
CERN

Oracle Tutorials 2013

SQL
Structured Query Language

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Agenda

Goal

- Understand basic SQL capabilities
- Being able to write a SQL query

Outline

- SQL overview
- Available statements
- Restricting, sorting and aggregating data
- Manipulating data from different tables

SQL Definition

Structured **Q**uery **L**anguage

- Non-procedural language to access a relational database
- Used to create, manipulate and maintain a relational database
- Official ANSI Standard

Basic SQL

Objective: be able to perform the basic operation of the RDBMS data model

- create, modify the layout of a table
- remove a table from the user schema
- insert data into the table
- retrieve and manipulate data from one or more tables
- update/ delete data in a table

Available statements

STATEMENT	DESCRIPTION
SELECT	Data Retrieval
INSERT UPDATE DELETE	Data Manipulation Language (DML)
CREATE ALTER DROP RENAME TRUNCATE	Data Definition Language (DDL)
GRANT REVOKE	Data Control Language (DCL)
COMMIT ROLLBACK	Transaction Control

Transaction

A transaction is a sequence of SQL Statements that Oracle treats as a single unit of work

- must be commited or rolled back

*Note: check COMMIT settings in your client tool (eg AUTOCOMMIT, EXITCOMMIT in SQL*Plus)*

Database Schema

Collection of logical structures of data

- called schema objects
- tables, views, indexes, synonyms, sequences, packages, triggers, links, …

Owned by a database user

- same name of the user

Schema objects can be created and manipulated with SQL

```
SELECT * FROM USER_OBJECTS | USER_TABLES (…)
SELECT user DROM dual;
SHOW USER; (in SQL*Plus)
```

Create a table

Define the table layout:

- table identifier
- column identifiers and data types
- integrity / consistency
  - column constraints, default values
  - relational constraints

```
CREATE TABLE employees (
 employee_id NUMBER(6) NOT NULL,
 first_name VARCHAR2(20),
 last_name VARCHAR2(25),
 hire_date DATE DEFAULT SYSDATE,
 department_id NUMBER(4),
 salary NUMBER(8,2) CHECK (salary )
```

```
SQL> describe employees
Name                 Null?    Type
 ----------------- -------- ------------
 EMPLOYEE_ID       NOT NULL NUMBER(6)
 FIRST_NAME                 VARCHAR2(20)
 LAST_NAME                  VARCHAR2(25)
 HIRE_DATE                  DATE
 DEPARTMENT_ID              NUMBER(4)
 SALARY                     NUMBER(8,2)
```

Datatypes

Each value has a datatype

- defines the domain of values that each column can contain
- when you create a table, you must specify a datatype for each of its columns

ANSI defines a common set

- Oracle has its set of built-in types
- user-defined types

ANSI data type	Oracle
integer	NUMBER(38)
smallint	NUMBER(38)
numeric(p,s)	NUMBER(p,s)
varchar(n)	VARCHAR2(n)
char(n)	CHAR(n)
float	NUMBER
real	NUMBER

NULL value

Special value that means

- unavailable
- unassigned
- unknown
- inapplicable

Not equivalent to

- zero
- blank space

Often used as default

Alter table

Modify the name and/or layout

```
ALTER TABLE employees RENAME TO newemployees;
```

```
ALTER TABLE employees ADD (salary NUMBER(7));
ALTER TABLE employees RENAME COLUMN div_id TO dep_id;
ALTER TABLE employees DROP (hiredate);
```

But also:

- add/modify/drop constraints
- enable/disable constraints
- modify more advanced properties…

Constraints

Rules that restrict values in database

- NOT NULL / CHECK

```
ALTER TABLE employees MODIFY last_name NOT NULL;
ALTER TABLE employees MODIFY salary CHECK (salary > 1000);
```

- PRIMARY KEY

```
ALTER TABLE employees ADD CONSTRAINT emp_pk PRIMARY KEY(emp_id);
```

- FOREIGN KEY

```
ALTER TABLE employees ADD CONSTRAINT emp_dept_fk FOREIGN
KEY(dept_id) REFERENCES departments(department_id);
```

Drop table

Remove the table from the user schema (recoverable in Oracle10g and onwards)

```
DROP TABLE employees;
```

the table is removed (or moved in the recycle bin) with all its data and dependencies (indexes, etc…)

Remove the table from the database entirely (Oracle10g)

```
DROP TABLE employees PURGE;
```

Remove a table with referential constraints

```
DROP TABLE employees CASCADE CONSTRAINTS;
```

Insert data in a table

Add data in a table as new rows

Insertion following the table defined layout

```
INSERT INTO employees VALUES
     (1369,'SMITH',TO_DATE('17-DEC-1980','DD-MON-YYYY'),20,NULL);
```

Insertion using a DEFAULT value

```
INSERT INTO employees VALUES (1369,'SMITH',DEFAULT,2,'john.smith@cern.ch');
```

Insertion specifying the column list

```
INSERT INTO employees (id, name, div_id, email )
        VALUES(1369, 'SMITH', 20, 'john.smith@cern.ch');
```

Insertion in a table outside the current working schema

```
INSERT INTO <schemaname>.employees …
```

Retrieve the table data (I)

How to query data from one or more tables

All data available

```
SELECT * FROM employees;
SELECT * FROM <schemaname>.employees …
```

Subset of the available columns

```
SELECT id, name FROM employees;
```

Distinguished column values

```
SELECT DISTINCT div_id FROM employees;
```

Retrieve from more tables:

```
SELECT employees.name,visitors.name FROM employees, visitors;
```

Retrieve the table data (II)

Additionally,

Assign pseudonyms to the columns to retrieve

```
SELECT name AS emp_name FROM employees;
SELECT id "emp_id", name "emp_name" FROM employees;
```

Columns concatenation

```
SELECT name || email AS name_email FROM employees;
SELECT 'employee ' || name || email FROM employees;
```

Treatment of NULL values (NVL operator)

```
SELECT NVL(email,'-') FROM employees;
SELECT NVL(salary,0) FROM employees;
```

Restricting and sorting data

Need to restrict and filter the rows of data that are displayed and/or specify the order in which these rows are displayed

- Clauses and Operators:
  - WHERE
    - Comparisons Operators (=, >, < …..)
    - BETWEEN, IN
    - LIKE
    - Logical Operators (AND,OR,NOT)
  - ORDER BY

Restricting data selection (I)

Filter the rows according to specified condition

Simple selections

```
SELECT * FROM employees WHERE id = 30;
SELECT name FROM employees WHERE NOT div_id = 2;
SELECT name FROM employees WHERE salary > 0;
SELECT name FROM employees WHERE email IS NULL;
```

More Conditions (AND/OR)

```
SELECT * FROM employees WHERE div_id = 20 AND salary > 0;
```

Restricting data selection (II)

More selection operators

Use of wildcards

```
SELECT * FROM employees WHERE name LIKE 'C%';
```

Ranges

```
SELECT * FROM employees WHERE salary BETWEEN 1000 and 2000;
```

Selection from a list

```
SELECT * FROM employees WHERE div_id IN (4,9,12);
```

List from an other selection

```
SELECT name FROM divisions WHERE id IN
       (SELECT div_id FROM employees WHERE salary > 2000);
```

Sorting selected data

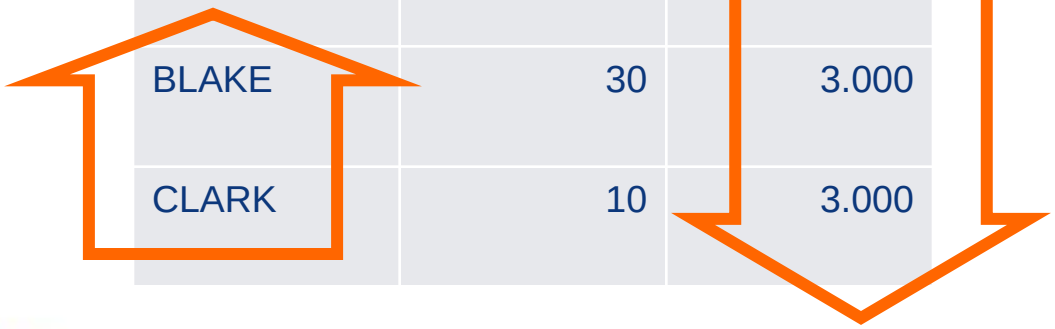
Set the order of the rows in the result set

```
SELECT name, div_id, salary FROM employees ORDER BY hiredate;
```

Ascending/Descending

```
SELECT name, div_id, salary FROM employees ORDER BY hiredate ASC;
SELECT name, div_id, salary FROM employees ORDER BY salary DESC, name;
```

NAME	DIV_ID	SALARY
KING	10	4.000
BLAKE	30	3.000
CLARK	10	3.000



Update data in a table

Change existing values in a table

```
UPDATE employees SET salary=1000;
```

```
UPDATE employees SET salary=(SELECT MAX(salary));
UPDATE employees SET salary=salary+1000;
UPDATE employees SET salary=5000 WHERE name=smith;
```

Delete data from a table

Remove existing data from a table

```
DELETE FROM employees;
DELETE FROM employees WHERE name=smith;
```

→ All rows will be deleted!

TRUNCATE removes **all rows** from a table. The operation cannot be rolled back!

```
TRUNCATE TABLE employees;
```

DUAL table

```
SQL> describe dual;

 Name                      Null?    Type
 ------------------------- -------- ------------
 DUMMY                              VARCHAR2(1)
```

Special one-row table present by default in all Oracle database installations

- Accessible (read-only) to all users

```
SELECT SYSDATE FROM DUAL;
SELECT USER FROM DUAL; -- equal to SHOW USER in SQL*Plus
```

- Create really big table in one command - use dual;

```
CREATE TABLE BIG_TABLE
AS SELECT trunc(dbms_random.value(0,20)) RANDOM_INT
FROM DUAL
CONNECT BY LEVEL <= 100000;
```

Types of join

Retrieve data from tables defining a condition for the row association

EQUIJOIN	Values in the two corresponding columns of the different tables must be equal
NON-EQUIJOIN	The relationship between the columns of the different tables must be other than equal
OUTERJOIN (LEFT, RIGHT, FULL)	It returns also the rows that do not satisfy the join condition
SELFJOIN	Joining data in a table to itself

Equijoin

```
SQL> SELECT e.emp_name, e.emp_deptno, d.dept_name
       FROM emp e, dept d
       WHERE e.emp_deptno = d.deptno
       ORDER BY emp_name;
```

EMP_NAME	EMP_DEPTNO
KING	10
BLAKE	30
CLARK	10

DEPT_NO	DEPT_NAME
10	ACCOUNTING
30	SALES
20	OPERATIONS

EMP_NAME	EMP_DEPTNO	DEPT_NAME
KING	10	ACCOUNTING
BLAKE	30	SALES
CLARK	10	ACCOUNTING

Outerjoin

```
SQL> SELECT e.emp_name, e.emp_deptno, d.dept_name
       FROM emp e, dept d
       WHERE e.emp_deptno = d.deptno(+)
       ORDER BY emp_name;
```

EMP_NAME	EMP_DEPTNO
KING	10
BLAKE	NULL
CLARK	10
MARTIN	20
TURNER	10
JONES	NULL

DEPT_NO	DEPT_NAME
10	ACCOUNTING
30	SALES
20	OPERATIONS

EMP_NAME	EMP_DEPTNO	DEPT_NAME
KING	10	ACCOUNTING
BLAKE	NULL	NULL
CLARK	10	ACCOUNTING
MARTIN	20	OPERATIONS
TURNER	10	ACCOUNTING
JONES	NULL	NULL

Aggregating data

Data can be grouped and some summary values can be computed

- Functions
  - AVG, COUNT, MAX, MIN, STDDEV, SUM, VARIANCE

```
SELECT COUNT(*) FROM employees;
SELECT COUNT(email) FROM employees;
SELECT COUNT(DISTINCT div_id) FROM employees;
SELECT SUM(salary) FROM employees;
```

- Clauses
  - **group by** - used to define the grouping parameter
  - **having** - used to limit the output of the statement

Aggregating clauses

Divide into smaller groups (group by)

- All columns in the SELECT that are not in the group function must be included in the GROUP BY clause
- GROUP BY column does not have to be in the SELECT

Restrict the groups (having)

```
SELECT div_id, MIN(salary), MAX (salary)
FROM employees
GROUP BY div_id;

SELECT div_id, MIN(salary), MAX (salary)
FROM employees
GROUP BY div_id HAVING MIN(salary) < 5000;
```

SQL Functions

Oracle provides a set of SQL functions for manipulation of column and constant values

- Numeric
- Character or Text
- Date
- Conversion
- Other

```
SELECT ROUND (unit_price) FROM product;
SELECT UPPER (product_name) FROM product;
SELECT TO_DATE('01/12/2006','DD/MM/YYYY')
FROM DUAL;
```

Summary

- What is SQL, for what and how do we use it
- User's schema
- Basic SQL for :
  - Create, Modify, Delete a table
  - Insert data into a table
  - Select data from one or more tables with/without conditions
  - Update or delete data from a table
- Basic SQL functions
- The Oracle DUAL table

- Hints on SQL good practice
- Examples to be used as a starting point
- Refer to the documentation for further details

References

Oracle Documentation

http://www.oracle.com/pls/db112/homepage

SQL language reference

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Oracle SQL: The essential reference

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Mastering Oracle SQL

Sanjay Mishra, Alan Beaulieu

O'Reilly & Associates; ISBN: 0596001290; (April 2002)

Questions & Answers