generated the required cast function, allowing the cast from HATSIZE to INTEGER for the argument and from INTEGER to HATSIZE for the result of the function.

Example 3: In a federated system, a user wants to invoke an Oracle UDF that returns table statistics in the form of values with double precision floating-points. The federated server can recognize this function only if there is a mapping between the function and a federated database counterpart. But no such counterpart exists. The user decides to provide one in the form of a function template, and to assign this template to a schema called NOVA. The

user uses the following code to register the template with the federated server; for the user's code for the mapping, refer to "Examples" on page 660.

```
CREATE FUNCTION NOVA.STATS (DOUBLE, DOUBLE)
     RETURNS DOUBLE
     AS TEMPLATE
```

Example 4: In a federated system, a user wants to invoke an Oracle UDF that returns the dollar amounts that employees of a particular organization earn as bonuses. The federated server can recognize this function only if there is a mapping between the function and a federated database counterpart. No such counterpart exists; thus, the user creates one in the form of a function template. The user uses the following code to register this template with the federated server; for the user's code for the mapping, refer to "Examples" on page 660.

```
CREATE FUNCTION BONUS ()
     RETURNS DECIMAL (8,2)
     AS TEMPLATE
```

CREATE FUNCTION (SQL Scalar, Table or Row)

This statement is used to define a user-defined SQL scalar, table or row function. A *scalar function* returns a single value each time it is invoked, and is generally valid wherever an SQL expression is valid. A *table function* may be used in a FROM clause and returns a table. A *row function* may be used as a transform function and returns a row.

Invocation

This statement can be embedded in an application program or issued through the use of dynamic SQL statements. It is an executable statement that can be dynamically prepared. However, if the bind option DYNAMICRULES BIND applies, the statement cannot be dynamically prepared (SQLSTATE 42509).

Authorization

The privileges held by the authorization ID of the statement must include at least one of the following:

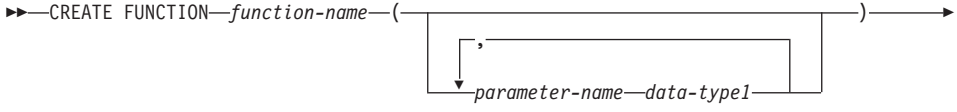
- SYSADM or DBADM authority
- IMPLICIT_SCHEMA authority on the database, if the schema name of the function does not refer to an existing schema
- CREATEIN privilege on the schema, if the schema name of the function refers to an existing schema.

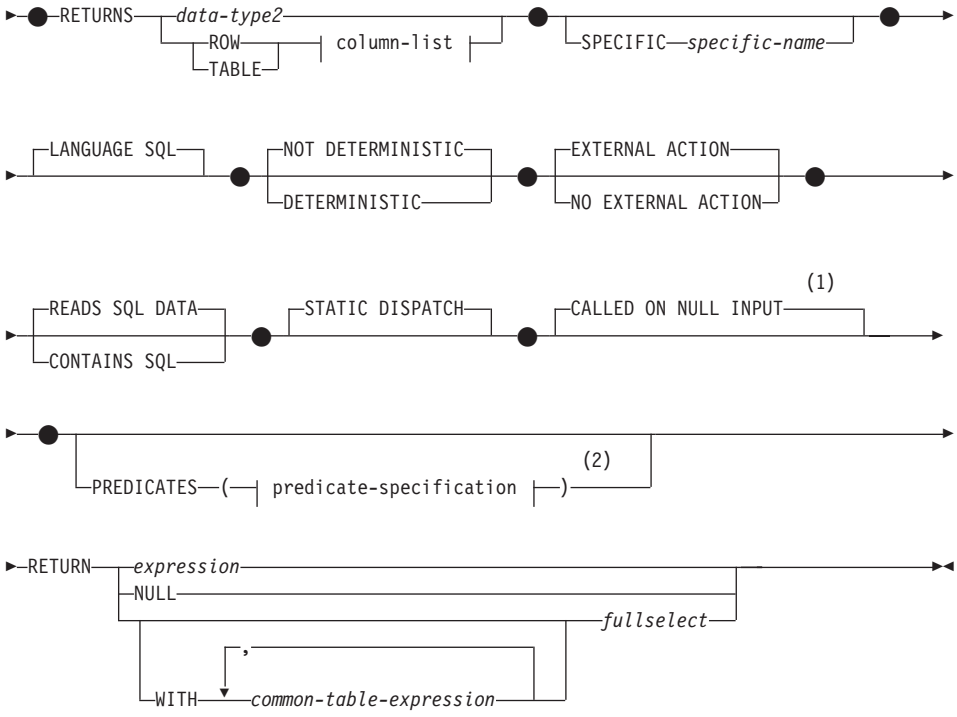
If the authorization ID of the statement does not have SYSADM or DBADM authority, and the function identifies a table or view, the privileges that the authorization ID of the statement holds (without considering GROUP privileges) must include SELECT WITH GRANT OPTION for each identified table and view.

If a function definer can only create the function because the definer has SYSADM authority, then the definer is granted implicit DBADM authority for the purpose of creating the function.

If the authorization ID has insufficient authority to perform the operation, an error (SQLSTATE 42502) is raised.

Syntax





column-list:

Notes:

1 NULL CALL may be specified in place of CALLED ON NULL INPUT

2 Valid only if RETURNS specifies a scalar result (data-type2)

Description

function-name

Names the function being defined. It is a qualified or unqualified name that designates a function. The unqualified form of *function-name* is an SQL identifier (with a maximum length of 18). In dynamic SQL statements, the CURRENT SCHEMA special register is used as a qualifier for an unqualified object name. In static SQL statements the QUALIFIER precompile/bind option implicitly specifies the qualifier for unqualified object names. The qualified form is a *schema-name* followed by a period and an SQL identifier.