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FairCom Typographical Conventions

Before you begin using this guide, be sure to review the relevant terms and typographical conventions used in the documentation.

The following formatted items identify special information.

<table>
<thead>
<tr>
<th>Formatting convention</th>
<th>Type of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bold</strong></td>
<td>Used to emphasize a point or for variable expressions such as parameters</td>
</tr>
<tr>
<td><strong>CAPITALS</strong></td>
<td>Names of keys on the keyboard. For example, SHIFT, CTRL, or ALT+F4</td>
</tr>
<tr>
<td><strong>FairCom Terminology</strong></td>
<td>FairCom technology term</td>
</tr>
<tr>
<td><strong>FunctionName()</strong></td>
<td>c-treeACE Function name</td>
</tr>
<tr>
<td><strong>Parameter</strong></td>
<td>c-treeACE Function Parameter</td>
</tr>
<tr>
<td><strong>Code Example</strong></td>
<td>Code example or Command line usage</td>
</tr>
<tr>
<td><strong>utility</strong></td>
<td>c-treeACE executable or utility</td>
</tr>
<tr>
<td><strong>filename</strong></td>
<td>c-treeACE file or path name</td>
</tr>
<tr>
<td><strong>CONFIGURATION KEYWORD</strong></td>
<td>c-treeACE Configuration Keyword</td>
</tr>
<tr>
<td><strong>CTREE_ERR</strong></td>
<td>c-treeACE Error Code</td>
</tr>
</tbody>
</table>
1. SQL Language Elements

This chapter describes language elements that are common to many c-treeACE SQL statements. Syntax diagrams in other chapters often refer to these language elements without detailed explanation. The major syntax elements described in the following sections are:

**Identifiers** - User-supplied names for elements such as tables, views, cursors, and columns. c-treeACE SQL statements use those names to refer to the elements.

**Data types** - Control how c-treeACE SQL stores column values.

**Query expressions** - Retrieve values from tables. Query expressions form the basis of other c-treeACE SQL statements and syntax elements.

**Search conditions** - Specify a condition that is true or false about a given row or group of rows. Query expressions and UPDATE statements specify search conditions to restrict the number of rows in the result table.

**Expressions** - A symbol or string of symbols used to represent or calculate a single value in a c-treeACE SQL statement. When c-treeACE SQL encounters an expression, it retrieves or calculates the value represented by the expression and uses that value when it executes the statement.

**Literals** - A type of c-treeACE SQL expression that specify a constant value. Some SQL constructs allow literals but prohibit other forms of expressions.

**Date-time format strings** - Control the output of date and time values. c-treeACE SQL interprets format strings and replaces them with formatted values.

**Functions** - A type of c-treeACE SQL expression that returns a value based on the argument supplied. Aggregate functions calculate a single value for a collection of rows in a result table. Scalar functions calculate a value based on another single value.

1.1 c-treeACE SQL Identifiers

SQL syntax requires users to supply names for elements such as tables, views, cursors, and columns when they define them. SQL statements then use those names to refer to the table, view, or other element. In syntax diagrams, c-treeACE SQL identifiers are shown in lowercase type.

The maximum length for c-treeACE SQL identifiers is 64 characters.

There are two types of c-treeACE SQL identifiers:

- Conventional identifiers
- Delimited identifiers enclosed in double quotation marks
Conventional Identifiers

Unless they are delimited identifiers (refer to Delimited Identifiers (page 10)), c-treeACE SQL identifiers must:

- Begin with an uppercase or lowercase letter
- Contain only letters, digits, or the underscore character (_)
- Not be reserved words

Except for delimited identifiers, c-treeACE SQL does not distinguish between uppercase and lowercase letters in identifiers. By default all names are converted to lowercase, however, statements can refer to the names in mixed case. The following examples show some of the characteristics of conventional identifiers:

```
-- Names are case-insensitive:
CREATE TABLE TeSt (CoLuMn1 CHAR);
INSERT INTO TEST (COLUMN1) VALUES('1');
1 record inserted.
SELECT * FROM TEST;
COL
---
1
1 record selected
```

```
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1.2 Data Types

The SQL statements *CREATE TABLE* and *ALTER TABLE* specify data types for each column in the tables they define. This section describes the data types c-treeACE SQL supports for table columns.

There are several categories of c-treeACE SQL data types:

- Character
- Exact numeric
- Approximate numeric
- Date-time
- Bit String

All of the data types can store null values. A null value indicates that the value is not known and is distinct from all non-null values.

**Syntax**

```
data_type ::
    char_data_type
    | exact_numeric_data_type
    | approx_numeric_data_type
    | date_time_data_type
    | bit_string_data_type
```

**Character Data Types**

Refer to *Character String Literals* (page 28) for details on specifying values to be stored in character columns.

**Syntax**

```
char_data_type ::
    { CHARACTER | CHAR } [(length)]
    | { CHARACTER VARYING | CHAR VARYING | VARCHAR } [(length)]
    | [ CHARACTER SET charset-name ]
    | LVARCHAR | LONG VARCHAR
```

**Arguments**

- `{ CHARACTER | CHAR } [(length)] [ CHARACTER SET charset-name ]`
  Type `CHARACTER` (abbreviated as `CHAR`) corresponds to a null terminated character string with the maximum length specified. The default length is 1. The maximum length is 8192.

- `LVARCHAR | LONG VARCHAR`
  Type `LONG VARCHAR` corresponds to an arbitrarily long character string with a maximum length of two gigabytes (2 Gb). The LVARCHAR data type is recommended for CLOB support. The arbitrary size and unstructured nature of LONG data types restrict where they can be used.
LONG columns are allowed in select lists of query expressions and in INSERT and UPDATE statements.

- INSERT statements can store data from columns of any type except LONG VARBINARY into a LONG VARCHAR column, however, LONG VARCHAR data cannot be stored in any other type.
- CONTAINS predicates are the only predicates that allow LONG columns.
- Conditional expressions, arithmetic expressions, and functions cannot specify LONG columns.
- UPDATE statements cannot specify LONG columns.

- \{ CHARACTER VARYING | CHAR VARYING | VARCHAR \}[\(\text{(length)}\)]
  Type CHARACTER VARYING corresponds to a variable-length character string with the maximum length specified.
  - The default length for columns defined as CHARACTER VARYING is 1. The maximum length is 8192.

**Exact Numeric Data Types**

Refer to *Numeric Literals* (page 27) for details on specifying values to be stored in numeric columns.

**Syntax**

\[
\text{exact\_numeric\_data\_type} ::=
\]

- TINYINT
- SMALLINT
- INTEGER
- BIGINT
- NUMERIC | NUMBER [\(\ (\text{precision} [\ , \text{scale}] \)\)]
- DECIMAL [(precision, scale)]
- MONEY [(precision)]
- [IDENTITY [\(\ (\pm \text{seed} , \pm \text{increment}) \)\]]

**Arguments**

- **TINYINT**
  - Type TINYINT corresponds to an integer value stored in one byte. The range of TINYINT is -128 to 127.

- **SMALLINT**
  - Type SMALLINT corresponds to an integer value of length two bytes. The range of SMALLINT is -32768 to +32767.

- **INTEGER**
  - Type INTEGER corresponds to an integer of length four bytes. The range of values for INTEGER columns is \(-2^{31}\ \text{to} \ 2^{31}-1\).

- **BIGINT**
  - Type BIGINT corresponds to an integer of length eight bytes. The range of values for BIGINT columns is \(-2^{63}\ \text{to} \ 2^{63}-1\).

  - [IDENTITY [\(\ (\pm \text{seed} , \pm \text{increment}) \)\]]
For TINYINT, SMALLINT, INTEGER and BIGINT column types, an optional auto-incrementing attribute can be defined with the IDENTITY option. This adds the column of the defined type to the table and automatically updates the value on each row insert. IDENTITY does not guarantee uniqueness of assigned values. IDENTITY can optionally specify seed and increment values. seed is the starting assignment value and is incremented by increment for each update.

CREATE TABLE t1 (name CHAR(10), id_num INTEGER IDENTITY (0, 1));

Only one IDENTIFY column can be defined per table. IDENTIFY columns cannot be specified on tables with only one column.

IDENTITY values assigned to aborted rows in a table are lost. Note that this can result in gaps in the numerical sequence order.

IDENTITY is not supported for NUMERIC, NUMBER, DECIMAL or MONEY column types. IDENTIFY can not be added to an existing field via ALTER TABLE.

- **NUMERIC | NUMBER [ ( precision [ , scale ] ) ]**

Type NUMERIC corresponds to a number with the given precision (maximum number of digits) and scale (the number of digits to the right of the decimal point). By default, NUMERIC columns have a precision of 32 and scale of 0. If NUMERIC columns omit the scale, the default scale is 0.

The range of values for a NUMERIC type column is -n to +n where n is the largest number that can be represented with the specified precision and scale. If a value exceeds the precision of a NUMERIC column, c-treeACE SQL generates an overflow error. If a value exceeds the scale of a NUMERIC column, c-treeACE SQL rounds the value.

NUMERIC type columns cannot specify a negative scale or specify a scale larger than the precision.

The following example shows what values will fit in a column created with a precision of 3 and scale of 2:

```sql
insert into t4 values(33.33);
error(-20052): Overflow error
insert into t4 values(33.9);
error(-20052): Overflow error
insert into t4 values(3.3);
1 record inserted.
insert into t4 values(33);
error(-20052): Overflow error
insert into t4 values(3.33);
1 record inserted.
insert into t4 values(3.33333);
1 record inserted.
insert into t4 values(3.3555);
1 record inserted.
select * from t4;
C1
--
3.30
3.33
3.33
3.36
4 records selected
```

- **DECIMAL [(precision, scale)]**

Type DECIMAL is comparable to type NUMERIC.
- `MONEY [(precision)]`
  Type `MONEY` is equivalent to type `NUMERIC` with a fixed scale of 2.

**Approximate Numeric Data Types**

Refer to *Numeric Literals* (page 27) for details on specifying values to be stored in numeric columns.

**Syntax**

```plaintext
approx_numeric_data_type ::
  REAL
  |  DOUBLE [ PRECISION ]
  |  FLOAT [ (precision) ]
```

**Arguments**

- **REAL**
  Type `REAL` corresponds to a single precision floating point number equivalent to the C language `float` type.

- **DOUBLE PRECISION**
  Type `DOUBLE PRECISION` corresponds to a double precision floating point number equivalent to the C language `double` type.
  In V11 and later, `DOUBLE` can be used as an alias for `DOUBLE PRECISION`.

- **FLOAT [ (precision) ]**
  Type `FLOAT` corresponds to a double-precision floating point number of the given precision.
  By default, `FLOAT` columns have a precision of 8.

**Date-Time Data Types**

Refer to *Numeric Literals* (page 27) for details on specifying values to be stored in date-time columns. See *Date Format Strings* (page 42) for details on date strings and *Time Format Strings* (page 43) for details on using format strings to specify the output format of date-time columns.

**Syntax**

```plaintext
date_time_data_type ::
  DATE
  |  TIME
  |  TIMESTAMP
```

**Arguments**

- **DATE**
  Type `DATE` stores a date value as three parts: year, month, and day. The range for the parts is:
    - Year: 1700 to 9999 (in the specific case of 1700 the actual minimum date is 03/01/1700 -- 1 March 1700)
    - Month: 1 to 12
• Day: Lower limit is 1. The upper limit is determined by the upper limit of the month.

The c-tree date field stores date as an unsigned 4 bytes integer value representing the number of days since 02/28/1700. Hence the first valid date is 03/01/1700.

A check is done to limit the date range lower bound to 03/01/1700 in case of a c-tree Plus date type and 01/01/1900 for the c-treeACE SQL TIMESTAMP type.

• TIME
Type TIME stores a time value as three parts: hours, minutes, and seconds. The range for the parts is:
  • Hours: 0 to 23
  • Minutes: 0 to 59
  • Seconds: 0 to 59

• TIMESTAMP
Type TIMESTAMP combines the parts of DATE and TIME.
  • Year: 1900 to 9999
  • Month: 1 to 12
  • Day: Lower limit is 1. The upper limit is determined by the upper limit of the month.
  • Hours: 0 to 23
  • Minutes: 0 to 59
  • Seconds: 0 to 59

Bit String Data Types

Syntax
bit_string_data_type ::=
  BIT
  | BINARY [(length)]
  | VARBINARY [(length)]
  | LVARBINARY | LONG VARBINARY

Arguments

• BIT
  Type BIT corresponds to a single bit value of 0 or 1.
  c-treeSQL statements can assign and compare values in BIT columns to and from columns of types BINARY, VARBINARY, TINYINT, SMALLINT, INTEGER, and Character types. However, in assignments from BINARY, VARBINARY, and LONG VARBINARY, the value of the first four bits must be 0001 or 0000.
  No arithmetic operations are allowed on BIT columns.

• BINARY [(length)]
  Type BINARY corresponds to a bit field of the specified length of bytes. The default length is 1 byte. The maximum length is 8192 bytes.
  In interactive SQL, INSERT statements must use a special format to store values in BINARY columns. They can specify the binary values as a bit string, hexadecimal string, or character string. INSERT statements must enclose binary values in single-quote marks, preceded by b for a bit string and x for a hexadecimal string:
### SQL Language Elements

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Suffix</th>
<th>Example (for same 2 byte data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit string</td>
<td><code>b'</code></td>
<td><code>b'1010110100010000'</code></td>
</tr>
<tr>
<td>hex string</td>
<td><code>x'</code></td>
<td><code>x'ad10'</code></td>
</tr>
<tr>
<td>char string</td>
<td><code>'</code></td>
<td><code>'ad10'</code></td>
</tr>
</tbody>
</table>

c-treeACE SQL interprets a character string as the character representation of a hexadecimal string.

If the data inserted into a BINARY column is less than the length specified, c-treeACE SQL pads it with zeroes.

BINARY data can be assigned and compared to and from columns of type BIT, VARBINARY, and Character types. No arithmetic operations are allowed.

- **VARBINARY [(length)]**
  Type VARBINARY corresponds to a variable-length bit field with the maximum length specified. The default length is one and the maximum length is 8192. Otherwise, VARBINARY columns have the same characteristics as BINARY.

- **LVARBINARY | LONG VARBINARY**
  Type LONG VARBINARY corresponds to an arbitrarily long bit field with the maximum length of less than two gigabytes. The LVARBINARY data type is recommended for BLOB support.
  The arbitrary size and unstructured nature of LONG data types restrict where they can be used.
  - LONG columns are allowed in select lists of query expressions and in INSERT statements.
  - INSERT statements can store data from columns of any type except LONG VARCHAR into a LONG VARBINARY column, but LONG VARBINARY data cannot be stored in any other type.
  - CONTAINS predicates are the only predicates that allow LONG columns.
  - Conditional expressions, arithmetic expressions, and functions cannot specify LONG columns.
  - UPDATE statements cannot specify LONG columns.

### 1.3 Search Conditions

**Description**

A search condition specifies a condition that is true or false about a given row or group of rows. Query expressions and UPDATE statements can specify a search condition. The search condition restricts the number of rows in the result table for the query expression or UPDATE statement.

Search conditions contain one or more predicates. The predicates that can be part of a search condition are described in the following subsections.

**Syntax**

```
search_condition ::=
    [NOT] predicate
    [ { AND | OR } { predicate | ( search_condition ) } ]
```
Logical Operators: OR, AND, NOT

Logical operators combine multiple search conditions. c-treeACE SQL evaluates multiple search conditions in this order:

1. Search conditions enclosed in parentheses. (For nested search conditions in parentheses, c-treeACE SQL evaluates the innermost search condition first.)
2. Search conditions preceded by NOT
3. Search conditions combined by AND
4. Search conditions combined by OR

Examples

```sql
SELECT * 
FROM customer 
WHERE name = 'LEVIEN' OR name = 'SMITH';
SELECT * 
FROM customer 
WHERE city = 'PRINCETON' AND state = 'NJ';
SELECT * 
FROM customer 
WHERE NOT (name = 'LEVIEN' OR name = 'SMITH');
```

Relational Operators

Relational operators specify how c-treeACE SQL compares expressions in basic and quantified predicates.

Syntax

```sql
relop ::=
    = | <> | != | ^= |
    < |
    <= |
    > |
    >= |
```

<table>
<thead>
<tr>
<th>Relational Operator</th>
<th>Predicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>True if the two expressions are equal.</td>
</tr>
<tr>
<td>&lt;&gt;</td>
<td>!=</td>
</tr>
</tbody>
</table>
### Relational Operator

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;</code></td>
<td>True if the first expression is less than the second expression.</td>
</tr>
<tr>
<td><code>&lt;=</code></td>
<td>True if the first expression is less than or equal to the second expression.</td>
</tr>
<tr>
<td><code>&gt;</code></td>
<td>True if the first expression is greater than the second expression.</td>
</tr>
<tr>
<td><code>&gt;=</code></td>
<td>True if the first expression is greater than or equal to the second expression.</td>
</tr>
</tbody>
</table>

Refer to *Basic Predicate* (page 18) and *Quantified Predicate* (page 18) for more information.

### Basic Predicate

**Description**

A basic predicate compares two values using a relational operator (see *Relational Operators* (page 17) for more detail). If a basic predicate specifies a query expression, then the query expression must return a single value. Basic predicates often specify an inner join. See *Inner Joins* (page 38) for more detail.

If the value of any expression is null or the *query_expression* does not return any value, then the result of the predicate is set to false.

**Syntax**

```
basic_predicate ::
    expr relop { expr | (query_expression) }
```

### Quantified Predicate

**Description**

The quantified predicate compares a value with a collection of values using a relational operator (see *Relational Operators* (page 17) for more detail). A quantified predicate has the same form as a basic predicate with the *query_expression* being preceded by `ALL`, `ANY` or `SOME` keyword. The result table returned by *query_expression* can contain only a single column.

When `ALL` is specified the predicate evaluates to true if the *query_expression* returns no values or the specified relationship is true for all the values returned.

When `SOME` or `ANY` is specified the predicate evaluates to true if the specified relationship is true for at least one value returned by the *query_expression*. There is no difference between the `SOME` and `ANY` keywords. The predicate evaluates to false if the *query_expression* returns no values or the specified relationship is false for all the values returned.

**Syntax**

```
quantified_predicate ::
    expr relop { ALL | ANY | SOME } (query_expression)
```

**Example**

```
10 < ANY ( SELECT COUNT(*)
```
FROM order_tbl
GROUP BY custid

BETWEEN Predicate

Description
The BETWEEN predicate can be used to determine if a value is within a specified value range or not. The first expression specifies the lower bound of the range and the second expression specifies the upper bound of the range.

The predicate evaluates to true if the value is greater than or equal to the lower bound of the range, or less than or equal to the upper bound of the range.

Syntax
between_predicate ::= 
.expr [ NOT ] BETWEEN expr AND expr

Example
salary BETWEEN 2000.00 AND 10000.00

NULL Predicate

Description
The NULL predicate can be used for testing null values of database table columns.

Syntax
null_predicate ::= 
column_name IS [ NOT ] NULL

Example
contact_name IS NOT NULL

LIKE Predicate

Description
The LIKE predicate searches for strings that have a certain pattern. The pattern is specified after the LIKE keyword in a scalar expression which can be as simple as a string constant or a complex expression containing concatenation operators, scalar functions, etc. The pattern can be specified by a string in which the underscore ( _ ) and percent sign ( % ) characters have special semantics.

The ESCAPE clause can be used to disable the special semantics given to characters ‘_’ and ‘%’. The escape character specified must precede the special characters to disable their special semantics.

Syntax
like_predicate ::= 
column_name [ NOT ] LIKE expr
[ ESCAPE escape-character ]
Notes
- The column name specified in the `LIKE` predicate must refer to a character string column.
- A percent sign in the pattern matches zero or more characters of the column string.
- A underscore sign in the pattern matches any single character of the column string.

Examples

cust_name LIKE '%Computer%'
cust_name LIKE '___'
item_name LIKE '%\_%' ESCAPE '\'
item_name LIKE left(part_name, 5) + '%'

In the first example, for all strings with the substring Computer, the predicate will evaluate to true. In the second example, for all strings which are exactly three characters long, the predicate will evaluate to true. In the third example, the backslash character ‘\’ has been specified as the escape character, which means that the special interpretation given to the character ‘_’ is disabled. The pattern will evaluate to TRUE if the column `item_name` has embedded underscore characters.

In the fourth example, the `LIKE` predicate evaluates to true if the first 5 characters of `item_name` match the first 5 characters of `part_name`.

CONTAINS Predicate

Description
The c-treeACE SQL `CONTAINS` predicate is an extension to the SQL standard providing search capabilities for LONG character and binary data.

Syntax

column_name [ NOT ] CONTAINS 'string'

Limitations
- `column_name` must be one of the following data types: Fixed or varying-length character type, LONG VARCHAR, BINARY, VARBINARY, or LONG VARBINARY.
- Unlike the `LIKE` clause, the wildcard characters ‘%’ and ‘_’ are not allowed with `CONTAINS`.
- `CONTAINS` does not take advantage of indices to perform the search.

EXISTS Predicate

Description
The EXISTS predicate can be used to check for the existence of specific rows. The `query_expression` returns rows rather than values. The predicate evaluates to true if the number of rows returned by the `query_expression` is non zero.
**Syntax**

exists_predicate ::
  EXISTS ( query_expression )

**Example**

EXISTS (SELECT * FROM order_tbl
  WHERE order_tbl.custid = :custid)

In this example, the predicate will evaluate to true if the specified customer has any orders.

**IN Predicate**

**Description**

The IN predicate can be used to compare a value with a set of values. If an IN predicate specifies a query expression, then the result table it returns can contain only a single column.

**Syntax**

in_predicate ::
  expr [ NOT ] IN { ( query_expression ) | ( constant , constant [ , ... ] ) }

**Example**

address.state IN ('MA', 'NH')

**Outer Join Predicate**

**Description**

An outer join predicate specifies two tables and returns a result table that contains all of the rows from one of the tables, even if there is no matching row in the other table. See *Outer Joins* (page 40) for more information.

**Syntax**

outer_join_predicate ::
  [ table_name. ] column = [ table_name. ] column (+)
  | [ table_name. ] column (+) = [ table_name. ] column

**1.4 Expressions**

**Description**

An expression is a symbol or string of symbols used to represent or calculate a single value in a c-treeACE SQL statement. When you specify an expression in a statement, c-treeACE SQL retrieves or calculates the value represented by the expression and uses that value when it executes the statement.

Expressions are also called scalar expressions or value expressions.

**Syntax**

expr ::
SQL Language Elements

[ { table_name | alias } . ] column-name

| character-literal |
| numeric-literal |
| date-time-literal |
| aggregate-function |
| scalar-function |
| concatenated-char-exp | 
| numeric-arith-exp |
| date-arith-exp |
| conditional-exp |
| scalar-subquery-exp |
| ( expr ) |

Arguments

[ { table_name | alias } . ] column-name

A column in a table.

You can qualify column names with the name of the table they belong to:

```
SELECT CUSTOMER.CUSTOMER_ID FROM CUSTOMERS
```

You must qualify a column name if it occurs in more than one table specified in the `FROM` clause:

```
SELECT CUSTOMER.CUSTOMER_ID
       FROM CUSTOMERS, ORDERS
```

Qualified column names are always allowed even when they are not required.

You can also qualify column names with an alias. Aliases are also called correlation names.

The `FROM` clause of a query expression can specify an optional alias after the table name (see `Query Expressions` (page 31) for more details). If you specify an alias, you must use it -not the table name - to qualify column names that refer to the table. Query expressions that join a table with itself must use aliases to distinguish between references to column names.

The following example shows a query expression that joins the table customer with itself. It uses the aliases x and y and returns information on customers in the same city as customer ‘SMITH’:

```
SELECT y.cust_no, y.name
       FROM customer x, customer y
      WHERE x.name = 'SMITH'
          AND y.city = x.city;
```

classical-literal | numeric-literal | date-time-literal

Literals that specify a constant value. See `Literals` (page 27) and subsequent pages for more details on all types of literals.

aggregate-function | scalar function

A c-treeACE SQL function. See `Functions` (page 44) for details.

concatenated-char-exp

An expression that concatenates multiple character expressions into a single character string. See `Concatenated Character Expressions` (page 23) for more details.

numeric-arith-exp
An expression that computes a value from numeric values. See *Numeric Arithmetic Expressions* (page 24) for more details.

**date-arith-expr**

An expression that computes a value from date-time values. See *Date Arithmetic Expressions* (page 25) for more details.

**conditional-expr**

An expression that evaluates a search condition or expression and returns one of multiple possible results depending on that evaluation. See *Conditional Expressions* (page 26) for more details.

**scalar-subquery-expr**

An expression which is a scalar sub-query. A scalar sub-query returns only one value. See *Scalar Sub-query Expressions* (page 26) for more details.

**( expr )**

An expression enclosed in parentheses. c-treeACE SQL evaluates expressions in parentheses first.

### Concatenated Character Expressions

**Description**

The || concatenation operator (two vertical bars) || or + (plus) concatenates the two character expressions it separates.

The concatenation operator is similar to the CONCAT scalar function. However, the concatenation operator allows easy concatenation of more than two character expressions, while the CONCAT scalar function requires nesting.

**Syntax**

concatenated-char-expr ::= {character-literal | character-expr} { || | + } { character-literal | character-expr} [ {character-literal | character-expr} { || | + } { character-literal | character-expr} ] [ … ]

**Arguments**

**character-literal**

A character literal. Refer to *Character String Literals* (page 28) for details on specifying character literals.

**character-expr**

Any expression that evaluates to a character string (refer to *Data Types* (page 11) for details of character data types), including column names and scalar functions that return a character string.

**Examples**

```sql
ISQL> SELECT 'Today''s date is ' || TO_CHAR(SYSDATE) FROM SYSCALCTABLE;
TODAY'S DATE IS 08/17/1998
--------------------------
```

---

All Rights Reserved 23 www.faircom.com
Today's date is 08/17/1998
1 record selected

ISQL> SELECT 'Today''s date is ' + TO_CHAR(SYSDATE) FROM SYSCALCTABLE;
TODAY'S DATE IS 08/17/1998
--------------------------
Today's date is 08/17/1998
1 record selected

Numeric Arithmetic Expressions

Description
Numeric arithmetic expressions compute a value using addition, subtraction, multiplication, and division operations on numeric literals and expressions that evaluate to any numeric data type.

Syntax
numeric-arith-expr ::

[ [ + | - ] [ numeric-literal | numeric-expr ] [ [ { + | - | * | / } numeric-arith-expr ]

Arguments
[ [ + | - ]
Unary plus or minus operator
numeric-literal
A numeric literal. Refer to Numeric Literals (page 27) for details on specifying numeric literals.
numeric-expr
Any expression that evaluates to a numeric data type (Refer to Data Types (page 11) for details of numeric data types), including:

- Column names
- Subqueries that return a single value
- Aggregate functions
- CAST or CONVERT operations to numeric data types
- Other scalar functions that return a numeric data type

{ [ + | - | * | / ]
Addition, subtraction, multiplication, or subtraction operator. c-treeACE SQL evaluates numeric arithmetic expressions in the following order:

- Unary plus or minus
- Expressions in parentheses
- Multiplication and division, from left to right
- Addition and subtraction, from left to right
Date Arithmetic Expressions

Description
Date arithmetic expressions compute the difference between date-time expressions in terms of days or milliseconds. c-treeACE SQL supports these forms of date arithmetic:

- Addition and subtraction of integers to and from date-time expressions
- Subtraction of a date-time expression from another

Syntax

date_arith_expr ::
   date_time_expr { + | - } int_expr
|    date_time_expr - date_time_expr

Arguments
date_time_expr
An expression that returns a value of type DATE or TIME or TIMESTAMP. A single date-time expression can not mix data types. All elements of the expression must be the same data type.

Date-time expressions can contain date-time literals, but they must be converted to DATE or TIME using the CAST, CONVERT, or TO_DATE functions (see the following examples as well as CAST function (SQL-92 compatible) (page 57) and CONVERT function (extension) (page 67)).

int_expr
An expression that returns an integer value. c-treeACE SQL interprets the integer differently depending on the data type of the date-time expression:

- For DATE expressions, integers represent days
- For TIME expressions, integers represent milliseconds
- For TIMESTAMP expressions, integers represent milliseconds

Examples
The following example manipulates DATE values using date arithmetic. c-treeACE SQL interprets integers as days and returns date differences in units of days:

```sql
SELECT C1, C2, C1-C2 FROM DTEST
C1          C2          C1-C2
1956-05-07  1952-09-29  1316
```

```sql
SELECT sysdate,
       sysdate - 3,
       sysdate - cast ('9/29/52' as date)
FROM dtest;
```

1995-03-24  1995-03-21  15516

The following example manipulates TIME values using date arithmetic. c-treeACE SQL interprets integers as milliseconds and returns time differences in milliseconds:

```sql
SELECT systime,
       systime - 3000,
       systime - cast ('15:28:01' as time)
FROM dtest;
```
Conditional Expressions

Conditional expressions are a subset of scalar functions that generate different results depending on the value of their arguments. They provide some of the flexibility of traditional programming constructs to allow expressions to return alternate results depending on the value of their arguments.

The following scalar functions provide support for conditional expressions. Refer to *Scalar Functions* (page 49) for a description of each function.

**CASE**

CASE is the most general conditional expression. It specifies a series of search conditions and associated expressions. c-treeACE SQL returns the value specified by the first expression whose associated search condition evaluates as true. If none of the expressions evaluate as true, the CASE expression returns a null value (or the value of some other default expression if the CASE expression includes the ELSE clause).

All the other conditional expressions can also be expressed as CASE expressions.

**DECODE**

DECODE provides a subset of the functionality of CASE that is compatible with Oracle SQL syntax. DECODE is not SQL-92 compatible.

**NULLIF**

NULLIF substitutes a null value for an expression if it is equal to a second expression.

**COALESCE**

COALESCE specifies a series of expressions. c-treeACE SQL returns the first expression whose value is not null. If all the expressions evaluate as null, COALESCE returns a null value.

**IFNULL**

IFNULL substitutes a specified value if an expression evaluates as null. If the expression is not null, IFNULL returns the value of the expression.

Scalar Sub-query Expressions

**Description**

A scalar sub-query expression, denoted by grammar symbol `scalar_subquery_expr`, is a query_expression that returns only one value, that is, a value for one row and one column. See Query Expressions (page 31) for more information on query_expression.

Scalar sub-query expressions can be specified in select lists, search conditions and arguments of scalar functions.

**Examples**

- Scalar sub-query in a select list
SELECT e.ename, (SELECT d.dname
FROM dept d
WHERE d.deptno = e.deptno)
FROM emp e;

- Scalar sub-query in a search condition

SELECT ename
FROM emp
WHERE (SELECT MAX(deptno)
FROM dept) = deptno;

- Scalar sub-query as an argument to a scalar function.

SELECT e.ename, LEN ((SELECT d.dname
from dept d
WHERE d.deptno = e.deptno))
FROM emp e;

1.5 Literals

Literals are a type of expression that specify a constant value (they are also called constants). You can specify literals wherever c-treeACE SQL syntax allows expressions. Some c-treeACE SQL constructs allow literals but prohibit other forms of expressions.

There are three types of literals:

- Numeric
- Character string
- Date-time

The following sections discuss each type of literal.

**Numeric Literals**

A numeric literal is a string of digits that c-treeACE SQL interprets as a decimal number. c-treeACE SQL allows the string to be in a variety of formats, including scientific notation.

**Syntax**

```
[+-]?([0-9][0-9]...)[.[0-9][0-9]...][E|e][+-]?[0-9][0-9]
```

**Examples**
The following are all valid numeric strings:

123
123.456
-123.456
12.34E-04
Character String Literals

A character string literal is a string of characters enclosed in single quotation marks (').

To include a single quotation mark in a character-string literal, precede it with an additional single quotation mark. The following c-treeACE SQL examples demonstrate embedding quotation marks in character-string literals:

```sql
insert into quote values('unquoted literal');
insert into quote values('''single-quoted literal''');
insert into quote values("double-quoted literal");
insert into quote values('O''Hare');
select * from quote;
c1
unquoted literal
'single-quoted literal'
"double-quoted literal"
O'Hare
```

To insert a character-string literal that spans multiple lines, enclose each line in single quotation marks. The following c-treeACE SQL examples shows this syntax, as well as embedding quotation marks in one of the lines:

```sql
insert into quote2 values ('Here''s a very long character string ' 'literal that will not fit on a single line.');
1 record inserted.
select * from quote2;
c1
--
Here's a very long character string literal that will not fit on a single line.
```

Date-Time Literals

SQL supports special formats for literals to be used in conjunction with date-time data types. Basic predicates and the VALUES clause of INSERT statements can specify date literals directly for comparison and insertion into tables. In other cases, you need to convert date literals to the appropriate date-time data type with the CAST, CONVERT, or TO_DATE scalar functions.

Enclose date-time literals in single quotation marks.

Date Literals

Date literals specify a day, month, and year. By default, c-treeACE SQL supports any of the following formats, enclosed in single quotation marks (').

**Syntax**

```
date-literal ::
   {d 'yyyy-mm-dd'}
   | mm-dd-yyyy
   | mm/dd/yyyy
   | yyyy-mm-dd
   | yyyy/mm/dd
   | dd-mon-yyyy
   | dd-mon/yyyy
```
Arguments

{d 'yyyy-mm-dd'}

A date literal enclosed in an escape clause compatible with ODBC. Precede the literal string with an open brace ({}) and a lowercase d. End the literal with a close brace. For example:

```sql
INSERT INTO DTEST VALUES ({d '1994-05-07'})
```

If you use the ODBC escape clause, you must specify the date using the format `yyyy-mm-dd`.

**dd**
The day of month as a 1- or 2-digit number (in the range 01-31).

**mm**
The month value as a 1- or 2-digit number (in the range 01-12).

**mon**
The first three characters of the name of the month (in the range 'JAN' to 'DEC').

**yyyy**
The year as four-digit number. By default, c-treeACE SQL generates an Invalid date string error if the year is specified as anything other than digits.

Examples

The following c-treeACE SQL examples demonstrate some supported formats for date literals:

```sql
CREATE TABLE T2 (C1 DATE, C2 TIME);
INSERT INTO T2 (C1) VALUES('5/7/56');
INSERT INTO T2 (C1) VALUES('7/MAY/1956');
INSERT INTO T2 (C1) VALUES('1956/05/07');
INSERT INTO T2 (C1) VALUES({d '1956-05-07'});
INSERT INTO T2 (C1) VALUES('29-SEP-1952');
SELECT C1 FROM T2;
```

<table>
<thead>
<tr>
<th>c1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956-05-07</td>
</tr>
<tr>
<td>1956-05-07</td>
</tr>
<tr>
<td>1956-05-07</td>
</tr>
<tr>
<td>1956-05-07</td>
</tr>
<tr>
<td>1952-09-29</td>
</tr>
</tbody>
</table>

Time Literals

Time literals specify an hour, minute, second, and millisecond, using the following format, enclosed in single quotation marks ('):

Syntax

```sql
time-literal ::
    {t 'hh:mi:ss'}
    | hh:mi:ss
```

Arguments

{t 'hh:mi:ss'}
A time literal enclosed in an escape clause compatible with ODBC. Precede the literal string with an open brace ( { ) and a lowercase t. End the literal with a close brace. For example:

```
INSERT INTO TTEST VALUES ({t '23:22:12'})
```

If you use the ODBC escape clause, you must specify the time using the format **hh:mi:ss**.

- **hh**
  - The hour value as a 1- or 2-digit number (in the range 00 to 23).
- **mi**
  - The minute value as a 1- or 2-digit number (in the range 00 to 59).
- **ss**
  - The seconds value as a 1- or 2-digit number (in the range 00 to 59).

**Examples**

The following c-treeACE SQL examples show some of the formats c-treeACE SQL will and will not accept for time literals:

```
INSERT INTO T2 (C2) VALUES('3');
error(-20234): Invalid time string

INSERT INTO T2 (C2) VALUES('8:30');
error(-20234): Invalid time string

INSERT INTO T2 (C2) VALUES('8:30:1');
INSERT INTO T2 (C2) VALUES('8:30:');
error(-20234): Invalid time string

INSERT INTO T2 (C2) VALUES('8:30:00');
INSERT INTO T2 (C2) VALUES('8:30:01');
INSERT INTO T2 (C2) VALUES({t'8:30:01'});
SELECT C2 FROM T2;
c2
08:30:01
08:30:00
08:30:01
08:30:01
```

**Timestamp Literals**

Timestamp literals specify a date and a time separated by a space, enclosed in single quotation marks ('):

**Syntax**

```
{ts 'yyyy-mm-dd hh:mi:ss'}
```

```latex
| date-literal time-literal |
```

**Arguments**

- **{ts 'yyyy-mm-dd hh:mi:ss'}**

A timestamp literal enclosed in an escape clause compatible with ODBC. Precede the literal string with an open brace ( { ) and a lowercase ts. End the literal with a close brace. For example:

```
INSERT INTO DTST VALUES ((ts '1956-05-07 10:41:37'))
```
If you use the ODBC escape clause, you must specify the timestamp using the format *yyyy-mm-dd hh:mm:ss*.

**date-literal**
A date literal.

**time-literal**
A time literal.

**Example**
```
SELECT * FROM DTEST WHERE C1 = {ts '1956-05-07 10:41:37'}
```

## 1.6 Query Expressions

**Description**
A query expression selects the specified column values from one or more rows contained in one or more tables specified in the **FROM** clause. The selection of rows is restricted by a search condition in the **WHERE** clause. The temporary table derived through the clauses of a **SELECT** statement is called a *result table*.

Query expressions form the basis of other SQL statements and syntax elements:

- SELECT statements are query expressions with optional **ORDER BY** and **FOR UPDATE** clauses.
- CREATE VIEW statements specify their result table as a query expression.
- INSERT statements can specify a query expression to add the rows of the result table to a table.
- UPDATE statements can specify a query expression that returns a single row to modify columns of a row.
- Some search conditions can specify query expressions. Basic predicates can specify query expressions, however, the result table can contain only a single value. Quantified and IN predicates can specify query expressions, however, the result table can contain only a single column.
- The **FROM** clause of a query expression can itself specify a query expression, called a derived table.

**Syntax**
```
query_expression ::
   WITH [ RECURSIVE ] with_list
   | query_specification
   | query_expression set_operator query_expression
   | ( query_expression )

set_operator ::
   { UNION [ ALL ] | INTERSECT | MINUS }

with_list ::
   with_list_element
   | with_list_element , with_list
```
with_list_element ::
    query_name  tmptbl_column_commalist AS ( query_expr )

query_name ::
    tblname

tmptbl_column_commalist ::
    ( [ , [table.]column_name ] )

query_specification ::
SELECT [ALL | DISTINCT] [SKIP N] [TOP N]
{ * |
  [ { table_name | alias } . * ] , [ { table_name | alias } . * ] ... |
  [ { { expr | NULL } [ AS ] [ ' ] column_title [ ' ] } ] |
  [ [ ' ] column_title [ ' ] - ] { expr | NULL } )

WHERE search_condition |
GROUP BY [table.]column_name |
[ , [table.]column_name ] ... |
HAVING search_condition |

FROM table_ref [ { ctree ORDERED } ] [ , table_ref [ { ctree ORDERED } ] ... |
joined_table ::
    table_ref CROSS JOIN table_ref |
    table_ref [ INNER | LEFT [ OUTER ] ] JOIN table_ref ON search_condition

Arguments

WITH [ RECURSIVE ] with_list

RECURSIVE specifies query_expr in with_list_element is a recursive query.

SELECT [ ALL | DISTINCT ]

DISTINCT specifies that the result table omits duplicate rows. ALL is the default, and specifies that the result table includes all rows.

SELECT [ SKIP N ]

SKIP skips the leading rows in result sets. N specifies the number of rows to be skipped.

SELECT [ TOP N ]
TOP limits the number of rows in result sets. \( N \) specifies the number of rows to be returned. When used in conjunction with SKIP, rows are first skipped, then the TOP \( N \) rows remaining are returned.

**SELECT \* | \{ table_name | alias \}.\***

Specifies that the result table includes all columns from all tables named in the FROM clause. For instance, the following examples both specify all the columns in the customers table:

```sql
SELECT * FROM customers;
SELECT customers.* FROM customers;
```

The `tablename.\*` syntax is useful when the select list refers to columns in multiple tables, and you want to specify all the columns in one of those tables:

```sql
SELECT CUSTOMERS.CUSTOMER_ID, CUSTOMERS.CUSTOMER_NAME, ORDERS.* FROM CUSTOMERS, ORDERS ...
```

**SELECT \{ \{ exp | NULL \} \[ AS \] \[ ' \] column_title \[ ' \] \} | \{ \[ \] column_title \[ ' \] = \} \{ exp | NULL \} \}**

Specifies a list of expressions, called a select list, whose results will form columns of the result table. Typically, the expression is a column name from a table named in the FROM clause. The expression can also be any supported mathematical expression, scalar function, aggregate function, or scalar sub-query that returns one value.

The example for an `expr` which is a scalar sub-query is as follows.

```sql
SELECT e.ename,
       ( SELECT d.dname FROM dept d WHERE d.deptno = e.deptno )
FROM emp e;
```

The optional `column_title` argument specifies a new heading for the associated column in the result table. Enclose the new title in single or double quotation marks if it contains spaces or other special characters:

```sql
SELECT order_value, order_value * .2 AS 'order "markup"' FROM orders;
```

<table>
<thead>
<tr>
<th>ORDER_VALUE</th>
<th>ORDER &quot;MARKUP&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000000.00</td>
<td>1000000.00</td>
</tr>
<tr>
<td>110000.00</td>
<td>22000.00</td>
</tr>
<tr>
<td>3300000.00</td>
<td>66000.00</td>
</tr>
</tbody>
</table>

You can qualify column names with the name of the table they belong to:

```sql
SELECT CUSTOMER.CUSTOMER_ID FROM CUSTOMERS
```

You must qualify a column name if it occurs in more than one table specified in the FROM clause:

```sql
SELECT CUSTOMERS.CUSTOMER_ID FROM CUSTOMERS, ORDERS
```

Qualified column names are always allowed even when they are not required.

**Note:** You should not use column_title elsewhere in the query such as WHERE, GROUP BY and HAVING clauses.

FROM table_ref ...
Specifies optional `FROM` clause. Without the `FROM` clause, the select list can contain all possible expressions that do not have references to columns of tables. For example, the select list can contain constants, scalar functions, aggregate functions, etc. Other clauses such as `WHERE` and `ORDER BY` and set operators such as `UNION` can also be used without the `FROM` clause.

Examples

```
SELECT statement with constant expression:
SELECT 10;
10
--
10

SELECT statement with scalar function:
SELECT abs(-10);
10
--
10

SELECT statement with UNION set operator:
SELECT 10 UNION SELECT 20;
10
--
10
20
```

If a `FROM` clause is specified, it is used to specify one or more table references. Each table reference resolves to one table (either a table stored in the database or a virtual table resulting from processing the table reference) whose rows the query expression uses to create the result table. There are three forms of table references:

- A direct reference to a table, view or synonym
- A derived table specified by a query expression in the `FROM` clause
- A joined table that combines rows and columns from multiple tables

The usage notes specific to each form of table reference follow.

If there are multiple table references, c-treeACE SQL joins the tables to form an intermediate result table that is used as the basis for evaluating all other clauses in the query expression. That intermediate result table is the Cartesian product of rows in the tables in the `FROM` clause, formed by concatenating every row of every table with all other rows in all tables.

```
FROM table_name [ AS ] [ alias ]
```

Explicitly names a table. The name listed in the `FROM` clause can be a table name, a view name, or a synonym.

*alias* is a name used to qualify column names in other parts of the query expression. Aliases are also called correlation names.

If you specify an alias, you must use it, and not the table name, to qualify column names that refer to the table. Query expressions that join a table with itself must use aliases to distinguish between references to column names.

For example, the following query expression joins the table `customer` with itself. It uses the aliases `x` and `y` and returns information on customers in the same city as customer ‘SMITH’:
SELECT y.cust_no, y.name
FROM customer x, customer y
WHERE x.name = 'SMITH'
AND y.city = x.city;

Similar to table aliases, the column_alias provides an alternative name to use in column references elsewhere in the query expression. If you specify column aliases, you must specify them for all the columns in table_name. Also, if you specify column aliases in the FROM clause, you must use them—not the column names—in references to the columns.

FROM ( query_expression ) [ AS ] alias [( column_alias [ , ... ] )]
Specifies a derived table through a query expression. With derived tables, you must specify an alias to identify the derived table.

Derived tables can also specify column aliases. Column aliases provides an alternative name to use in column references elsewhere in the query expression. If you specify column aliases, you must specify them for all the columns in the result table of the query expression. Also, if you specify column aliases in the FROM clause, you must use them, and not the column names, in references to the columns.

FROM [ ( ] joined_table [ ) ]
Combines data from two table references by specifying a join condition. The syntax currently allowed in the FROM clause supports only a subset of possible join conditions:

- CROSS JOIN specifies a Cartesian product of rows in the two tables
- INNER JOIN specifies an inner join using the supplied search condition
- LEFT OUTER JOIN specifies a left outer join using the supplied search condition

You can also specify these and other join conditions in the WHERE clause of a query expression. See Inner Joins (page 38) and Outer Joins (page 40) for further details on both ways of specifying joins.

{ ctree ORDERED }
Directs the c-treeACE SQL optimizer to join tables in a specified order. Use this clause when you want to override the SQL engine's join-order optimization. This is useful for special cases when you know in fact a particular join order results in better performance. Since this clause bypasses join-order optimization, carefully test queries that use it to make sure your specified join order is faster than relying on the optimizer. In addition, future c-treeACE SQL releases will further improve join ordering, outperforming manually created orders.

Note that the braces ( { and } ) are part of the required syntax.

SELECT sc.tbl 'Table', sc.col 'Column',
   sc.coltype 'Data Type', sc.width 'Size'
FROM admin.syscolumns sc, admin.systables st
{ ctree ORDERED }
WHERE sc.tbl = st.tbl AND st.tbltype = 'S'
ORDER BY sc.tbl, sc.col;

WHERE search_condition
The **WHERE** clause specifies a *search_condition* that applies conditions to restrict the number of rows in the result table. If the query expression does not specify a **WHERE** clause, the result table includes all the rows of the specified table reference in the **FROM** clause.

The *search_condition* is applied to each row of the result table set of the **FROM** clause. Only rows that satisfy the conditions become part of the result table. If the result of the *search_condition* is NULL for a row, the row is not selected.

Search conditions can specify different conditions for joining two or more tables. See *Inner Joins* (page 38) and *Outer Joins* (page 40) for more information.

Refer to *Search Conditions* (page 16) for details on the different kinds of search conditions.

```
SELECT *
FROM customer
WHERE city = 'COLUMBIA' AND state = 'MO';
```

```
SELECT *
FROM customer
WHERE city IN (SELECT city
FROM customer
WHERE name = 'SMITH');
```

**GROUP BY** column_name …

Specifies grouping of rows in the result table:

- For the first column specified in the **GROUP BY** clause, c-treeACE SQL arranges rows of the result table into groups whose rows all have the same values for the specified column.

- If a second **GROUP BY** column is specified, c-treeACE SQL then groups rows in each main group by values of the second column.

- SQL groups rows for values in additional **GROUP BY** columns in a similar fashion.

All columns named in the **GROUP BY** clause must also be in the select list of the query expression. Conversely, columns in the select list must also be in the **GROUP BY** clause or be part of an aggregate function.

**Note:** Prior to version 10.0 of c-treeACE SQL, rows in result tables were in ascending order of the **GROUP BY** columns. Subsequent use of a hashing scheme to group rows, results in the rows in the result table may not be in any specific order. Any explicit ordering must be defined by the SQL statement.

**HAVING** search_condition

The **HAVING** clause allows conditions to be set on the groups returned by the **GROUP BY** clause. If the **HAVING** clause is used without the **GROUP BY** clause, the implicit group against which the search condition is evaluated is all the rows returned by the **WHERE** clause.

A condition of the **HAVING** clause can compare one aggregate function value with another aggregate function value or a constant.

```
-- select customer number and number of orders for all
-- customers who had more than 10 orders prior to
SELECT cust_no, count(*)
```
FROM orders
WHERE order_date < to_date ('3/31/1991')
GROUP BY cust_no
HAVING count(*) > 10;

**UNION [ALL]**

Appends the result table from one query expression to the result table from another.

The two query expressions must have the same number of columns in their result table, and those columns must have the same or compatible data types.

The final result table contains the rows from the second query expression appended to the rows from the first. By default, the result table does not contain any duplicate rows from the second query expression. Specify `UNION ALL` to include duplicate rows in the result table.

-- Get a merged list of customers and suppliers.
   SELECT name, street, state, zip
   FROM customer
UNION
   SELECT name, street, state, zip
   FROM supplier;

-- Get a list of customers and suppliers
-- with duplicate entries for those customers who are
-- also suppliers.
   SELECT name, street, state, zip
   FROM customer
UNION ALL
   SELECT name, street, state, zip
   FROM supplier;

**INTERSECT**

Limits rows in the final result table to those that exist in the result tables from both query expressions.

The two query expressions must have the same number of columns in their result table, and those columns must have the same or compatible data types.

-- Get a list of customers who are also suppliers.
   SELECT name, street, state, zip
   FROM customer
INTERSECT
   SELECT name, street, state, zip
   FROM supplier;

**MINUS**

Limits rows in the final result table to those that exist in the result table from the first query expression minus those that exist in the second. In other words, the MINUS operator returns rows that exist in the result table from the first query expression but that do not exist in the second.

The two query expressions must have the same number of columns in their result table, and those columns must have the same or compatible data types.

-- Get a list of suppliers who are not customers.
   SELECT name, street, state, zip
   FROM supplier
MINUS
   SELECT name, street, state, zip
   FROM customer;
Authorization

The user executing a query expression must have any of the following privileges:

- DBA privilege
- SELECT permission on all the tables/views referred to in the query_expression.

<table>
<thead>
<tr>
<th>SQL Compliance</th>
<th>SQL-92. Extensions: { ctree ORDERED } clause, MINUS set operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Embedded SQL, interactive SQL, ODBC applications</td>
</tr>
<tr>
<td>Related Statements</td>
<td>CREATE TABLE, CREATE VIEW, INSERT, Search Conditions, SELECT, UPDATE</td>
</tr>
</tbody>
</table>

1.7 Inner Joins

Description

Inner joins specify how the rows from one table reference are to be joined with the rows of another table reference. Inner joins usually specify a search condition that limits the number of rows from each table reference that become part of the result table generated by the inner join operation.

If an inner join does not specify a search condition, the result table from the join operation is the Cartesian product of rows in the tables, formed by concatenating every row of one table with every row of the other table. Cartesian products (also called cross products or cross joins) are not practically useful, however, c-treeACE SQL logically processes all join operations by first forming the Cartesian products of rows from tables participating in the join.

If specified, the search condition is applied to the Cartesian product of rows from the two tables. Only rows that satisfy the search condition become part of the result table generated by the join.

A query expression can specify inner joins in either its FROM clause or in its WHERE clause. For each formulation in the FROM clause, there is an equivalent syntax formulation in the WHERE clause. Currently, not all syntax specified by the SQL-92 standard is allowed in the FROM clause.

Syntax

```
from_clause_inner_join ::
  | FROM table_ref CROSS JOIN table_ref
  | FROM table_ref [ INNER ] JOIN table_ref ON search_condition
where_clause_inner_join ::
  FROM table_ref, table_ref WHERE search_condition
```

Arguments

**FROM table_ref CROSS JOIN table_ref**

Explicitly specifies that the join generates the Cartesian product of rows in the two table references. This syntax is equivalent to omitting the WHERE clause and a search condition. The
following queries illustrate the results of a simple CROSS JOIN operation and an equivalent formulation that does not use the CROSS JOIN syntax:

```
SELECT * FROM T1;  -- Contents of T1
  C1  C2
  10  15
  20  25
2 records selected
SELECT * FROM T2;  -- Contents of T2
  C3  C4
  10  BB
  15  DD
2 records selected
SELECT * FROM T1 CROSS JOIN T2; -- Cartesian product
  C1  C2  C3  C4
  10  15  10  BB
  10  15  15  DD
  20  25  10  BB
  20  25  15  DD
4 records selected
SELECT * FROM T1, T2; -- Different formulation, same results
  C1  C2  C3  C4
  10  15  10  BB
  10  15  15  DD
  20  25  10  BB
  20  25  15  DD
4 records selected
```

```
FROM table_ref [ INNER ] JOIN table_ref ON search_condition
FROM table_ref, table_ref WHERE search_condition
```

These two equivalent syntax constructions both specify search_condition for restricting rows that will be in the result table generated by the join. In the first format, INNER is optional and has no effect. There is no difference between the WHERE form of inner joins and the JOIN ON form.

**Equi-joins**

An equi-join specifies that values in one table equal some corresponding column’s values in the other:

```
-- For customers with orders, get their name and order info, :
SELECT customer.cust_no, customer.name, 
  orders.order_no, orders.order_date
FROM customers INNER JOIN orders 
  ON customer.cust_no = orders.cust_no ;
```

```
-- Different formulation, same results:
SELECT customer.cust_no, customer.name, 
  orders.order_no, orders.order_date
FROM customers, orders 
  WHERE customer.cust_no = orders.cust_no ;
```

**Self joins**

A self join, or auto join, joins a table with itself. If a WHERE clause specifies a self join, the FROM clause must use aliases to have two different references to the same table:
-- Get all the customers who are from the same city as customer SMITH:
    SELECT y.cust_no, y.name
    FROM  customer AS x INNER JOIN customer AS y
    ON x.name = 'SMITH' AND y.city = x.city ;

-- Different formulation, same results:
    SELECT y.cust_no, y.name
    FROM  customer x, customer y
    WHERE  x.name = 'SMITH' AND y.city = x.city ;

1.8 Outer Joins

Description
An outer join between two tables returns more information than a corresponding inner join. An
outer join returns a result table that contains all the rows from one of the tables even if there is no
row in the other table that satisfies the join condition.

In a left outer join, the information from the table on the left is preserved: the result table contains
all rows from the left table even if some rows do not have matching rows in the right table. Where
there are no matching rows in the left table, c-treeACE SQL generates null values.

In a right outer join, the information from the table on the right is preserved: the result table
contains all rows from the right table even if some rows do not have matching rows in the left
table. Where there are no matching rows in the right table, c-treeACE SQL generates null values.

c-treeACE SQL supports two forms of syntax to support outer joins:

- In the FROM clause, specify one of the outer join clauses between two table names, followed
  by a search condition:
    LEFT OUTER JOIN
    RIGHT OUTER JOIN
    The search condition can contain only the join condition between the specified tables.
- In the WHERE clause of a query expression, specify the outer join operator (+) after the
column name of the table for which rows will not be preserved in the result table. Both sides
of an outer-join search condition in a WHERE clause must be simple column references. This
syntax allows both left and right outer joins.

c-treeACE SQL does not support full (two-sided) outer joins.

Syntax
from_clause_inner_join ::
    FROM table_ref LEFT OUTER JOIN table_ref ON search_condition
| FROM table_ref RIGHT OUTER JOIN table_ref ON search_condition

where_clause_inner_join ::
    WHERE [table_name.]column (+) = [table_name.]column
| WHERE [table_name.]column = [table_name.]column (+)

Examples
The following example shows a left outer join. It displays all the customers with their orders. Even
if there is not a corresponding row in the orders table for each row in the customer table, NULL
values are displayed for the orders.order_no and orders.order_date columns.
SELECT customer.cust_no, customer.name, orders.order_no, orders.order_date
FROM customers, orders
WHERE customer.cust_no = orders.cust_no (+); 

The following series of examples illustrates the outer join syntax:

```sql
SELECT * FROM T1; -- Contents of T1
C1  C2
--  --
10  15
20  25
2 records selected

SELECT * FROM T2; -- Contents of T2
C3  C4
--  --
10  BB
15  DD
2 records selected

-- Left outer join
SELECT * FROM T1 LEFT OUTER JOIN T2 ON T1.C1 = T2.C3;
C1  C2  C3  C4
--  --  --  --
10  15  10  BB
20  25
2 records selected

-- Left outer join: different formulation, same results
SELECT * FROM T1, T2 WHERE T1.C1 = T2.C3 (+);
C1  C2  C3  C4
--  --  --  --
10  15  10  BB
20  25
2 records selected

-- Right outer join
SELECT * FROM T1 RIGHT OUTER JOIN T2 ON T1.C1 = T2.C3;
C1  C2  C3  C4
--  --  --  --
10  15  10  BB
15  DD
2 records selected

-- Right outer join
SELECT * FROM T1, T2 WHERE T1.C1 (+) = T2.C3;
C1  C2  C3  C4
--  --  --  --
10  15  10  BB
15  DD
2 records selected
```
1.9 Date-Time Format Strings

The `TO_CHAR` scalar function supports a variety of format strings to control the output of date and time values. The format strings consist of keywords that c-treeACE SQL interprets and replaces with formatted values.

The format strings are case sensitive. For instance, c-treeACE SQL replaces 'DAY' with all uppercase letters, but follows the case of 'Day'.

Supply the format strings, enclosed in single quotation marks, as the second argument to the `TO_CHAR` function.

**Example**

```sql
SELECT C1 FROM T2;
C1
--
09/29/1952
1 record selected

SELECT TO_CHAR(C1, 'DAY, MONTH ddth'),
TO_CHAR(C2, 'HH12 a.m.') FROM T2;

TO_CHAR(C1,'DAY, MONTH ddth')  TO_CHAR(C2,'HH12 a.m.')
----------------------------  ---------------------
Monday , September 29th 02 p.m.
1 record selected

For details of the TO_CHAR function, see "TO_CHAR".
```

**Date Format Strings**

A date format string can contain any of the following format keywords along with other characters. The format keywords in the format string are replaced by corresponding values to get the result. The other characters are displayed as literals.

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>The century as a two digit number.</td>
</tr>
<tr>
<td>YYYY</td>
<td>The year as a four digit number.</td>
</tr>
<tr>
<td>YYY</td>
<td>The last three digits of the year.</td>
</tr>
<tr>
<td>YY</td>
<td>The last two digits of the year.</td>
</tr>
<tr>
<td>Y</td>
<td>The last digit of the year.</td>
</tr>
<tr>
<td>Y,YYY</td>
<td>The year as a four digit number with a comma after the first digit.</td>
</tr>
<tr>
<td>Q</td>
<td>The quarter of the year as one digit number (with values one, two, three, or four).</td>
</tr>
<tr>
<td>MM</td>
<td>The month value as two digit number (in the range 01-12).</td>
</tr>
<tr>
<td>MONTH</td>
<td>The name of the month as a string of nine characters (‘JANUARY’ to ‘DECEMBER’).</td>
</tr>
<tr>
<td>MON</td>
<td>The first three characters of the name of the month (in the range ‘JAN’ to ‘DEC’).</td>
</tr>
<tr>
<td>WW</td>
<td>The week of year as a two digit number (in the range 01-52).</td>
</tr>
<tr>
<td>W</td>
<td>The week of month as a one digit number (in the range 1-5).</td>
</tr>
<tr>
<td>DDD</td>
<td>The day of year as a three digit number (in the range 001-365).</td>
</tr>
<tr>
<td>DD</td>
<td>The day of month as a two digit number (in the range 01-31).</td>
</tr>
</tbody>
</table>
The day of week as a one digit number (in the range 1-7, 1 for Sunday and 7 for Saturday).

**DAY**

The day of week as a nine character string (in the range ‘SUNDAY’ to ‘SATURDAY’).

**DY**

The day of week as a three character string (in the range ‘SUN’ to ‘SAT’).

**J**

The Julian day (number of days since DEC 31, 1899) as an eight digit number.

**TH**

When added to a format keyword that results in a number, this format keyword (‘TH’) is replaced by the string ‘ST’, ‘ND’, ‘RD’ or ‘TH’ depending on the last digit of the number.

**Example**

```
SELECT C1 FROM T2;
C1
--
09/29/1952
1 record selected
SELECT TO_CHAR(C1, 'Day, Month ddth'),
      TO_CHAR(C2, 'HH12 a.m.') FROM T2;
TO_CHAR(C1,DAY, MONTH DDTH)  TO_CHAR(C2,HH12 A.M.)
---------------------------  ---------------------
Monday   , September 29th    02 p.m.
1 record selected
```

**Time Format Strings**

A time format string can contain any of the following format keywords along with other characters. The format keywords in the format string are replaced by corresponding values to get the result. The other characters are displayed as literals.

**AM**

The string "AM" or "PM" depending on whether time corresponds to forenoon or afternoon.

**PM**

The string "AM" or "PM" depending on whether time corresponds to forenoon or afternoon.

**A.M.**

The string "A.M." or "P.M." depending on whether time corresponds to forenoon or afternoon.

**P.M.**

The string "A.M." or "P.M." depending on whether time corresponds to forenoon or afternoon.

**HH12**

The hour value as a two-digit number (in the range 00 to 11).

**HH24**

The hour value as a two-digit number (in the range 00 to 23).

**HH**

The hour value as a two-digit number (in the range 00 to 23).

**MI**

The minute value as a two-digit number (in the range 00 to 59).

**SS**

The seconds value as a two-digit number (in the range 00 to 59).

**SSSSS**

The seconds from midnight as a five-digit number (in the range 00000 to 86399).

**Example**

```
SELECT C1 FROM T2;
C1
--
09/29/1952
1 record selected
SELECT TO_CHAR(C1, 'Day, Month ddth'),
      TO_CHAR(C2, 'HH12 a.m.') FROM T2;
TO_CHAR(C1, 'Day, Month ddth')  TO_CHAR(C2, 'HH12 a.m.')
---------------------------  ---------------------
Monday , September 29th        02 p.m.
1 record selected
```
1.10 Functions

Functions are a type of c-treeACE SQL expression that return a value based on the argument they are supplied. c-treeACE SQL supports two types of functions:

- Aggregate functions calculate a single value for a collection of rows in a result table (if the function is in a statement with a GROUP BY clause, it returns a value for each group in the result table). Aggregate functions are also called set or statistical functions. Aggregate functions cannot be nested.
- Scalar functions calculate a value based on another single value. Scalar functions are also called value functions. Scalar functions can be nested.

Aggregate Functions
AVG

Syntax
AVG ( { [ALL] expression } | { DISTINCT column_ref } )

Description
The aggregate function \( \text{AVG} \) computes the average of a collection of values. The keyword \( \text{DISTINCT} \) specifies that the duplicate values are to be eliminated before computing the average.

- Null values are eliminated before the average value is computed. If all the values are null, the result is null.
- The argument to the function must be of type \( \text{SMALLINT} \), \( \text{INTEGER} \), \( \text{NUMERIC} \), \( \text{REAL} \) or \( \text{FLOAT} \).
- The result is of type \( \text{NUMERIC} \).

Example
```
SELECT AVG (salary)
FROM employee
WHERE deptno = 20 ;
```
## COUNT

### Syntax

```
COUNT ( { [ALL] expression } | { DISTINCT column_ref } | * )
```

### Description

The aggregate function `COUNT` computes either the number of rows in a group of rows or the number of non-null values in a group of values.

- The keyword `DISTINCT` specifies that the duplicate values are to be eliminated before computing the count.
- If the argument to `COUNT` function is `*`, then the function computes the count of the number of rows in group.

For fixed length files, an exact row count is stored in the file header and can be immediately returned. For variable length files, an index is required that returns the number of keys. The first index that is found from the following is chosen: `RECBYT`, `ROWID`, first unique Index, first duplicate Index. If no index is available, then a physical table scan is performed to count the actual number of rows in the table.

- If the argument to `COUNT` function is not `*`, then null values are eliminated before the number of rows is computed.
- The argument `column_ref` or expression can be of any type.
- The result of the function is of `INTEGER` type. The result is never null.

### Example

```
SELECT COUNT (*)
FROM orders
WHERE order_date = SYSDATE ;
```
MAX

Syntax
MAX ( { [ALL] expression } | { DISTINCT column_ref } )

Description
The aggregate function MAX returns the maximum value in a group of values.

- The specification of DISTINCT has no effect on the result.
- The result of the function is of the same data type as that of the argument.
- The argument column_ref or expression can be of any type.
- The result is null if the result set is empty or contains only null values.

Example
SELECT order_date, product, MAX (qty)
FROM orders
GROUP BY order_date, product ;
**MIN**

**Syntax**

\[
\text{MIN} \ (\{ [\text{ALL}] \ \text{expression} \} \ | \ \{ \text{DISTINCT} \ \text{column\_ref} \})
\]

**Description**

The aggregate function `MIN` returns the minimum value in a group of values.

- The specification of `DISTINCT` has no effect on the result.
- The argument `column\_ref` or expression can be of any type.
- The result of the function is of the same data type as that of the argument.
- The result is null if the result set is empty or contains only null values.

**Example**

```
SELECT MIN (salary)
FROM employee
WHERE deptno = 20 ;
```
SUM

Syntax
SUM ( { [ALL] expression } | { DISTINCT column_ref } )

Description
The aggregate function SUM returns the sum of the values in a group. The keyword DISTINCT specifies that the duplicate values are to be eliminated before computing the sum.

- The argument column_ref or expression can be of any numeric type.
- The result of the function is of the same data type as that of the argument except that the result is of type INTEGER when the argument is of type SMALLINT or TINYINT.
- The result can have a null value.

Example
SELECT SUM (amount)
FROM orders
WHERE order_date = SYSDATE ;

Scalar Functions

c-treeACE SQL does not provide a mechanism for calling a scalar function directly from a user-defined function. To use scalar functions, it is necessary to call the function from within a c-treeACE SQL statement. c-treeACE SQL defines the special table SYSCALCTABLE which has only one row for use in situations where all the data is in the inputs.
ABS function (ODBC compatible)

Syntax
ABS (expression)

Description
The scalar function ABS computes the absolute value of expression.

Example
SELECT ABS (MONTHS_BETWEEN (SYSDATE, order_date))
FROM orders
WHERE ABS (MONTHS_BETWEEN (SYSDATE, order_date)) > 3 ;

Notes
- The argument to the function must be of type TINYINT, SMALLINT, INTEGER, NUMERIC, REAL or FLOAT.
- The result is of type NUMERIC.
- If the argument expression evaluates to null, the result is null.
ACOS function (ODBC compatible)

Syntax
ACOS ( expression )

Description
The scalar function ACOS returns the arccosine of expression.

Example
select acos (.5) 'Arccosine in radians' from syscalctable;
ARCCOSINE IN RAD
----------------
1.047197551196598
1 record selected

select acos (.5) * (180/ pi()) 'Arccosine in degrees' from syscalctable;
ARCCOSINE IN DEG
----------------
59.999999999999993
1 record selected

Notes
ACOS takes the ratio (expression) of two sides of a right triangle and returns the corresponding angle. The ratio is the length of the side adjacent to the angle divided by the length of the hypotenuse.

The result is expressed in radians and is in the range -Pi/2 to Pi/2 radians. To convert degrees to radians, multiply degrees by Pi/180. To convert radians to degrees, multiply radians by 180/Pi.

- Expression must be in the range -1 to 1.
- Expression must evaluate to an approximate numeric data type.
ADD_MONTHS function (extension)

Syntax
ADD_MONTHS ( date_expression, integer_expression )

Description
The scalar function ADD_MONTHS adds to the date value specified by the date_expression, the given number of months specified by integer_expression and returns the resultant date value.

Example
SELECT *
FROM customer
WHERE ADD_MONTHS (start_date, 6) > SYSDATE ;

Notes
- The first argument must be of DATE type.
- The second argument to the function must be of numeric type.
- The result is of type DATE.
- If any of the arguments evaluate to null, the result is null.
ASCII function (ODBC compatible)

Syntax
ASCII ( char_expression )

Description
The scalar function ASCII returns the ASCII value of the first character of the given character expression.

Example
SELECT  ASCII ( zip )
FROM  customer ;

Notes
- The argument to the function must be of character type.
- The result is of type INTEGER.
- If the argument char_expression evaluates to null, the result is null.
**ASIN function (ODBC compatible)**

**Syntax**

ASIN (expression)

**Description**

The scalar function ASIN returns the arcsine of expression.

**Example**

```sql
select asin (1) * (180/ pi()) 'Arcsine in degrees' from syscalctable;
```

```
ARCSINE IN DEGRE
----------------
90.000000000000000
1 record selected
```

```sql
select asin (1) 'Arcsine in radians' from syscalctable;
```

```
ARCSINE IN RADIA
----------------
1.570796326794897
1 record selected
```

**Notes**

ASIN takes the ratio (expression) of two sides of a right triangle and returns the corresponding angle. The ratio is the length of the side opposite the angle divided by the length of the hypotenuse.

The result is expressed in radians and is in the range -Pi/2 to Pi/2 radians. To convert degrees to radians, multiply degrees by Pi/180. To convert radians to degrees, multiply radians by 180/Pi.

- Expression must be in the range -1 to 1.
- Expression must evaluate to an approximate numeric data type.
**ATAN function (ODBC compatible)**

**Syntax**

```
ATAN ( expression )
```

**Description**

The scalar function `ATAN` returns the arctangent of `expression`.

**Example**

```sql
select atan (1) * (180/ pi()) 'Arctangent in degrees' from syscalctable;
```

```
ARCTANGENT IN DE
----------------
45.000000000000000
1 record selected
```

```sql
select atan (1) 'Arctangent in radians' from syscalctable;
```

```
ARCTANGENT IN RA
----------------
0.785398163397448
1 record selected
```

**Notes**

`ATAN` takes the ratio (expression) of two sides of a right triangle and returns the corresponding angle. The ratio is the length of the side opposite the angle divided by the length of the side adjacent to the angle.

The result is expressed in radians and is in the range `-Pi/2` to `Pi/2` radians. To convert degrees to radians, multiply degrees by `Pi/180`. To convert radians to degrees, multiply radians by `180/Pi`.

- Expression must be in the range `-1` to `1`.
- Expression must evaluate to an approximate numeric data type.
ATAN2 function (ODBC compatible)

Syntax
ATAN2 ( expression1 , expression2 )

Description
The scalar function ATAN2 returns the arctangent of the x and y coordinates specified by expression1 and expression2.

Example
select atan2 (1,1) * (180/ pi()) 'Arctangent in degrees' from syscalctable;
ARCTANGENT IN DE
----------------
45.000000000000000
1 record selected

select atan2 (1,1) 'Arctangent in radians' from syscalctable;
ARCTANGENT IN RA
----------------
0.785398163397448
1 record selected

Notes
ATAN2 takes the ratio of two sides of a right triangle and returns the corresponding angle. The ratio is the length of the side opposite the angle divided by the length of the side adjacent to the angle.

expression1 and expression2 specify the x and y coordinates of the end of the hypotenuse opposite the angle.

The result is expressed in radians and is in the range -Pi/2 to Pi/2 radians. To convert degrees to radians, multiply degrees by Pi/180. To convert radians to degrees, multiply radians by 180/Pi.

Both expression1 and expression2 must evaluate to approximate numeric data types.
CASE (SQL-92 Compatible)

Syntax

\[
\text{case-exp}::= \text{searched-case-exp} \mid \text{simple-case-exp} \\
\text{searched-case-exp}::= \text{CASE} \quad \text{WHEN search-condition THEN} \{ \text{result-exp} \mid \text{NULL} \} \\
\quad \text{[ ... ]} \\
\quad \text{[ ELSE expr | NULL ]} \\
\text{END} \\
\text{simple-case-exp}::= \text{CASE primary-exp} \quad \text{WHEN expr THEN} \{ \text{result-exp} \mid \text{NULL} \} \\
\quad \text{[ ... ]} \\
\quad \text{[ ELSE expr | NULL ]} \\
\text{END}
\]

Description

The \texttt{CASE} scalar function is a type of conditional expression. (See Conditional Expressions (page 26) for more details and a summary of all the conditional expressions.)

The general form of the \texttt{CASE} scalar function specifies a series of search conditions and associated result expressions. It is called a searched case expression. \texttt{c-treeSQL} returns the value specified by the first result expression whose associated search condition evaluates as true. If none of the search conditions evaluate as true, the \texttt{CASE} expression returns a null value (or the value of some other default expression if the \texttt{CASE} expression includes the \texttt{ELSE} clause).

\texttt{CASE} also supports syntax for a shorthand notation, called a simple case expression, for evaluating whether one expression is equal to a series of other expressions.

Notes

- This function is not allowed in a \texttt{GROUP BY} clause
- Arguments to this function cannot be query expressions

Arguments

\texttt{CASE}

The \texttt{CASE} keyword alone, not followed by \texttt{primary-exp}, specifies a searched case expression. It must be followed by one or more \texttt{WHEN-THEN} clauses each that specify a search condition and corresponding expression.

\texttt{WHEN search-condition THEN} \{ \text{result-exp} \mid \text{NULL} \}

\texttt{WHEN} clause for searched case expressions. \texttt{c-treeSQL} evaluates search condition. If \texttt{search-condition} evaluates as true, \texttt{CASE} returns the value specified by \texttt{result-exp} (or null, if the clause specifies \texttt{THEN NULL}).

If \texttt{search-condition} evaluates as false, \texttt{c-treeACE SQL} evaluates the next \texttt{WHEN-THEN} clause, if any, or the \texttt{ELSE} clause, if it is specified.
CASE primary-expr
The CASE keyword followed by an expression specifies a simple case expression. In a simple case expression, one or more WHEN-THEN clauses specify two expressions.

A simple case expression can always be expressed as a searched case expression. Consider the following general simple case expression:

```sql
CASE primary-expr
    WHEN expr1 THEN result-expr1
    WHEN expr2 THEN result-expr2
    ELSE expr3
END
```

The preceding simple case expression is equivalent to the following searched case expression:

```
CASE
    WHEN primary-expr = expr1 THEN result-expr1
    WHEN primary-expr = expr2 THEN result-expr2
    ELSE expr3
END
```

**WHEN expr THEN { result-expr | NULL }

WHEN clause for simple case expressions. c-treeSQL evaluates expr and compares it with primary-expr specified in the CASE clause. If they are equal, CASE returns the value specified by result-expr (or null, if the clause specifies THEN NULL).

If expr is not equal to primary-expr, c-treeSQL evaluates the next WHEN-THEN clause, if any, or the ELSE clause, if it is specified.

```
[ ELSE { expr | NULL } ]
```

In both searched case expressions and simple case expressions, the ELSE clause specifies an optional expression whose value c-treeACE SQL returns if none of the conditions specified in WHEN-THEN clauses were satisfied. If the CASE expression omits the ELSE clause, it is the same as specifying ELSE NULL.

**Examples**

The following example shows a searched case expression that assigns a label denoting tables as system tables if they begin with the letters sys. Note that this example can not be reformulated as a simple case expression, since it specifies a relational operator other than =.

```sql
SELECT tbl,
    CASE
        WHEN tbl like 'sys%' THEN 'System Table'
        ELSE 'Not System table'
    END
FROM systables;
```

<table>
<thead>
<tr>
<th>TBL</th>
<th>SEARCHED_CASE(TBLSY</th>
</tr>
</thead>
<tbody>
<tr>
<td>systblspaces</td>
<td>System Table</td>
</tr>
<tr>
<td>systables</td>
<td>System Table</td>
</tr>
<tr>
<td>syscolumns</td>
<td>System Table</td>
</tr>
<tr>
<td>sysindexes</td>
<td>System Table</td>
</tr>
<tr>
<td>sysdbauth</td>
<td>System Table</td>
</tr>
<tr>
<td>systabauth</td>
<td>System Table</td>
</tr>
<tr>
<td>syscolauth</td>
<td>System Table</td>
</tr>
<tr>
<td>sysviews</td>
<td>System Table</td>
</tr>
</tbody>
</table>
The following example shows a searched CASE expression and an equivalent simple CASE expression.

- Searched case expression:
  ```sql
  SELECT tbl,
  CASE
    WHEN tbltype = 'S' THEN 'System Table'
    ELSE 'Not System table'
  END
  FROM systables;
  ```

- Equivalent simple case expression:
  ```sql
  SELECT tbl,
  CASE tbltype
    WHEN 'S' THEN 'System Table'
    ELSE 'Not System table'
  END
  FROM systables;
  ```
CAST function (SQL-92 compatible)

Syntax
CAST ( { expression | NULL } AS data_type [{length}] )

Description
The scalar function CAST converts an expression to another data type. The first argument is the expression to be converted. The second argument is the target data type.

The length option for the data_type argument specifies the length for conversions to character data types. If omitted, the default length is 30 bytes.

If the expression evaluates to null, the result of the function is null. Specifying NULL with the CAST function is useful for set operations such as UNION that require two tables to have the same structure. CAST NULL allows you to specify a column of the correct data type so a table with a similar structure to another, but with fewer columns, can be in a union operation with the other table.

The CAST function provides a data-type-conversion mechanism compatible with the SQL-92 standard.

Use the CONVERT function, enclosed in the ODBC escape clause {fn }, to specify ODBC-compliant syntax for data type conversion. See CONVERT function (ODBC compatible) (page 68) for more information.

Example
The following c-treeSQL example uses CAST to convert an integer field from a catalog table to a character data type:

```
SELECT CAST(fld AS CHAR(25)), fld FROM admin.syscalctable;
```

<table>
<thead>
<tr>
<th>CAST(CHARACTER(25),FLD)</th>
<th>FLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

1 record selected
CEILING function (ODBC compatible)

Syntax
CEILING ( expression )

Description
The scalar function CEILING returns the smallest integer greater than or equal to expression.

Example
SELECT CEILING (32.5) 'Ceiling'
FROM ADMIN.SYSCALCTABLE;

Notes
- Expression must evaluate to a numeric data type.
CHAR function (ODBC compatible)

Syntax
CHAR ( integer_expression )

Description
The scalar function CHAR returns a character string with the first character having an ASCII value equal to the argument expression. CHAR is identical to CHR but provides ODBC-compatible syntax.

Example
SELECT *
FROM   customer
WHERE  SUBSTR (zip, 1, 1) = CHAR (53) ;

Notes
- The argument to the function must be of type INTEGER, TINYINT, or SMALLINT.
- The result is of type character.
- If the argument integer_expression evaluates to null, the result is null.
CHARTOROWID (extension)

Syntax
CHARTOROWID ( char_expression )

Description
The scalar function CHARTOROWID returns a ROWID contained in the input argument in character form.

Example
The following example shows the character-string format for a row identifier supplied as an argument to CHARTOROWID. In this example, the format for a row identifier is an integer (delimited as a character string by single quotes).

```
SELECT ROWID, FLD FROM SYSCALCTABLE;
ROWID  FLD
-----  ---
 0     100
1 record selected
```

CHARTOROWID requires single quotes around its argument

```
SELECT * FROM SYSCALCTABLE WHERE ROWID = CHARTOROWID ('0');
FLD
---
100
1 record selected
```

Notes
- The argument to the function must be of type character.
- The result is of internal ROWID type.
- If the argument char_expression evaluates to null, the result is null.
- The c-treeSQL statement execution returns error if the result of the input character expression does not contain a character string in the proper format for a row identifier.
CHR function (extension)

Syntax
CHR ( integer_expression )

Description
The scalar function CHR returns a character string with the first character having an ASCII value equal to the argument expression.

Example
SELECT *
FROM   customer
WHERE  SUBSTR (zip, i, 1) = CHR (53) ;

Notes
- The argument to the function must be of type INTEGER, TINYINT, or SMALLINT.
- The result is of type character.
- If the argument integer_expression evaluates to null, the result is null.
COALESCE (SQL-92 compatible)

Syntax
COALESCE ( expression1, expression2 [ , ... ] )

Description
The COALESCE scalar function is a type of conditional expression. (See Conditional Expressions (page 26) for more information and a summary of all the conditional expressions.)

COALESCE specifies a series of expressions, and returns the first expression whose value is not null. If all the expressions evaluate as null, COALESCE returns a null value.

The COALESCE syntax is shorthand notation for a common case that can also be represented in a CASE expression. The following two formulations are equivalent:

COALESCE ( expression1 , expression2 , expression3 )
CASE
  WHEN expression1 IS NOT NULL THEN expression1
  WHEN expression2 IS NOT NULL THEN expression2
  ELSE expression3

Example
SELECT COALESCE(end_date, start_date) from job_hist;

Notes
• This function is not allowed in a GROUP BY clause
• Arguments to this function cannot be query expressions
**CONCAT function (ODBC compatible)**

**Syntax**

CONCAT ( char_expression , char_expression )

**Description**

The scalar function CONCAT returns a concatenated character string formed by concatenating argument one with argument two.

The CONCAT scalar function is similar to the concatenation operator. However, the concatenation operator allows easy concatenation of more than two character expressions by nesting the CONCAT function.

**Example**

SELECT name, empno, salary
FROM customer
WHERE project = CONCAT('US',proj_nam);

**Notes**

- Both the arguments must be of character type.
- If one of the arguments is a literal and the other one a field reference, concatenation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- The result belongs to the character set of the arguments.
- If any of the argument expressions evaluates to null, the result is null.
- The trailing blanks for the first arguments are removed.
CONVERT function (extension)

Syntax

\[
\text{CONVERT} \ (\ [\ '\text{data_type}\{(\text{length})\}' | \text{data_type}\{(\text{length})\} \], \text{expression})
\]

Description

The scalar function \textsc{convert} converts an expression to another data type. The first argument is the target data type. The second argument is the expression to be converted to that type.

As indicated in the syntax, single quotes surrounding the data type are optional.

The length option for the \textit{data_type} argument specifies the length for conversions to character types. If omitted, the default length is 30.

If the expression evaluates to null, the result of the function is null.

The \textsc{convert} function syntax is similar to but not compatible with the ODBC \textsc{convert} function. Enclose the function in the ODBC escape clause \{\textit{fn}\}, to specify ODBC-compliant syntax. See \textsc{convert} function (ODBC compatible) (page 68) for more information.

Examples

The following c-treeACE SQL examples convert an integer field from a catalog table to a character string:

```
SELECT CONVERT('CHAR', fld), fld FROM admin.syscalctable;
CONVERT(CHAR,FLD)               FLD
-----------------------------
100                             100
1 record selected
```

```
SELECT CONVERT('CHAR(35)', fld), fld FROM admin.syscalctable;
CONVERT(CHAR(35),FLD)           FLD
-------------------------------
100                             100
1 record selected
```

```
SELECT CONVERT('CHARACTER', fld), fld FROM systpe.syscalctable;
CONVERT(CHARACTER,FLD) FLD
----------------------
100 100
1 record selected
```
**CONVERT function (ODBC compatible)**

**Syntax**
{fn CONVERT (expression , data_type ) }

**data_type::

- SQL_BIGINT
- SQL_BINARY
- SQL_BIT
- SQL_CHAR
- SQL_DATE
- SQL_DECIMAL
- SQL_DOUBLE
- SQL_FLOAT
- SQL_INTEGER
- SQL_LONGVARBINARY
- SQL_LONGVARCHAR
- SQL_REAL
- SQL_SMALLINT
- SQL_TIME
- SQL_TIMESTAMP
- SQL_TINYINT
- SQL_VARBINARY
- SQL_VARCHAR

**Description**
The ODBC scalar function `CONVERT` converts an expression to another data type. The first argument is the expression to be converted. The second argument is the target data type.

If the expression evaluates to null, the result of the function is null.

The ODBC `CONVERT` function provides ODBC-compliant syntax for data type conversion. You must enclose the function with the ODBC escape clause `{ fn }` to use ODBC-compliant syntax.
COS function (ODBC compatible)

Syntax
COS ( expression )

Description
The scalar function COS returns the cosine of expression.

Example
select cos(45 * pi()/180) 'Cosine of 45 degrees' from syscalctable;
COSINE OF 45 DEG
----------------
0.707106781186548
1 record selected

Notes
COS takes an angle (expression) and returns the ratio of two sides of a right triangle. The ratio is the length of the side adjacent to the angle divided by the length of the hypotenuse.

- Expression specifies an angle in radians
- Expression must evaluate to an approximate numeric data type.

To convert degrees to radians, multiply degrees by Pi/180. To convert radians to degrees, multiply radians by 180/Pi.
COT SQL Scaler Function

Syntax
COT(expression)

Description
The scalar function COT returns the cotangent of the expression. COT takes an angle expression and returns the ratio of two sides of a right angle triangle. The ratio is the length of the side adjacent to the angle to the length of the side opposite to the angle.

Example
SELECT COT(45 * PI()/180) 'COT OF 45 DEGREES' from admin.syscalctable;
COT OF 45 DEGREES
------------------
 1.000000000000000
1 record selected

Details
Expression specifies an angle in radians. Expression must evaluate to an approximate numeric data type. To convert degrees to radians, multiply degrees by PI/180. To convert radians to degrees, multiply radians by 180/PI.

Note: ODBC compatible


**CURDATE function (ODBC compatible)**

**Syntax**

CURDATE ()

**Description**

CURDATE returns the current date as a DATE value. This function takes no arguments.

c-treeSQL statements can refer to CURDATE anywhere they can refer to a DATE expression. For example,

```
INSERT INTO objects (object_owner, object_id, create_date)
VALUES (USER, 1001, CURDATE());
```
CURRENT_DATE SQL function

Syntax
CURRENT_DATE

Description
CURRENT_DATE returns the current date as a DATE value. A c-treeACE SQL statement can refer to CURRENT_DATE anywhere you can refer to a DATE expression.

Example
```
INSERT INTO objects(object_owner, object_id, create_date)
    VALUES(user, 1002, CURRENT_DATE);
```

**Note:** SQL-99 compatible
**CURRENT_TIMESTAMP function**

**Syntax**

```
CURRENT_TIMESTAMP
```

**Description**

`CURRENT_TIMESTAMP` is a synonymous replacement for `SYSTIMESTAMP`. 
CURRENT_USER SQL Function

Syntax
CURRENT_USER

Description
CURRENT_USER returns a character string identifier for the database user as specified in the current connection. It returns a character in the database character set. If the current connection did not specify an user, CURRENT_USER returns the login name as determined by the host operating system.

c-treeACE SQL statements can refer to CURRENT_USER anywhere they can refer to a character string expression.

Example
ISQL>SELECT CURRENT_USER FROM admin.syscalctable;
FRED
----------
fred
1 record selected

Note: SQL-99 compatible
CURTIME function (ODBC compatible)

Syntax
CURTIME ()

Description
CURTIME returns the current time as a TIME value. This function takes no arguments.
c-treeSQL statements can refer to CURTIME anywhere they can refer to a TIME expression. For example,

```
INSERT INTO objects (object_owner, object_id, create_time)
VALUES (USER, 1001, CURTIME()) ;
```
**DATABASE (ODBC compatible)**

**Syntax**
```
DATABASE [ ( ) ]
```

**Description**
The scalar function `DATABASE` returns the name of the database corresponding to the current connection name. This function takes no arguments, and the trailing parentheses are optional.

**Example**
```
select database() from t2;
```
```
DATABASE
-------
steel
1 record selected
```
DATALENGTH function

Syntax
DATALENGTH( expr )

Description
Returns the number of bytes used to represent any expression. DATALENGTH is especially useful with VARCHAR, VARBINARY, LVARCHAR and LVARBINARY data types because these data types can store variable length data.

Arguments
- expr - An expression of any type.

Example
SELECT DATALENGTH(tbl) FROM systables WHERE tbl='systables';
DATALENGTH(TBL)
--
9
DATEADD function

Syntax

DATEADD( interval, integer_exp, date_time_exp )

Description

This scalar function is the same as the scalar function TIMESTAMPADD. Refer to TIMESTAMPADD (page 158) for usage.
DATEDIFF function

Syntax
DATEDIFF( interval, date_time_exp1, date_time_exp2 )

Description
This scalar function is the same as the scalar function TIMESTAMPDIFF. Refer to TIMESTAMPDIFF (page 160) for usage.
DAYNAME function (ODBC compatible)

Syntax

DAYNAME ( date_expression )

Description

Returns a character string containing the name of the day (for example, Sunday, through Saturday) for the day portion of date_expression. The argument date_expression can be the name of a column, the result of another scalar function, or a date or timestamp literal.

Example

SELECT *
FROM orders
WHERE order_no = 342 and DAYNAME(order_date)='SATURDAY';

<table>
<thead>
<tr>
<th>ORDER_NO</th>
<th>ORDER_DATE</th>
<th>REFERENCE</th>
<th>CUST_NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>342</td>
<td>08/10/1991</td>
<td>tdfg/101</td>
<td>10001</td>
</tr>
</tbody>
</table>

1 record selected
DAYOFMONTH function (ODBC compatible)

Syntax
DAYOFMONTH ( date_expression )

Description
The scalar function DAYOFMONTH returns the day of the month in the argument as a short integer value in the range of 1 - 31.

Example
SELECT *
FROM  orders
WHERE DAYOFMONTH (order_date) = 14 ;

Notes
• The argument to the function must be of type DATE.
• The argument must be specified in the format MM/DD/YYYY.
• The result is of type SHORT.
• If the argument expression evaluates to null, the result is null.
DAYOFWEEK function (ODBC compatible)

Syntax

`DAYOFWEEK ( date_expression )`

Description

The scalar function `DAYOFWEEK` returns the day of the week in the argument as a short integer value in the range of 1 - 7.

Example

```sql
SELECT *
FROM  orders
WHERE DAYOFWEEK (order_date) = 2 ;
```

Notes

- The argument to the function must be of type `DATE`.
- The argument must be specified in the format `MM/DD/YYYY`.
- The result is of type `SHORT`.
- If the argument expression evaluates to null, the result is null.
DAYOFYEAR function (ODBC compatible)

Syntax

DAYOFYEAR ( date_expression )

Description

The scalar function DAYOFYEAR returns the day of the year in the argument as a short integer value in the range of 1 - 366.

Example

SELECT *
FROM orders
WHERE DAYOFYEAR (order_date) = 300 ;

Notes

- The argument to the function must be of type DATE.
- The argument must be specified in the format MM/DD/YYYY.
- The result is of type SHORT.
- If the argument expression evaluates to null, the result is null.
DB_NAME (extension)

Syntax
DB_NAME ( )

Description
The scalar function DB_NAME returns the name of the database corresponding to the current connection name. It provides compatibility with the Sybase SQL Server function db_name.

Example
SELECT DB_NAME() FROM T2;
DB_NAME
-------
ctreev4
1 record selected
DECODE function (extension)

Syntax

```
DECODE ( expression, search_expression, match_expression
       [ , search_expression, match_expression …]
       [ , default_expression ] )
```

Description

The DECODE scalar function is a type of conditional expression. (Refer to Conditional Expressions (page 26) for a summary of all the conditional expressions.)

The scalar function DECODE compares the value of the first argument expression with each search_expression and if a match is found, returns the corresponding match_expression. If no match is found, then the function returns default_expression. If default_expression is not specified and no match is found, the function returns a null value.

DECODE provides a subset of the functionality of CASE that is compatible with Oracle SQL syntax. Use a simple case expression for SQL-compatible syntax (See CASE (SQL-92 Compatible) (page 57)).

Example

```
SELECT ename, DECODE (deptno,
   10, 'ACCOUNTS    ',
   20, 'RESEARCH    ',
   30, 'SALES       ',
   40, 'SUPPORT     ',
   'NOT ASSIGNED'
) FROM employee ;
```

Notes

- The first argument expression can be of any type. The types of all search_expressions must be compatible with the type of the first argument.
- The match_expressions can be of any type. The types of all match_expressions must be compatible with the type of the first match_expression.
- The type of the default_expression must be compatible with the type of the first match_expression.
- The type of the result is the same as that of the first match_expression.
- If the first argument expression is null then the value of the default_expression is returned, if it is specified. Otherwise null is returned.
DEGREES function (ODBC compatible)

Syntax
DEGREES ( expression )

Description
The scalar function DEGREES returns the number of degrees in an angle specified in radians by expression.

Example
SELECT DEGREES(3.14159265359) 'Degrees in pi Radians'
      FROM ADMIN.SYSCALCTABLE;

Notes
- Expression specifies an angle in radians.
- Expression must evaluate to a numeric data type.
DIFFERENCE function (ODBC compatible)

Syntax
DIFFERENCE ( string_exp1,string_exp2 )

Description
The scalar function DIFFERENCE returns an integer value that indicates the difference between the values returned by the SOUNDEX function for string_exp1 and string_exp2.

Example
SELECT DIFFERENCE(name,'Robets')
FROM customer
WHERE name = 'Roberts';

DIFFEREN

   2
1 record selected

Notes
- The arguments of the function are of character types.
- The result is INTEGER.
- If the argument expression evaluates to null, the result is null.
**EXP function (ODBC compatible)**

**Syntax**
EXP ( expression )

**Description**
The scalar function `EXP` returns the exponential value of expression (e raised to the power of expression).

**Example**
```
SELECT EXP(1) FROM SYSCALCTABLE;
```
```
2.718282
--------
2.718281828459046
1 record selected
```

**Notes**
- Expression must evaluate to an approximate numeric data type.
**EXTRACT SQL Function**

**Syntax**

EXTRACT(date_time_field FROM date_time_expression)

date_time_field ::

    | SECOND
    | MINUTE
    | HOUR
    | DAY
    | MONTH
    | YEAR

**Description**

The scalar function `EXTRACT` returns the a date and time field from a date and time expression.

**Example**

```sql
SELECT SYSDATE() , EXTRACT(MONTH FROM SYSDATE()) 'month'
FROM admin.syacalctable;
```

<table>
<thead>
<tr>
<th>SYSDATE</th>
<th>MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/21/2004</td>
<td>11</td>
</tr>
</tbody>
</table>

**Details**

The `date_time_expression` can evaluate to a TIME, DATE or TIMESTAMP data type.

The `date_time_field` and `date_time_expression` must be compatible.

`date_time_expression` is a TIME, DATE or TIMESTAMP from which `EXTRACT` returns the specified `date_time_field`.

`date_time_field` keywords that specify the field to be extracted from the `date_time_expression`.

- **SECOND** specifies that second part has to be extracted from the `date_time_expression`.
- **MINUTE** specifies that minute part has to be extracted from the `date_time_expression`.
- **HOUR** specifies that hour part has to be extracted from the `date_time_expression`.
- **DAY** specifies that day part has to be extracted from the `date_time_expression`.
- **MONTH** specifies that month part has to be extracted from the `date_time_expression`.
- **YEAR** specifies that year part has to be extracted from the `date_time_expression`.

**Note:** SQL-99 and ODBC compatible
FLOOR function (ODBC compatible)

Syntax
FLOOR ( expression )

Description
The scalar function FLOOR returns the largest integer less than or equal to expression.

Example
SELECT FLOOR (32.5) 'Floor'
        FROM ADMIN.SYSCALCTABLE;

Notes
- Expression must evaluate to a numeric data type.
GETDATE function (ODBC compatible)

Syntax
GETDATE ( )

Description
Synonymous with NOW() (page 121).
GREATEST function (extension)

Syntax
GREATEST ( expression, expression, ... )

Description
The scalar function GREATEST returns the greatest value among the values of the given expressions.

Example
SELECT cust_no, name,
       GREATEST (ADD_MONTHS (start_date, 10), SYSDATE)
FROM customer ;

Notes
- The first argument to the function can be of any type. The types of the subsequent arguments must be compatible with that of the first argument.
- The type of the result is the same as that of the first argument.
- If any of the argument expressions evaluates to null, the result is null.
HOUR function (ODBC compatible)

Syntax
HOUR ( time_expression )

Description
The scalar function HOUR returns the hour in the argument as a short integer value in the range of 0 - 23.

Example
SELECT *
FROM  arrivals
WHERE HOUR (in_time) < 12 ;

Notes
- The argument to the function must be of type TIME.
- The argument must be specified in the format hh:mm:ss.
- The result is of type SHORT.
- If the argument expression evaluates to null, the result is null.
IFNULL function (ODBC compatible)

Syntax
IFNULL( expr, value)

Description
The scalar function IFNULL returns value if expr is null. If expr is not null, IFNULL returns expr.

Example
select c1, ifnull(c1, 9999) from temp order by c1;
c1       ifnull(c1,9999)
  9999
  9999
  9999
  1
  3

Notes
The data type of value must be compatible with the data type of expr.
INITCAP function (extension)

Syntax

\[
\text{INITCAP ( char_expression )}
\]

Description

The scalar function INITCAP returns the result of the argument character expression after converting the first character to uppercase and the subsequent characters to lowercase.

Example

```
SELECT INITCAP (name)
FROM  customer ;
```

Notes

- The argument to the function must be of the character types.
- The result type is based on the argument type.
- If the argument expression evaluates to null, the result is null.
**INSERT function (ODBC compatible)**

**Syntax**

```
INSERT(string_exp1,start,length,string_exp2)
```

**Description**

The scalar function `INSERT` returns a character string where length characters have been deleted from `string_exp1` beginning at start and `string_exp2` has been inserted into `string_exp1`, beginning at start. The above operation will be performed only if both the arguments belong to the same character set (exceptions are shown below in the Notes section).

**Example**

```sql
SELECT INSERT(name,2,4,'xx')
FROM customer
WHERE name = 'Goldman';
```

```
Gxxan
1 record selected
```

**Notes**

- The `string_exp` can be of fixed length or variable length character types.
- The start and length can be of the type `INTEGER`, `SMALLINT`, `TINYINT` or `BIGINT`.
- The `string_exp2` has to belong to the `string_exp1`'s character set.
- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- The result string is of the type `string_exp1` and will belong to same character set as `string_exp1`.
- If any of the argument expression evaluates to a null, the result is a null.
- If start is negative or zero, the result string evaluates to a null.
- If length is negative, the result evaluates to a null.
INSTR function (extension)

Syntax

INSTR (char_expression, char_expression [, start_position [, occurrence]])

Description

The scalar function INSTR searches for the character string corresponding to the second argument in the character string corresponding to the first argument starting at \textit{start_position}. If occurrence is specified, then INSTR searches for the \textit{nth} occurrence where \textit{n} is the value of the fourth argument.

The position (with respect to the start of string corresponding to the first argument) is returned if a search is successful. Zero is returned if no match can be found.

Example

SELECT cust_no, name
FROM customer
WHERE INSTR (LOWER (addr), 'heritage') > 0 ;

Notes

- The first and second arguments must be of character type.
- The third and fourth arguments, if specified, must be of type \textit{INTEGER}.
- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- The values for specifying position in a character string starts from one. That is, the very first character in a string is at position one, the second character is at position two and so on.
- If the third argument is not specified, a default value of one is assumed.
- If the fourth argument is not specified, a default value of one is assumed.
- The result is of type \textit{INTEGER}.
- If any of the argument expressions evaluates to null, the result is null.
ISNULL function

Syntax
ISNULL ( expr, value )

Description
This scalar function is the same as the scalar function IFNULL. Refer to IFNULL (page 94) for usage.
**ISNUMERIC function**

**Syntax**

\[ \text{ISNUMERIC}( \text{expr} ) \]

**Description**

The scalar function `ISNUMERIC` returns 1 if the input expression evaluates to an exact numeric or approximate numeric type; otherwise it returns 0. A return value of 1 guarantees that `expr` can be converted to one of these numeric types.

**Arguments**

- `expr` - Is an expression to be evaluated.

**Example**

```sql
SELECT ISNUMERIC(id), ISNUMERIC(tbl) FROM systables
WHERE tbl = 'systables';
```

<table>
<thead>
<tr>
<th>ISNUMERIC(ID)</th>
<th>ISNUMERIC(TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
LAST_DAY function (extension)

Syntax
LAST_DAY ( date_expression )

Description
The scalar function LAST_DAY returns the date corresponding to the last day of the month containing the argument date.

Example
SELECT *  
FROM orders  
WHERE LAST_DAY (order_date) + 1 = '08/01/1991' ;

Notes
- The argument to the function must be of type DATE.
- The result is of type DATE.
- If the argument expression evaluates to null, the result is null.
**LAST_IDENT function (extension)**

**Syntax**

```
LAST_IDENT()
```

**Description**

The scalar function LAST_IDENT() returns the last inserted IDENTITY value for the session.

**Example**

```
SELECT LAST_IDENT();
```

**Notes**

- The result is of type NUMERIC(32,0)
**LCASE function (ODBC compatible)**

**Syntax**

```
LCASE ( char_expression )
```

**Description**

The scalar function `LCASE` returns the result of the argument character expression after converting all the characters to lowercase. `LCASE` is the same as `LOWER` but provides ODBC-compatible syntax.

**Example**

```
SELECT *
FROM customer
WHERE LCASE (name) = 'smith' ;
```

**Notes**

- The argument to the function must be of character type.
- The result type is based on the argument type.
- If the argument expression evaluates to null, the result is null.
LEAST function (extension)

Syntax
LEAST ( expression, expression, ... )

Description
The scalar function LEAST returns the lowest value among the values of the given expressions.

Example
SELECT cust_no, name,
    LEAST (ADD_MONTHS (start_date, 10), SYSDATE)
FROM customer ;

Notes
- The first argument to the function can be of any type. The types of the subsequent arguments must be compatible with that of the first argument.
- The type of the result is the same as that of the first argument.
- If any of the argument expressions evaluates to null, the result is null.
LEFT function (ODBC compatible)

Syntax
LEFT ( string_exp, count )

Description
The scalar function LEFT returns the leftmost count of characters of string_exp.

Example
SELECT LEFT(name,4)
FROM   customer
WHERE  name = 'Goldman';

LEFT(NAME,4)
Gold
1 record selected

Notes
- The string_exp can be of type fixed or variable length character type.
- The count can be of the type INTEGER, SMALLINT, BIGINT, or TINYINT.
- If any of the arguments of the expression evaluates to a null, the result would be null.
- If the count is negative, the result evaluates to a null.
LEN function (ODBC compatible)

Syntax
LEN ( char_expression )

Description
Synonymous with LENGTH() (page 106)
LENGTH function (ODBC compatible)

Syntax
LENGTH ( char_expression )

Description
The scalar function LENGTH returns the number of characters in char_expression, excluding trailing blanks.

Example
SELECT name 'LONG NAME'
FROM customer
WHERE LENGTH (name) > 5 ;

Notes
- The argument to the function must be of character type.
- The result is of type INTEGER.
- If the argument expression evaluates to null, the result is null.
LOCATE function (ODBC compatible)

Syntax
LOCATE( char-expr1 , char-expr2, [start-position] )

Description
The scalar function LOCATE returns the location of the first occurrence of char-expr1 in char-expr2. If the function includes the optional integer argument start-position, LOCATE begins searching char-expr2 at that position. If the function omits the start-position argument, LOCATE begins its search at the beginning of char-expr2.

LOCATE denotes the first character position of a character expression as one. If the search fails, LOCATE returns zero. If either character expression is null, LOCATE returns a null value.

Example
The following example uses two string literals as character expressions. LOCATE returns a value of six:

```
SELECT  LOCATE('this', 'test this test', 1) FROM TEST;
LOCATE(THIS,----------------------------------------
-------------------6
1 record selected
```
LOCALTIME SQL Function

Syntax
LOCALTIME([time_precision])

Description
The scalar function LOCALTIME returns current time as TIME value. This function takes an optional argument which decides the milliseconds precision in the result. The optional argument is an integer ranging between 0 and 3.

c-treeACE SQL statements can refer to LOCALTIME anywhere they can refer to a TIME expression.

Example
SELECT LOCALTIME(3) 'LOCALTIME' FROM admin.syscalctable;
LOCALTIME
----------
12:34:000
1 record selected

Details
The time_precision value is always set as three irrespective of what the user has specified and milliseconds is always returned as '000'.

LOCALTIMESTAMP SQL Function

Syntax
LOCALTIMESTAMP{ [timestamp_precision] }

Description
The scalar function LOCALTIMESTAMP returns current date and time as TIMESTAMP value. This function takes an optional argument which decides the milliseconds precision in the result. The optional argument timestamp_precision is an integer ranging between 0 and 9.
c-treeACE SQL statements can refer to LOCALTIMESTAMP anywhere they can refer to a TIMESTAMP expression.

Example
SELECT LOCALTIMESTAMP(3) 'localtimestamp' FROM
admin.syscalctable ;
LOCALTIMESTAMP
----------------
12/05/2004  12:25:000
1 record selected

Details
The timestamp_precision value is always set as 3 irrespective of what the user has specified and milliseconds is always returned as '000'.

LOG SQL Scaler Function

Syntax
LOG ( expression )

Description
The scalar function LOG returns the natural logarithm of expression.

Example
SELECT LOG( 100 ) 'Natural Logarithm of 100' FROM admin.syscalctable ;
NATURAL LOGARITH
----------------
4.605170185988092
1 record selected

Details
Expression must evaluate to an approximate numeric data type.

Note: ODBC compatible
LOG10 function (ODBC compatible)

Syntax
LOG10 ( expression )

Description
The scalar function LOG10 returns the base 10 logarithm of expression.

Example
SELECT LOG10 (100) 'Log base 10 of 100'
FROM ADMIN.SYSCALCTABLE;

Notes
- Expression must evaluate to an approximate numeric data type.
LOWER function (SQL-92 compatible)

Syntax
LOWER ( char_expression )

Description
The scalar function LOWER returns the result of the argument character expression after converting all the characters to lowercase.

Example
SELECT *
FROM customer
WHERE LOWER (name) = 'smith' ;

Notes
- The argument to the function must be of character type.
- The result type is based on the argument type.
- If the argument expression evaluates to null, the result is null.
**LPAD function (extension)**

**Syntax**

```
LPAD ( char_expression, length [, pad_expression] )
```

**Description**

The scalar function `LPAD` pads the character string corresponding to the first argument on the left with the character string corresponding to the third argument so that after the padding, the length of the result is `length`.

**Example**

```sql
SELECT LPAD (name, 30) 
FROM customer ;
SELECT LPAD (name, 30, '.') 
FROM customer ;
```

**Notes**

- The first argument to the function must be of character type.
- The second argument to the function must be of type `INTEGER`.
- The third argument, if specified, must be of character type.
- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- If the third argument is not specified, the default value is a string of length one containing one blank.
- If L1 is the length of the first argument and L2 is the value of the second argument, then:
  - If L1 is less than L2, the number of characters padded is equal to L2 - L1.
  - If L1 is equal to L2, no characters are padded and the result string is the same as the first argument.
  - If L1 is greater than L2, the result string is equal to the first argument truncated to the first L2 characters.
- The result is of character type whose character set is same as that of the arguments.
- If the argument expression evaluates to null, the result is null.
LTRIM function (ODBC compatible)

Syntax

```
LTRIM ( char_expression [ , char_set ] )
```

Description

The scalar function `LTRIM` removes all the leading characters in `char_expression`, that are present in `char_set` and returns the resultant string. Thus, the first character in the result is guaranteed to be not in `char_set`. If the `char_set` argument is omitted, the function removes the leading and trailing blanks from `char_expression`.

Example

```
SELECT name, LTRIM (addr, ' ') 
FROM  customer ;
```

Notes

- The first and second arguments to the function must be of character type.
- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- The result is of character type whose character set is same as that of the arguments.
- If the argument expression evaluates to null, the result is null.
MINUTE function (ODBC compatible)

Syntax
MINUTE ( time_expression )

Description
The scalar function MINUTE returns the minute value in the argument as a short integer in the range of 0 - 59.

Example
SELECT *
FROM arrivals
WHERE MINUTE (in_time) > 10 ;

Notes
- The argument to the function must be of type TIME.
- The argument must be specified in the format HH:MI:SS.
- The result is of type SHORT.
- If the argument expression evaluates to null, the result is null.
MOD function (ODBC compatible)

Syntax
MOD ( expression1, expression2 )

Description
The scalar function MOD returns the remainder of expression1 divided by expression2.

Example
SELECT MOD (11, 4) 'Modulus'
    FROM ADMIN.SYSCALCTABLE;

Notes
- Both expression1 and expression2 must evaluate to exact numeric data types.
- If expression2 evaluates to zero, MOD returns zero.
MONTHNAME function (ODBC compatible)

Syntax
MONTHNAME ( date_expression )

Description
Returns a character string containing the name of the month (for example, January, through December) for the month portion of date_expression. Argument date_expression can be name of a column, the result of another scalar function, or a date or timestamp literal.

Example
SELECT *
FROM orders
WHERE order_no = 346 and MONTHNAME(order_date) = 'JUNE';

ORDER NO  ORDER DATE    REFERENCE              CUST NO
346       06/01/1991    87/rd                  10002

1 record selected
MONTH function (ODBC compatible)

Syntax
MONTH ( date_expression )

Description
The scalar function `MONTH` returns the month in the year specified by the argument as a short integer value in the range of 1 - 12.

Example
```
SELECT *
FROM orders
WHERE MONTH (order_date) = 6 ;
```

Notes
- The argument to the function must be of type `DATE`.
- The argument must be specified in the format `MM/DD/YYYY`.
- The result is of type `SHORT`.
- If the argument expression evaluates to null, the result is null.
MONTHS_BETWEEN function (extension)

Syntax
MONTHS_BETWEEN ( date_expression, date_expression )

Description
The scalar function MONTHS_BETWEEN computes the number of months between two date values corresponding to the first and second arguments.

Example
SELECT MONTHS_BETWEEN (SYSDATE, order_date)  FROM orders WHERE order_no = 1002 ;

Notes
- The first and the second arguments to the function must be of type DATE.
- The result is of type INTEGER.
- The result is negative if the date corresponding to the second argument is greater than that corresponding to the first argument.
- If any of the arguments expression evaluates to null, the result is null.
NEXT_DAY function (extension)

Syntax
NEXT_DAY ( date_expression, day_of_week )

Description
The scalar function NEXT_DAY returns the minimum date that is greater than the date corresponding to the first argument for which the day of the week is same as that specified by the second argument.

Example
SELECT NEXT_DAY (order_date, 'MONDAY')
FROM orders;

Notes
- The first argument to the function must be of type DATE.
- The second argument to the function must be of type NCHAR or NVARCHAR for Unicode builds and type CHAR or VARCHAR for ANSI builds. The result of the second argument must be a valid day of week ('SUNDAY', 'MONDAY' etc.)
- The result is of type DATE.
- If any of the argument expressions evaluates to null, the result is null.
NOW function (ODBC compatible)

Syntax
NOW ( )

Description
NOW returns the current date and time as a TIMESTAMP value. This function takes no arguments.
SQL Language Elements

NULLIF (SQL-92 compatible)

Syntax
NULLIF ( expression1, expression2 )

Description
The NULLIF scalar function is a type of conditional expression (See Conditional Expressions (page 26) for more information and a summary of all the conditional expressions).

The NULLIF scalar function returns a null value for expression1 if it is equal to expression2. It's useful for converting values to null from applications that use some other representation for missing or unknown data.

Notes
- This function is not allowed in a GROUP BY clause.
- Arguments to this function cannot be query expressions.
- The NULLIF expression is shorthand notation for a common case that can also be represented in a CASE expression, as follows:

  ```
  CASE
    WHEN expression1 = expression2 THEN NULL
    ELSE expression1
  END
  ```

Example
This example uses the NULLIF scalar function to insert a null value into an address column if the host-language variable contains a single space character.

```sql
INSERT INTO employee (add1) VALUES (NULLIF (:address1, ' '));
```
NVL function (extension)

Syntax
NVL ( expression, expression )

Description
The scalar function NVL returns the value of the first expression if the first expression value is not null. If the first expression value is null, the value of the second expression is returned.

The NVL function is not ODBC compatible. Use the IFNULL function for ODBC-compatible syntax.

Example
SELECT salary + NVL (comm, 0) 'TOTAL SALARY'
   FROM employee ;

Notes
- The first argument to the function can be of any type except for LONG data types.
- The type of the second argument must be compatible with that of the first argument.
- The type of the result is the same as the first argument.
OBJECT_ID function (extension)

Syntax

OBJECT_ID ('table_name')

Description

The scalar function OBJECT_ID returns the value of the id column in the admin.systables, plus one. This function provides compatibility with the Sybase SQL Server function object_id.

Arguments

table_name

The name of the table for which OBJECT_ID returns an identification value.

Example

```sql
select id, object_id(tbl), tbl from admin.systables
where owner = 'admin';
```

<table>
<thead>
<tr>
<th>ID</th>
<th>OBJECT_ID(TBL)</th>
<th>TBL</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>systblspaces</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>systables</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>syscolumns</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>sysindexes</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>systsfiles</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>syslogfiles</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>sysdbsyncpt</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>syslogbackup</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>sysdbsuuid</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>syssyssvr</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>sysruarsvr</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>
**OCTET_LENGTH SQL Function**

**Syntax**

OCTET_LENGTH ( char_expression )

**Description**

The scalar function OCTET_LENGTH returns the number of bytes in the `char_expression`.

**Example**

```sql
SELECT NAME FROM customers
WHERE OCTET_LENGTH( name ) < 10 ;
```

<table>
<thead>
<tr>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>rathan</td>
</tr>
<tr>
<td>Dany</td>
</tr>
</tbody>
</table>

2 records selected

**Note:** SQL-99 and ODBC compatible
OVERLAY SQL Function

Syntax
OVERLAY ( char_exp1 PLACING char_exp2 FROM start_position
[ FOR length ] )

The argument length is optional. If length is not specified, the scalar function returns a character string where char_exp2 has been appended to the char_exp1 beginning at start_position.

Description
The scalar function OVERLAY returns a character string where length characters have been deleted from the char_exp1 beginning at start_position and char_exp2 has been inserted into char_exp1 beginning at start_position.

Example
SELECT OVERLAY( name PLACING 'Technologies' FROM 9 FOR 12 )
From customers
WHERE name = 'FairCom Corporation' ;
OVERLAY(NAME,8,9,TECHNOLOGIES)
--------------------
FairCom Technologies
1 record selected

Details
- The char_exp can be of fixed length or variable character types.
- The start_position and length can be of the type INTEGER, SMALLINT, TINYINT or BIGINT.
- The char_exp2 has to belong to char_exp1's character set.
- The result expression is of the type char_exp1 and will belong to the same character set as char_exp1.
- If start_position is negative or zero, the result expression evaluates to a null.
- If length is negative the result evaluates to a null.

Note: SQL-99 compatible
PI function (ODBC compatible)

Syntax
PI ( )

Description
The scalar function PI returns the constant value of pi as a floating point value.

Example
SELECT PI ()
    FROM ADMIN.SYSCALCTABLE;
POSITION SQL Function

Syntax
POSITION ( char_exp1 IN char_exp2 )

Description
The scalar function POSITION returns the first occurrence of char_exp1 in char_exp2.

Example
SELECT POSITION ( 'Fa' IN 'FairCom' )
FROM customers;
POSITION
--------
1
1 record selected

Details
If any one of the expressions evaluates to be null, POSITION returns null.

Note: SQL-99 and ODBC compatible
POWER function (ODBC compatible)

Syntax
POWER ( expression1 , expression2 )

Description
The scalar function POWER returns expression1 raised to the power of expression2.

Example
SELECT POWER ( 3 , 2) '3 raised to the 2nd power'
FROM ADMIN.SYSCALCTABLE;

Notes
- Expression1 must evaluate to a numeric data type.
- Expression2 must evaluate to an exact numeric data type.
PREFIX function (extension)

Syntax

PREFIX(char_expression, start_position, char_expression)

Description

The scalar function PREFIX returns the substring of a character string starting from the position specified by start position, and ending before the specified character.

Arguments

char_expression
An expression that evaluates to a character string, typically a character-string literal or column name. If the expression evaluates to null, PREFIX returns null.

start_position
An expression that evaluates to an integer value. PREFIX searches the string specified in the first argument starting at that position. A value of one indicates the first character of the string.

char_expression
An expression that evaluates to a single character. PREFIX returns the substring that ends before that character. If PREFIX does not find the character, it returns the substring beginning with start_position, to the end of the string. If the expression evaluates to more than one character, PREFIX ignores all but the first character.

Example

SELECT C1, C2, PREFIX(C1, 1, '.') FROM T1;
C1           C2   PREFIX(C1,1,.
--           --   ------------
test.pref    .    test
pref.test    s    pref
2 records selected

SELECT C1, C2, PREFIX(C1, 1, C2) FROM T1;
C1           C2   PREFIX(C1,1,C
--           --   ------------
test.pref    .    test
pref.test    s    pref.te
2 records selected

SELECT C1, C2, PREFIX(C1, 1, 'Q') FROM T1;
C1           C2   PREFIX(C1,1,Q
--           --   ------------
test.pref    .    test.pref
pref.test    s    pref.test
2 records selected

Notes

- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
QUARTER function (ODBC compatible)

Syntax
QUARTER ( time_expression )

Description
The scalar function QUARTER returns the quarter in the year specified by the argument as a short integer value in the range of 1 - 4.

Example
SELECT *  
FROM   orders  
WHERE  QUARTER (order_date) = 3 ;

Notes
- The argument to the function must be of type DATE.
- The argument must be specified in the format MM/DD/YYYY.
- The result is of type SHORT.
- If the argument expression evaluates to null, the result is null.
RADIANS function (ODBC compatible)

Syntax
RADIANS ( expression )

Description
The scalar function RADIANS returns the number of radians in an angle specified in degrees by expression.

Example
SELECT RADIANS(180) 'Radians in 180 degrees'
FROM ADMIN.SYSCALCTABLE;

Notes
- Expression specifies an angle in degrees.
- Expression must evaluate to a numeric data type.
**RAND function (ODBC compatible)**

**Syntax**

```
RAND ( [ expression ] )
```

**Description**

The scalar function `RAND` returns a randomly-generated number, using `expression` as an optional seed value.

**Example**

```sql
SELECT RAND(3) 'Random number using 3 as seed value'
FROM ADMIN.SYSCALCTABLE;
```

**Notes**

- Expression must evaluate to an exact numeric data type.
**REPEAT function (ODBC compatible)**

**Syntax**
REPEAT ( string_exp,count )

**Description**
The scalar function `REPEAT` returns a character string composed of `string_exp` repeated `count` times.

**Example**
SELECT REPEAT(fld1,3)
FROM test100
WHERE fld1 = 'Afghanistan'

**Results**
REPEAT(FLD1,3)
AfghanistanAfghanistanAfghanistan

1 record selected

**Notes**
- The string expression can be any of the fixed length or variable length character types.
- The count can be of the type `INTEGER`, `SMALLINT`, `BIGINT`, or `TINYINT`.
- If any of the arguments of the expression evaluates to a null, the result would be null.
- If the count is negative or zero, the result evaluates to a null.
REPLACE function (ODBC compatible)

Syntax

REPLACE ( string_exp1, string_exp2, string_exp3 )

Description

The scalar function REPLACE replaces all occurrences of string_exp2 in string_exp1 with string_exp3. The resultant character string will have the same character set as that of the arguments.

Example

SELECT REPLACE ( name, 'mi', 'moo' )
FROM customer
WHERE name = 'Smith';

REPLACE(NAME,MI,MOO)

Smooth
1 record selected

Notes

- string_exp can be any of the type fixed or variable length character types.
- If any of the arguments of the expression evaluates to null, the result is null.
- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- If the replacement string is not found in the search string, it returns the original string.
RIGHT function (ODBC compatible)

Syntax
RIGHT ( string_exp, count )

Description
The scalar function RIGHT returns the rightmost count of characters of string_exp.

Example
SELECT RIGHT(fld1,6)
FROM test10
WHERE fld1 = 'Afghanistan';
RIGHT(FLD1,6)

istan
1 record selected

Notes
- The string_exp can be any of the fixed or variable length Character types.
- The count can be of the type INTEGER, SMALLINT, BIGINT, or TINYINT.
- If any of the arguments of the expression evaluates to a null, the result would be null.
- If the count is negative, the result evaluates to a null.
ROUND function

Syntax
ROUND( number, length [,operation_type] )

Description
The scalar function rounds number to length decimal places.

If value of length is positive, number is rounded to the number of decimal places specified by length.

If length is negative, number is rounded on the left side of the decimal point, as specified by the positive value of length.

Arguments
- number - This is an expression of an exact numeric or approximate numeric data type.
- length - This is the precision or number of digits to which number is to be rounded. The argument value must be of data type TINYINT, SMALLINT or INTEGER.
- operation_type - This is the type of operation - rounding or truncation - to perform. The argument value must be of type TINYINT, SMALLINT or INTEGER. If the argument is omitted or has a value of 0 (default), number is rounded. If a value other than 0 is specified, number is truncated.

Example
SELECT price, ROUND(price, 1), ROUND(price, -1)
FROM custorder;
PRICE ROUND(PRI ROUND(PRI
----- -------- --------
1546.56 1546.60 1550.00
SELECT price, ROUND(price, 1, 1), ROUND(price, -1, 1)
FROM custorder;
PRICE ROUND(PRI ROUND(PRI
----- -------- --------
1546.56 1546.50 1540.00
**ROWID (extension)**

**Syntax**

ROWID

**Description**

The scalar function `ROWID` returns the row identifier of the current row in a table. This function takes no arguments. The `ROWID` of a row is determined when the row is inserted into the table. Once assigned, the `ROWID` remains the same for the row until the row is deleted. At any given time, each row in a table is uniquely identified by its `ROWID`.

Selecting a row in a table using its `ROWID` is the most efficient way of selecting the row. For example:

```sql
SELECT *
FROM customers
WHERE ROWID = '10';
```
ROWIDTOCHAR (extension)

Syntax
ROWIDTOCHAR ( expression )

Description
The scalar function ROWIDTOCHAR returns the character form of a ROWID contained in the input argument.

Example
The following example uses ROWIDTOCHAR to convert a row identifier from its internal representation to a character string.

```sql
SELECT cust_no,
       SUBSTR (ROWIDTOCHAR (ROWID), 1, 8) 'PAGE NUMBER',
       SUBSTR (ROWIDTOCHAR (ROWID), 10, 4) 'LINE NUMBER',
       SUBSTR (ROWIDTOCHAR (ROWID), 15, 4) 'TABLE SPACE NUMBER'
FROM customer ;
```

Notes
- The argument to the function must be a ROWID.
- The result is of type NCHAR for Unicode builds and CHAR for ANSI builds.
- If the argument expression evaluates to null, the result is null.
**RPAD function (extension)**

**Syntax**

```
RPAD (char_expression, length [, pad_expression] )
```

**Description**

The scalar function `RPAD` pads the character string corresponding to the first argument on the right with the character string corresponding to the third argument so that after the padding, the length of the result would be equal to the value of the second argument length.

**Example**

```
SELECT RPAD (name, 30)
FROM customer ;
```

```
SELECT RPAD (name, 30, '.')
FROM customer ;
```

**Notes**

- The first argument to the function must be of character type.
- The second argument to the function must be of type `INTEGER`.
- The third argument, if specified, must be of character type.
- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- If L1 is the length of the first argument and L2 is the value of the second argument, then:
  - If L1 is less than L2, the number of characters padded is equal to L2 - L1.
  - If L1 is equal to L2, no characters are padded and the result string is the same as the first argument.
  - If L1 is greater than L2, the result string is equal to the first argument truncated to first L2 characters.
- The result is of character type whose character set is same as that of it’s arguments.
- If the argument expression evaluates to null, the result is null.
RTRIM function (ODBC compatible)

Syntax
RTRIM ( char_expression [, char_set ] )

Description
The scalar function RTRIM removes all the trailing characters in char_expression, that are present in char_set and returns the resultant string. Thus, the last character in the result is guaranteed to be not in char_set. If the char_set argument is omitted, the function removes the leading and trailing blanks from char_expression.

Example
SELECT RPAD ( RTRIM (addr, ' '), 30, '.' )
   FROM customer ;

Notes
- The first and second arguments to the function must be of character type.
- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
- The result is of character type.
- If the argument expression evaluates to null, the result is null.
SECON D function (ODBC compatible)

Syntax
SECOND ( time_expression )

Description
The scalar function SECOND returns the seconds in the argument as a short integer value in the range of 0 - 59.

Example
SELECT *
FROM arrivals
WHERE SECOND (in_time) <= 40 ;

Notes
- The argument to the function must be of type TIME.
- The argument must be specified in the format HH:MI:SS.
- The result is of type SHORT.
- If the argument expression evaluates to null, the result is null.
SESSION_USER SQL Function

Syntax
SESSION_USER

Description
The scalar function SESSION_USER returns the value of the c-treeACE SQL session identifier. c-treeACE SQL returns the user.

Example
ISQL>SELECT SESSION_USER FROM admin.syscalctable;
FRED
-------
fred
1 record selected

Note: SQL-99 compatible
SIGN function (ODBC compatible)

Syntax
SIGN ( expression )

Description
The scalar function SIGN returns 1 if expression is positive, -1 if expression is negative, or zero if it is zero.

Example
SELECT SIGN(-14) 'Sign'
    FROM ADMIN.SYSCALCTABLE;

Notes
- Expression must evaluate to a numeric data type.
**SIN function (ODBC compatible)**

**Syntax**

SIN ( expression )

**Description**

The scalar function SIN returns the sine of expression.

**Example**

```sql
select sin(45 * pi()/180) 'Sine of 45 degrees' from syscalctable;
```

```
SINE OF 45 DEGRE
----------------
0.707106781186547
1 record selected
```

**Notes**

SIN takes an angle (expression) and returns the ratio of two sides of a right triangle. The ratio is the length of the side opposite the angle divided by the length of the hypotenuse.

- Expression specifies an angle in radians.
- Expression must evaluate to an approximate numeric data type.

To convert degrees to radians, multiply degrees by Pi/180. To convert radians to degrees, multiply radians by 180/Pi.
**SOUNDEX function (ODBC compatible)**

**Syntax**

```sql
SOUNDEX ( string_exp )
```

**Description**

The scalar function `SOUNDEX` returns a four-character soundex code for character strings that are composed of a contiguous sequence of valid single- or double-byte roman letters.

**Example**

```sql
SELECT SOUNDEX('Roberts')
FROM syscalctable;
```
**SPACE function (ODBC compatible)**

**Syntax**

```
SPACE ( count )
```

**Description**

The scalar function `SPACE` returns a character string consisting of count spaces.

**Example**

```
SELECT CONCAT(SPACE(3), name)
FROM customer
WHERE name = 'Roberts';
```

```
CONCAT (   ,NAME)
Roberts
```

1 record selected

**Notes**

- The count argument can be of type `INTEGER`, `SMALLINT`, `BIGINT`, or `TINYINT`.
- If count is null, the result is null.
- If count is negative, the result is null.
**SQRT function (ODBC compatible)**

**Syntax**

```sql
SQRT ( expression )
```

**Description**

The scalar function `SQRT` returns the square root of the expression.

**Example**

```sql
SELECT SQRT(28) 'square root of 28'
FROM ADMIN.SYSCALCTABLE;
```

**Notes**

- The value of the expression must be positive.
- The expression must evaluate to an approximate numeric data type.
SUBSTR function (extension)

Syntax
SUBSTR ( char_expression, start_position [, length ] )

Description
The scalar function SUBSTR returns the substring of the character string corresponding to the first argument starting at start_position and length characters long. If the third argument length is not specified, substring starting at start_position up to the end of char_expression is returned.

Example
SELECT name, '(', SUBSTR (phone, 1, 3) , ')',
       SUBSTR (phone, 4, 3), '-',
       SUBSTR (phone, 7, 4)
FROM customer ;

Notes
• The first argument must be of character type.
• The second argument must be of type INTEGER.
• The third argument, if specified, must be of type INTEGER.
• The values for specifying position in the character string start from one. The very first character in a string is at position one, the second character is at position two and so on.
• The result is of character type.
• If any of the argument expressions evaluates to null, the result is null.
SUBSTRING SQL Function (SQL-99 compatible)

Syntax
SUBSTRING (char_exp FROM start_position [ FOR length ])

Description
The scalar function SUBSTRING returns the substring of a character string corresponding to the first argument starting at start_position and length characters long.

The third argument length is optional. If the length is not specified the substring starting at start_position up to the end of the char_exp is returned.

Example
SELECT SUBSTRING( 'FairCom Corporation' FROM 1 FOR 7)
From customers ;
FAIRCOM
------
FairCom
1 record selected

Details
- The first argument, char_exp, must be of character type.
- The second argument, start_position, must be of type INTEGER.
- The third argument, length, if specified, must be of type INTEGER.
- The values for specifying position in char_exp start from 1. The very first character in a string is at position 1, the second character is at position 2 and so on.
- The result is of character type.
- If any of the argument expressions evaluates to null, the result is null.

Note: SQL-99 compatible
SUBSTRING function (ODBC compatible)

Syntax

```
SUBSTRING ( char_expression, start_position [, length ] )
```

Description

The scalar function `SUBSTRING` returns the substring of the character string corresponding to the first argument starting at `start_position` and `length` characters long. If the third argument, `length`, is not specified, the substring starting at `start_position` up to the end of `char_expression` is returned. `SUBSTRING` is identical to `SUBSTR` and provides ODBC-compatible syntax.

Example

```
SELECT name, '(', SUBSTRING (phone, 1, 3) , ')',
       SUBSTRING (phone, 4, 3), '-',
       SUBSTRING (phone, 7, 4)
FROM customer ;
```

Notes

- The first argument must be of character type.
- The second argument must be of type `INTEGER`.
- The third argument, if specified, must be of type `INTEGER`.
- The values for specifying position in the character string start from one. The very first character in a string is at position one, the second character is at position two and so on.
- The result is of character type.
- If any of the argument expressions evaluates to null, the result is null.
**SUFFIX function (extension)**

**Syntax**

\[ \text{SUFFIX(char_expression1, start_position, char_expression2)} \]

**Description**

The scalar function \( \text{SUFFIX} \) returns the substring of a character string starting after the position specified by \( \text{start_position} \) and the second \( \text{char_expression} \), to the end of the string.

**Arguments**

\( \text{char_expression1} \)

An expression that evaluates to a character string, typically a character-string literal or column name. If the expression evaluates to null, \( \text{SUFFIX} \) returns null.

\( \text{start_position} \)

An expression that evaluates to an integer value. \( \text{SUFFIX} \) searches the string specified in the first argument starting at that position. A value of one indicates the first character of the string.

\( \text{char_expression2} \)

An expression that evaluates to a single character. \( \text{SUFFIX} \) returns the substring that begins with that character. If \( \text{SUFFIX} \) does not find the character after \( \text{start_position} \), it returns null. If the expression evaluates to more than one character, \( \text{SUFFIX} \) ignores all but the first character.

**Example**

```
SELECT C1, C2, SUFFIX(C1, 6, '.') FROM T1;
C1           C2   SUFFIX(C1,6,.
--  --  ------------
test.pref     .   pref.test     s
2 records selected
SELECT C1, C2, SUFFIX(C1, 1, C2) FROM T1;
C1           C2   SUFFIX(C1,1,C
--  --  ------------
test.pref     .   pref.test     s
t  2 records selected
SELECT C1, C2, SUFFIX(C1, 6, '.') FROM T1;
C1           C2   SUFFIX(C1,6,.
--  --  ------------
test.pref     .   pref.test     s
2 records selected
```

**NOTES**

- If one of the arguments is a literal and the other one a field reference, the operation is possible only if the literal is convertible to the character set of the field reference. Otherwise an error is returned.
**SUSER_NAME function (extension)**

**Syntax**

SUSER_NAME ( [user_id] )

**Description**

The scalar function SUSER_NAME returns the user login name for the user_id specified in the input argument. If no user_id is specified, SUSER_NAME returns the name of the current user.

This function provides compatibility with the Sybase SQL Server function suser_name. It is identical to the USER_NAME function.

**Example**

```sql
select suser_name() from admin.syscalctable;
```

SUSER_NAME
----------
searle
1 record selected

```sql
select suser_name(104) from admin.syscalctable;
```

SUSER_NAME(104)
---------------
dbp
1 record selected

```sql
select id, tbl, owner from admin.systables
1 where owner = suser_name();
```

<table>
<thead>
<tr>
<th>ID</th>
<th>TBL</th>
<th>OWNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>test</td>
<td>searle</td>
</tr>
<tr>
<td>42</td>
<td>t2</td>
<td>searle</td>
</tr>
<tr>
<td>43</td>
<td>t1</td>
<td>searle</td>
</tr>
</tbody>
</table>

3 records selected
SYSDATE function (extension)

Syntax
SYSDATE [ ( ) ]

Description
SYSDATE returns the current date as a DATE value. This function takes no arguments, and the trailing parentheses are optional.

c-treeACE SQL statements can refer to SYSDATE anywhere they can refer to a DATE expression. For example,

```
INSERT INTO objects (object_owner, object_id, create_date)
    VALUES (USER, 1001, SYSDATE) ;
```
SYSTIME function (extension)

Syntax

SYSTIME [ ( ) ]

Description

SYSTIME returns the current time as a TIME value. This function takes no arguments, and the trailing parentheses are optional.

c-treeACE SQL statements can refer to SYSTIME anywhere they can refer to a TIME expression. For example,

```
INSERT INTO objects (object_owner, object_id, create_time)
VALUES (USER, 1001, SYSTIME) ;
```
SYSTIMESTAMP function (extension)

Syntax

SYSTIMESTAMP [ ( ) ]

Description

SYSTIMESTAMP returns the current date and time as a TIMESTAMP value. This function takes no arguments, and the trailing parentheses are optional.

The following c-treeSQL example shows the different formats for SYSDATE, SYSTIME, and SYSTIMESTAMP:

```sql
SELECT SYSDATE FROM test;
SYMDATE
-------
09/13/1994
1 record selected

SELECT SYSTIME FROM test;
SYSTIME
-------
14:44:07:000
1 record selected

SELECT SYSTIMESTAMP FROM test;
SYSTIMESTAMP
------------
1994-09-13 14:44:15:000
1 record selected
```
TAN function (ODBC compatible)

Syntax
TAN ( expression )

Description
The scalar function TAN returns the tangent of expression.

Example
select tan(45 * pi()/180) 'Tangent of 45 degrees' from syscalctable;
TANGENT OF 45 DE
----------------
1.000000000000000
1 record selected

Notes
TAN takes an angle (expression) and returns the ratio of two sides of a right triangle. The ratio is the length of the side opposite the angle divided by the length of the side adjacent to the angle.

- Expression specifies an angle in radians.
- Expression must evaluate to an approximate numeric data type.

To convert degrees to radians, multiply degrees by Pi/180. To convert radians to degrees, multiply radians by 180/Pi.
TIMESTAMPADD function (ODBC compatible)

Syntax
TIMESTAMPADD(interval, integer_exp, date_time_exp)

interval:

| SQL_TSI_FRAC_SECOND |
| SQL_TSI_SECOND   |
| SQL_TSI_MINUTE   |
| SQL_TSI_HOUR     |
| SQL_TSI_DAY      |
| SQL_TSI_DAYOFYEAR|
| SQL_TSI_WEEK     |
| SQL_TSI_MONTH    |
| SQL_TSI_QUARTER  |
| SQL_TSI_YEAR     |
| MILLISECOND     |
| SECOND           |
| MINUTE           |
| HOUR             |
| DAY              |
| DAYOFYEAR        |
| WEEK             |
| MONTH            |
| QUARTER          |
| YEAR             |

Description
Returns the timestamp calculated by adding integer_exp intervals of type interval to timestamp_exp.

Arguments
interval
Keywords that specify the interval to add to timestamp_exp. The SQL_TSI_FRAC_SECOND keyword specifies fractional seconds as milliseconds.

Keywords such as SECOND and HOUR are functionally equivalent to the keywords with the same name but having prefix SQL_TSI, i.e., the keywords such as SQL_TSI_SECOND and SQL_TSI_HOUR. The keyword MILLISECOND is the same as SQL_TSI_FRAC_SECOND and this interval means milliseconds. The keyword DAYOFYEAR or SQL_TSI_DAYOFYEAR indicates an interval value which ranges from 1 to 366 (See scalar function DAYOFYEAR()).

integer_exp
The number of interval values to add to timestamp_exp. integer_exp can be any expression that evaluates to an integer data type.

date_time_exp
A date-time expression from which TIMESTAMPADD calculates the return value. If date_time_exp is a date value and interval specifies fractional seconds, seconds, minutes, or hours, the time portion of timestamp_exp is set to 0 before calculating the resulting timestamp.
Example

The following example displays the current system time and uses the `TIMESTAMPADD` scalar function to add 8 hours to it.

```sql
> select systime, timestampadd(sql_tsi_hour, 8, systime) from syscalctable;
15:03:57:000  06/08/1999 23:03:57:000
-------------------------
15:03:57:000,   1999-06-08 23:03:57:000
```
TIMESTAMPDIFF function (ODBC compatible)

Syntax
TIMESTAMPDIFF(interval, date_time_exp1, date_time_exp2)

interval:
- SQL_TSI_FRAC_SECOND
- SQL_TSI_SECOND
- SQL_TSI_MINUTE
- SQL_TSI_HOUR
- SQL_TSI_DAY
- SQL_TSI_WEEK
- SQL_TSI_MONTH
- SQL_TSI_QUARTER
- SQL_TSI_YEAR

Description
Returns an integer representing the number of intervals by which date_time_exp2 is greater than date_time_exp1.

Arguments
interval
Keywords that specify the interval in which to express the difference between the two date-time arguments. The SQL_TSI_FRAC_SECOND keyword specifies fractional seconds in milliseconds.

date_time_exp1
A date-time expression which TIMESTAMPADD subtracts from date_time_exp2.

date_time_exp2
A date-time expression from which TIMESTAMPADD subtracts date_time_exp1.

Example
The following example displays difference in seconds between the current system time and one day later.

> select timestampdiff(sql_tsi_second, sysdate, sysdate + 1) from syscalctable;

          86400
       -----
          86400

Notes
If either date-time expression is a time value and interval specifies days, weeks, months, quarters, or years, the date portion of that expression is set to the current date before calculating the difference between the expressions.

If either date-time expression is a date value and interval specifies fractional seconds, seconds, minutes, or hours, the time portion of that expression is set to 0 before calculating the difference between the expressions.
TO_CHAR function (extension)

Syntax
TO_CHAR ( expression [ , format_string ] )

Description
The scalar function TO_CHAR converts the given expression to character form and returns the result. The primary use for TO_CHAR is to format the output of date-time expressions through the format_string argument.

Arguments
expression
Specifies the expression to be converted to character form. To use the format_string argument, expression must evaluate to a date or time value.

format_string
A date-time format string that specifies the format of the output. See Date Format Strings (page 42) and Time Format Strings (page 43) for more details.
c-treeACE SQL ignores the format string if the expression argument does not evaluate to a date or time.

Example
SELECT C1 FROM T2;
C1
--
09/29/1952
1 record selected

SELECT TO_CHAR(C1, 'Day, Month ddth'), TO_CHAR(C2, 'HH12 a.m.') FROM T2;

TO_CHAR(C1,DAY, MONTH DDTH)  TO_CHAR(C2,HH12 A.M.)
---------------------------  ---------------------
Monday   , September 29th    02 p.m.
1 record selected

Notes
- The first argument to the function can be of any type.
- The second argument, if specified, must be of type NCHAR or NVARCHAR for UNICODE builds and of type CHAR or VARCHAR for ANSI builds.
- The result is of character type.
- The format argument can be used only when the type of the first argument is DATE.
- If any of the argument expressions evaluates to null, the result is null.
**TO_DATE function (extension)**

**Syntax**

```
TO_DATE ( date_lit )
```

**Description**
The scalar function TO_DATE converts the given date literal to a date value.

**Example**

```
SELECT * FROM orders
    WHERE order_date <= TO_DATE ('12/31/1991') ;
```

**Notes**
- The result is of type `DATE`.
- Supply the date literal in any valid format. See *Date Literals* (page 28) for valid formats of `DATE` literals.
**TO_NUMBER function (extension)**

**Syntax**

```
TO_NUMBER ( char_expression )
```

**Description**

The scalar function `TO_NUMBER` converts the given character expression to a number value.

**Example**

```
SELECT * FROM customer
WHERE TO_NUMBER (SUBSTR (phone, 1, 3)) = 603 ;
```

**Notes**

- The argument to the function must be of type `NCHAR` or `NVARCHAR` for Unicode builds and of type `CHAR` or `VARCHAR` for ANSI builds.
- The result is of type `NUMERIC`.
- If any of the argument expressions evaluates to null, the result is null.
TO_TIME function (extension)

Syntax

TO_TIME ( time_lit )

Description

The scalar function TO_TIME converts the given time literal to a time value.

Example

SELECT * FROM orders
    WHERE order_date < TO_DATE ('05/15/1991')
    AND order_time < TO_TIME ('12:00:00') ;

Notes

- The result is of type TIME.
- Supply the time literal in any valid format. See Time Literals (page 29) for valid formats of TIME literals.
TO_TIMESTAMP function (extension)

Syntax

TO_TIMESTAMP (timestamp_lit)

Description

The scalar function TO_TIMESTAMP converts the given timestamp literal to a timestamp value.

Example

SELECT * FROM orders
WHERE order_timestamp > TO_TIMESTAMP('4/18/95 10:41:19')

Notes

- The result is of type TIMESTAMP.
- Supply the timestamp literal in any valid format. See Timestamp Literals (page 30) for valid formats of TIMESTAMP literals.
TRANSLATE function (extension)

Syntax
TRANSLATE ( char_expression, from_set, to_set )

Description
The scalar function TRANSLATE translates each character in char_expression that is in from_set to the corresponding character in to_set. The translated character string is returned as the result. This function is similar to the Oracle TRANSLATE function.

Example
This example substitutes underscores for spaces in customer names.

```
SELECT TRANSLATE (customer_name, ' ', '_')
     "TRANSLATE Example" from customers;
```

```
TRANSLATE EXAMPLE
-----------------
Sports_Cars_Inc.__________________________________
Mighty_Bulldozer_Inc._____________________________
Ship_Shapers_Inc.________________________________
Tower_Construction_Inc.___________________________
Chemical_Construction_Inc.________________________
Aerospace_Enterprises_Inc.________________________
Medical_Enterprises_Inc.__________________________
Rail_Builders_Inc.________________________________
Luxury_Cars_Inc.________________________________
Office_Furniture_Inc._____________________________
```

Notes
- char_expression, from_set, and to_set can be any character expression.
- For each character in char_expression, TRANSLATE checks for the same character in from_set:
  - If it is in from_set, TRANSLATE translates it to the corresponding character in to_set (if the character is the nth character in from_set, the nth character in to_set).
  - If the character is not in from_set TRANSLATE does not change it.
  - If from_set is longer than to_set, TRANSLATE does not change trailing characters in from_set that do not have a corresponding character in to_set.
  - If either from_set or to_set is null, TRANSLATE does nothing.
**TRIM SQL Function**

**Syntax**

```sql
TRIM([trim_specification] [trim_characters] FROM char_expression )
```

*trim_specification ::*

- LEADING
- TRAILING
- BOTH

**Description**

The function TRIM removes leading, trailing or both leading and trailing characters from the `char_expression`, that are present in `trim_characters` and returns the resultant string.

**Example**

```sql
SELECT TRIM ( LEADING 'x' FROM 'xxFairCom' )
FROM customers ;
```

FAIRCOM
--------
FairCom
1 record selected

**Details**

- If `trim_specification` is not specified, the function TRIM removes both the leading and trailing `trim_characters` from the `char_expression`.
- If `trim_characters` are not specified, the function TRIM removes leading, trailing or both leading and trailing blank spaces from the `char_expression`.
- If both `trim_specification` and `trim_characters` are not specified, the function TRIM removes both leading and trailing blank spaces from the `char_expression`.

**Note:** SQL-99 compatible
TRUNCATE function

Syntax
TRUNCATE( number, length )

Description
The scalar function truncates number to length decimal places.

If value of length is positive, number is truncated to the length of places to the right of the decimal point.

If length is negative, number is truncated to positive value of length places to the left of decimal point.

Arguments
- number - This is an expression of an exact numeric or approximate numeric data type.
- length - Is the precision to which number is truncated.

Example
SELECT price, TRUNCATE(price, 1), TRUNCATE(price, -1)
FROM custorder;

Price | TRUNCATE( | TRUNCATE( |
----- | --------- | --------- |
1546.56 | 1546.50 | 1540.00 |
UCASE function (ODBC compatible)

Syntax
UCASE ( char_expression )

Description
The scalar function UCASE returns the result of the argument character expression after converting all the characters to uppercase. UCASE is identical to UPPER, but provides ODBC-compatible syntax.

Example
SELECT *
  FROM customer
  WHERE UCASE (name) = 'SMITH' ;

Notes
- The argument to the function must be of character type.
- The result is of character type.
- If the argument expression evaluates to null, the result is null.
**UPPER function (SQL-92 compatible)**

**Syntax**

```
UPPER ( char_expression )
```

**Description**

The scalar function `UPPER` returns the result of the argument character expression after converting all the characters to uppercase.

**Example**

```
SELECT *
    FROM customer
    WHERE UPPER (name) = 'SMITH';
```

**Notes**

- The argument to the function must be of character type.
- The result is of character type.
- If the argument expression evaluates to null, the result is null.
USER function (ODBC compatible)

Syntax
USER [ ( ) ]

Description
USER returns a character-string identifier for the database user, as specified in the current connection. If the current connection did not specify a user, USER returns the login name as determined by the host operating system. This function takes no arguments, and the trailing parentheses are optional.

c-treeSQL statements can refer to USER anywhere they can refer to a character string expression.

Example
The following interactive c-treeSQL example shows connecting to a database as the user fred. Queries on two system tables illustrate the USER scalar function and retrieve the names of any tables owned by the user fred:

```sql
% isql -u fred tstdb
ISQL> select user from admin.syscalctable;
FRED
----
fred
1 record selected
ISQL> select tbl, owner from adminadmin.systables where owner = user();
TBL                                OWNER
---                                ----
flab                               fred
1 record selected
```
USER_NAME function (extension)

Syntax

USER_NAME ( [user_id] )

Description

The scalar function USER_NAME returns the user login name for the user_id specified in the input argument. If no user_id is specified, USER_NAME returns the name of the current user.

The scalar function USER_NAME is identical to SUSER_NAME.
WEEK function (ODBC compatible)

Syntax

WEEK ( time_expression )

Description

The scalar function WEEK returns the week of the year as a short integer value (range 1 - 53).

Example

```
SELECT * FROM orders
WHERE WEEK (order_date) = 5;
```

Notes

- The argument to the function must be of type DATE.
- The argument must be specified in the format MM/DD/YYYY.
- The result is of type SHORT.
- If the argument expression evaluates to null, the result is null.
YEAR function (ODBC compatible)

Syntax
YEAR ( date_expression )

Description
The scalar function YEAR returns the year as a short integer value in the range of 0 - 9999.

Example
SELECT *
FROM orders
WHERE YEAR (order_date) = 1992 ;

Notes
- The argument to the function must be of type DATE.
- The argument must be specified in the format MM/DD/YYYY.
- The result is of type SHORT.
- If the argument expression evaluates to null, the result is null.
2. SQL Statements

This chapter provides detailed reference material on each SQL statement.

2.1 Syntax Conventions

Syntax diagrams appear in monospace type and use the following conventions:

<table>
<thead>
<tr>
<th>UPPERCASE</th>
<th>Uppercase type denotes reserved words. You must include reserved words in statements, but they can be upper or lower case.</th>
</tr>
</thead>
<tbody>
<tr>
<td>lowercase</td>
<td>Lowercase type denotes either user-supplied elements or names of other syntax diagrams. User-supplied elements include names of tables, host-language variables, expressions, and literals. Syntax diagrams can refer to each other by name. If a diagram is named, the name appears in lowercase type above and to the left of the diagram, followed by a double-colon (for example, privilege ::). The name of that diagram appears in lowercase in diagrams that refer to it.</td>
</tr>
<tr>
<td>{ }</td>
<td>Braces denote a choice among mandatory elements. They enclose a set of options, separated by vertical bars (</td>
</tr>
<tr>
<td>[ ]</td>
<td>Brackets denote an optional element or a choice among optional elements.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td>A horizontal ellipsis denotes that the preceding element can optionally be repeated any number of times.</td>
</tr>
<tr>
<td>( ), ;</td>
<td>Parentheses and other punctuation marks are required elements. Enter them as shown in syntax diagrams.</td>
</tr>
</tbody>
</table>
**ALTER INDEX**

### Description

Alters an existing index by passing specific c-tree file attributes to change, or by renaming the index.

### Syntax

```
ALTER INDEX [ owner_name. ] index_name [ON [ owner_name. ] table_name
{STORAGE_ATTRIBUTES 'attributes'
| RENAME TO new_index_name
};
```

(Support for altering an index by renaming it, RENAME TO new_index_name, was added in V11.)

### Arguments

**STORAGE_ATTRIBUTES 'attributes'**

A quoted string specifying index attributes to modify. c-treeACE SQL recognizes the following attributes:

- ‘HUGE’ -- Recreate the index file as a c-tree HUGE file.
- ‘partition=<rule>’ -- Use this index with <rule> as a partition rule and create table as partitioned file. Only one index can be the partitioning index rule for a table at a time.

### Examples

By default, c-treeACE SQL returns an error in response to an ALTER INDEX statement:

```
ISQL> alter index t1_ix ON t1 RENAME TO t1_mod_ix;
```

### Authorization

The user executing this statement must have any of the following privileges:

- DBA privilege.
- Ownership of the index.
- EXCLUSIVE file access is required for any ALTER operation.

### SQL Compliance

<table>
<thead>
<tr>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedded SQL, interactive SQL, ODBC applications</td>
</tr>
<tr>
<td>CREATE INDEX, DROP INDEX</td>
</tr>
</tbody>
</table>

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ALTER TABLE

Description
Alters the schema of an existing table by adding new columns or modifying existing columns of the specified table.

Syntax
```
ALTER TABLE [ owner_name. ] table_name 
{ ADD new_column_definition [, new_column_definition] ... 
  | MODIFY (column_name [ new_column_type ] 
  | default_value ] [ NULL | NOT NULL ] 
  | DROP [ COLUMN ] { column_name | ( column_name , ... ) } 
  | ADD [ CONSTRAINT new_constraint_name ] tableConstraint 
  | RENAME CONSTRAINT constraint_name TO new_constraint_name 
  | RENAME COLUMN column_name TO new_column_name 
  | RENAME TO new_table_name 
} ;
```

```
new_column_definition ::
  new_column_name  column_type 
  [ [ NULL | NOT NULL ] 
  [ default_value 
    | IDENTITY [(seed, increment)] ] ]
```

```
default_value ::
  DEFAULT { literal | USER | NULL | UID | SYSDATE | SYSTIME | SYSTIMESTAMP } 
```

```
table_constraint ::
  PRIMARY KEY ( column [, ... ] ) 
  | UNIQUE ( column [, ... ] ) 
  | FOREIGN KEY ( column [, ... ] ) 
  REFERENCES [ owner_name. ] table_name [ ( column [, ... ] ) ] 
  | CHECK ( search_condition ) 
  | REORG 
```

Notes
- Column additions and modifications have the following restrictions:
  - A NOT NULL column can be added to a table only if the table does not contain any rows.
  - The type can be modified or the length of the column can be decreased only if all the rows contain null values for the column being modified.
  - An existing column can be made NOT NULL only if none of the rows contain a null value for that column.
- When a new column is added to an existing table, it is added after the existing columns for the table.
- Views that automatically refer to all the columns of a table (such as SELECT * FROM ...) need to be dropped and added to select any columns that have been added to the table after the view has been created.
- If you add a FOREIGN KEY constraint to an existing table, the table and column specified in the REFERENCES clause must exist before the constraint will work as expected. However, c-treeACE SQL does not check for the existence of the table and column specified in the REFERENCES clause. It is up to you to make sure they exist.
When you drop or rename a column, the following database objects dependent on that column are also automatically dropped or updated:

- Indexes that specify the column as one of the components
- Update triggers that specify the column
- Unique, foreign key, and check constraints that refer to the column
- UPDATE and REFERENCES privileges that refer to the column

However, columns referenced in check constraints, views, procedures, triggers and UDFs cannot be modified from an ALTER TABLE event and need to be simultaneously addressed by a database administrator.

ALTER TABLE DROP COLUMN statements cannot:

- Specify a column created as a primary key, if columns in other tables refer to the column in a referential constraint
- Name all the columns in a table

When new columns are added IDENTITY can be specified for one of the columns only if the table does not already contain an identity column. A DEFAULT value can not be specified for and IDENTITY column.

Existing rows are not updated to the default value, even if the data was initially missing. Only new inserted rows are assigned the new default value.

(c-treeACE SQL V10.3 and later) Any table altered in the structure using ALTER TABLE or truncated using TRUNCATE will have the $DELFLD$ set to 4 bytes despite the size in the original table.

RENAME CONSTRAINT is available in V11 and later.

REORG is available in V11.5 and later.

Examples

To add columns to the tmp table:

```
ISQL> ALTER TABLE tmp
            ADD  mname CHAR(8) ;
ISQL> ALTER TABLE tmp
            ADD  (mname CHAR(8), nname CHAR(8)) ;
```

To add table-level constraints, consider the table tmp consisting of integer fields, `fld`, `fld1`, `fld2`, and `fld3`.

- To create a unique key on `fld`:
  
  ```
  ISQL> ALTER TABLE tmp
            ADD UNIQUE(fld) ;
  ```

- To create a primary key on `fld1`:
  
  ```
  ISQL> ALTER TABLE tmp
            ADD primary key(fld1) ;
  ```

- To create a foreign key constraint named `fri_cns` on `fld2`:
  
  ```
  ISQL> ALTER TABLE tmp
            ADD constraint fri_cns foreign key(fld2) ;
  ```

- To create a check constraint, `chk_cns` on `fld3`:
  
  ```
  ISQL> ALTER TABLE tmp
            ADD constraint chk_cns (fld2 > 10) ;
  ```

Authorization

The user executing this statement must have any of the following privileges:

- DBA privilege.
Ownership of the table.
ALTER privilege on the table.

SQL Compliance: SQL-92, ODBC Core SQL grammar
Environment: Embedded SQL, interactive SQL, ODBC applications
Related Statements: CREATE TABLE, DROP TABLE
ALTER VIEW

Description
Creates a view with the specified name on existing tables and/or views.

Syntax
ALTER VIEW [ owner_name. ] view_name
  [ ( column_name, column_name, ... ) ]
  AS [ ( ) query_expression [ ) ]
  [ WITH CHECK OPTION ] ;

Notes
- ALTER VIEW has the same syntax as CREATE VIEW. ALTER VIEW does not modify an existing view, but rather replaces the existing view with a complete new definition. However, it retains the permissions from the existing view for the new view. It is best practice, therefore, to use a script file to create a view that may be modified in the future. The script can then be modified and used with ALTER VIEW to effect the change without needing to reenter the permissions of the view.
- The owner_name is made the owner of the created view.
- The column names specified for the view are optional and provide an alias for the columns selected by the query specification. If the column names are not specified then the view will be created with the same column names as the tables and/or views it is based on.
- A view is deletable if deleting rows from that view is allowed. For a view to be deletable, the view definition has to satisfy the following conditions:
  • The first FROM clause contains only one table reference or one view reference.
  • There are no aggregate functions, DISTINCT clause, GROUP BY or HAVING clause in the view definition.
  • If the first FROM clause contains a view reference, then the view referred to is deletable.
- A view is updatable if updating rows from that view is allowed. For a view to be updatable, the view has to satisfy the following conditions:
  • The view is deletable (That is, it satisfies all the conditions specified above for deletability).
  • All the select expressions in the first SELECT clause of the view definition are simple column references.
  • If the first FROM clause contains a view reference, then the view referred to is updatable.
- A view is insertable if inserting rows into that view is allowed. For a view to be insertable, the view has to satisfy the following conditions:
  • The view is updatable (That is, it satisfies all the conditions specified above for updatability).
  • If the first FROM clause contains a table reference, then all NOT NULL columns of the table are selected in the first SELECT clause of the view definition.
  • If the first FROM clause contains a view reference, then the view referred to is insertable.
- The WITH CHECK OPTION clause can be specified only if the view is updatable.
If **WITH CHECK OPTION** clause is specified when defining a view, then during any update or insert of a row on this view, it is checked that the updated/inserted row satisfies the view definition (That is, the row is selectable using the view).

### Examples

```
ALTER VIEW ne_customers AS
    SELECT cust_no, name, street, city, state, zip
    FROM customer
    WHERE state IN ('NH', 'MA', 'NY', 'VT')
    WITH CHECK OPTION ;
```

```
ALTER VIEW order_count (cust_number, norders) AS
    SELECT cust_no, COUNT(*)
    FROM orders
    GROUP BY cust_no;
```

### Authorization

The user executing this statement must have the following privileges:

- DBA or RESOURCE privilege.
- SELECT privilege on all the tables/views referred to in the view definition.

If **owner_name** is specified and is different from the name of the user executing the statement, then the user must have DBA privilege.

### SQL Compliance

SQL-92, ODBC Core SQL grammar

### Environment

Embedded SQL, interactive SQL, ODBC applications

### Related Statements

Query Expressions, DROP VIEW
CALL

Description
Invokes a built-in c-treeACE SQL procedure or Java stored procedure (JSP).

Syntax
[ ? = ] CALL proc_name([parameter][, ...]);

Arguments
[ ? = ]
A parameter marker for the return value of the procedure. Programs must determine if the procedure returns a value and use the parameter marker as a placeholder for a variable that will receive the return value.

CALL proc_name
The name of the procedure to invoke.

parameter
Literal or variable values to pass to the procedure.

Example
The following example shows invocation of the SQLPROC built-in procedure from interactive c-treeACE SQL. It invokes SQLPROC to retrieve information about another built-in procedure, SQLTABLES:

CALL SQLPROC('',0,'admin',6,'sqltables',9); -- specific procedure

<table>
<thead>
<tr>
<th>PROCEDURE_QUALIFIER</th>
<th>PROCEDURE_OWNER</th>
<th>PROCEDURE_NAME</th>
<th>NUM_INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>admin</td>
<td>sqltables</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NUM_OUTPUT</th>
<th>NUM_RESULTS</th>
<th>REMARKS</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Returns info about a table</td>
<td>1</td>
</tr>
</tbody>
</table>

Authorization
- Users must have the DBA or EXECUTE privilege to invoke a stored procedure.
- Users invoking a stored procedure do not need privileges to database objects accessed by the procedure. When a user executes a stored procedure, c-treeACE SQL checks the privileges of the procedure owner, not the procedure user, on any objects that the procedure accesses. This enables a user to execute a procedure successfully even when that user does not have the privileges to directly access objects used by the procedure.

SQL Compliance
ODBC Extended SQL grammar, when enclosed in ODBC escape clause

Environment
Embedded SQL, interactive SQL, ODBC applications

Related Statements
CREATE PROCEDURE, DROP PROCEDURE
**COMMIT WORK**

**Description**

Used to commit a transaction explicitly after executing one or more c-treeACE SQL statements. Committing a transaction makes permanent any changes made by the c-treeACE SQL statements.

**Syntax**

```
COMMIT [ WORK ] ;
```

**Notes**

- The set of c-treeACE SQL statements executed prior to executing `COMMIT WORK` statement are executed as one atomic transaction that is recoverable, serializable and durable.
- On a system failure and/or the execution of the `ROLLBACK WORK`, the transaction is marked for abortion and the database is rolled back to its initial state.
- A commit operation makes any database modifications made by that transaction permanent.
- Once a commit operation is executed the database modifications cannot be rolled back.
- Once a commit operation is executed the transaction modifications are guaranteed to be durable irrespective of any transient system failures.
- The atomicity applies only to the database modification and not to any direct I/O performed to devices such as the terminal, printer and OS files by the application code.
- A commit operation releases any locks implicitly or explicitly acquired by the transaction on the database.
- Under certain circumstances, c-treeACE SQL marks a transaction for abort but does not actually roll it back. Without an explicit rollback, any subsequent updates will not take effect, since a `COMMIT` statement cause c-treeACE SQL to recognize the transaction as marked for abort, and instead implicitly rolls back the transaction. c-treeACE SQL marks a transaction for abort under these conditions:
  - Hardware or software system failures
  - Lock timeout errors

**SQL Compliance**

- SQL-92

**Environment**

- Embedded SQL and interactive

**Related Statements**

- ROLLBACK WORK
CONNECT

Description
Establishes a connection to a database. Optionally, the CONNECT statement can also specify a name for the connection and a user-name/password for authentication.

Syntax
CONNECT TO connect_string
   [AS connection_name]
   [USER user_name]
   [USING password]
connect_string::=
   { DEFAULT
   | db_name
   | port@host_name:db_name }

Arguments
Arguments to CONNECT must either be string literals enclosed in quotation marks or character-string host variables.

connect_string
The string that specifies the database to connect to. If the CONNECT statement specifies DEFAULT, c-treeACE SQL tries to connect to the environment-defined database, if any. (How you define the default database varies between operating systems. On Unix, the value of the DB_NAME environment variable specifies the default connect string.)

The connect string can be a simple database name or a complete connect string. A complete connect string has the following components:

   port          The port number, default 6597
   host_name     Name or IP address of the system where the database resides.
   db_name       Name of the database.

connection_name
The name for the connection for use in DISCONNECT and SET CONNECTION statements. If the CONNECT statement omits a connection name, the default is the name of the database.
Connection names must be unique.

user_name
User name for authentication of the connection. c-treeACE SQL verifies the user name against a corresponding password before it connects to the database. If omitted, the default value depends on the environment. (On UNIX, the value of the DH_USER environment variable specifies the default user name. If DH_USER is not set, the value of the USER environment variable specifies the default user name.)

password
Password for authentication of the connection. c-treeACE SQL verifies the password against a corresponding user name before it connects to the database. If omitted, the default value depends on the environment.

(On Unix, the value of the DH_PASSWD environment variable specifies the default password.)

Notes
- Arguments to CONNECT must either be string literals enclosed in quotation marks or character-string host variables.
- An application can connect to more than one database at a time, with a maximum of 10 connections. However, the application can actually gain access to only one database at a time. The database name specified in the CONNECT statement becomes the active one.
- If an application executes an c-treeACE SQL statement before connecting to a database, c-treeACE Sqltries to connect to the database specified through the DB_NAME environment variable, if that environment variable is defined. If the connection is successful, the c-treeACE SQL statement executes on that database.

Authorization
None.

Examples
The following examples illustrate the CONNECT statement:
- The first statement shown connects to the “salesdb” database on the local system.
- The second statement connects to the “custdb” database on the local system using a network protocol.
- The third statement connects to the “custdb” database on the local mode, using the local pipe IPC protocol.
- The fourth statement connects to the environment-defined database by default (if any).

```
CONNECT TO 'salesdb' AS 'sales_conn';
CONNECT TO '6597@localhost:custdb' AS 'cust_conn';
CONNECT TO '6597@testbox:custdb' AS 'cust_conn';
CONNECT TO DEFAULT;
```

SQL Compliance
- SQL-92

Environment
- Embedded SQL and interactive

Related Statements
- DISCONNECT, SET CONNECTION
CREATE FUNCTION

Description
Creates a User Defined Scalar Function (UDF) for the specified table. User Defined Scalar Functions are an extension to the existing built-in scalar functions and return a single value each time one is invoked. These functions can be used in queries in the same way that system defined scalar functions are used. UDFs are written with Java source code. For more detail on creating and using triggers, see the c-treeACE SQL Guide to Using Stored Procedures and Triggers and User Defined Functions.

Syntax
CREATE FUNCTION [ IF NOT EXISTS ] [ owner_name.]function_name
( [parameter_decl , ... ] )
RETURNS (data_type)
[ IMPORT
    java_import_clause ]
BEGIN
    java_snippet
END
parameter_decl ::
    [ IN ] parameter_name data_type Arguments

IF NOT EXISTS
This argument avoids failure by creating the function only if a function of the same name does not already exist.

owner_name
Specifies the owner of the user defined function. If the name is different from the user name of the user executing the statement, then the user must have DBA privileges.

function_name
Names the user defined function. DROP FUNCTION statements specify the function_name defined here. c-treeACE SQL also uses function_name in the name of the Java class it creates from the Java snippet.

RETURNS
data_type
The return value of the function as defined by the data_type declaration.

IMPORT
    java_import_clause
Specifies standard Java classes to import. The IMPORT keyword must be upper case and on a separate line.

BEGIN
    java_snippet
END
The body of the function. The body contains the Java source code that implements the user defined function. The Java statements become a method in a class that c-treeACE SQL creates and submits to the Java compiler.

The BEGIN and END keywords must be upper case and on separate lines.

Notes
- User Defined Scalar Function are a type of c-treeACE SQL expression that return a value based on the argument(s) supplied. User Defined Scalar Function are invoked in exactly the same manner as built in scalar functions.
- User Defined Scalar Functions can be used in the SELECT list or in the WHERE clause. They can be used as parameters of other scalar functions or in any expression. The parameter passed to a user defined scalar function can be a literal, field reference or any expression.

Example
The following example creates a User Defined Scalar Function named ‘str_cat’ that takes two input arguments and returns the concatenated string.

```java
CREATE FUNCTION str_cat(IN org_string VARCHAR(20), IN string_to_concat VARCHAR(20))
RETURNS VARCHAR(40)
IMPORT
    import java.math.*;
BEGIN
    String new_str = org_string +  string_to_concat ;
    return new_str;
END
```

Authorization
Users executing CREATE FUNCTION must have the DBA privilege or RESOURCE privilege. The owner or users with the DBA privilege can execute or drop any User Defined Scalar Function, and grant the EXECUTE privilege to other users.

When a User Defined Scalar Function is executed on behalf of a user with EXECUTE privilege on that User Defined Scalar Function, for the objects that are accessed by the User Defined Scalar Function, the User Defined Scalar Function owner’s privileges are checked and not the user’s. This enables a user to execute a User Defined Scalar Function successfully even when he does not have the privileges to directly access the objects that are accessed by the User Defined Scalar Function, so long as he has EXECUTE privilege on the User Defined Scalar Function.

SQL Compliance
- SQL-93, ODBC Core SQL grammar

Environment
- Embedded SQL, interactive SQL, ODBC and JDBC applications

Related Statements
- DROP FUNCTION
CREATE INDEX

Description
Creates an index on the specified table using the specified columns of the table. An index improves the performance of c-treeACE SQL operations whose predicates are based on the indexed column. However, an index slows performance of INSERT, DELETE and UPDATE operations.

Syntax
CREATE [ UNIQUE ] INDEX [ IF NOT EXISTS ] index_name
    ON table_name
    ( {column_name [ASC | DESC]} [, ... ]
    [ STORAGE_ATTRIBUTES 'attributes' ];

Arguments
UNIQUE
A UNIQUE index will not allow the table to contain any rows with duplicate column values for the set of columns specified for that index.

IF NOT EXISTS
This argument avoids failure by creating the index only if an index of the same name does not already exist.

index_name
The name of the index has to be unique for the specified table.

table_name
The name of the table on which the index is being built.

column_name [, ... ]
The columns on which searches and retrievals will be ordered. These columns are called the index key. When more than one column is specified in the CREATE INDEX statement a concatenated index is created.

ASC | DESC
The index can be ordered as either ascending (ASC) or descending (DESC) on each column of the concatenated index. The default is ASC.

STORAGE_ATTRIBUTES 'attributes'
A quoted string that specifies index attributes that are specific to c-treeACE SQL indexes. c-treeACE SQL interprets the following attribute strings:

- "PARTITION=<rule>" - Creates the index as the partition index to the table enabling multiple table partitions. This option can be specified after a table has been created, and the table will be rebuilt according to the partition rule in effect.

<rule> is a c-treeACE conditional expression evaluating to a numeric value.
- "PARTITION' - Creates the index as the partition index to the table enabling multiple table partitions. This option can be specified after a table has been created, and the table will be rebuilt according to the partition rule in effect. (This type of partitioned file currently require a server with your partition rules included at compile time. See the c-treeACE Programmer's Reference Guide (http://docs.faircom.com/doc/ctreeplus) for details.)

To combine STORAGE_ATTRIBUTE options, separate them with a semicolon (;).

**Example**

```sql
CREATE UNIQUE INDEX postdate_idx ON customer (invoice_date) STORAGE_ATTRIBUTES 'partition' ;
```

**Authorization**

The user executing this statement must have any of the following privileges:

- DBA privilege.
- Ownership of the index.
- INDEX privilege on the table.
- EXCLUSIVE file access is required for any this operation.

**SQL Compliance**

ODBC Core SQL grammar. Extensions: STORAGE_ATTRIBUTES,

**Environment**

Embedded SQL, interactive SQL, ODBC applications

**Related Statements**

CREATE TABLE, DROP INDEX, ALTER TABLE
CREATE PROCEDURE

Description
Creates a stored procedure. Stored procedures contain a Java code “snippet” that is processed by c-treeACE SQL into a Java class definition and stored in the database in text and compiled form. c-treeACE SQL applications invoke stored procedures through the SQL CALL statement or the procedure-calling mechanisms of ODBC and JDBC.

For more detail on creating and using stored procedures, see the c-treeACE SQL Guide to Java Stored Procedures and Triggers.

Syntax
CREATE PROCEDURE [ IF NOT EXISTS ] [ owner_name. ] procname
   ( [ parameter_decl | , ... ] )
   [ RESULT ( column_name data_type [ , ... ] ) ]
   [ IMPORT java_import_clause ]
BEGIN
   java_snippet
END

parameter_decl ::=
   { IN | OUT | INOUT } parameter_name data_type

Arguments

IF NOT EXISTS
This argument avoids failure by creating the procedure only if a procedure of the same name does not already exist.

owner_name
Specifies the owner of the procedure. If the name is different from the user name of the user executing the statement, then the user must have DBA privileges.

procname
Names the stored procedure. DROP PROCEDURE statements specify the procedure name defined here. c-treeSQL also uses procname in the name of the Java class that it creates from the Java snippet.

IN | OUT | INOUT
Specifies whether the following parameter declaration is input, output, or both:

- Calling applications pass values for input parameters in the CALL statement or CALL escape sequence
- Stored procedures assign values to output parameters as part of their processing
- INOUT parameters both have a value passed in and receive a new value during procedure processing

parameter_name data_type
Names a parameter and associates an c-treeACE SQL data type with it. The **data_type** must be one of the supported data types described in *Data Types* (page 11).

**RESULT ( column_name data_type [ , ... ] )**

Specifies columns in the result set the procedure returns. If the CREATE PROCEDURE statement includes this clause, the Java snippet must explicitly insert rows into the result set using the c-treeACE SQL Java class SQLResultSet.

Note that the **column_name** argument is not used within the stored procedure body. Instead, methods of the c-treeACE SQL Java classes refer to columns in the result set by ordinal number, not by name. (Interactive c-treeACE SQL uses the column names as headers when it displays procedure result sets.)

**IMPORT**

  java_import_clause

Specifies standard Java classes to import. The IMPORT keyword must be upper case and on a separate line.

**BEGIN**

  java_snippet

**END**

The body of the stored procedure. The body is a sequence of Java statements between the BEGIN and END keywords. The Java statements become a method in a class c-treeACE SQL creates and submits to the Java compiler.

The BEGIN and END keywords must be upper case and on separate lines. You cannot follow the END keyword with a semicolon.

**Example**

```
CREATE PROCEDURE new_sal (  
    IN deptnum INTEGER,  
    IN pct_incr INTEGER,  
)  
RESULT (  
    empname CHAR(20),  
    oldsal NUMERIC,  
    newsal NUMERIC  
)  
BEGIN  
    StringBuffer ename = new StringBuffer (20) ;  
    BigDecimal osal = new BigDecimal () ;  
    BigDecimal nsal = new BigDecimal () ;  
    SQLCursor empcursor = new SQLCursor (  
        "SELECT empname, sal, (sal * (? /100) + NVL (comm, 0)) total,  
        FROM emp WHERE deptnum = ? " ") ;  
    empcursor.setParam (1, pct_incr);  
    empcursor.setParam (2, deptnum);  
    empcursor.open () ;  
    do  
    {  
        empcursor.fetch () ;  
        if (empcursor.found ())  
```
{  
  empursor.getValue (1, ename);
  empursor.getValue (2, osal);
  empursor.getValue (3, nsal) ;

  SQLResultSet.set (1, ename);
  SQLResultSet.set (2, osal);
  SQLResultSet.set (3, nsal) ;
  SQLResultSet.insert ();
}

} while (empursor.sound());

empursor.close () ;

END

**Authorization**

- Users issuing the `CREATE PROCEDURE` statement must have the `DBA` privilege or `RESOURCE` privilege.
- The owner or users with the `DBA` privilege can execute or drop any stored procedure, and grant the `EXECUTE` privilege to other users.
- Users must have the `DBA` or `EXECUTE` privilege to invoke a stored procedure.
- Users invoking a stored procedure do not need privileges to database objects accessed by the procedure. When a user executes a stored procedure, c-treeACE SQL checks the privileges of the procedure owner, not the procedure user, on any objects that the procedure accesses. This enables a user to execute a procedure successfully even when that user does not have the privileges to directly access objects used by the procedure.

**SQL Compliance**

- SQL-93, ODBC Core SQL grammar

**Environment**

- Embedded SQL, interactive SQL, ODBC applications

**Related Statements**

- CALL, DROP Procedure
CREATE SYNONYM

Description
Creates a synonym for the table, view or synonym specified. A synonym is an alias that c-treeACE SQL statements can use instead of the name specified when the table, view, or synonym was created.

Syntax
CREATE [PUBLIC] SYNONYM synonym
    FOR [owner_name.] { table_name | view_name | synonym } ;

Arguments
PUBLIC
Specifies that the synonym will be public: all users can refer to the name without qualifying it. By default, the synonym is private: other users must qualify the synonym by preceding it with the user name of the user who created it.

Users must have the DBA privilege to create public synonyms.

SYNONYM synonym
Name for the synonym.

FOR [owner_name.] { table_name | view_name | synonym }
Table, view, or synonym for which c-treeACE SQL creates the new synonym.

Example
CREATE SYNONYM customer FOR smith.customer ;
CREATE PUBLIC SYNONYM public_suppliers FOR smith.suppliers ;

Authorization
Users executing CREATE SYNONYM must have the DBA privilege or RESOURCE privilege. Users executing CREATE PUBLIC SYNONYM statement must have the DBA privilege.

SQL Compliance Extension
Environment Embedded SQL, interactive SQL, ODBC applications
Related Statements DROP SYNONYM
CREATE TABLE

Description

Creates a table definition. A table definition consists of a list of column definitions that make up a table row. c-treeACE SQL provides two forms of the CREATE TABLE statement. The first form explicitly specifies column definitions. The second form, with the AS query_expression clause, implicitly defines the columns using the columns in the query expression.

Syntax

CREATE TABLE [ IF NOT EXISTS ] [ owner_name. ] table_name
( column_definition [ , { column_definition | table_constraint } ] … )

CREATE TABLE [ IF NOT EXISTS ] [ owner_name. ] table_name
[ ( column_name [ NULL | NOT NULL ], … ) ]
[ STORAGE_ATTRIBUTES 'attributes' ]
AS query_expression
;

column_definition ::=
  column_name data_type
  [ DEFAULT { literal | USER | NULL | UID
    | SYSDATE | SYSTIME | SYSTIMESTAMP } ]
  | [ IDENTITY [(seed, increment)] ]
  [ column_constraint [ column_constraint … ] ]

Arguments

IF NOT EXISTS

This argument avoids failure by creating the table only if a table of the same name does not already exist.

owner_name

Specifies the owner of the table. If the name is different from the user name of the user executing the statement, then the user must have DBA privileges.

table_name

Names the table definition. c-treeACE SQL defines the table in the database named in the last CONNECT statement.

column_name data_type

Names a column and associates a data type with it. The column names specified must be different than other column names in the table definition. The data_type must be one of the supported data types described in Data Types (page 11).

DEFAULT

Specifies an explicit default value for a column. The column takes on the value if an INSERT statement does not include a value for the column. If a column definition omits the DEFAULT clause, the default value is NULL.

The DEFAULT clause accepts the following arguments:
**literal**
An integer, numeric or string constant.

**USER**
The name of the user issuing the INSERT or UPDATE statement on the table. Valid only for columns defined with character data types.

**NULL**
A null value.

**UID**
The user id of the user executing the INSERT or UPDATE statement on the table.

**SYSDATE**
The current date. Valid only for columns defined with DATE data types.

**SYSTIME**
The current time. Valid only for columns defined with TIME data types.

**SYSTIMESTAMP**
The current date and time. Valid only for columns defined with TIMESTAMP data types.

**IDENTITY**
Specifies that the column is an **IDENTITY** column. An **IDENTITY** column is one for which the data is not provided by the user but it is automatically generated by the DBMS. There can be only one identity column for a table. A default value can not be specified for an identity column. **IDENTITY** can only be specified on columns of type INTEGER, SMALLINT, TINYINT and BIGINT.

**seed**
Specifies a value that used for the identity column when the first row is inserted into the table. Specifying a seed value is optional. If a seed value is not specified, then it defaults to 1.

**increment**
Specifies a value by which the identity value of the previous row is incremented, which is then used for the identity column when the second and subsequent rows are inserted into the table. Specifying the increment value is optional. If it is not specified, then it defaults to 1.

**Note:** Although both the seed and increment values are optional, they must both be specified or both be left unspecified. It is not possible to specify only one of them.

**column_constraint**
Specifies a constraint that applies while inserting or updating a value in the associated column. For more information, see *Column Constraints* (page 197).

**table_constraint**
Specifies a constraint that applies while inserting or updating a row in the table. For more information, see *Table Constraints* (page 199).

**STORAGE_ATTRIBUTES 'attributes’**
Specifies a string describing underlying c-treeACE table storage attributes. For more information see *Storage Attributes* (page 201).

**AS query_expression**
Specifies a query expression to use for the data types and contents of the columns for the table. The types and lengths of the columns of the query expression result become the types and lengths of the respective columns in the table created. The rows in the resultant set of the query
expression are inserted into the table after creating the table. In this form of the `CREATE TABLE` statement, column names are optional.

If omitted, the names for the table columns are also derived from the query expression. For more information, see *Query Expressions* (page 31).

**Examples**

In the following example, the user issuing the `CREATE TABLE` statement must have `REFERENCES` privilege on the column "itemno" of the table "john.item".

```sql
CREATE TABLE supplier_item (  
supp_no     INTEGER NOT NULL PRIMARY KEY,  
item_no     INTEGER NOT NULL REFERENCES john.item (itemno),  
qty         INTEGER  
) ;
```

The following `CREATE TABLE` statement explicitly specifies a table owner, admin:

```sql
CREATE TABLE admin.account (  
    account  integer,  
    balance  money (12),  
    info     char (84)  
) ;
```

The following example shows the `AS query_expression` form of `CREATE TABLE` to create and load a table with a subset of the data in the customer table:

```sql
CREATE TABLE admin.dealer (name, street, city, state) AS  
    SELECT name, street, city, state  
    FROM customer  
    WHERE customer.state IN ('CA','NY', 'TX') ;
```

The following example includes a `NOT NULL` column constraint and `DEFAULT` clauses for column definitions:

```sql
CREATE TABLE emp (  
    empno  integer NOT NULL,  
    deptno  integer DEFAULT 10,  
    join_date date DEFAULT NULL  
) ;
```

**Authorization**

The user executing this statement must have either `DBA` or `RESOURCE` privilege. If the `CREATE TABLE` statement specifies a foreign key that references a table owned by a different user, the user must have the `REFERENCES` privilege on the corresponding columns of the referenced table.

The `AS query_expression` form of `CREATE TABLE` requires the user to have select privilege on all the tables and views named in the query expression.

**SQL Compliance**

- SQL-92, ODBC Minimum SQL grammar. Extensions: `AS query_expression`

**Environment**

- Embedded SQL, interactive SQL, ODBC applications

**Related Statements**

- DROP TABLE, ALTER TABLE, Query Expressions
Column Constraints

Description
Specifies a constraint for a column that restricts the values that the column can store. INSERT, UPDATE, or DELETE statements that violate the constraint fail. c-treeACE SQL returns a constraint violation error with SQLCODE -20116.

Column constraints are similar to table constraints but their definitions are associated with a single column.

Syntax
```
column_constraint ::= 
  UNIQUE |
  NOT NULL [ PRIMARY KEY | UNIQUE ] |
  REFERENCES [ owner_name. ] table_name [ ( column_name ) ] |
  CHECK ( search_condition )
```

Arguments
NOT NULL
Restricts values in the column to values that are not null.

NOT NULL PRIMARY KEY
PRIMARY KEY is a valid abbreviation of NOT NULL PRIMARY KEY.

Defines the column as the primary key for the table. There can be only one primary key for a table. A column with the NOT NULL PRIMARY KEY constraint cannot contain null or duplicate values. Other tables can name primary keys as foreign keys in their REFERENCES clauses.

If other tables name primary keys in their REFERENCES clauses, c-treeACE SQL restricts operations on the table containing the primary key:

- DROP TABLE statements that delete the table fail
- DELETE and UPDATE statements that modify values in the column that match a foreign key’s value also fail

The following example shows the creation of a primary key column on the table supplier.

```
CREATE TABLE supplier ( 
  supp_no INTEGER NOT NULL PRIMARY KEY, 
  name CHAR (30), 
  status SMALLINT, 
  city CHAR (20) 
) ;
```

NOT NULL UNIQUE

Defines the column as a unique key that cannot contain null or duplicate values. Columns with NOT NULL UNIQUE constraints defined for them are also called candidate keys.

Other tables can name unique keys in their REFERENCES clauses. If they do, c-treeACE SQL restricts operations on the table containing the unique key:

- DROP TABLE statements that delete the table fail
• DELETE and UPDATE statements that modify values in the column that match a foreign key's value also fail

The following example creates a NOT NULL UNIQUE constraint to define the column ss_no as a unique key for the table employee:

```sql
CREATE TABLE employee (
  empno        INTEGER NOT NULL PRIMARY KEY,
  ss_no        INTEGER NOT NULL UNIQUE,
  name        CHAR (19),
  sal          NUMERIC (10, 2),
  deptno       INTEGER NOT NULL
) ;
```

**REFERENCES table_name [ (column_name) ]**

Defines the column as a foreign key and specifies a matching primary or unique key in another table. The REFERENCES clause names the matching primary or unique key.

A foreign key and its matching primary or unique key specify a referential constraint: A value stored in the foreign key must either be null or be equal to some value in the matching unique or primary key.

You can omit the column_name argument if the table specified in the REFERENCES clause has a primary key and you want the primary key to be the matching key for the constraint.

The following example defines order_item.orditem_order_no as a foreign key that references the primary key orders.order_no.

```sql
CREATE TABLE orders (
  order_no INTEGER NOT NULL PRIMARY KEY,
  order_date DATE
) ;
CREATE TABLE order_item (
  orditem_order_no INTEGER REFERENCES orders ( order_no ),
  orditem_quantity INTEGER
) ;
```

Note that the second CREATE TABLE statement in the previous example could have omitted the column name order_no in the REFERENCES clause, since it refers to the primary key of table orders.

**CHECK (search_condition)**

Specifies a column-level check constraint. c-treeACE SQL restricts the form of the search condition. The search condition must not:

• Refer to any column other than the one with which it is defined
• Contain aggregate functions, subqueries, or parameter references

The following example creates a check constraint:

```sql
CREATE TABLE supplier (
  supp_no     INTEGER NOT NULL,
  name        CHAR (30),
  status      SMALLINT,
  city        CHAR (20) CHECK (supplier.city <> 'MOSCOW')
) ;
```
Table Constraints

Description
Specifies a constraint for a table that restricts the values that the table can store. INSERT, UPDATE, or DELETE statements that violate the constraint fail. c-treeACE SQL returns a Constraint violation error.

Table constraints have syntax and behavior similar to column constraints. Note the following differences:

- The syntax for table constraints is separated from column definitions by commas.
- Table constraints must follow the definition of columns they refer to.
- Table constraint definitions can include more than one column and c-treeACE SQL evaluates the constraint based on the combination of values stored in all the columns.

Syntax

```
table_constraint ::
   PRIMARY KEY ( column [ , ... ] )
| UNIQUE ( column [ , ... ] )
| FOREIGN KEY ( column [ , ... ] )
   REFERENCES [ owner_name. ] table_name [ ( column [ , ... ] ) ]
| CHECK ( search_condition )
```

Arguments

**PRIMARY KEY ( column [ , ... ] )**
Defines the column list as the primary key for the table. There can be at most one primary key for a table.

All the columns that make up a table-level primary key must be defined as NOT NULL, or the CREATE TABLE statement fails. The combination of values in the columns that make up the primary key must be unique for each row in the table.

Other tables can name primary keys in their REFERENCES clauses. If they do, c-treeACE SQL restricts operations on the table containing the primary key:

- DROP TABLE statements that delete the table fail
- DELETE and UPDATE statements that modify values in the combination of columns that match a foreign key’s value also fail

The following example shows creation of a table-level primary key. Note that its definition is separated from the column definitions by a comma:

```
CREATE TABLE supplier_item (  
supp_no   INTEGER NOT NULL,
item_no   INTEGER NOT NULL,
qty       INTEGER NOT NULL DEFAULT 0,
             PRIMARY KEY (supp_no, item_no)
) ;
```

**UNIQUE ( column [ , ... ] )**
Defines the column list as a unique, or candidate, key for the table. Unique key table-level constraints have the same rules as primary key table-level constraints, except that you can specify more than one UNIQUE table-level constraint in a table definition.

The following example shows creation of a table with two UNIQUE table-level constraints:

```
CREATE TABLE order_item (
    order_no    INTEGER NOT NULL,
    item_no     INTEGER NOT NULL,
    qty         INTEGER NOT NULL,
    price       MONEY NOT NULL,
    UNIQUE (order_no, item_no),
    UNIQUE (qty, price)
) ;
```

**FOREIGN KEY ... REFERENCES**

Defines the first column list as a foreign key and, in the REFERENCES clause, specifies a matching primary or unique key in another table.

A foreign key and its matching primary or unique key specify a referential constraint: The combination of values stored in the columns that make up a foreign key must either:

- Have at least one of the column values be null
- Be equal to some corresponding combination of values in the matching unique or primary key

You can omit the column list in the REFERENCES clause if the table specified in the REFERENCES clause has a primary key and you want the primary key to be the matching key for the constraint.

The following example defines the combination of columns `student_courses.teacher` and `student_courses.course_title` as a foreign key that references the primary key of the table `courses`. Note that the REFERENCES clause does not specify column names because the foreign key refers to the primary key of the courses table.

```
CREATE TABLE courses (
    teacher        CHAR (20) NOT NULL,
    course_title   CHAR (30) NOT NULL,
    PRIMARY KEY (teacher, course_title)
) ;
CREATE TABLE student_courses {
    student_id     INTEGER,
    teacher        CHAR (20),
    course_title   CHAR (30),
    FOREIGN KEY (teacher, course_title) REFERENCES courses
} ;
```

c-treeACE SQL evaluates the referential constraint to see if it satisfies the following search condition:

```
(student_courses.teacher IS NULL
 OR student_courses.course_title IS NULL)
OR
EXISTS (SELECT * FROM student_courses WHERE
 (student_courses.teacher = courses.teacher AND
  student_courses.course_title = courses.course_title)
)
```

INSERT, UPDATE or DELETE statements that cause the search condition to be false violate the constraint, fail, and generate an error.
**CHECK (search_condition)**

Specifies a table-level check constraint. The syntax for table-level and column level check constraints is identical. Table-level check constraints must be separated by commas from surrounding column definitions.

c-treeACE SQL restricts the form of the search condition. The search condition must not:

- Refer to any column other than columns that precede it in the table definition
- Contain aggregate functions, subqueries, or parameter references

The following example creates a table with two column-level check constraints and one table-level check constraint:

```sql
CREATE TABLE supplier (
    supp_no   INTEGER NOT NULL,
    name      CHAR (30),
    status    SMALLINT CHECK (
        supplier.status BETWEEN 1 AND 100 ),
    city      CHAR (20) CHECK (
        supplier.city IN ('NEW YORK', 'BOSTON', 'CHICAGO')),
    CHECK (supplier.city <> 'CHICAGO' OR supplier.status = 20)
) ;
```

**Storage Attributes**

A quoted string that specifies specific c-treeACE SQL table attributes. c-treeACE SQL supports the following `STORAGE_ATTRIBUTES` parameters:

- ‘CAMO’ - A lightweight option for obscuring data. This option gives a small amount of protection from casual inspection of the c-tree data and index files. CAMO or “Camouflage” is an older, legacy method of hiding data, which is not a standards-conforming encryption scheme, such as AES. It is not intended as a replacement for Advanced Encryption or other security systems.
- ‘ENCR=crypt’ - Advanced encryption options providing the highest level of security and protection for your data. Options include AES (Rijndael), Twofish, Blowfish, and DES. `crypt` can be one of the following:
  - AES16 (Rijndael)
  - AES24
  - AES32
  - DES8
  - DES16
  - DES24
  - BLF8 through BLF56 (Blowfish)
  - TWF16 (Twofish)
  - TWF24
  - TWF32
- ‘RECBYT_IDX’ - Creates the table with a `RECBYT` index. This index is required for physical backward traversal of variable length type files. The `RECBYT` index does impose a minimal amount of overhead, however, when inserting/updating/deleting records. This index is not required for usual operations, and as such, is off by default.
- ‘NORECBYIDX’ - (Default) Creates the table without a RECBY INDEX.
- ‘ROWID_FLD’ - (Default) The ROWID field is an auto-incrementing number which takes advantage of the c-tree serial segment index mode. This hidden field is a sequential number added to each record insert, and maintained with an associated index. This field is not required for proper SQL operation, however, is referenced directly by the ROWID related scalar functions. In the case of no ROWID field, the record RECBY value is returned, which may not maintain uniqueness over time. As there is a limit of only one serial segment index per c-tree data file, this value is unavailable for other fields when a ROWID is present. Conversely, no ROWID is available when an existing c-tree data file with a serial segment field is imported into c-treeACE SQL. The IDENTITY field attribute should be used for auto-incrementing values as it is better performing with greater field type flexibility.
- ‘NOROWID_FLD’ - Creates a table without the ROWID serial segment field and index.
- ‘PREIMG’ - This option disables transaction logging for the table. This can be useful for temporary c-treeACE SQL tables that are not required to be recovered in the event of catastrophic failure, yet retain atomicity of transactions.
- ‘HOTALTER’ - (Supported in V11.5 and later) Creates the the table with Hot Alter Table support.
- ‘NOHOTALTER’ - (Supported in V11.5 and later) Create the table with Hot Alter Table support disabled.
- ‘HUGE’ - (Default) Denotes that a table should be created as a c-tree HUGE file (64-bit file offset addressing).
- ‘NOTHUGE’ - Denotes that a table should be created as a c-tree non-HUGE file (32-bit file offset addressing). These files have a limit of 2Gb or 4Gb depending on your OS platform.

Note: See the SQL_OPTION NO_HUGEFILE c-treeACE Server configuration option to reverse this behavior.

Example
To combine STORAGE ATTRIBUTE options, separate them with a semicolon (;) as shown here:

```
CREATE TABLE small_preimage_table (name CHAR(10), age SMALLINT) STORAGE_ATTRIBUTES 'ENC=TWF24;PREIMG'
```
CREATE TRIGGER

Description

Creates a trigger for the specified table. A trigger is a special type of stored procedure that helps ensure referential integrity for a database.

Triggers contain Java source code which can use c-treeACE SQL Java classes to carry out database operations. Triggers are automatically activated when an INSERT, UPDATE, or DELETE statement affects the trigger’s target table. The Java source code details what actions the trigger takes when it is activated.

For more detail on creating and using triggers, see the c-treeACE SQL Guide to Using Stored Procedures and Triggers.

Syntax

CREATE TRIGGER [ IF NOT EXISTS ] [ owner_name. ] trigname
  [ BEFORE | AFTER ] { INSERT | DELETE | UPDATE [ OF ( column_name [ , ... ] ) ] }
  ON table_name
  { REFERENCING { OLDROW [ , NEWROW ] | NEWROW [ , OLDROW ] } }
  [ FOR EACH { ROW | STATEMENT } ]
  [ IMPORT java_import_clause ]
BEGIN
  java_snippet
END

Arguments

IF NOT EXISTS

This argument avoids failure by creating the trigger only if a trigger of the same name does not already exist.

owner_name

Specifies the owner of the trigger. If the name is different from the user name of the user executing the statement, then the user must have DBA privileges.

trigname

Names the trigger. DROP TRIGGER statements specify the trigger name defined here. c-treeACE SQL also uses trigname in the name of the Java class that it creates from the Java snippet.

BEFORE | AFTER

The trigger action time. Specifies whether the triggered action implemented by java_snippet executes before or after the triggering INSERT, UPDATE, or DELETE statement.

INSERT | DELETE | UPDATE [ OF column_name [ , ... ] ]

The statement that activates the trigger. Also called the trigger event.

If UPDATE is the trigger event, this clause can include an optional column list. Updates to any of the specified columns or use of a specified column in a search condition to update other values will activate the trigger. As long as a specified column is not used in either case then the trigger
will not be activated. If an UPDATE trigger does not include the optional column list, an update statement specifying any of the table columns will activate the trigger.

**ON table_name**

The name of the table for which the trigger is defined. *table_name* cannot be the name of a view or a remote table. A triggering statement that specifies *table_name* causes the trigger to execute.

**REFERENCING { OLDROW [ , NEWROW ] | NEWROW [ , OLDROW ] }**

Allowed only if the trigger also specifies the FOR EACH ROW clause. The REFERENCING clause provides a mechanism for c-treeSQL to pass row values as input parameters to the stored procedure implemented by *java_snippet*. The code in *java_snippet* uses the `getValue()` method of the NEWROW and OLDROW objects to retrieve values of columns in rows affected by the trigger event and store them in procedure variables.

The meaning of the OLDROW and NEWROW arguments of REFERENCING clause depends on whether the trigger event is INSERT, UPDATE, or DELETE:

- **INSERT...REFERENCING NEWROW** means the triggered action can access values of columns of each row inserted. c-treeSQL passes the column values specified by the INSERT statement.

- **INSERT...REFERENCING OLDROW** is meaningless, since there are no existing values for a row being inserted. INSERT...REFERENCING OLDROW generates a syntax error.

- **UPDATE...REFERENCING NEWROW** means the triggered action can access the values of columns, after they are changed, of each row updated. SQL passes the column values specified by the UPDATE statement.

- **UPDATE...REFERENCING OLDROW** means the triggered action can access the values of columns, before they are changed, of each row updated. c-treeSQL passes the column values of the row as it exists in the database before the update operation.

- **DELETE...REFERENCING OLDROW** means the triggered action can access values of columns of each row deleted. c-treeSQL passes the column values of the row as it exists in the database before the delete operation.

- **DELETE...REFERENCING NEWROW** is meaningless, since there are no new existing to pass for a row being deleted. DELETE...REFERENCING OLDROW generates a syntax error.

**UPDATE** is the only triggering statement that allows both NEWROW and OLDROW in the REFERENCING clause.

Note that the trigger action time (BEFORE or AFTER) does not affect the meaning of the REFERENCING clause. For instance, BEFORE UPDATE...REFERENCING NEWROW still means the values of columns after they are updated will be available to the triggered action.

The REFERENCING clause generates an error if the trigger does not include the FOR EACH ROW clause.

**FOR EACH { ROW | STATEMENT }**

The frequency with which the triggered action implemented by *java_snippet* executes:
FOR EACH ROW means the triggered action executes once for each row being updated by the triggering statement. CREATE TRIGGER must include the FOR EACH ROW clause if it also includes a REFERENCING clause.

FOR EACH STATEMENT means the triggered action executes only once for the whole triggering statement. FOR EACH STATEMENT is the default.

IMPORT

java_import_clause

Specifies standard Java classes to import. The IMPORT keyword must be upper case and on a separate line.

BEGIN

java_snippet

END

The body of the trigger. Also called the triggered action. The body contains the Java source code that implements the actions to be completed when a triggering statement specifies the target table. The Java statements become a method in a class the c-treeACE SQL engine creates and submits to the Java compiler.

The BEGIN and END keywords must be upper case and on separate lines.

Notes

• Triggers can take action on their own table so that they invoke themselves. c-treeSQL limits such recursion to five levels.

• You can you have multiple triggers on the same table. c-treeACE SQL executes all triggers applicable to a given combination of table, trigger event, and action time. If more than one trigger is applicable for a particular combination, c-treeSQL executes the triggers in the order they were created. (You can determine the creation order from the triggerid column in the admin.systrigger system table. The higher the triggerid value, the later the trigger was created.) The interaction of multiple triggers on the same table can be confusing, so exercise care.

• The actions carried out by a trigger may fire another trigger. When this happens, the other trigger's actions execute before the rest of the first trigger finishes executing. c-treeSQL limits such nesting to five levels.

• If a c-treeSQL statement both fires a trigger and violates a constraint (possible if the trigger action time is BEFORE), any actions taken by the trigger are rolled back and do not take effect.

• To modify an existing trigger, you must delete it and issue another CREATE TRIGGER statement. You can query the admin.systrigger and sysproctxt system tables for details of the trigger before deleting it.

Example

This example illustrates an update trigger on a table called BUG_INFO. If the STATUS or PRIORITY fields are modified, the trigger modifies the BUG_SUMMARY and BUG_STATUS tables appropriately based on some conditions.

CREATE TRIGGER BUG_UPDATE_TRIGGER
AFTER UPDATE OF STATUS, PRIORITY ON BUG_INFO
REFERENCING OLDROW, NEWROW
FOR EACH ROW

IMPORT
import java.sql.*;

BEGIN
try {

    // column number of STATUS is 10
    String old_status, new_status;
    OLDROW.GetValue(10, old_status);
    NEWROW.GetValue(10, new_status);

    if ((old_status.compareTo("OPEN") == 0) &&
        (new_status.compareTo("FIXED") == 0)) {
        // If STATUS has changed from OPEN to FIXED
        // increment the bugs_fixed_cnt by 1 in the
        // row corresponding to current month
        // and current year
        SQLIStatement update_stmt =
            new SQLIStatement("update BUG_STATUS set bugs_fixed_cnt = bugs_fixed_cnt + 1 
                  where month = ? and year = ?");
        Integer current_month = 10;
        Integer current_year = 1997;
        update_stmt.SetParam(1, current_month);
        update_stmt.SetParam(2, current_year);
        update_stmt.Execute();

        SQLIStatement insert_stmt =
            new SQLIStatement("insert into BUG_SUMMARY values (?, ?, ?)");
        String bug_id, priority;
        Date reported_on, fixed_on;
        NEWROW.GetValue(1, bug_id);
        NEWROW.GetValue(2, priority);
        NEWROW.GetValue(5, reported_on);
        NEWROW.GetValue(6, fixed_on);
        Integer turn_around_time = fixed_on - reported_on;
        insert_stmt.SetParam(1, bug_id);
        insert_stmt.SetParam(2, priority);
        insert_stmt.SetParam(3, turn_around_time);
        insert_stmt.Execute();
    }

    // If PRIORITY has changed to URGENT,
    // increment the bugs_escalated by 1 in the month field.
}
String old_priority, new_priority;
OLDRow.GetValue(2, old_priority);
NEWRow.GetValue(2, new_priority);
if ((new_priority.CompareTo("URGENT") == 0) &&
(old_priority.CompareTo("URGENT") != 0))
{
// If PRIORITY has changed to URGENT
// increment the bugs_escalated by 1 in the row corresponding to current month
// and current year
SQLIStatement update_stmt {
"update BUG_STATUS set bugs_escalated_cnt = bugs_escalated_cnt + 1"
"where month = ? and year = ?"
};

Integer current_month = 10;
Integer current_year = 1997;

update_stmt.SetParam(1, current_month);
update_stmt.SetParam(2, current_year);

update_stmt.Execute();
}
}
catch (SQLException e)
{
// Log the exception message from e.
SQLException sqle = new SQLException("UPDATE_BUG_TRIGGER failed");
throw sqle;
}

Authorization

Users executing CREATE TRIGGER must have the DBA privilege or RESOURCE privilege.

SQL Compliance       SQL-93, ODBC Core SQL grammar
Environment          Embedded SQL, interactive SQL, ODBC applications
Related Statements   DROP TRIGGER
**CREATE VIEW**

**Description**

Creates a view with the specified name on existing tables and/or views.

**Syntax**

```
CREATE VIEW [ owner_name. ] view_name
    [ ( column_name, column_name, ... ) ]
    AS [ ( ) query_expression [ ) ]
    [ WITH CHECK OPTION ];
```

**Notes**

- The `owner_name` is made the owner of the created view.
- The column names specified for the view are optional and provide an alias for the columns selected by the query specification. If the column names are not specified then the view will be created with the same column names as the tables and/or views it is based on.
- A view is deletable if deleting rows from that view is allowed. For a view to be deletable, the view definition has to satisfy the following conditions:
  - The first `FROM` clause contains only one table reference or one view reference.
  - There are no aggregate functions, `DISTINCT` clause, `GROUP BY` or `HAVING` clause in the view definition.
  - If the first `FROM` clause contains a view reference, then the view referred to is deletable.
- A view is updatable if updating rows from that view is allowed. For a view to be updatable, the view has to satisfy the following conditions:
  - The view is deletable (That is, it satisfies all the conditions specified above for deletability).
  - All the select expressions in the first `SELECT` clause of the view definition are simple column references.
  - If the first `FROM` clause contains a view reference, then the view referred to is updatable.
- A view is insertable if inserting rows into that view is allowed. For a view to be insertable, the view has to satisfy the following conditions:
  - The view is updatable (That is, it satisfies all the conditions specified above for updatability).
  - If the first `FROM` clause contains a table reference, then all NOT NULL columns of the table are selected in the first `SELECT` clause of the view definition.
  - If the first `FROM` clause contains a view reference, then the view referred to is insertable.
- The `WITH CHECK OPTION` clause can be specified only if the view is updatable.
- If `WITH CHECK OPTION` clause is specified when defining a view, then during any update or insert of a row on this view, it is checked that the updated/inserted row satisfies the view definition (That is, the row is selectable using the view).

**Examples**

```sql
CREATE VIEW ne_customers AS
    SELECT cust_no, name, street, city, state, zip
    FROM customer
```
WHERE state IN ('NH', 'MA', 'NY', 'VT')
WITH CHECK OPTION ;

CREATE VIEW order_count (cust_number, norders) AS
SELECT cust_no, COUNT(*)
FROM orders
GROUP BY cust_no;

Authorization

The user executing this statement must have the following privileges:

- DBA or RESOURCE privilege.
- SELECT privilege on all the tables/views referred to in the view definition.

If owner_name is specified and is different from the name of the user executing the statement, then the user must have DBA privilege.

SQL Compliance
SQL-92, ODBC Core SQL grammar

Environment
Embedded SQL, interactive SQL, ODBC applications

Related Statements
Query Expressions, DROP VIEW
**DELETE**

**Description**
Deletes zero, one or more rows from the specified table that satisfy the search condition specified in the **WHERE** clause. If the optional **WHERE** clause is not specified, then the **DELETE** statement deletes all rows of the specified table.

**Syntax**
```
DELETE FROM [owner_name.] { table_name | view_name }
[ WHERE search_condition ];
```

**Notes**
- If the table has primary/candidate keys, and if there exists references from other tables to the rows to be deleted, the statement is rejected.
- While our **DELETE** doesn't directly support a TOP clause, you can do this with any indexed field with a subquery as such:
```
DELETE FROM <table> WHERE <idxfield> <= (SELECT MAX(<idxfield>) FROM (SELECT TOP 1000 <idxfield> FROM <table>) x )
```

**Example**
```
DELETE FROM customer
    WHERE customer_name = 'RALPH';
```

**Authorization**
The user executing this statement must have any of the following privileges:
- DBA privilege.
- Ownership of the table.
- **DELETE** permission on the table.

If the target is a view, then the **DELETE** privilege is required on the target base table referred to in the view definition.

**SQL Compliance**
SQL-92, ODBC Extended SQL grammar

**Environment**
Embedded SQL, interactive SQL, ODBC applications

**Related Statements**
Search Conditions
DISCONNECT

Description
Terminates the connection between an application and a database environment.

Syntax
DISCONNECT
   { connection_name | ALL | CURRENT | DEFAULT }
connection_name::=
   { character_literal | host_variable }

Notes
- If a connection name is specified it should identify a dormant or current connection. If the connection_name specified is the current connection, the connection to the dormant DEFAULT database, if any, (this connection should have been previously achieved through CONNECT TO DEFAULT) is made the current connection; else no current connection exists.
- If ALL is specified, all established connections are disconnected. After the execution of this statement, a current connection does not exist.
- If CURRENT is specified, the current connection, if any, is disconnected. Here too, the connection to the dormant DEFAULT database, if any, (this connection should have been previously achieved through CONNECT TO DEFAULT) is made the current connection; else no current connection exists.
- If DEFAULT is specified, the DEFAULT connection, if any, is disconnected. If this connection happens to be the current connection, no current connection exists after the execution of this statement.

Examples
DISCONNECT 'conn_1';
DISCONNECT CURRENT;
DISCONNECT ALL;
DISCONNECT DEFAULT;

Authorization
None.

SQL Compliance
SQL-92

Environment
Embedded SQL and interactive

Related Statements
DISCONNECT, SET CONNECTION
DROP FUNCTION

Description
Deleting a User Defined Scalar Function (UDF) on the specified table.

Syntax
DROP FUNCTION [IF EXISTS] function_name

Arguments
IF EXISTS
This argument avoids failure by attempting to drop the function only if a function of that name already exists.

function_name
The user defined function to be deleted from the table.

Example
DROP FUNCTION str_cat;

Authorization
The user executing this statement must have any of the following privileges:

- DBA privilege
- Ownership of the index

SQL Compliance
ODBC Core SQL grammar

Environment
Embedded SQL, interactive SQL, ODBC and JDBC applications

Related Statements
CREATE FUNCTION
DROP INDEX

Description
Deletes an index on the specified table.

Syntax
DROP INDEX [IF EXISTS] [index_owner_name.]index_name
[ON [table_owner_name.]table_name]

Arguments
[IF EXISTS]
This argument avoids failure by attempting to drop the index only if an index of that name already exists.

index_owner_name
If index_owner_name is specified and is different from the name of the user executing the statement, then the user must have DBA privileges.

table_name
The table_name argument is optional. If specified, the index_name is verified to correspond to the table.

Warning: Do not DROP indexes on primary or foreign keys. This can lead to relational integrity issues. Use ALTER TABLE to perform any changes involving constraints.

Example
DROP INDEX custindex ON customer ;

Authorization
The user executing this statement must have any of the following privileges:

- DBA privilege
- Ownership of the index
- EXCLUSIVE file access is required for any this operation

SQL Compliance
ODBC Core SQL grammar

Environment
Embedded SQL, interactive SQL, ODBC applications

Related Statements
CREATE INDEX
DROP PROCEDURE

Description
Deletes a stored procedure.

Syntax
DROP PROCEDURE [IF EXISTS] [ owner_name. ] procedure_name ;

Arguments
IF EXISTS
This argument avoids failure by attempting to drop the procedure only if a procedure of that name already exists.

owner_name
Specifies the owner of the procedure.

procedure_name
Names of the stored procedure to delete.

Example
DROP PROCEDURE new_sal ;

Authorization
To drop a stored procedure, users must be the owner of the procedure or have the DBA privilege.

SQL Compliance
SQL-93, ODBC Core SQL grammar

Environment
Embedded SQL, interactive SQL, ODBC applications

Related Statements
CALL, CREATE PROCEDURE
DROP SYNONYM

Description
Drops the specified synonym.

Syntax
DROP [PUBLIC] SYNONYM [owner_name.]synonym ;

Arguments
PUBLIC
Specifies that the synonym was created with the PUBLIC argument.

c-treeACE SQL generates the Base table not found error if DROP SYNONYM specifies PUBLIC and the synonym was not a public synonym. Conversely, the same error message occurs if DROP SYNONYM does not specify public and the synonym was created with the PUBLIC argument.

To drop a public synonym, you must have the DBA privilege.

owner_name
If owner_name is specified and is different from the name of the user executing the statement, then the user must have DBA privileges.

synonym
Name for the synonym.

Example
DROP SYNONYM customer ;
DROP PUBLIC SYNONYM public_suppliers ;

Authorization
Users executing DROP SYNONYM must have either the DBA privilege or be the owner of the synonym. Users executing DROP PUBLIC SYNONYM must have the DBA privilege.

SQL Compliance
Extension

Environment
Embedded SQL, interactive SQL, ODBC applications

Related Statements
CREATE SYNONYM
**DROP TABLE**

**Description**

Deletes the specified table.

**Syntax**

```
DROP TABLE  [IF EXISTS]  [owner_name.]table_name ;
```  

**Notes**

- If `owner_name` is specified and is different from the name of the user executing the statement, then the user must have DBA privileges.
- When a table is dropped, the indexes on the table and the privileges associated with the table are dropped automatically.
- Views dependent on the dropped table are not automatically dropped, but become invalid.
- If the table is part of another table’s referential constraint (if the table is named in another table’s `REFERENCES` clause), the `DROP TABLE` statement fails. Use the `ALTER TABLE` statement to delete any referential constraints that refer to the table before issuing the `DROP TABLE` statement.
- `IF EXISTS` avoids failure by attempting to drop the table only if a table of that name already exists.

**Example**

```
DROP TABLE customer ;
```  

**Authorization**

The user executing this statement must have any of the following privileges:

- DBA privilege.
- Ownership of the table.

**SQL Compliance**

SQL-92, ODBC Minimum SQL grammar

**Environment**

Embedded SQL, interactive SQL, ODBC applications

**Related Statements**

CREATE TABLE
DROP TRIGGER

Description
Deletes a trigger.

Syntax
DROP TRIGGER [IF EXISTS] [ owner_name. ] trigger_name ;

Arguments
IF EXISTS
This argument avoids failure by attempting to drop the trigger only if a trigger of that name already exists.

owner_name
Specifies the owner of the trigger.

trigger_name
Names of the trigger to delete.

Example
DROP TRIGGER sal_check ;

Authorization
- The DBA privilege entitles a user to drop any trigger.
- The owner of a trigger is given EXECUTE and DROP privilege on that trigger at creation time, by default.

SQL Compliance
SQL-93, ODBC Core SQL grammar

Environment
Embedded SQL, interactive SQL, ODBC applications

Related Statements
CREATE TRIGGER
**DROP VIEW**

**Description**
Deletes the view from the database.

**Syntax**
```
DROP VIEW [owner_name.]view_name ;
```

**Notes**
- If `owner_name` is specified and is different from the name of the user executing the statement, then the user must have **DBA** privileges.
- When a view is dropped, other views that are dependent on this view are not dropped. The dependent views become invalid.

**Example**
```
DROP VIEW newcustomers ;
```

**Authorization**
The user executing this statement must have any of the following privileges:
- DBA privilege
- Ownership of the view

**SQL Compliance**
SQL-92, ODBC Core SQL grammar

**Environment**
Embedded SQL, interactive SQL, ODBC applications

**Related Statements**
CREATE VIEW
**EXPLAIN PLAN**

**Description**
Generates a query execution plan for a SQL query.

**Syntax**
```
EXPLAIN PLAN [ INTO [ owner_name. ] table_name ] [ SET STATEMENT_ID = <stmt id> ] FOR <SQL statement>
```

**Arguments**

- **table name**
  The table into which the query plan is to be saved. Any valid table name may be specified. If the table does not exist, then it is created, provided the user has resource privilege. If the current owner is not the owner of the table specified he should have adequate privilege to write into it.
  
  **Note:** The INTO table_name clause is optional. If it is not specified, then the query plan is stored in the default plan table `admin.qep_tbl`.

- **stmt_id**
  The user provided identifier for the query plan. Any character string (less than 32 characters) can be specified. The `stmt_id` is stored along with the query plan and is used to distinguish between the various Query plans stored in the Query plan table.
  
  The SET STATEMENT_ID = <stmt id> clause is optional. If not specified, a unique ID of the form `qep_stmtid_xx` is generated internally.

**Notes**
For complex SQL operation, the query plan of the SQL query being executed has a very large impact on its performance. It is useful to have a mechanism wherein the execution plan of a query can be made available before actually executing the query. This aids in designing efficient queries.

- c-treeACE SQL has the ability to dynamically generate and store query plans. The query plan can be generated and even viewed graphically with the c-treeACE SQL Explorer utility.

- An internal stored procedure is used to retrieve the query plan.

  ```
  access_get_qep( table_owner, table_name, stmt_id, max_nodeinfo_len )
  ```

  - **table_owner** is the owner of the query plan table
  - **table_name** is the name of the query plan table where the plan is stored
  - **stmt_id** is the Statement Id provided by the user or the id internally generated when the execution plan was generated.
  - **max_nodeinfo_len (integer)** - is the length of the information displayed per node in the resultset. By default this is set to 256. Set this value to 0 if the default value is to be used (8192).

  The output of the procedure is a resultset consisting of a single column. Each record of the resultset corresponds to a node in the query plan. The ordering of the nodes in the resultset is, from bottom to top and left to right of the query execution plan tree.
Authorization

If the table does not exist, then it is created, provided the user has resource privilege. If the current owner is not the owner of the table specified they should have adequate privilege to write into it.

<table>
<thead>
<tr>
<th>SQL Compliance</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Embedded SQL, interactive SQL, ODBC applications</td>
</tr>
</tbody>
</table>
GET DIAGNOSTICS

Description
Retrieves information about the execution of the previous c-treeACE SQL statement. GET DIAGNOSTICS extracts information from the c-treeACE SQL diagnostics area, a data structure that contains information about the execution status of the most recent c-treeACE SQL statement. There are two components to the diagnostics area:

- The header contains overall information about the last c-treeACE SQL statement as a whole
- The detail area contains information for a particular condition (an error, warning, or success condition) associated with execution of the last c-treeACE SQL statement. The diagnostics area can potentially contain multiple detail areas corresponding to multiple conditions generated by the c-treeACE SQL statement described by the header.

Note: The c-treeACE SQL diagnostics area currently supports only one detail area.

There are two forms of the GET DIAGNOSTICS statement, one that extracts header information (GET DIAGNOSTICS), and one that extracts detail information (GET DIAGNOSTICS EXCEPTION number).

Syntax
GET DIAGNOSTICS
:param = header_info_item [ , :param = header_info_item ] ...

GET DIAGNOSTICS EXCEPTION number
:param = detail_info_item [ , :param = detail_info_item ] ...

header_info_item ::
{ NUMBER | MORE | COMMAND_FUNCTION | DYNAMIC_FUNCTION | ROW_COUNT }

detail_info_item ::
{ CONDITION_NUMBER | RETURNED_SQLSTATE | CLASS_ORIGIN | SUBCLASS_ORIGIN | TABLE_NAME | COLUMN_NAME | MESSAGE_TEXT | MESSAGE_LENGTH }

Arguments
:parameter
A host-language variable to receive the information returned by the GET DIAGNOSTICS statement. The host-language program must declare parameter to be compatible with the SQL data type of the information item.

header_info_item
One of the following keywords, which returns associated information about the diagnostics area
or the c-treeACE SQL statement:

**NUMBER**

The number of detail areas in the diagnostics area. Currently, NUMBER is always 1. NUMBER is type NUMERIC with a scale of 0.

**MORE**

Whether the diagnostics area contains information on all the conditions
resulting from the statement. MORE is a one-character string with a value
of Y (all conditions are detailed in the diagnostics area) or N (all
conditions are not detailed).

**COMMAND_FUNCTION**

If the statement was a static c-treeACE SQL statement, contains the
color-string code for the statement (as specified in the SQL-92
standard). If the statement was a dynamic statement, contains either the
color string ‘EXECUTE’ or ‘EXECUTE IMMEDIATE’.

**DYNAMIC_FUNCTION**

For dynamic c-treeACE SQL statements only (as indicated by
‘EXECUTE’ or ‘EXECUTE IMMEDIATE’ in the COMMAND_FUNCTION
item), contains the character-string code for the statement (as specified
in the SQL-92 standard).

**ROW_COUNT**

The number of rows affected by the c-treeACE SQL statement.

**EXCEPTION number**

Specifies that GET DIAGNOSTICS extracts detail information. number specifies which of multiple
detail areas GET DIAGNOSTICS extracts. Currently, number must be the integer 1.

**detail_info_item**

One of the following keywords, which returns associated information about the particular error
condition:

**CONDITION_NUMBER**

The sequence of this detail area in the diagnostics area. Currently,
CONDITION_NUMBER is always 1.

**RETURNED_SQLSTATE**

The SQLSTATE value that corresponds to the condition. See the
individual sections in Error Messages (page 249) for a list of SQLSTATE
values.

**CLASS_ORIGIN**

Whether the SQLSTATE class code is defined by the SQL standard
(indicated by the character string ‘ISO 9075’) or by c-treeACE SQL.

**SUBCLASS_ORIGIN**

Whether the SQLSTATE subclass code is defined by the c-treeACE
SQL standard (indicated by the character string ‘ISO 9075’) or by
ctreeACE SQL.

**TABLE_NAME**

If the error condition involves a table, the name of the table.

**COLUMN_NAME**

If the error condition involves a column, the name of the affected
columns.

**MESSAGE_TEXT**

The associated message text for the error condition.

**MESSAGE_LENGTH**

The length in characters of the message in the MESSAGE_TEXT item.

**Notes**

The GET DIAGNOSTICS statement itself does not affect the contents of the diagnostics area. This
means applications can issues multiple GET DIAGNOSTICS statements to retrieve different items
of information about the same c-treeACE SQL statement.
Example
GET DIAGNOSTICS :num = NUMBER, :cmdfunc = COMMAND_FUNCTION
GET DIAGNOSTICS EXCEPTION :num
:sstate = RETURNED_SQLSTATE, :msgtxt = MESSAGE_TEXT

Authorization
    SQL Compliance  SQL-92
    Environment     Embedded SQL
GRANT

Description
Grants various privileges to the specified users or user group for the database. There are different forms of the GRANT statement for various purposes:

- To grant database-wide privileges, either system administration (DBA) or general creation (RESOURCE)
- To grant privileges on the specified tables or view
- To grant the privilege to execute the specified stored procedure

Syntax
GRANT { RESOURCE, DBA }
TO {user_name | usergroup_name} [ , {user_name | usergroup_name} ] ...

GRANT { privilege [ , privilege ] ... | ALL { PRIVILEGES } }
ON table_name
TO { {user_name | usergroup_name} [ , {user_name | usergroup_name} ] ... | PUBLIC }
[WITH GRANT OPTION];

GRANT EXECUTE ON procedure_name
TO { {user_name | usergroup_name} [ , {user_name | usergroup_name} ] ... | PUBLIC };

privilege ::= { SELECT | INSERT | DELETE | ALTER | INDEX 
| UPDATE [ {column, column, ...} ] 
| REFERENCES [ {column, column, ...} ] }

Arguments

DBA
Allows the specified users to create, access, modify, or delete any database object, and to grant other users any privileges.

RESOURCE
Allows the specified users to issue CREATE statements. The RESOURCE privilege does not allow users to issue DROP statements on database objects. Only the owner of the object and users with the DBA privilege can drop database objects.

SELECT
Allows the specified users to read data in the table or view.

INSERT
Allows the specified users to add new rows to the table or view.

DELETE
Allows the specified users to delete rows in the table or view

ALTER
Allows the specified users to modify the table or view
INDEX
Allows the specified users to create an index on the table or view.

UPDATE [ (column, column, … ) ]
Allows the specified users to modify existing rows in the table or view. If followed by a column list, the users can modify values only in the columns named.

REFERENCES [ (column, column, … ) ]
Allows the specified users to refer to the table from other tables’ constraint definitions. If followed by a column list, constraint definitions can refer only to the columns named. For more detail on constraint definitions, see Column Constraints (page 197).

ALL
Grants all privileges for the table or view.

ON table_name
The table or view for which c-treeACE SQL grants the specified privileges.

EXECUTE ON procedure_name
Allows execution of the specified stored procedure.

TO user_name [ , user_name ] …
The list of users for which c-treeACE SQL grants the specified privileges.

TO PUBLIC
Grants the specified privileges to any user with access to the system.

WITH GRANT OPTION
Allows the specified users to grant their access rights or a subset of their rights to other users.

Example
GRANT SELECT ON custmaster TO odbc_group;
GRANT ALTER ON cust_view TO dbuser1 ;
GRANT SELECT ON newcustomers TO dbuser2 ;
GRANT EXECUTE ON sample_proc TO searle;

Authorization
The user granting DBA or RESOURCE privileges must have the DBA privilege.

The user granting privileges on a table must have any of the following privileges:
- DBA privilege
- Ownership of the table
- All the specified privileges on the table, granted with the WITH GRANT OPTION clause

SQL Compliance
SQL-92, ODBC Core SQL grammar. Extensions: ALTER, INDEX, RESOURCE, DBA privileges

Environment
Embedded SQL, interactive SQL, ODBC applications
**INSERT**

**Description**

Inserts new rows into the specified table/view that will contain either the explicitly specified values or the values returned by the query expression.

**Syntax**

```
INSERT INTO [owner_name.] { table_name | view_name }
   [ (column_name, column_name, ... ) ]
   { VALUES (value, value, ... ) | query_expression };
```

**Notes**

- If the optional list of column names is specified, then only the values for those columns need be supplied. The rest of the columns of the inserted row will contain NULL values, provided the table definition allows NULL values and there is no `DEFAULT` clause for the columns. If a `DEFAULT` clause is specified for a column and the column name is not present in the optional column list, then the column takes the default value.
- If the optional list is not specified then all the column values have to be either explicitly specified or returned by the query expression. The order of the values should be the same as the order in which the columns have been declared in the declaration of the table/view.
- Explicit specification of the column values provides for insertion of only one row at a time. The query expression option allows for insertion of multiple rows at a time.
- If the table contains a foreign key, and there does not exist a corresponding primary key that matches the values of the foreign key in the record being inserted, the insert operation is rejected.
- You can use `INSERT` statements with query expressions to transfer rows from one remote table to another.
- `IDENTITY` columns are populated automatically based on the seed and increment values that were specified for the `IDENTITY` column, values for the `IDENTITY` column can not be specified as part of the `INSERT` statement. An `IDENTITY` column can not be specified in the list of column names.

**Examples**

```
INSERT INTO customer (cust_no, name, street, city, state)
   VALUES
   (1001, 'RALPH', '#10 Columbia Street', 'New York', 'NY') ;
```

```
INSERT INTO neworders (order_no, product, qty)
   SELECT order_no, product, qty
   FROM orders
   WHERE order_date = SYSDATE ;
```

**Authorization**

The user executing this statement must have any of the following privileges:

- `DBA` privilege.
- Ownership of the table.
SQL Statements

- INSERT privilege on the table.

If a `query_expression` is specified, then the user must have any of the following privileges:
- DBA privilege.
- SELECT privilege on all the tables/views referred to in the `query_expression`.

**SQL Compliance**
- SQL-92, ODBC Core SQL grammar

**Environment**
- Embedded SQL, interactive SQL, ODBC applications

**Related Statements**
- Query Expressions
LOCK TABLE

Description
Explicitly locks the specified tables for shared or exclusive access.

Syntax
LOCK TABLE table_name [ , ... ]
   IN { SHARE | EXCLUSIVE } MODE
   [ NOWAIT ] ;

Notes
- Explicit locking can be used to improve the performance of a single transaction at the cost of decreasing the concurrency of the system and potentially blocking other transactions. It is more efficient to explicitly lock a table if you know ahead of time that the transaction would be updating a substantial part of a table. The efficiency is gained by decreased overhead of the implicit locking mechanism and any potential waits for acquiring page level locks for the table.
- Explicit locking can be used to minimize potential deadlocks in situations where a substantial part of a table is being modified by a transaction. The benefits of table locking should always be compared with the disadvantages of losing concurrency before a choice is made between explicit and implicit locking.
- The SHARE mode allows other transactions to read the table but does not allow modifications on the table.
- The EXCLUSIVE mode does not allow any other transactions to read and/or modify the table.
- If the lock request cannot be honored by the system (due to a conflict lock held by another transaction) then in the normal case the transaction is suspended until the specified lock can be acquired. The NOWAIT option provides an immediate return of control if the lock cannot be acquired.
- Locks that are acquired explicitly and/or implicitly are released only when the transaction is ended using either the COMMIT or the ROLLBACK WORK statement.

Example
LOCK TABLE custmaster
   IN EXCLUSIVE MODE ;

Authorization
The user executing this statement must have any of the following privileges:
- DBA, or INSERT, UPDATE, DELETE, or ALTER privilege.

SQL Compliance
| SQL-92 |
---|---|
Environment
| Embedded SQL, interactive SQL |
Related Statements
| SELECT, INSERT, DELETE |
ORDER BY

Description
The `ORDER BY` clause specifies the sorting of rows retrieved by the `SELECT` statement. c-treeACE SQL does not guarantee the sort order of rows unless the `SELECT` statement includes an `ORDER BY` clause.

Syntax
```sql
ORDER BY { expr | posn } [ ASC | DESC ]
   [ , { expr | posn } [ASC | DESC] , ... ]
```

Notes
- Ascending order is the default ordering. The descending order will be used only if the keyword `DESC` is specified for that column.
- Each `expr` is an expression of one or more columns of the tables specified in the `FROM` clause of the `SELECT` statement. Each `posn` is a number identifying the column position of the columns being selected by the `SELECT` statement.
- The selected rows are ordered on the basis of the first `expr` or `posn` and if the values are the same then the second `expr` or `posn` is used in the ordering.
- The `ORDER BY` clause if specified should follow all other clauses of the `SELECT` statement.
- An `ORDER BY` clause can appear in a subquery, however, subqueries with a combination of `TOP`, `GROUP BY` and outer references remain unsupported.
- An `ORDER BY` clause can appear in a `FOR UPDATE` query.

Note: This is a non-standard SQL feature as specified by SQL92. Also, full cursor update is not supported by c-treeACE SQL.

- A query expression followed by an optional `ORDER BY` clause can be specified. In such a case, if the query expression contains set operators, then the `ORDER BY` clause can specify column names or position from the first `SELECT` statement.

For example:
```sql
-- Get a merged list of customers and suppliers
-- sorted by their name.
(SELECT name, street, state, zip
 FROM customer
UNION
SELECT name, street, state, zip
 FROM supplier)
ORDER BY 1 ;

(SELECT name, street, state, zip
 FROM customer
UNION
SELECT name, street, state, zip
 FROM supplier)
ORDER BY customer.name;
```

- In V11 and later, a query projecting an `LVARBINARY` column using an `ORDER BY` clause that requires sorting in memory may result in projecting null values. Prior to this change,
LVARCHAR was the only supported long type. The logic has been updated to handle LVARBINARY.

**Example**

```sql
SELECT name, street, city, state, zip
FROM customer
ORDER BY name ;
```
**RENAME**

**Description**
Renames the specified table name, view name or synonym to the new name specified.

**Syntax**
```
RENAME [owner_name.] oldname TO [owner_name.] newname ;
```

**Arguments**
- **[owner_name.]**
  Optional owner-name qualifier for the name. If the owner name is not the same as that of the current user, the current user must have the DBA privilege.
  If specified, the owner name must be the same for *oldname* and *newname*. In other words, you cannot change the owner of a table, view, or synonym with *RENAME*.
- **oldname**
  Current name of the table, view, or synonym.
- **newname**
  New name for the table, view, or synonym.

**Example**
```
RENAME sitem TO supplier_item ;
```

**Authorization**
The user executing this statement must have any of the following privileges:
- DBA privilege
- Ownership of the table/view/synonym.
- ALTER privilege on the table/view.

**SQL Compliance** | **Extension**
---|---
Environment | Embedded SQL, interactive SQL, ODBC applications
Related Statements | CREATE TABLE, CREATE VIEW, CREATE SYNONYM
REVOKE

Description
Revoke various privileges to the specified users for the database. There are three forms of the REVOKE statement:

- The first form revokes database-wide privileges, either system administration (DBA) or general creation (RESOURCE)
- The second form revokes various privileges on specific tables and views
- The third form revokes the privilege to execute the specified stored procedure

Syntax
REVOKE { RESOURCE | DBA }
FROM { {user_name | usergroup_name} [ , {user_name | usergroup_name} ] … } ;

REVOKE [ GRANT OPTION FOR ]
{ privilege [ , privilege, ] … | ALL [ PRIVILEGES ] }
ON table_name
FROM { {user_name | usergroup_name} [ , {user_name | usergroup_name} ] … | PUBLIC } [ RESTRICT | CASCADE ] ;

REVOKE [ GRANT OPTION FOR ] EXECUTE ON procedure_name
FROM { {user_name | usergroup_name} [ , {user_name | usergroup_name} ] … | PUBLIC } [ RESTRICT | CASCADE ] ;

privilege ::
{ SELECT | INSERT | DELETE | ALTER | INDEX
| UPDATE [ (column, column, …) ]
| REFERENCES [ (column, column, …) ] }

Arguments
GRANT OPTION FOR
Revoke the grant option for the privilege from the specified users. The actual privilege itself is not revoked. If specified with RESTRICT, and the privilege was passed on to other users, the REVOKE statement fails and generates an error. Otherwise, GRANT OPTION FOR implicitly revokes any rights the user may have in turn given to other users.

{ privilege [ , privilege, ] … | ALL [ PRIVILEGES ] }

List of privileges to be revoked. See the description in GRANT (page 224) for details on specific privileges. Revoking RESOURCE and DBA rights can only be done by the administrator or a user with DBA rights.

If a user has been granted access to a table by more than one user then all the users have to perform a revoke for the user to lose his access to the table.

Using the keyword ALL revokes all the rights granted on the table/view.

ON table_name
The table or view for which c-treeACE SQL revokes the specified privileges.

EXECUTE ON procedure_name
Revoke the right to execute the specified stored procedure.

```sql
FROM {user_name | usergroup_name} [ , {user_name | usergroup_name} ] ...
```

Revoke the specified rights on the table or view from the specified list of users.

```sql
FROM PUBLIC
```

Revoke the specified rights on the table or view from any user with access to the system.

**RESTRICT | CASCADE**

If the `REVOKE` statement specifies `RESTRICT`, c-treeACE SQL checks to see if the privilege being revoked was passed on to other users (possible only if the original privilege included the `WITH GRANT OPTION` clause). If so, the `REVOKE` statement fails and generates an error. If the privilege was not passed on, the `REVOKE` statement succeeds.

If the `REVOKE` statement specifies `CASCADE`, revoking the access right of a user also revokes the rights from all users who received the privilege as a result of that user giving the privilege to others.

If the `REVOKE` statement specifies neither `RESTRICT` nor `CASCADE`, the behavior is the same as for `CASCADE`.

**Example**

```sql
REVOKE INSERT ON customer FROM dbuser1 ;
REVOKE ALTER ON cust_view FROM dbuser2 ;
```

**Authorization**

The user revoking DBA or RESOURCE privileges must have the DBA privilege.

The user revoking privileges on a table must have any of the following privileges:

- DBA privilege
- Ownership of the table
- All the specified privileges on the table, granted with the `WITH GRANT OPTION` clause

**SQL Compliance**

SQL-92, ODBC Core SQL grammar. Extensions: ALTER, INDEX, RESOURCE, DBA privileges

**Environment**

Embedded SQL, interactive SQL, ODBC applications

**Related Statements**

GRANT
ROLLBACK WORK

Description
Ends the current transaction and undoes any database changes performed during the transaction.

Syntax
ROLLBACK [ WORK ] ;

Notes
Under certain circumstances, c-treeACE SQL marks a transaction for abort but does not actually roll it back. Without an explicit rollback, any subsequent updates will not take effect, since a COMMIT statement cause c-treeACE SQL to recognize the transaction as marked for abort, and instead implicitly rolls back the transaction. c-treeACE SQL marks a transaction for abort under these conditions:

- Hardware or software system failures
- Lock timeout errors

Authorization
None.

SQL Compliance
SQL-92.

Environment
Embedded SQL and interactive

Related Statements
COMMIT WORK
**SELECT**

**Description**

Selects the specified column values from one or more rows contained in the table(s) specified in the **FROM** clause. The selection of rows is restricted by the **WHERE** clause. The temporary table derived through the clauses of a select statement is called a result table.

The format of the **SELECT** statement is a query expression with optional **ORDER BY** and **FOR UPDATE** clauses. For more detail on query expressions, see *Query Expressions* (page 31).

**Syntax**

```
select_statement ::=  
   query_expression
   ORDER BY { expr | posn } [ ASC | DESC ]
   [ , { expr | posn } [ASC | DESC], ... ]
   FOR UPDATE [ OF [table].column_name, ... ] [ NOWAIT ];

query_expression ::=  
   query_specification
   | query_expression set_operator query_expression
   | ( query_expression )

set_operator ::=  
   { UNION [ ALL ] | INTERSECT | MINUS }

query_specification ::=  
   SELECT [ ALL | DISTINCT ] [ SKIP N ] [ TOP N ]
   { *
   | { table_name | alias } . * [ , { table_name | alias } . * ] ...  
   | { ( expr | NULL ) [ [ AS ] [ ' ] column_title [ ' ] ] }
   | { [ [ ' ] column_title [ ' ] = ] { expr | NULL } }
   | ,
   | { ( expr | NULL ) [ [ AS ] [ ' ] column_title [ ' ] ] }
   | { [ [ ' ] column_title [ ' ] = ] { expr | NULL } }
   | ...  
   } FROM table_ref [ { ctree ORDERED } ] [ , table_ref [ { ctree ORDERED } ] ... ]
   [ WHERE search_condition ]
   [ GROUP BY [table.]column_name
   [ , [table.]column_name ] ... ]
   [ HAVING search_condition ]

table_ref ::=  
   table_name [ AS ] [ alias [ ( column_alias [ , ... ] ) ] ]
   | ( query_expression ) [ AS ] alias [ ( column_alias [ , ... ] ) ]
   | { ( ) joined_table [ ] }  
   | procedure_name(proc_arg [,...]) [ AS ] [ alias ]

joined_table ::=  
   table_ref CROSS JOIN table_ref
   | table_ref [ INNER | LEFT [ OUTER ] ] JOIN table_ref ON search_condition
```
Arguments

query_expression
See Query Expressions (page 31).

expr
See Expressions (page 21)
expr can also be a scalar sub-query.
See Scalar Sub-query Expressions (page 26)

ORDER BY clause
See ORDER BY CLAUSE (page 230)

FOR UPDATE clause

procedure_name
A procedure used in a table_ref must return a result_set and may not have any OUT or IN/OUT parameters. That is, only IN parameters are supported.

Note: Use of ORDER BY in a FOR UPDATE clause is a non-standard SQL feature as specified by SQL92. Also, full cursor update is not supported by c-treeACE SQL.
See UPDATE (page 244).

Authorization

The user executing this statement must have any of the following privileges:

- DBA privilege
- SELECT permission on all the tables/views referred to in the query_expression.

SQL Compliance


Environment

Embedded SQL (within DECLARE), interactive SQL, ODBC applications

Related Statements

Query Expressions, DECLARE CURSOR, OPEN, FETCH, CLOSE
SET CONNECTION

Description
SET CONNECTION sets the database associated with the connection name as the current database.

Syntax
SET CONNECTION connection_name ;
connection_name::
            { character_literal | host_variable | DEFAULT }

Notes
If DEFAULT is specified, there should exist a DEFAULT connection (this could have been previously achieved through a CONNECT TO DEFAULT statement). All c-treeACE SQL statements are executed for the current database.

Examples
SET CONNECTION 'salesdb';
SET CONNECTION DEFAULT;

Authorization
None.

SQL Compliance
SQL-92

Environment
Embedded SQL and interactive

Related Statements
DISCONNECT, SET CONNECTION
SET TRANSACTION ISOLATION

Description
Explicitly sets the isolation level for a transaction. Isolation levels specify the degree to which one transaction can modify data or database objects being used by another concurrent transaction.

Syntax
SET TRANSACTION ISOLATION LEVEL  isolation_level ;

isolation_level ::
   READ UNCOMMITTED
| READ COMMITTED
| REPEATABLE READ
| SERIALIZABLE

Arguments

READ UNCOMMITTED
Allows dirty reads, non-repeatable reads, and phantoms (described below in Notes).

READ COMMITTED
Default. Prohibits dirty reads; allows non-repeatable reads and phantoms.

REPEATABLE READ
Prohibits dirty reads and non-repeatable reads; allows phantoms.

SERIALIZABLE
Prohibits dirty reads, non-repeatable reads, and phantoms (see the following notes). It guarantees that concurrent transactions will not affect each other; they behave as if they were executing serially, not concurrently.

Notes
SET TRANSACTION allows the user to choose the isolation level for future transactions. If a transaction is currently active, SET TRANSACTION generates an error.

The isolation level specifies the degree to which one transaction is isolated from the effects of concurrent access of the database by other transactions. The appropriate level of isolation depends on how a transaction needs to be isolated from effects of another transaction. Higher isolation levels provide greater data consistency to the user’s transaction but reduce access to data by concurrent transactions.

The isolation level SERIALIZABLE guarantees the highest consistency. The isolation level READ UNCOMMITTED guarantees the least consistency. Only READ COMMITTED and REPEATABLE READ are supported. The ANSI/ISO standard defines isolation levels in terms of the of the inconsistencies they allow, as detailed next:
Permitted Inconsistencies in Transactions

Dirty read
Allows the transaction to read a row that has been inserted or modified by another transaction, but not committed. If the other transaction rolls back its changes, the transaction will have read a row that never existed, in the sense that it was never committed.

Non-repeatable read
Allows the transaction to read a row that another transaction modifies or deletes before the next read operation. If the other transaction commits the change, the transaction will receive modified values, or discover the row is deleted, on subsequent read operations.

Phantom
Allows the transaction to read a range of rows that satisfies a given search condition. If another transaction adds rows before a second read operation using the same search condition, then the transaction receives a different collection of rows with the same search condition.

Authorization
None.

SQL Compliance
SQL-92.

Environment
Embedded SQL and interactive

Related Statements
COMMIT, ROLLBACK
SET SCHEMA

Description

SET SCHEMA specifies a new default qualifier for database object names (database objects include tables, indexes, views, synonyms, procedures, and triggers).

When you connect to a database with a particular user name, that name becomes the default qualifier for database object names. This means you do not have to qualify references to tables, for instance, that were created under the same user name. However, you must qualify references to all other tables with the user name of the user who created them.

SET SCHEMA allows you to change the user name that c-treeACE SQL uses as the default qualifier for database object names. The name specified in SET SCHEMA becomes the new default qualifier for object names.

Note: SET SCHEMA does not change your user name or affect authentication. It only changes the default qualifier.

Syntax

SET SCHEMA ' qualifier_name ' ;

Arguments

' qualifier_name '

The new qualifier name is enclosed in single quotation marks.

Notes

- SET SCHEMA does not check whether qualifier_name is a valid user name.
- Metadata for objects created without an explicit qualifier will show qualifier_name as the owner.
- SET SCHEMA does not start or end a transaction.

Examples

The following interactive SQL example shows changing the default qualifier through SET SCHEMA. The example:

- Invokes ISQL as the user admin, the owner of the system catalog tables
- Queries the systables catalog tables as admin
- Uses SET SCHEMA to change the default qualifier to fred
- Creates a table and queries systables to show that the newly-created table is owned by fred

ISQL> -- What is the user name for the current connection?
ISQL> select user() from syscalctable;
ADMIN
------
admin
1 record selected
ISQL> -- Show the name and owner of non-system tables:
ISQL> select tbl, owner from systables where tbltype <> 'S';
TBL OWNER
---

<table>
<thead>
<tr>
<th>TBL</th>
<th>OWNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>t1</td>
<td>admin</td>
</tr>
<tr>
<td>test</td>
<td>admin</td>
</tr>
<tr>
<td>test</td>
<td>ctree</td>
</tr>
<tr>
<td>t1</td>
<td>admin</td>
</tr>
<tr>
<td>test</td>
<td>admin</td>
</tr>
<tr>
<td>test</td>
<td>ctree</td>
</tr>
<tr>
<td>freds_table</td>
<td>fred</td>
</tr>
</tbody>
</table>

3 records selected

ISQL> set schema 'fred';
ISQL> create table freds_table (c1 int);
ISQL> create index freds_table_ix on freds_table (c1);
ISQL> select tbl, owner from systables where tbltype <> 'S';
select tbl, owner from systables where tbltype <> 'S';
* error(-20005): Table/View/Synonym not found
ISQL> -- Oops! Must now qualify references to the admin-owned tables:
ISQL> select tbl, owner from admin.systables where tbltype <> 'S';

<table>
<thead>
<tr>
<th>TBL</th>
<th>OWNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>t1</td>
<td>admin</td>
</tr>
<tr>
<td>test</td>
<td>admin</td>
</tr>
<tr>
<td>test</td>
<td>ctree</td>
</tr>
<tr>
<td>freds_table</td>
<td>fred</td>
</tr>
</tbody>
</table>

4 records selected

Authorization

None.

SQL Compliance

SQL-92

Environment

Embedded SQL and interactive

Related Statements

None
TRUNCATE TABLE

Description
Delete all the rows of a table in a single action.
(In V10.3 and later) Any table truncated using TRUNCATE will have the $DELFLD$ set to 4 bytes despite the size in the original table.

Syntax
TRUNCATE TABLE [ table_name ]

Arguments
table_name
Specifies a single table to truncate.

Authorization
The user must have the DBA privilege or SELECT privilege on all the tables in the database. To issue the TRUNCATE TABLE statement for a specific table, the user must be the owner or have UPDATE privilege on the table.

SQL Compliance Extension
Environment Embedded SQL, interactive SQL, ODBC applications
UPDATE

Description
Updates the columns of the specified table with the given values that satisfy the search_condition.

Syntax
UPDATE table_name
    SET assignment, assignment, ...
    [ WHERE search_condition ]
assignment ::
    column = { expr | NULL }
    | ( column, column, ... ) = ( expr, expr, ... )
    | ( column, column, ... ) = ( query_expression )

Arguments
If the optional WHERE clause is specified, then only rows that satisfy the search_condition are updated. If the WHERE clause is not specified then all rows of the table are updated.

The expressions in the SET clause are evaluated for each row of the table if they are dependent on the columns of the target table.

If a query expression is specified on the right hand side for an assignment, the number of expressions in the first SELECT clause of the query expression must be the same as the number of columns listed on the left hand side of the assignment.

If a query expression is specified on the right hand side for an assignment, the query expression must return one row.

Expressions other than the query expressions mentioned above can be scalar subqueries. A scalar sub-query returns one value. The expressions and search conditions can also contain scalar sub-queries. Refer to Scalar Sub-query Expressions (page 26) for more information on the scalar sub-queries.

If a table has check constraints and if the columns to be updated are part of a check expression, then the check expression is evaluated. If the result of evaluation is FALSE, the UPDATE statement fails.

If a table has primary/candidate keys and if the columns to be updated are part of the primary/candidate key, a check is made as to whether there exists any corresponding row in the referencing table. If so, the UPDATE operation fails.

IDENTITY columns cannot be updated and hence cannot be specified as one of the column names for assignment.

Examples
UPDATE orders
    SET qty = 12000
    WHERE order_no = 1001;
UPDATE orders
    SET (product) =
        (SELECT item_name
            FROM items
WHERE item_no = 2401
)
WHERE order_no = 1002 ;
UPDATE orders
SET (amount) = (2000 * 30)
WHERE order_no = 1004 ;
UPDATE orders
SET (product, amount) =
(SELECT item_name, price * 30
FROM items
WHERE item_no = 2401 )
WHERE order_no = 1002 ;
UPDATE orders
SET status='delivered'
WHERE EXISTS (SELECT status
FROM orders o,customers c
WHERE o.cust_id=c.id AND c.name='FairCom');
UPDATE orders
SET product = (SELECT item_name
FROM items
WHERE item_no = 2401),
amount = (SELECT price * 30
FROM items
WHERE item_no = 2401)
WHERE order_no = 1002 ;
UPDATE item
SET stock = stock + (SELECT SUM(order_item.quantity)
FROM order_item
WHERE order_item.order_no = 341
AND order_item.item_no = item.item_no)
WHERE item_no = (SELECT MAX(item_no)
FROM order_item
WHERE order_no = 341);

Authorization
The user executing this statement must have:

- DBA privilege.
- UPDATE privilege on all the specified columns of the target table and SELECT privilege on all the other tables referred to in the statement.

SQL Compliance
SQL-92, ODBC Extended SQL grammar. Extensions: assignments of the form (column, column, … ) = ( expr, expr, … )

Environment
Embedded SQL, interactive SQL, ODBC applications

Related Statements
SELECT, OPEN, FETCH, search conditions, query expressions
UPDATE STATISTICS

Description

Queries system tables and updates table and column statistics:

- The number of rows in the table (the cardinality)
- The approximate number of occurrences of a value in each column

The optimizer uses the information from UPDATE STATISTICS to calculate a query strategy for a particular c-treeACE SQL statement.

Until a user, application, or c-treeACE SQL script issues an UPDATE STATISTICS statement, the optimizer bases query strategies on values it generates from various defaults. These values will not lead to the best performance, so it is good practice for database administrators to periodically update statistics.

UPDATE STATISTICS only works on tables that have indexes defined on them.

Syntax

UPDATE STATISTICS [ FOR table_name ]

Arguments

table_name

Specifies a single table on which to update statistics. The default is to update statistics on all tables in the database.

Authorization

To issue the UPDATE STATISTICS statement for all tables in the database, the user must have DBA privilege or SELECT privilege on all the tables in the database. To issue the UPDATE STATISTICS statement for a specific table, the user must be the owner or have SELECT privilege on the table.

SQL Compliance

Extension

Environment

Embedded SQL, interactive SQL, ODBC applications

Related Statements

SET DISPLAY COST ON (interactive SQL)
3. c-treeACE SQL Reserved Words

Frequently, an application developer chooses a logically apt column name, however, this name happens to collide with a c-treeACE SQL reserved word. Surrounding identifiers in double quotes ensures they are properly interpreted as a table name, column name, or other identifier.

Example
CREATE TABLE "version" ("character" VARCHAR(10), "hour" VARCHAR(10));
INSERT INTO "version" VALUES ("Cinderella", "midnight");
SELECT "character", "hour" FROM "version";

To ensure your application is always prepared for future versions of c-treeACE SQL it could be considered prudent to always quote identifiers, thus avoiding issues with future reserved words.

A complete list of Reserved Words follows.

3.1 c-treeACE SQL Reserved Words

<table>
<thead>
<tr>
<th>3.1 c-treeACE SQL Reserved Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
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<td>F</td>
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<td>G</td>
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<tr>
<td>H</td>
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<tr>
<td>I</td>
</tr>
<tr>
<td>J</td>
</tr>
<tr>
<td>K</td>
</tr>
<tr>
<td>L</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>N</td>
</tr>
</tbody>
</table>

All Rights Reserved
| O | object, object_id, odbc_convert, odbcinfo, of, oldrow, on, open, option, or, order, out, outer, output |
| P | pctfree, percent, pi, placing, plan, position, power, precision, prefix, prepare, primary, privileges, procedure, public |
| Q | quarter |
| R | radians, rand, range, raw, real, record, recursive, references, referencing, rename, repeat, replace, resource, restrict, result, return, returns, revoke, right, rollback, row, rowid, rowidtochar, rownum, rpad, rtrim |
| S | schema, searched_case, second, section, select, service, set, session_user, share, short, sign, simple_case, sin, size, smallint, some, soundex, space, sql, sql_bigint, sql_binary, sql_bit, sql_char, sql_date, sql_decimal, sql_double, sql_float, sql_integer, sql_longvarbinary, sql_longvarchar, sql_numeric, sql_real, sql_smallint, sql_time, sql_timestamp, sql_tinyint, sql_tsi_day, sql_tsi_frac_second, sql_tsi_hour, sql_tsi_minute, sql_tsi_month, sql_tsi_quarter, sql_tsi_second, sql_tsi_week, sql_tsi_year, sql_varbinary, sql_varchar, sqlerror, sqlwarning, sort, start, statement, statement_id, statistics, storage_attributes, storage_manager, substr, substring, suffix, sum, synonym, sysdate, systime, systimestamp |
| T | table, tan, then, ties, time, timeout, timestamp, timestampadd, timestampdiff, tinyint, to, top, to_char, to_date, to_number, to_time, to_timestamp, tpe, trailing, transaction, translate, trigger, trim, truncate, type |
| U | ucase, uid, union, unique, unsigned, update, upper, user, user_id, user_name, using, uuid |
| V | values, varbinary, varchar, variables, varying, version, view |
| W | week, when, whenever, where, with, work |
| Y | year |
4. Error Messages

This appendix lists the error messages generated by the various components of c-treeACE SQL. In addition to the c-treeACE SQL-specific error codes, error conditions have an associated SQLSTATE value, a 5-character status parameter that indicates the condition status returned by the most recent c-treeACE SQL statement. The first two characters of SQLSTATE specify the class code and the last three characters specify the subclass code:

- Class codes beginning with A-H and 0-4 are reserved by the SQL standard. For those class codes only, subclass codes beginning with A-H and 0-4 are also reserved by the standard.
- Class codes beginning with I-Z and 5-9 are specific to database implementations such as c-treeACE SQL. All subclass codes in those classes are implementation defined.

Error Codes Used by c-treeACE SQL Components

The following sections list the c-treeACE SQL error messages and show the corresponding SQLSTATE values:

- 0, 10xxx (page 250)
- 11xxx - c-treeACE SQL RDS Errors (page 251)
- 15xxx - c-treeACE SQL Flat-File Storage System (page 252)
- 160xx - Main Memory Storage System (page 253)
- 16xxx - Latte and Polka Subsystems (page 255)
- ctree FSS Errors:
  - 170xx (page 257)
  - 171xx (page 261)
  - 173xx (page 265)
  - 174xx (page 265)
  - 175xx (page 269)
  - 177xx (page 272)
  - 178xx (page 276)
  - 179xx (page 281)
  - 18xxx (page 284)
- 20xxx - c-treeACE SQL (page 285)
- 21xxx - c-treeDB FSS DB Layer (page 296)
- 22xxx - c-treeDB FSS DB Layer (page 302)
- 23xxx - c-treeACE SQL Data Exceptions (page 307)
- 250xx - c-treeACE SQL ODBC Integrator (page 307)
- 251xx - c-treeACE SQL ODBC Driver (page 310)
- 26xxx - c-treeACE SQL JDBC Driver (page 312)
- 30xxx - c-treeACE SQL Network (page 312)
- 40xxx - c-treeACE SQL Environment Errors (page 315)
- 50xxx - c-treeACE SQL DHRSS errors (page 315)
### 4.1 0, 10xxx

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
<th>Class Condition</th>
<th>Subclass Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00000</td>
<td>Successful completion</td>
<td>***status okay</td>
</tr>
<tr>
<td>10002</td>
<td>02503</td>
<td>No data</td>
<td>Tuple not found for the specified TID.</td>
</tr>
<tr>
<td>10012</td>
<td>n0n12</td>
<td>Flag</td>
<td>ETPL_SCAN_EOP flag is set.</td>
</tr>
<tr>
<td>10013</td>
<td>02514</td>
<td>No data</td>
<td>No more records to be fetched.</td>
</tr>
<tr>
<td>100</td>
<td>02000</td>
<td>No data</td>
<td>**SQL not found.</td>
</tr>
<tr>
<td>10100</td>
<td>2150b</td>
<td>Cardinality violation</td>
<td>Too many fields specified.</td>
</tr>
<tr>
<td>10101</td>
<td>02701</td>
<td>No data</td>
<td>No more records exist.</td>
</tr>
<tr>
<td>10102</td>
<td>5050c</td>
<td>c-treeACE SQL RDS error</td>
<td>Duplicate record specified.</td>
</tr>
<tr>
<td>10104</td>
<td>22505</td>
<td>Data exception</td>
<td>Field size is too high.</td>
</tr>
<tr>
<td>10106</td>
<td>m0m06</td>
<td>c-treeACE SQL RSS error</td>
<td>Specified index method is not supported.</td>
</tr>
<tr>
<td>10107</td>
<td>n0n07</td>
<td>Flag</td>
<td>EIX_SCAN_EOP flag is set.</td>
</tr>
<tr>
<td>10108</td>
<td>2350i</td>
<td>Integrity constraint</td>
<td>Duplicate primary/index key value.</td>
</tr>
<tr>
<td>10301</td>
<td>m030a</td>
<td>c-treeACE SQL RSS error</td>
<td>Table is locked and LCKF_NOWAIT.</td>
</tr>
<tr>
<td>10309</td>
<td>m030a</td>
<td>c-treeACE SQL RSS error</td>
<td>Row locked and NOWAIT specified.</td>
</tr>
<tr>
<td>10400</td>
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<td>Data exception</td>
<td>Invalid file size for alter log statement.</td>
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<tr>
<td>10920</td>
<td>22521</td>
<td>Data exception</td>
<td>Already existing value specified.</td>
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### 4.2 11xxx - c-treeACE SQL RDS Errors

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<th>Error Code</th>
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<th>Class condition</th>
<th>Subclass Message</th>
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<td>TDS area specified is not found.</td>
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<td>TDS not found for binding.</td>
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<td>Transaction aborted.</td>
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<td>Active Transaction error.</td>
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<td>11109</td>
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<td>Invalid Transaction handle.</td>
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<td>11111</td>
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<td>Invalid isolation level.</td>
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<td>Isolation level cannot be changed within active transaction.</td>
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<td>Specified INFO type is not supported.</td>
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<td>m0m01</td>
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<td>Specified index type is not supported.</td>
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## 4.3 15xxx - c-treeACE SQL Flat-File Storage System

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<th>Subclass Message</th>
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<td>FF- No more records</td>
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<td>15003</td>
<td>42603</td>
<td>Access violation error</td>
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<td>15004</td>
<td>22604</td>
<td>Data exception</td>
<td>FF- Invalid record number</td>
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<td>15005</td>
<td>60605</td>
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<td>FF- Record deleted</td>
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<td>60606</td>
<td>c-treeACE SQL FF errors</td>
<td>FF- Invalid type</td>
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<td>15007</td>
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<td>c-treeACE SQL FF errors</td>
<td>FF- Duplicate value</td>
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<td>15008</td>
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<td>08609</td>
<td>Connection exception</td>
<td>FF- No database found</td>
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<td>FF- Version mismatch</td>
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<td>FF- Virtual file cache exceeded</td>
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<td>c-treeACE SQL FF errors</td>
<td>FF- Physical file open error</td>
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<td>FF- Corrupt virtual file handle</td>
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<td>FF- Overflow error</td>
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<td>FF- dbm_calls not implemented</td>
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## 4.4 160xx - Main Memory Storage System

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<td>MM- No cache block</td>
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<td>MM- Invalid row number</td>
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<td>MM- Invalid cache block</td>
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<td>MM- Bad swap file</td>
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<td>16007</td>
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<td>MM- Row too big</td>
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<td>MM- Array initialized</td>
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<td>MM- Invalid chunk number</td>
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<td>MM- Can't create table</td>
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<td>MM- Can't alter table</td>
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<td>MM- Can't drop table</td>
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<td>MM- TPL ctor error</td>
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<td>MM- Insertion error</td>
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<td>MM- Deletion error</td>
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<td>MM- Updation error</td>
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<td>MM- Fetching error</td>
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<td>MM- Printing error</td>
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<td>Class Condition</td>
<td>Subclass Message</td>
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<td>MM- Can't drop index</td>
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<td>MM- Rollback savepoint</td>
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<td>MM- Set &amp; Get isolation</td>
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<td>MM- TID to char</td>
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<td>MM- char to TID</td>
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## 4.5 16xxx - Latte and Polka Subsystems

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## 4.6 c-tree FSS Errors

### 170xx

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<th>Subclass Message</th>
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<td>CT - General error</td>
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<td>FSS ctree error</td>
<td>CT - Key value already exists in index %s</td>
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<td>00003</td>
<td>FSS ctree error</td>
<td>CT - Could not delete since pointers don't match</td>
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<td>FSS ctree error</td>
<td>CT - Could not find key to delete</td>
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<td>FSS ctree error</td>
<td>CT - Cannot call delete w/o verification with duplicate keys</td>
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<td>FSS ctree error</td>
<td>CT - c-tree(...) jump table error</td>
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<td>FSS ctree error</td>
<td>CT - Terminate user</td>
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<td>CT - File open failed due to conflicting file access modes (exclusive/shared)</td>
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<td>CT - File open or create failed due to device access error</td>
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<td>CT - Tried to create existing index file</td>
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<td>CT - drn before beginning of data records</td>
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<td>CT - Attempt to delete record twice in a row</td>
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<td>CT - c-tree has not been initialized</td>
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<td>CT - Variable length keys disabled OR invalid key type</td>
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<td>CT - File mode inconsistent with c-tree config</td>
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<td>CT - File must be opened exclusive for delete</td>
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<td>CT - Proper lock is not held (CHECKLOCK/READ)</td>
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<td>CT - LOADKEY called with incorrect key number. You cannot continue</td>
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<td>CT - LOADKEY called with key out of order You may skip this key &amp; continue</td>
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<td>CT - Percent out of range</td>
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<td>CT - Start file / log file serial number error</td>
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<td>CT - Node does not belong to index</td>
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<td>CT - File name length exceeds message size</td>
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<td>CT - No room for application message buffer</td>
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<td>CT - Server is not active</td>
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<td>CT - Could not get servers message ID</td>
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## Error Messages

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<td>FSS ctree error</td>
<td>CT - Transactional replication - Failed to establish a savepoint because savepoint number is out of sync with master</td>
</tr>
<tr>
<td>17856</td>
<td>00856</td>
<td>FSS ctree error</td>
<td>CT - Transactional replication - Failed to read record for update - local record differs from master record</td>
</tr>
<tr>
<td>17857</td>
<td>00857</td>
<td>FSS ctree error</td>
<td>CT - The superfile host is open in exclusive mode</td>
</tr>
<tr>
<td>17858</td>
<td>00858</td>
<td>FSS ctree error</td>
<td>CT - Transactional replication - This feature is not supported for replicas</td>
</tr>
<tr>
<td>17859</td>
<td>00859</td>
<td>FSS ctree error</td>
<td>CT - The client's structure definition for the file FAIRCOM.FCS!USER.dat is out of date. Update client library</td>
</tr>
<tr>
<td>17860</td>
<td>00860</td>
<td>FSS ctree error</td>
<td>CT - The server's structure definition for the file FAIRCOM.FCS!USER.dat is out of date. Update c-tree Server.</td>
</tr>
<tr>
<td>17861</td>
<td>00861</td>
<td>FSS ctree error</td>
<td>CT - After recovery, a key level lock for an undone transaction discovered in optional diagnostic scan</td>
</tr>
<tr>
<td>17862</td>
<td>00862</td>
<td>FSS ctree error</td>
<td>CT - LOCK_CACHE - System pagesize query failed</td>
</tr>
<tr>
<td>17863</td>
<td>00863</td>
<td>FSS ctree error</td>
<td>CT - The request to impersonate the specified connection was denied because the target connection does not allow impersonation.</td>
</tr>
<tr>
<td>17864</td>
<td>00864</td>
<td>FSS ctree error</td>
<td>CT - The request to impersonate the specified connection was denied because the target connection does not allow impersonation by the specified connection.</td>
</tr>
<tr>
<td>17865</td>
<td>00865</td>
<td>FSS ctree error</td>
<td>CT - The request to impersonate the specified connection was denied because the target connection is already being impersonated.</td>
</tr>
<tr>
<td>17866</td>
<td>00866</td>
<td>FSS ctree error</td>
<td>CT - The request to impersonate the specified connection was denied because the target connection is executing a database operation or is blocked.</td>
</tr>
<tr>
<td>17867</td>
<td>00867</td>
<td>FSS ctree error</td>
<td>CT - Failed to load the filter callback library. See CTSTATUS.FCS for details.</td>
</tr>
<tr>
<td>17868</td>
<td>00868</td>
<td>FSS ctree error</td>
<td>CT - Failed to resolve the filter callback function in the filter callback DLL. See CTSTATUS.FCS for details.</td>
</tr>
<tr>
<td>Error Code</td>
<td>SQLSTATE Value</td>
<td>Class Condition</td>
<td>Subclass Message</td>
</tr>
<tr>
<td>------------</td>
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<tr>
<td>17869</td>
<td>00869</td>
<td>FSS ctree error</td>
<td>CT - A user-defined callback function terminated the rebuild operation.</td>
</tr>
<tr>
<td>17870</td>
<td>00870</td>
<td>FSS ctree error</td>
<td>CT - The filter callback DLL version is not compatible with the c-tree Server's filter callback version. See CTSTATUS.FCS for details.</td>
</tr>
<tr>
<td>17871</td>
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<td>FSS ctree error</td>
<td>CT - File transfer failed - the source file could not be opened for reading.</td>
</tr>
<tr>
<td>17872</td>
<td>00872</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - the destination file could not be opened for writing.</td>
</tr>
<tr>
<td>17873</td>
<td>00873</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - the source file could not be read.</td>
</tr>
<tr>
<td>17874</td>
<td>00874</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - the destination file could not be written.</td>
</tr>
<tr>
<td>17875</td>
<td>00875</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - bound database call not supported.</td>
</tr>
<tr>
<td>17876</td>
<td>00876</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - invalid file transfer block size.</td>
</tr>
<tr>
<td>17877</td>
<td>00877</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - NULL or empty source file name.</td>
</tr>
<tr>
<td>17878</td>
<td>00878</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - NULL or empty destination file name.</td>
</tr>
<tr>
<td>17879</td>
<td>00879</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - incompatible file transfer structure</td>
</tr>
<tr>
<td>17880</td>
<td>00880</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - the destination file exists and the caller did not specify that the destination file is to be overwritten.</td>
</tr>
<tr>
<td>17881</td>
<td>00881</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - the server does not support the transactional replication feature.</td>
</tr>
<tr>
<td>17882</td>
<td>00882</td>
<td>FSS ctree error</td>
<td>CT - File transfer failed - the server is not configured as a local server. Use the REPL_MAPPINGS option to configure the server as a local server.</td>
</tr>
<tr>
<td>17883</td>
<td>00883</td>
<td>FSS ctree error</td>
<td>CT - An attempt was made to open a file multiple times by the same user with different user file numbers but this support is disabled</td>
</tr>
<tr>
<td>17884</td>
<td>00884</td>
<td>FSS ctree error</td>
<td>CT - User file number mismatch during lock or unlock operations.</td>
</tr>
<tr>
<td>17885</td>
<td>00885</td>
<td>FSS ctree error</td>
<td>CT - API call to perform a checkpoint took no action because a checkpoint was already in progress.</td>
</tr>
<tr>
<td>17886</td>
<td>00886</td>
<td>FSS ctree error</td>
<td>CT - Unexpected CHG_UFLOCK failure - call FairCom.</td>
</tr>
<tr>
<td>Error Code</td>
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<td>Class Condition</td>
<td>Subclass Message</td>
</tr>
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</tr>
<tr>
<td>17887</td>
<td>00887</td>
<td>FSS ctree error</td>
<td>CT - Promoting a secondary lock from read to write is not supported.</td>
</tr>
<tr>
<td>17888</td>
<td>00888</td>
<td>FSS ctree error</td>
<td>CT - The specified task ID does not correspond to an active client connection.</td>
</tr>
<tr>
<td>17889</td>
<td>00889</td>
<td>FSS ctree error</td>
<td>CT - The specified connection is a member of a connection group.</td>
</tr>
<tr>
<td>17890</td>
<td>00890</td>
<td>FSS ctree error</td>
<td>CT - An attempt to get the name of the host system failed.</td>
</tr>
<tr>
<td>17891</td>
<td>00891</td>
<td>FSS ctree error</td>
<td>CT - An attempt to get the IP addresses associated with the host system failed.</td>
</tr>
<tr>
<td>17892</td>
<td>00892</td>
<td>FSS ctree error</td>
<td>CT - Sequential, index based retrieval when the index failed - ctISAMKBUFhdr has turned off.</td>
</tr>
<tr>
<td>17893</td>
<td>00893</td>
<td>FSS ctree error</td>
<td>CT - Sequential, index based retrieval when the index failed - partial record read or changing current ISAM record location.</td>
</tr>
<tr>
<td>17894</td>
<td>00894</td>
<td>FSS ctree error</td>
<td>CT - Sequential, index based retrieval when the index failed - conditional index constraint or NUL key results in no key value</td>
</tr>
<tr>
<td>17895</td>
<td>00895</td>
<td>FSS ctree error</td>
<td>CT - Partition index segment definition error.</td>
</tr>
<tr>
<td>17896</td>
<td>00896</td>
<td>FSS ctree error</td>
<td>CT - Covering index segment definitions do not map to partition index - Call FairCom.</td>
</tr>
<tr>
<td>17897</td>
<td>00897</td>
<td>FSS ctree error</td>
<td>CT - Covering index segment map (ptmap) is empty.</td>
</tr>
<tr>
<td>17898</td>
<td>00898</td>
<td>FSS ctree error</td>
<td>CT - Abandoned ctQUIET blocks attempts to validate user logons.</td>
</tr>
<tr>
<td>17899</td>
<td>00899</td>
<td>FSS ctree error</td>
<td>CT - Cannot perform ISAM Context operations on partition member.</td>
</tr>
</tbody>
</table>
### Error Messages

#### 179xx

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
<th>Class Condition</th>
<th>Subclass Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>17900</td>
<td>00900</td>
<td>FSS ctree error</td>
<td>CT - A sequence having the specified name already exists.</td>
</tr>
<tr>
<td>17901</td>
<td>00901</td>
<td>FSS ctree error</td>
<td>CT - An invalid sequence name was specified.</td>
</tr>
<tr>
<td>17902</td>
<td>00902</td>
<td>FSS ctree error</td>
<td>CT - The specified sequence handle is invalid.</td>
</tr>
<tr>
<td>17903</td>
<td>00903</td>
<td>FSS ctree error</td>
<td>CT - Invalid combination of sequence type options.</td>
</tr>
<tr>
<td>17904</td>
<td>00904</td>
<td>FSS ctree error</td>
<td>CT - The initial value specified for the sequence is out of range.</td>
</tr>
<tr>
<td>17905</td>
<td>00905</td>
<td>FSS ctree error</td>
<td>CT - The current value specified for the sequence is out of range.</td>
</tr>
<tr>
<td>17906</td>
<td>00906</td>
<td>FSS ctree error</td>
<td>CT - The limit value specified for the sequence is out of range.</td>
</tr>
<tr>
<td>17907</td>
<td>00907</td>
<td>FSS ctree error</td>
<td>CT - The increment value specified for the sequence is out of range.</td>
</tr>
<tr>
<td>17908</td>
<td>00908</td>
<td>FSS ctree error</td>
<td>CT - Maximum number of partial key distinct counts supported by the file is greater than the system support limit.</td>
</tr>
<tr>
<td>17909</td>
<td>00909</td>
<td>FSS ctree error</td>
<td>CT - The structure version specified for the input and output structures is not supported by this version of the code.</td>
</tr>
<tr>
<td>17910</td>
<td>00910</td>
<td>FSS ctree error</td>
<td>CT - A user-defined callback function terminated the index verify operation.</td>
</tr>
<tr>
<td>17911</td>
<td>00911</td>
<td>FSS ctree error</td>
<td>CT - File contains a Direct Access Resource (DAR) that is not supported.</td>
</tr>
<tr>
<td>17912</td>
<td>00912</td>
<td>FSS ctree error</td>
<td>CT - Special resource can only be added by system routine.</td>
</tr>
<tr>
<td>17913</td>
<td>00913</td>
<td>FSS ctree error</td>
<td>CT - Duplicate DAR not allowed.</td>
</tr>
<tr>
<td>17914</td>
<td>00914</td>
<td>FSS ctree error</td>
<td>CT - Requested DAR does not exist.</td>
</tr>
<tr>
<td>17915</td>
<td>00915</td>
<td>FSS ctree error</td>
<td>CT - Log file requires augmented log entries that are not supported.</td>
</tr>
<tr>
<td>17916</td>
<td>00916</td>
<td>FSS ctree error</td>
<td>CT - Mismatch between header DAR count, and DARs found in resource chain.</td>
</tr>
<tr>
<td>17917</td>
<td>00917</td>
<td>FSS ctree error</td>
<td>CT - Reached limit on the number of instances of a particular DAR type for a single file.</td>
</tr>
<tr>
<td>17918</td>
<td>00918</td>
<td>FSS ctree error</td>
<td>CT - DAR attribute word is marked deleted.</td>
</tr>
<tr>
<td>Error Code</td>
<td>SQLSTATE Value</td>
<td>Class Condition</td>
<td>Subclass Message</td>
</tr>
<tr>
<td>------------</td>
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<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>17919</td>
<td>00919</td>
<td>FSS ctree error</td>
<td>CT - Low-level operations are not allowed on replicated files.</td>
</tr>
<tr>
<td>17920</td>
<td>00920</td>
<td>FSS ctree error</td>
<td>CT - The file exists but could not be accessed- check for permission or sharing restrictions.</td>
</tr>
<tr>
<td>17921</td>
<td>00921</td>
<td>FSS ctree error</td>
<td>CT - Attempt to change IDfield during an ISAM rewrite operation.</td>
</tr>
<tr>
<td>17922</td>
<td>00922</td>
<td>FSS ctree error</td>
<td>CT - Attempt an ISAM rewrite operation without current ISAM IDfield buffer contents.</td>
</tr>
<tr>
<td>17923</td>
<td>00923</td>
<td>FSS ctree error</td>
<td>CT - An internal error has occurred; similar to a catastrophic err. See CTSTATUS.FCS for details.</td>
</tr>
<tr>
<td>17924</td>
<td>00924</td>
<td>FSS ctree error</td>
<td>CT - Only the super administrator user account (named ADMIN) can perform this operation.</td>
</tr>
<tr>
<td>17925</td>
<td>00925</td>
<td>FSS ctree error</td>
<td>CT - The c-tree client is attempting to use features of the SECURITY API function that this c-tree Server does not support. Update your c-tree Server.</td>
</tr>
<tr>
<td>17926</td>
<td>00926</td>
<td>FSS ctree error</td>
<td>CT - The transaction history log scan terminated because the user-specified limit on the number of logs to scan was reached.</td>
</tr>
<tr>
<td>17938</td>
<td>00938</td>
<td>FSS ctree error</td>
<td>CT - Could not decompress the data record.</td>
</tr>
<tr>
<td>17941</td>
<td>00941</td>
<td>FSS ctree error</td>
<td>CT - This c-tree Server requires a secure logon that your c-tree client library does not support. Update your c-tree client library.</td>
</tr>
<tr>
<td>17942</td>
<td>00942</td>
<td>FSS ctree error</td>
<td>CT - This c-tree client uses a secure logon that your c-tree Server does not support. Update your c-tree Server.</td>
</tr>
<tr>
<td>17959</td>
<td>00959</td>
<td>FSS ctree error</td>
<td>CT - This c-tree client uses a different secure logon version than your c-tree Server. Update your c-tree client library.</td>
</tr>
<tr>
<td>17965</td>
<td>00965</td>
<td>FSS ctree error</td>
<td>CT - c-tree Server was not able to decrypt the buffer sent to it by the client. This is an unexpected error. Contact FairCom support.</td>
</tr>
<tr>
<td>17967</td>
<td>00967</td>
<td>FSS ctree error</td>
<td>CT - Logon is denied because this user account has reached its maximum number of concurrent logons.</td>
</tr>
<tr>
<td>17968</td>
<td>00968</td>
<td>FSS ctree error</td>
<td>CT - Logon is denied because one of the groups for this user account has reached its maximum number of concurrent logons.</td>
</tr>
<tr>
<td>Error Code</td>
<td>SQLSTATE Value</td>
<td>Class Condition</td>
<td>Subclass Message</td>
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</tr>
<tr>
<td>17970</td>
<td>00970</td>
<td>FSS ctree error</td>
<td>CT - The connection attempt has been rejected because it would exceed the maximum number of concurrent ISAM connections allowed.</td>
</tr>
<tr>
<td>17971</td>
<td>00971</td>
<td>FSS ctree error</td>
<td>CT - The connection attempt has been rejected because it would exceed the maximum number of concurrent SQL connections allowed.</td>
</tr>
<tr>
<td>17979</td>
<td>00979</td>
<td>FSS ctree error</td>
<td>CT - c-tree is not licensed to use this feature.</td>
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<tr>
<td>17980</td>
<td>00980</td>
<td>FSS ctree error</td>
<td>CT - Secure key exchange failed.</td>
</tr>
<tr>
<td>17981</td>
<td>00981</td>
<td>FSS ctree error</td>
<td>CT - Could not load the specified DLL or shared library.</td>
</tr>
<tr>
<td>17982</td>
<td>00982</td>
<td>FSS ctree error</td>
<td>CT - Could not resolve the specified function name in the specified DLL or shared library.</td>
</tr>
<tr>
<td>17984</td>
<td>00984</td>
<td>FSS ctree error</td>
<td>CT - Logon is denied because the number of distinct user accounts that are allowed to be connected at one time has been reached.</td>
</tr>
<tr>
<td>17985</td>
<td>00985</td>
<td>FSS ctree error</td>
<td>CT - Logon is denied because this user account requires LDAP authentication, but c-tree Server has not enabled LDAP authentication.</td>
</tr>
<tr>
<td>17990</td>
<td>00990</td>
<td>FSS ctree error</td>
<td>CT - This operation is not supported for a dynamic partitioned file.</td>
</tr>
<tr>
<td>17991</td>
<td>00991</td>
<td>FSS ctree error</td>
<td>CT - No partition members have been associated with this dynamic partition host file.</td>
</tr>
<tr>
<td>17993</td>
<td>00993</td>
<td>FSS ctree error</td>
<td>CT - The table, index, record, or field definitions of the partition member differ from those of the dynamic partition host file.</td>
</tr>
<tr>
<td>Error Code</td>
<td>SQLSTATE Value</td>
<td>Class Condition</td>
<td>Subclass Message</td>
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</tr>
<tr>
<td>18001</td>
<td>01001</td>
<td>FSS ctree error</td>
<td>CT - Could not update the specified key value because this index does not allow an ISAM record update to change the key value.</td>
</tr>
<tr>
<td>18002</td>
<td>01002</td>
<td>FSS ctree error</td>
<td>CT - Identity field overflow/underflow error.</td>
</tr>
<tr>
<td>18003</td>
<td>01003</td>
<td>FSS ctree error</td>
<td>CT - Identity field invalid extended attribute error.</td>
</tr>
<tr>
<td>18006</td>
<td>01005</td>
<td>FSS ctree error</td>
<td>CT - Inconsistent co-file lock attribute for file.</td>
</tr>
<tr>
<td>18007</td>
<td>01006</td>
<td>FSS ctree error</td>
<td>CT - A superfile can only have one open instance at a time per connection.</td>
</tr>
<tr>
<td>18008</td>
<td>01007</td>
<td>FSS ctree error</td>
<td>CT - A partitioned file can only have one open instance at a time per connection.</td>
</tr>
<tr>
<td>18024</td>
<td>01024</td>
<td>FSS ctree error</td>
<td>CT - Could not obtain data record lock because the table is locked, or a request to lock the table is pending.</td>
</tr>
<tr>
<td>18025</td>
<td>01025</td>
<td>FSS ctree error</td>
<td>CT - Could not obtain table lock because the table is locked, or a request to lock the table is pending, or a conflicting data record read or write lock exists.</td>
</tr>
<tr>
<td>18026</td>
<td>01026</td>
<td>FSS ctree error</td>
<td>CT - Could not update the table because the table is locked.</td>
</tr>
<tr>
<td>18030</td>
<td>01030</td>
<td>FSS ctree error</td>
<td>CT - Maximum concurrent active connections exceeded.</td>
</tr>
<tr>
<td>18104</td>
<td>01104</td>
<td>FSS ctree error</td>
<td>CT - SSL connection attempt failed.</td>
</tr>
</tbody>
</table>
## 4.7 20xxx - c-treeACE SQL

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
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<th>Subclass Message</th>
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</thead>
<tbody>
<tr>
<td>20000</td>
<td>50501</td>
<td>c-treeACE SQL RDS error</td>
<td>SQL internal error</td>
</tr>
<tr>
<td>20001</td>
<td>50502</td>
<td>c-treeACE SQL RDS error</td>
<td>Memory allocation failure</td>
</tr>
<tr>
<td>20002</td>
<td>50503</td>
<td>c-treeACE SQL RDS error</td>
<td>Open database failed</td>
</tr>
<tr>
<td>20003</td>
<td>2a504</td>
<td>Syntax error</td>
<td>Syntax error</td>
</tr>
<tr>
<td>20004</td>
<td>28505</td>
<td>Invalid auth specs</td>
<td>User %s not found</td>
</tr>
<tr>
<td>20005</td>
<td>22506</td>
<td>Data exception</td>
<td>Table/View/Synonym %s not found</td>
</tr>
<tr>
<td>20006</td>
<td>22507</td>
<td>Data exception</td>
<td>Column %s%s%s not found/specified</td>
</tr>
<tr>
<td>20007</td>
<td>22508</td>
<td>Data exception</td>
<td>No columns in table</td>
</tr>
<tr>
<td>20008</td>
<td>22509</td>
<td>Data exception</td>
<td>Inconsistent types</td>
</tr>
<tr>
<td>20009</td>
<td>22510</td>
<td>Data exception</td>
<td>Column %s ambiguously specified</td>
</tr>
<tr>
<td>20010</td>
<td>22511</td>
<td>Data exception</td>
<td>Duplicate column %s specification</td>
</tr>
<tr>
<td>20011</td>
<td>22512</td>
<td>Data exception</td>
<td>Invalid length at column %s</td>
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<td>Cannot modify table %s referred to in subquery</td>
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<td>Subclass Message</td>
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<td>Number of columns in column list is less than in select list</td>
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<td>Number of columns in column list is more than in select list</td>
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<td>Class Condition</td>
<td>Subclass Message</td>
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<td>Subclass Message</td>
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<td>Sorry, feature not supported in this Edition.</td>
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<td>Contains operator is not supported for this datatype</td>
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<td>Index is not defined or does not support CONTAINS</td>
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<td>Order by in subquery without top or skip</td>
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<td>Column group column doesn't exist</td>
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## 4.8 21xxx - c-treeDB FSS DB Layer

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<th>Error Code</th>
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<th>Class Condition</th>
<th>Subclass Message</th>
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## 4.9 22xxx - c-treeDB FSS DB Layer

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### 4.10 23xxx - c-treeACE SQL Data Exceptions

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### 4.11 250xx - c-treeACE SQL ODBC Integrator

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<td>c-treeACE SQL ODBC integrator</td>
<td>Bad sync SQL statement</td>
</tr>
<tr>
<td>25016</td>
<td>i0i16</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Sync object exists</td>
</tr>
<tr>
<td>25017</td>
<td>i0i17</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Create sync object failed</td>
</tr>
<tr>
<td>25018</td>
<td>i0i18</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Create copy object failed</td>
</tr>
<tr>
<td>25019</td>
<td>i0i19</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Unknown sync object</td>
</tr>
<tr>
<td>25020</td>
<td>i0i20</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Illegal column name</td>
</tr>
<tr>
<td>25021</td>
<td>i0i21</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Duplicate column name</td>
</tr>
<tr>
<td>25022</td>
<td>i0i22</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Install failure</td>
</tr>
<tr>
<td>25023</td>
<td>i0i23</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Invalid sync mode</td>
</tr>
<tr>
<td>25024</td>
<td>i0i24</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Download or snapshot table missing</td>
</tr>
<tr>
<td>25025</td>
<td>i0i25</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Upload table missing</td>
</tr>
<tr>
<td>25026</td>
<td>i0i26</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Update operation failed</td>
</tr>
<tr>
<td>25027</td>
<td>i0i27</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Delete operation failed</td>
</tr>
<tr>
<td>25028</td>
<td>i0i28</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Close cursor failed</td>
</tr>
<tr>
<td>25029</td>
<td>i0i29</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>No primary key</td>
</tr>
<tr>
<td>25030</td>
<td>i0i30</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Missing row</td>
</tr>
<tr>
<td>25031</td>
<td>i0i31</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Bad primary key</td>
</tr>
<tr>
<td>25032</td>
<td>i0i32</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Update contention</td>
</tr>
<tr>
<td>25033</td>
<td>i0i33</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Link table failed</td>
</tr>
<tr>
<td>25034</td>
<td>i0i34</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Unlink table failed</td>
</tr>
<tr>
<td>Error Code</td>
<td>SQLSTATE Value</td>
<td>Class Condition</td>
<td>Subclass Message</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>25035</td>
<td>i0i35</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Link data source failed</td>
</tr>
<tr>
<td>25036</td>
<td>i0i36</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Unlink data source failed</td>
</tr>
<tr>
<td>25037</td>
<td>i0i37</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Integrator internal error</td>
</tr>
<tr>
<td>25038</td>
<td>i0i38</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Operation already started</td>
</tr>
<tr>
<td>25039</td>
<td>i0i39</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Opening of copy SQL statement failed</td>
</tr>
<tr>
<td>25040</td>
<td>i0i40</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Sync object failed</td>
</tr>
<tr>
<td>25041</td>
<td>i0i41</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Dropping copy object failed</td>
</tr>
<tr>
<td>25042</td>
<td>i0i42</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Closing copy SQL statement failed</td>
</tr>
<tr>
<td>25043</td>
<td>i0i43</td>
<td>c-treeACE SQL ODBC integrator</td>
<td>Failure to update metadata timestamp</td>
</tr>
</tbody>
</table>
## 4.12 251xx - c-treeACE SQL ODBC Driver

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
<th>Class Condition</th>
<th>Subclass Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>25101</td>
<td>j0j01</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLAllocEnv failed</td>
</tr>
<tr>
<td>25102</td>
<td>j0j02</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLAllocConnect failed</td>
</tr>
<tr>
<td>25103</td>
<td>j0j03</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLConnect failed</td>
</tr>
<tr>
<td>25104</td>
<td>j0j04</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLGetConnectOption failed</td>
</tr>
<tr>
<td>25105</td>
<td>j0j05</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLSetConnectOption failed</td>
</tr>
<tr>
<td>25106</td>
<td>j0j06</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>Failed to map statement handle to UUID</td>
</tr>
<tr>
<td>25107</td>
<td>j0j07</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLSetParam failed</td>
</tr>
<tr>
<td>25108</td>
<td>j0j08</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLDisconnect failed</td>
</tr>
<tr>
<td>25109</td>
<td>j0j09</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLExecute failed</td>
</tr>
<tr>
<td>25110</td>
<td>j0j10</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLRowCount failed</td>
</tr>
<tr>
<td>25111</td>
<td>j0j11</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLSetParam failed</td>
</tr>
<tr>
<td>25112</td>
<td>j0j12</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLBindCol failed</td>
</tr>
<tr>
<td>25113</td>
<td>j0j13</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLPrepare failed</td>
</tr>
<tr>
<td>25114</td>
<td>j0j14</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLResultCols failed</td>
</tr>
<tr>
<td>25115</td>
<td>j0j15</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLDescribeCol failed</td>
</tr>
<tr>
<td>25116</td>
<td>j0j16</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLFreeStmt failed</td>
</tr>
<tr>
<td>25117</td>
<td>j0j17</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLFetch failed</td>
</tr>
<tr>
<td>25118</td>
<td>j0j18</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLTransact failed</td>
</tr>
<tr>
<td>25119</td>
<td>j0j19</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLAllocStmt failed</td>
</tr>
<tr>
<td>Error Code</td>
<td>SQLSTATE Value</td>
<td>Class Condition</td>
<td>Subclass Message</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>25120</td>
<td>j0j20</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLTables failed</td>
</tr>
<tr>
<td>25121</td>
<td>j0j21</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLColumns failed</td>
</tr>
<tr>
<td>25122</td>
<td>j0j22</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLStatistics failed</td>
</tr>
<tr>
<td>25123</td>
<td>j0j23</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>ODBC Driver interface mismatch</td>
</tr>
<tr>
<td>25124</td>
<td>j0j24</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>ODBC Driver metadata exceeds storage limits</td>
</tr>
<tr>
<td>25125</td>
<td>j0j25</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>SQLGetInfo failed</td>
</tr>
<tr>
<td>25126</td>
<td>j0j26</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>Operation not allowed on the read-only database</td>
</tr>
<tr>
<td>25127</td>
<td>j0j27</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>Cannot update views-with-check-option on remote tables</td>
</tr>
<tr>
<td>25128</td>
<td>j0j28</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>Query terminated as max row limit exceeded for a remote table</td>
</tr>
<tr>
<td>25131</td>
<td>j0j29</td>
<td>c-treeACE SQL ODBC trans layer</td>
<td>Unable to read column info from remote table</td>
</tr>
</tbody>
</table>
## 4.13 26xxx - c-treeACE SQL JDBC Driver

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
<th>Class Condition</th>
<th>Subclass Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>26039</td>
<td>50581</td>
<td>c-treeACE SQL RDS error</td>
<td>Statement_id exceeds maximum length supported %s</td>
</tr>
<tr>
<td>26000</td>
<td>26000</td>
<td>Access rule violation</td>
<td>ctree options conflict</td>
</tr>
<tr>
<td>26001</td>
<td>26001</td>
<td>Feature not supported</td>
<td>Support for this future feature is not enabled</td>
</tr>
</tbody>
</table>

## 4.14 30xxx - c-treeACE SQL Network

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
<th>Class Condition</th>
<th>Subclass Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>30001</td>
<td>5050w</td>
<td>c-treeACE SQL RDS errors</td>
<td>Query aborted on user request</td>
</tr>
<tr>
<td>30002</td>
<td>k0k02</td>
<td>c-treeACE SQL network interface</td>
<td>Invalid network handle</td>
</tr>
<tr>
<td>30003</td>
<td>k0k03</td>
<td>c-treeACE SQL network interface</td>
<td>Invalid sqlnetwork INTERFACE</td>
</tr>
<tr>
<td>30004</td>
<td>k0k04</td>
<td>c-treeACE SQL network interface</td>
<td>Invalid sqlnetwork INTERFACE procedure</td>
</tr>
<tr>
<td>30005</td>
<td>k0k05</td>
<td>c-treeACE SQL network interface</td>
<td>INTERFACE is already attached</td>
</tr>
<tr>
<td>30006</td>
<td>k0k06</td>
<td>c-treeACE SQL network interface</td>
<td>INTERFACE entry not found</td>
</tr>
<tr>
<td>30007</td>
<td>k0k07</td>
<td>c-treeACE SQL network interface</td>
<td>INTERFACE is already registered</td>
</tr>
<tr>
<td>30008</td>
<td>k0k08</td>
<td>c-treeACE SQL network interface</td>
<td>Mismatch in packet header size and total argument size</td>
</tr>
<tr>
<td>30009</td>
<td>k0k09</td>
<td>c-treeACE SQL network interface</td>
<td>Invalid server ID</td>
</tr>
<tr>
<td>30010</td>
<td>k0k10</td>
<td>c-treeACE SQL network interface</td>
<td>Reply does not match the request</td>
</tr>
<tr>
<td>30011</td>
<td>k0k02</td>
<td>c-treeACE SQL network interface</td>
<td>Memory allocation failure</td>
</tr>
<tr>
<td>30012</td>
<td>S1000</td>
<td>c-treeACE SQL Query Timeout</td>
<td>Query has timed out</td>
</tr>
<tr>
<td>Error Code</td>
<td>SQLSTATE Value</td>
<td>Class Condition</td>
<td>Subclass Message</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>--------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>30031</td>
<td>k0k11</td>
<td>c-treeACE SQL network interface</td>
<td>Error in transmission of packet</td>
</tr>
<tr>
<td>30032</td>
<td>k0k12</td>
<td>c-treeACE SQL network interface</td>
<td>Error in reception of packet</td>
</tr>
<tr>
<td>30033</td>
<td>k0k13</td>
<td>c-treeACE SQL network interface</td>
<td>No packet received</td>
</tr>
<tr>
<td>30034</td>
<td>k0k14</td>
<td>c-treeACE SQL network interface</td>
<td>Connection reset</td>
</tr>
<tr>
<td>30051</td>
<td>k0k15</td>
<td>c-treeACE SQL network interface</td>
<td>Network handle is inprocess handle</td>
</tr>
<tr>
<td>30061</td>
<td>k0k16</td>
<td>c-treeACE SQL network interface</td>
<td>Could not connect to SQL network daemon</td>
</tr>
<tr>
<td>30062</td>
<td>k0k17</td>
<td>c-treeACE SQL network interface</td>
<td>Error in number of arguments</td>
</tr>
<tr>
<td>30063</td>
<td>k0k18</td>
<td>c-treeACE SQL network interface</td>
<td>Requested INTERFACE not registered</td>
</tr>
<tr>
<td>30064</td>
<td>k0k19</td>
<td>c-treeACE SQL network interface</td>
<td>Invalid INTERFACE procedure id</td>
</tr>
<tr>
<td>30065</td>
<td>k0k20</td>
<td>c-treeACE SQL network interface</td>
<td>Requested server executable not found</td>
</tr>
<tr>
<td>30066</td>
<td>k0k21</td>
<td>c-treeACE SQL network interface</td>
<td>Invalid configuration information</td>
</tr>
<tr>
<td>30067</td>
<td>k0k22</td>
<td>c-treeACE SQL network interface</td>
<td>INTERFACE not supported</td>
</tr>
<tr>
<td>30091</td>
<td>k0k23</td>
<td>c-treeACE SQL network interface</td>
<td>invalid service name</td>
</tr>
<tr>
<td>30092</td>
<td>k0k24</td>
<td>c-treeACE SQL network interface</td>
<td>Invalid host</td>
</tr>
<tr>
<td>30093</td>
<td>k0k25</td>
<td>c-treeACE SQL network interface</td>
<td>Error in TCP/IP accept call</td>
</tr>
<tr>
<td>30094</td>
<td>k0k26</td>
<td>c-treeACE SQL network interface</td>
<td>Error in TCP/IP connect call</td>
</tr>
<tr>
<td>30095</td>
<td>k0k27</td>
<td>c-treeACE SQL network interface</td>
<td>Error in TCP/IP bind call</td>
</tr>
<tr>
<td>30096</td>
<td>k0k28</td>
<td>c-treeACE SQL network interface</td>
<td>Error in creating socket</td>
</tr>
<tr>
<td>30097</td>
<td>k0k29</td>
<td>c-treeACE SQL network interface</td>
<td>Error in setting socket option</td>
</tr>
<tr>
<td>30101</td>
<td>k0k30</td>
<td>c-treeACE SQL network interface</td>
<td>Interrupt occurred</td>
</tr>
<tr>
<td>30102</td>
<td>k0k31</td>
<td>c-treeACE SQL network interface</td>
<td>Client/Server not WideChar Compatible</td>
</tr>
</tbody>
</table>
### 4.15 40xxx - c-treeACE SQL Environment Errors

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
<th>Class Condition</th>
<th>Subclass Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001</td>
<td>L0L01</td>
<td>c-treeACE SQL environment error</td>
<td>Error in reading configuration</td>
</tr>
</tbody>
</table>

### 4.16 50xxx - c-treeACE SQL DHRSS Errors

<table>
<thead>
<tr>
<th>Error Code</th>
<th>SQLSTATE Value</th>
<th>Class Condition</th>
<th>Subclass Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>50000</td>
<td>60614</td>
<td>c-treeACE SQL DHRSS errors</td>
<td>DHRSS - Improper call to DFLT SS</td>
</tr>
</tbody>
</table>
5. System Catalog Tables

5.1 Overview

c-treeACE SQL maintains a set of system tables for storing information about table spaces, tables, columns, indexes, constraints, and privileges.

c-treeACE SQL data definition statements and GRANT and REVOKE statements update system catalog tables. Users have read access to the system catalog tables. The database administrator has update access to the tables, but should avoid modifying them directly.

There are two types of tables in the system catalog: base tables and extended tables. Base tables store the information on the table spaces, tables, columns, and indexes that make up the database. There are four system tables:

- systables
- systblspaces
- syscolumns
- sysindexes

The rest of the system catalog tables are extended tables. They contain detailed information on database objects and statistical information.

The owner of the system tables is admin. If you connect to a c-treeACE SQL environment with a User ID other than admin, you need to qualify references to the tables in c-treeACE SQL queries. For example:

```
SELECT * FROM ADMIN.SYSTABLES
```

The following table shows details of the columns in each system table. Here is the c-treeACE SQL query that generated the data for this table. You can modify it to generate a similar list that includes user-created tables by omitting the line: and st.tbltype = 'S'.

```
select sc.tbl 'Table', sc.col 'Column',
       sc.coltype 'Data Type', sc.width 'Size'
from admin.syscolumns sc, admin.systables st
where sc.tbl = st.tbl
       and st.tbltype = 'S'
order by sc.tbl, sc.id
```

5.2 System Catalog Tables Definitions

The following table lists all the tables in the system catalog. It gives a brief description of their purpose and lists the column definitions for every table.

**System Catalog Table Definitions**
<table>
<thead>
<tr>
<th>Table</th>
<th>Purpose</th>
<th>Column</th>
<th>Data Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>sys_chk_constrs</td>
<td>Contains the CHECK clause for each check constraint specified on a user table.</td>
<td>chkclause</td>
<td>varchar</td>
<td>8192</td>
</tr>
<tr>
<td></td>
<td></td>
<td>chkseq</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cnstname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>sys_chkcol_usage</td>
<td>Contains one entry for each column on which the check constraint is specified</td>
<td>cnstname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>colname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>sys_keycol_usage</td>
<td>Contains one entry for each column on which primary or foreign key is specified</td>
<td>cnstname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>colname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>colposition</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>sys_ref_constrs</td>
<td>Contains one entry for each referential constraint specified on a user table</td>
<td>cnstname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>deleterule</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>refcnstname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>refowner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>reftblname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>sys_tbl_constrs</td>
<td>Contains one entry for each table constraint.</td>
<td>cnstname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cnstrtype</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>idxname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>sysattachtbls</td>
<td>Contains one entry for each table link.</td>
<td>db_link</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>linkowner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>remtbl</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>remowner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tbl</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>sysbigintstat</td>
<td>Contains one row for each bigint column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val1</td>
<td>bigint</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...</td>
<td>bigint</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val10</td>
<td>bigint</td>
<td>8</td>
</tr>
<tr>
<td>syscalctable</td>
<td>Contains exactly one row with a single column with a value of 100.</td>
<td>fld</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td>syscharstat</td>
<td>Contains one row for each char column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val1</td>
<td>varchar</td>
<td>8192</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...</td>
<td>varchar</td>
<td>8192</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val10</td>
<td>varchar</td>
<td>8192</td>
</tr>
<tr>
<td>Table</td>
<td>Purpose</td>
<td>Column</td>
<td>Data Type</td>
<td>Size</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>syscolauth</td>
<td>Contains the update privileges held by users on individual columns of tables in the database.</td>
<td>col</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grantee</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grantor</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ref</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tbl</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblowner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>upd</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td>syscolstat</td>
<td>Provides mapping information between syscolumns and sys*stat tables.</td>
<td>colid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>coltype</td>
<td>varchar</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td>syscolumns</td>
<td>Contains one row for each column of every table in the database.</td>
<td>charset</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>col</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>collation</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>coltype</td>
<td>varchar</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dflt_value</td>
<td>varchar</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>id</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nullflag</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>scale</td>
<td>varchar</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tbl</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>width</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td>sysdatatypes</td>
<td>Contains information on each data type supported by the database.</td>
<td>autoincr</td>
<td>smallint</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>casesensitive</td>
<td>smallint</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>createparams</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>datatype</td>
<td>varchar</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dhtypename</td>
<td>varchar</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>literalprefix</td>
<td>varchar</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>literalsuffix</td>
<td>varchar</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>locallytypename</td>
<td>varchar</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nullable</td>
<td>varchar</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>odbcmoney</td>
<td>varchar</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>searchable</td>
<td>integer</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typeprecision</td>
<td>integer</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>unsignedadtr</td>
<td>smallint</td>
<td>2</td>
</tr>
<tr>
<td>sysdatestat</td>
<td>Contains one row for each date column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val1</td>
<td>date</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...</td>
<td>date</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val10</td>
<td>date</td>
<td>4</td>
</tr>
<tr>
<td>sysdlinks</td>
<td>Contains one entry for each data source link.</td>
<td>host</td>
<td>varchar</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td></td>
<td>password</td>
<td>varchar</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>username</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>db_link</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>sysdbauth</td>
<td>Contains the database-wide privileges held by users.</td>
<td>dba_acc</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grantee</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>res_acc</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td>Table</td>
<td>Purpose</td>
<td>Column</td>
<td>Data Type</td>
<td>Size</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>sysfloatstat</td>
<td>Contains one row for each float column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid rssid tblid val1 ... val10</td>
<td>integer integer integer float float</td>
<td>4 4 4 8 8</td>
</tr>
<tr>
<td>syslogroupauth</td>
<td>Contains privileges held by user groups</td>
<td>grantor grantee tblowner tbl ins del upd sel exe ndx alt ref</td>
<td>[n]varchar [n]varchar [n]varchar [n]varchar [n]varchar [n]varchar [n]varchar [n]varchar [n]varchar [n]varchar [n]varchar</td>
<td>64 64 64 64 64 64 64 64 64 64 64 64</td>
</tr>
<tr>
<td>sysgroups</td>
<td>Contains list of user groups</td>
<td>groupname gid</td>
<td>[n]varchar integer</td>
<td>64 4</td>
</tr>
<tr>
<td>syslogroupusers</td>
<td>Contains list of users in each group</td>
<td>username groupname</td>
<td>[n]varchar [n]varchar</td>
<td>64 64</td>
</tr>
<tr>
<td>sysidentity</td>
<td>Contains one row for each identity field in the database. Used for SQL IDENTITY support.</td>
<td>owner tbl colid seed incr</td>
<td>varchar varchar integer integer integer</td>
<td>64 64 4 4 4</td>
</tr>
<tr>
<td>sysidxstat</td>
<td>Contains statistics for each index in the database.</td>
<td>idxid nleaf nlevels recsz rssid tblid</td>
<td>integer integer smallint integer integer integer</td>
<td>4 4 2 4 4 4</td>
</tr>
<tr>
<td>sysindexes</td>
<td>Contains one row for each component of an index in the database. For an index with n components, there will be n rows in this table.</td>
<td>colname id idcompress idmethod idname idxorder idxowner idxsegid idxseq idstype rssid tbl tblowner</td>
<td>varchar integer varchar varchar varchar varchar varchar varchar varchar varchar varchar varchar</td>
<td>64 4 1 1 64 1 64 1 4 4 4 4 64 64</td>
</tr>
<tr>
<td>Table</td>
<td>Purpose</td>
<td>Column</td>
<td>Data Type</td>
<td>Size</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>sysintstat</td>
<td>Contains one row for each integer column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td>sysmoneystat</td>
<td>Contains one row for each money column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>money</td>
<td>32</td>
</tr>
<tr>
<td>sysncharstat</td>
<td>Contains one row for each national char() column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>nchar</td>
<td>8192</td>
</tr>
<tr>
<td>sysnumstat</td>
<td>Contains one row for each numeric column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>numeric</td>
<td>64</td>
</tr>
<tr>
<td>sysnvarcharstat</td>
<td>Contains one row for each national varchar column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>varchar</td>
<td>8192</td>
</tr>
<tr>
<td>sysprocbin</td>
<td>Contains one or more rows for each stored procedure and trigger in the database, which contain the compiled Java bytecode for their procedure or trigger.</td>
<td>id, proc_bin, proc_type, rssid, seq</td>
<td>varbinary</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>char</td>
<td>8192</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>2</td>
</tr>
<tr>
<td>sysproccolumns</td>
<td>Contains one row for each column of a stored procedure’s result set.</td>
<td>argtype, col, datatype, dfil_value, id, nullflag, proc_id, rssid, scale, width</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>varchar</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>character</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td>Table</td>
<td>Purpose</td>
<td>Column</td>
<td>Data Type</td>
<td>Size</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>sysprocedures</td>
<td>Contains one row for each stored procedure in the database.</td>
<td>creator</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>has_resultset</td>
<td>character</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>has_return_val</td>
<td>character</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>owner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>proc_id</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>proc_name</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>proc_type</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td>sysproctext</td>
<td>Contains one or more rows for each stored procedure and trigger in the database, which contain the Java source code for their procedure or trigger.</td>
<td>id</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>proc_text</td>
<td>varchar</td>
<td>8192</td>
</tr>
<tr>
<td></td>
<td></td>
<td>proc_type</td>
<td>char</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>seq</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td>sysrealstat</td>
<td>Contains one row for each real column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val1</td>
<td>real</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...</td>
<td>real</td>
<td>4</td>
</tr>
<tr>
<td>syssmintstat</td>
<td>Contains one row for each smallint column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rssid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblid</td>
<td>integer</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>val1</td>
<td>smallint</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...</td>
<td>smallint</td>
<td>2</td>
</tr>
<tr>
<td>syssynonyms</td>
<td>Contains one entry for each synonym in the database.</td>
<td>ispublic</td>
<td>smallint</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>screator</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sname</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sowner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sremdb</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stbl</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stblowner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td>systabauth</td>
<td>Contains privileges held by users for tables, views, and procedures.</td>
<td>alt</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>del</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>exe</td>
<td>character</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grantee</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grantor</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ins</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ndx</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ref</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sel</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tbl</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tblowner</td>
<td>varchar</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>upd</td>
<td>varchar</td>
<td>1</td>
</tr>
<tr>
<td>Table</td>
<td>Purpose</td>
<td>Column</td>
<td>Data Type</td>
<td>Size</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>systables</td>
<td>Contains one row for each table in the database.</td>
<td>creator, has_ccnstrs, has_fnstrs, has_pcnnstrs, has_ocnstrs, id, owner, rssid, segid, tbl, tbl_status, tblpcfree, tbltype</td>
<td>varchar, varchar, varchar, varchar, varchar, integer, varchar, integer, varchar, integer, varchar, integer, varchar</td>
<td>64, 1, 1, 1, 4, 64, 4, 4, 64, 4, 4, 1, 4</td>
</tr>
<tr>
<td>systblspaces</td>
<td>No longer used.</td>
<td>id, tname</td>
<td>integer, varchar</td>
<td>4, 64</td>
</tr>
<tr>
<td>systblstat</td>
<td>Contains table statistics for each user table.</td>
<td>card, npages, pagesz, recsz, rssid, tblid</td>
<td>integer, integer, integer, integer, integer</td>
<td>4, 4, 4, 4, 4</td>
</tr>
<tr>
<td>systimestat</td>
<td>Contains one row for each time column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer, integer, integer, time, time</td>
<td>4, 4, 4, 4, 4</td>
</tr>
<tr>
<td>systinyintstat</td>
<td>Contains one row for each tinyint column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer, integer, integer, time, time</td>
<td>4, 4, 4, 4, 4</td>
</tr>
<tr>
<td>systrigcols</td>
<td>Contains one row for each column specified in each UPDATE trigger in the database.</td>
<td>colid, owner, triggername</td>
<td>integer, varchar, varchar</td>
<td>4, 64, 64</td>
</tr>
<tr>
<td>systrigger</td>
<td>Contains one row for each trigger in the database.</td>
<td>owner, refers_to_new, refers_to_old, rssid, statement_or_row, tbl, tblowner, trigger_event, trigger_time, triggerid, triggername</td>
<td>varchar, character, character, integer, character, varchar, varchar, varchar, integer, varchar, integer, varchar</td>
<td>64, 1, 1, 4, 1, 64, 64, 1, 1, 64, 1, 4, 64</td>
</tr>
</tbody>
</table>
### System Catalog Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Purpose</th>
<th>Column</th>
<th>Data Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>systsstat</td>
<td>Contains one row for each timestamp column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer, integer, integer, timestamp</td>
<td>4, 4, 4, 8</td>
</tr>
<tr>
<td>sysvarcharstat</td>
<td>Contains one row for each varchar column. Used by the optimizer, each row contains a sampling of values in the column.</td>
<td>colid, rssid, tblid, val1, ... val10</td>
<td>integer, integer, integer, varchar</td>
<td>4, 4, 4, 8192</td>
</tr>
<tr>
<td>sysviews</td>
<td>Contains information on each view in the database.</td>
<td>creator, owner, seq, viewname, viewtext</td>
<td>varchar, varchar, integer, varchar</td>
<td>64, 64, 4, 64, 8192</td>
</tr>
</tbody>
</table>
6. System Limits

6.1 Maximum Values for c-treeACE SQL Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of procedure arguments in a c-treeACE SQL CALL statement</td>
<td>50</td>
</tr>
<tr>
<td>Maximum length of a c-treeACE SQL statement</td>
<td>32MB (prior to V10.2, the limit was 35,000 characters)</td>
</tr>
<tr>
<td>Maximum length of a column: standard data types.</td>
<td>8192</td>
</tr>
<tr>
<td>Maximum length of a column: VARBINARY and VARCHAR specifying the character set designated as NATIONAL CHARACTER</td>
<td>32752</td>
</tr>
<tr>
<td>Maximum length of default value specification</td>
<td>250</td>
</tr>
<tr>
<td>Maximum length for an identifier</td>
<td>64</td>
</tr>
<tr>
<td>Maximum length of a connect string</td>
<td>100</td>
</tr>
<tr>
<td>Maximum length for a user-name in a connect string</td>
<td>64</td>
</tr>
<tr>
<td>Maximum number of database connections (Remote server connections. This feature is not currently supported with c-treeACE SQL.)</td>
<td>10</td>
</tr>
<tr>
<td>Maximum length of an error message</td>
<td>511</td>
</tr>
<tr>
<td>Maximum number of columns in a table</td>
<td>2000</td>
</tr>
<tr>
<td>Maximum number of index components for a table, for all indexes on that table</td>
<td>200</td>
</tr>
<tr>
<td>Maximum length of a CHECK constraint clause</td>
<td>20,000</td>
</tr>
<tr>
<td>Maximum number of check constraints in a table</td>
<td>4000</td>
</tr>
<tr>
<td>Maximum number of foreign constraints in a table</td>
<td>4000</td>
</tr>
<tr>
<td>Maximum number of nesting levels in a c-treeACE SQL statement</td>
<td>25</td>
</tr>
<tr>
<td>Maximum number of table references in a c-treeACE SQL statement</td>
<td>250</td>
</tr>
<tr>
<td>Maximum size of input parameters for a c-treeACE SQL statement</td>
<td>512</td>
</tr>
<tr>
<td>Maximum number of outer references in a c-treeACE SQL statement</td>
<td>25</td>
</tr>
<tr>
<td>Maximum nesting level for view references</td>
<td>25</td>
</tr>
<tr>
<td>Maximum recursion level for stored procedures</td>
<td>10</td>
</tr>
</tbody>
</table>
7. Glossary

add [an ODBC data source]
Make a data source available to ODBC through the Add operation of the ODBC Administrator utility. Adding a data source tells ODBC where a specific database resides and which ODBC driver to use to access it. Adding a data source also invokes a setup dialog box for the particular driver so you can provide other details the driver needs to connect to the database.

admin
The user name for the database administrator in a c-treeACE SQL environment. The admin user is the owner of all system tables. Users must qualify references to system tables as admin.tablename.

alias
A temporary name for a table or column specified in the FROM clause of an c-treeACE SQL query expression. Also called correlation name. Derived tables and search conditions that join a table with itself must specify an alias. Once a query specifies an alias, references to the table or column must use the alias and not the underlying table or column name.

applet
A special kind of Java program whose compiled class files a Java-enabled browser can download from the Internet and run.

ASCII

bytecode
Machine-independent code generated by the Java compiler and executed by the Java interpreter.

candidate key
Another term for unique key.

cardinality
Number of rows in a result table.

Cartesian product
Also called cross-product. In a query expression, the result table generated when a FROM clause lists more than one table but specifies no join conditions. In such a case, the result table is formed by concatenating every row of every table with all other rows in all tables. Typically, Cartesian products are not useful and are slow to process.

client
Generally, in client/server systems, the part of the system that sends requests to servers and processes the results of those requests.
**client character set**
A client character set is a character set used by a client application for representing c-treeACE SQL statements and data.

**clipboard**
A temporary storage area for text and graphics that you want to copy from one location or application to another. Most Windows applications support the clipboard through cut, copy, and paste operations.

**collation**
The rules used to control how character strings in a character set compare with each other. Each character set specifies a collating sequence that defines relative values of each character for comparing, merging and sorting character strings.

**column alias**
An alias specified for a column. See alias.

**constraint**
Part of a c-treeACE SQL table definition that restricts the values that can be stored in a table. When you insert, delete, or update column values, the constraint checks the new values against the conditions specified by the constraint. If the value violates the constraint, it generates an error. Along with triggers, constraints enforce referential integrity by insuring that a value stored in the foreign key of a table must either be null or be equal to some value in the matching unique or primary key of another table.

**correlation name**
Another term for alias.

**cross product**
Another term for Cartesian product.

**data dictionary**
Another term for system catalog.

**data source**
See ODBC data source

**database administrator**
The user name admin is the database administrator.

**delete [an ODBC data source]**
Remove information about an ODBC data source through the Delete operation of the ODBC Administrator utility. Deleting a data source does not delete the database it corresponds to, but removes information about the database’s location from the registry (on Windows NT) or the odbc.ini file (on Unix).

**delimited identifiers**
Names in c-treeACE SQL statements enclosed in double quotation marks (""). Enclosing a name in double quotation marks preserves the case of the name and allows it to include reserved words.
and special characters. Subsequent references to a delimited identifier must also use enclosing double quotation marks.

**derived table**
A virtual table specified as a query expression in the FROM clause of another query expression.

**driver manager**
See JDBC driver manager and ODBC driver manager.

**foreign key**
A column or columns in a table whose values must either be null or equal to some value in a corresponding column (called the primary key) in another table. Use the REFERENCES clause in the c-treeACE SQL CREATE TABLE statement to create foreign keys.

**form of use**
The storage format for characters in a character set. Some character sets, such as ASCII, require one byte (octet) for each character. Others, such as Unicode, use two bytes, and are called multi-octet character sets.

**input parameter**
In a stored procedure specification, an argument that an application must pass when it calls the stored procedure. In an c-treeACE SQL statement, a parameter marker in the statement string that acts as a placeholder for a value that will be substituted when the statement executes.

**interface**
In Java, a definition of a set of methods that one or more objects will implement. Interfaces declare only methods and constants, not variables. Interfaces provide multiple-inheritance capabilities.

**Java snippet**
See snippet.

**JDBC**
Java Database Connectivity: a part of the Java language that allows applications to embed standard SQL statements and access any database that implements a JDBC driver.

**JDBC driver**
Database-specific software that receives calls from the JDBC driver manager, translates them into a form that the database can process, and returns data to the application.

**JDBC driver manager**
A Java class that implements methods to route calls from a JDBC application to the appropriate JDBC driver for a particular JDBC URL.

**join**
A relational operation that combines data from two tables.

**manager**
A main component of c-treeACE SQL. c-treeACE SQL includes several managers, including the c-treeACE SQL statement manager, parser, and optimizer.
metadata
Data that details the structure of tables and indexes in the proprietary storage system. The c-treeACE SQL engine stores metadata in the system catalog.

octet
A group of 8 bits. Synonymous with byte, and often used in descriptions of character-set encoding format.

ODBC Administrator
On Windows NT, a Microsoft-supplied utility to add and delete ODBC data sources and drivers. The Administrator maintains information in the system registry.

ODBC application
Any program that calls ODBC functions and uses them to issue c-treeACE SQL statements. Many vendors have added ODBC capabilities to their existing Windows-based tools.

ODBC data source
In ODBC terminology, the technical information needed to access data—the driver name, network address, network software, and so on. Before applications can access a database through ODBC, you use the ODBC Administrator (or, on Unix, edit the odbc.ini file) to add a data source for that database. More than one data source name can refer to the same database, and deleting a data source does not delete the associated database.

ODBC driver
Vendor-supplied software that processes ODBC function calls for a specific data source. The driver connects to the data source, translates the standard c-treeACE SQL statements into syntax the data source can process, and returns data to the application. c-treeACE SQL includes an ODBC driver that provides access to c-treeACE SQL.

ODBC driver manager
On Windows NT, a Microsoft-supplied program that routes calls from an application to the appropriate ODBC driver for a data source.

optimizer
Within c-treeACE SQL the manager that analyzes costs and statistics associated with the statement and converts the relational algebra tree to the most efficient form for execution. The optimizer stores the trees for later use.

output parameter
In a stored procedure specification, an argument in which the stored procedure returns a value after it executes.

package
A group of related Java classes and interfaces, like a class library in C++. The Java development environment includes many packages of classes that procedures can import. The Java runtime system automatically imports the java.lang package. Stored procedures must explicitly import other classes by specifying them in the IMPORT clause of a CREATE PROCEDURE statement.

parameter marker
A question mark (?) in a procedure call or c-treeACE SQL statement string that acts as a placeholder for an input or output parameter supplied at runtime when the procedure executes. The CALL statement (or corresponding ODBC or JDBC escape clause) uses parameter markers to pass parameters to stored procedures. The SQLStatement, SQLPStatement, and SQLCursor objects use them within procedures.

**postfix notation**
Notation in which the numbers precede the operation. For example, 2 + 2 is expressed as 2 2 +, and 10 - 3 * 4 would be 10 3 4 * -. If a storage manager supports processing of expressions, c-treeACE SQL passes them to the storage manager using postfix notation.

**primary key**
A subset of the fields in a table, characterized by the constraint that no two records in a table may have the same primary key value, and that no fields of the primary key may have a null value. Primary keys are specified in a CREATE TABLE statement.

**procedure body**
In a stored procedure, the Java code between the BEGIN and END keywords of a CREATE PROCEDURE statement.

**procedure result set**
In a stored procedure, a set of data rows returned to the calling application. The number and data types of columns in the procedure result set are specified in the RESULT clause of the CREATE PROCEDURE statement. The procedure can transfer data from an c-treeACE SQL result set to the procedure result set or it can store data generated internally. A stored procedure can have only one procedure result set.

**procedure specification**
In a CREATE PROCEDURE statement, the clauses preceding the procedure body that specify the procedure name, any input and output parameters, any result set columns, and any Java packages to import.

**procedure variable**
A Java variable declared within the body of a stored procedure, as compared to a procedure input parameter or output parameter, which are declared outside the procedure body and are visible to the application that calls the stored procedure.

**query expression**
The fundamental element in c-treeACE SQL syntax. Query expressions specify a result table derived from some combination of rows from the tables or views identified in the FROM clause of the expression. Query expressions are the basis of SELECT, CREATE VIEW, and INSERT statements, and can be used in some expressions and search conditions.

**referential integrity**
The condition where the value stored in a database table’s foreign key must either be null or be equal to some value in another table’s the matching unique or primary key. c-treeACE SQL provides two mechanisms to enforce referential integrity: constraints specified as part of CREATE
TABLE statements prevent updates that violate referential integrity, and triggers specified in CREATE TRIGGER statements execute a stored procedure to enforce referential integrity.

repertoire
The set of characters allowed in a character set.

result set
In a stored procedure, either an c-treeACE SQL result set or a procedure result set. More generally, another term for result table.

result table
A temporary table of values derived from columns and rows of one or more tables that meet conditions specified by a query expression.

row identifier
Another term for tuple identifier.

search condition
c-treeACE SQL syntax element that specifies a condition that is true or false about a given row or group of rows. Query expressions and UPDATE statements can specify a search condition. The search condition restricts the number of rows in the result table for the query expression or UPDATE statement. Search conditions contain one or more predicates. Search conditions follow the WHERE or HAVING keywords in c-treeACE SQL statements.

selectivity
The fraction of a table’s rows returned by a query.

server
Generally, in client/server systems, the part of the system that receives requests from clients and responds with results to those requests.

snippet
In a stored procedure, the sequence of Java statements between the BEGIN and END keywords in the CREATE PROCEDURE (or CREATE TRIGGER) statement. The Java statements become a method in a class c-treeACE SQL creates and submits to the Java compiler.

SQL diagnostics area
A data structure that contains information about the execution status (success, error or warning conditions) of the most recent c-treeACE SQL statement. The SQL-92 standard specified the diagnostics area as a standardized alternative to widely varying implementations of the SQLCA. c-treeACE SQL supports both the SQLCA and the c-treeACE SQL diagnostics area. The GET DIAGNOSTICS statement returns information about the diagnostics area to an application, including the value of the SQLSTATE status parameter.

SQL engine
The core component of the c-treeACE SQL environment. c-treeACE SQL receives requests from applications, processes them, and returns results. c-treeACE SQL calls c-treeDB to convey requests to c-treeACE.
**SQL result set**
In a stored procedure, the set of data rows generated by an c-treeACE SQL statement (SELECT and, in some cases, CALL).

**SQLCA**
c-treeACE SQL Communications area: A data structure that contains information about the execution status (success, error or warning conditions) of the most recent c-treeSQL statement. The SQLCA includes an SQLCODE field. The SQLCA provides the same information as the c-treeACE SQL diagnostics area, however, is not compliant with the SQL-92 standard. c-treeACE SQL supports both the SQLCA and the c-treeACE SQL diagnostics area.

**SQLCODE**
An integer status parameter whose value indicates the condition status returned by the most recent c-treeACE SQL statement. An SQLCODE value of zero means success, a positive value means warning, and a negative value means an error status. SQLCODE is superseded by SQLSTATE in the SQL-92 standard. Applications declare either SQLSTATE or SQLCODE, or both. c-treeACE SQL returns the status to SQLSTATE or SQLCODE after execution of each c-treeACE SQL statement.

**SQLSTATE**
A 5-character status parameter whose value indicates the condition status returned by the most recent c-treeACE SQL statement. SQLSTATE is specified by the SQL-92 standard as a replacement for the SQLCODE status parameter (which was part of SQL-89). SQLSTATE defines many more specific error conditions than SQLCODE, which allows applications to implement more portable error handling. Applications declare either SQLSTATE or SQLCODE, or both. c-treeACE SQL returns the status to SQLSTATE or SQLCODE after execution of each c-treeACE SQL statement.

**storage environment**
The combination of storage systems which have implemented the storage interfaces. One possible combination of storage systems in an implementation is the flat-file and main-memory storage system, with a proprietary database containing user data.

**stored procedure**
A snippet of Java source code embedded in an CREATE PROCEDURE statement. The source code can use all standard Java features as well as use c-treeACE SQL supplied Java classes for processing any number of c-treeACE SQL statements.

**system catalog**
Tables created by c-treeACE SQL that store information about tables, columns, and indexes that make up the database. c-treeACE SQL creates and manages the system catalog.

**system tables**
Another term for system catalog.

**tid**
Another term for tuple identifier.

**transaction**
A group of operations whose changes can be made permanent or undone only as a unit to protect against data corruption.

**trigger**
A special type of stored procedure that helps insure referential integrity for a database. Like stored procedures, triggers also contain Java source code (embedded in a `CREATE TRIGGER` statement) and use c-treeACE SQL Java classes. However, triggers are automatically invoked (“fired”) by certain c-treeACE SQL operations (an insert, update, or delete operation) on the trigger’s target table.

**trigger action time**
The **BEFORE** or **AFTER** keywords in a `CREATE TRIGGER` statement. The trigger action time specifies whether the actions implemented by the trigger execute before or after the triggering `INSERT`, `UPDATE`, or `DELETE` statement.

**trigger event**
The statement that causes a trigger to execute. Trigger events can be c-treeACE SQL `INSERT`, `UPDATE`, or `DELETE` statements that affect the table for which a trigger is defined.

**triggered action**
The Java code within the `BEGIN END` clause of a `CREATE TRIGGER` statement. The code implements actions to be completed when a triggering statement specifies the target table.

**tuple identifier**
A unique identifier for a tuple (row) in a table. A tuple identifier for the tuple that was inserted is returned after an insert operation. c-treeACE SQL passes a tuple identifier to the delete, update, and fetch stubs to indicate which tuple is affected. The c-treeACE SQL scalar function `ROWID` and related functions return tuple identifiers to applications.

**unicode**
A superset of the ASCII character set that uses two bytes for each character rather than ASCII’s 7-bit representation. Able to handle 65,536 character combinations instead of ASCII’s 128, Unicode includes alphabets for many of the world’s languages. The first 128 codes of Unicode are identical to ASCII, with a second-byte value of zero.

**unique key**
A column or columns in a table whose value (or combination of values) must be unique. Use the **UNIQUE** clause of the SQL `CREATE TABLE` statement to create unique keys. Unique keys are also called candidate keys.

**URL**
In general, a Universal Resource Locator used to specify protocols and locations of items on the Internet. In JDBC, a database connection string in the form `jdbc:subprotocol:subname`. The c-treeACE SQL JDBC Driver format for database URLs is `jdbc:ctree:T:host_name:db_name`.

**utility class**
A set of utility functions that a storage manager uses to assemble and disassemble data elements passed through the storage interfaces.
**view**
A virtual table that recreates the result table specified by a `SELECT` statement. No data is stored in a view, but other queries can refer to it as if it were a table containing data corresponding to the result table it specifies.

**virtual machine**
The Java specification for a hardware-independent and portable language environment. Java language compilers generate code that can execute on a virtual machine. Implementations of the Java virtual machine for specific hardware and software platforms allow the same compiled code to execute without modification.

**virtual table**
A table of values that is not physically stored in a database, but instead derived from columns and rows of other tables. c-treeACE SQL generates virtual tables in its processing of query expressions: the `FROM`, `WHERE`, `GROUP BY` and `HAVING` clauses each generate a virtual table based on their input.
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