# DBMS SQL

## Lesson 6: Joins and Subqueries

# Lesson Objectives

- To understand the following topics:
  - Join
    - Oracle Proprietary Joins
    - SQL: 1999 Compliant Joins
  - Sub-queries
    - Co-related sub-query
    - Exists / Non-Exists Operators
  - CONNECT BY and START WITH clauses

# What are Joins?

- If we require data from more than one table in the database, then a join is used.
  - Tables are joined on columns, which have the same “data type” and “data width” in the tables.
  - The JOIN operator specifies how to relate tables in the query.
    - When you join two tables a Cartesian product is formed, by default.
  - Oracle supports
    - Oracle Proprietary
    - SQL: 1999 Compliant Joins

# Types of Joins

- Given below is a list of JOINs supported by Oracle:

| **Oracle Proprietary Joins** | **SQL: 1999 Compliant Joins** |
|---|---|
| Cartesian Product | Cross Joins |
| Equijoin | Inner Joins (Natural Joins) |
| Outer-join | Left, Right, Full outer joins |
| Non-equijoin | Join on |
| Self-join | Join on |

# Cartesian Joins

- A Cartesian product is a product of all the rows of all the tables in the query.
- A Cartesian product is formed when the join condition is omitted or it is invalid
- To avoid having Cartesian product always include a valid join condition

Example

```
SELECT Student_Name, Dept_Name
FROM   Student_Master, Department_Master;
```

# Guidelines for Joining Tables

- The JOIN condition is written in the WHERE clause
- The column names which appear in more than one table should be prefixed with the table name
- To improve performance of the query, table name prefix can be include for the other selected columns too

6.2: Oracle Proprietary Joins

# EquiJoin

- In an Equijoin, the WHERE statement compares two columns from two tables with the equivalence operator “=”.
- This JOIN returns all rows from both tables, where there is a match.

Syntax :

```
SELECT <col1>, <col2>,…
FROM <table1>,<table2>
Where <table1>.<col1>=<table2>.<col2>
[AND <condition>] [ORDER BY <col1>, <col2>,…]
```

6.2: Oracle Proprietary Joins

# EquiJoin - Example

Example 1: To display student code and name along with the department name to which they belong

```
SELECT Student_Code,Student_name,Dept_name
 FROM Student_Master ,Department_Master
 WHERE Student_Master.Dept_code =
            Department_Master.Dept_code;
```

Example 2: To display student and staff name along with the department name to which they belong

```
 SELECT student_name,staff_name, dept_name
 FROM student_master, department_master,staff_master
WHERE student_master.dept_code=department_master.dept_code
and staff_master.dept_code=department_master.dept_code;
```

# Non-EquiJoin

- A non-equi join is based on condition other than an equality operator
- Example: To display details of staff_members who receive salary
- in the range defined as per grade

```
SELECT  s.staff_name,s.staff_sal,sl.grade
FROM staff_master s,salgrade sl
WHERE staff_sal BETWEEN sl.losal and sl.hisal
```

# Outer Join

- If a row does not satisfy a JOIN condition, then the row will not appear in the query result.
- The missing row(s) can be returned by using OUTER JOIN operator in the JOIN condition.
- The operator is PLUS sign enclosed in parentheses (+), and is placed on the side of the join(table), which is deficient in information.

```
WHERE table1 <OUTER JOIN INDICATOR> = table 2
```

# Outer Join

Syntax

- Table1.column = table2.column (+) means OUTER join is taken on table1.
- The (+) sign must be kept on the side of the join that is deficient in information
- Depending on the position of the outer join (+), it can be denoted as Left Outer or Right outer Join

# Outer Join - Example

- To display  Department details which have staff members and also display department details who do not have any staff members

```
          SELECT
staff.staff_code,staff.Dept_Code,dept.Dept_name
          FROM Staff_master staff, Department_Master dept
          WHERE staff.Dept_Code(+) = dept.Dept_Code
```

6.2: Oracle Proprietary Joins

# Self Join

- In Self Join, two rows from the “same table” combine to form a “resultant row”.
    - It is possible to join a table to itself, as if they were two separate tables, by using aliases for table names.
    - This allows joining of rows in the same table.

Example: To display staff member information along with their

- manager information

```
SELECT staff.staff_code, staff.staff_name,
                mgr.staff_code, mgr.staff_name
 FROM staff_master staff, staff_master mgr
 WHERE staff.mgr_code  = mgr.staff_code;
```

# SQL: 1999 Compliant Joins - Syntax

- Syntax:

```
SELECT table1.column, table2.column
FROM table1
[CROSS JOIN table2] |
[NATURAL JOIN table2] |
[JOIN table2 USING (column_name)] |
[JOIN table2 ON (table1.column_name =
              table2.column_name)] |
[LEFT|RIGHT|FULL OUTER JOIN table2
ON (table1.column_name = table2.column_name)];
```

# Cross Join

- The Cross Join and Cartesian product are same which produces the cross-product of the tables

Example: Cross Join on Student_Master and Department_Master

```
SELECT student_name, dept_name
FROM student_master
CROSS JOIN department_master;
```

# Natural Join

- The Natural Join is based on the all columns that have same name and datatype in the tables include in the query
- All the rows that have equal values in the matched columns are fetched

Example: To display student details along with their department details

```
SELECT  Student_Code,Student_name,Dept_Code,
                              Dept_name
FROM Student_Master
NATURAL JOIN Department_Master
```

6.3: SQL:1999 Compliant Joins

# USING clause

- The USING clause can be replace the NATURAL JOIN if the columns have same names but data types do not match.
- The table name or aliases should not be used in the referenced columns
- This clause should be used to match only one column when there are more than one column matches

# USING clause - Example

Example 1: To display student details along with their department details. The department code does not match in datatype, hence the join is performed with the USING clause

```
SELECT student_code, student_name, dept_code, dept_name
FROM student_master
JOIN department_master
USING (dept_code, dept_code);
```

# ON clause

- Explicit join condition can be specified by using ON clause
- Other search conditions can be specified in addition to join condition

Example: To display student along with department details from Computer Science department

```
 SELECT student.student_code, student.student_name,
 student.dept_code, dept.dept_name
 FROM student_master student
JOIN department_master dept
ON (student.dept_Code = dept.dept_Code)
AND dept.dept_Name =‘Computer Science’ ;
```

# LEFT, RIGHT & FULL Outer Join

- A join between two tables that return rows that match the join condition and also unmatched rows from left table is LEFT OUTER JOIN
- A join between two tables that return rows that match the join condition and unmatched rows from the right table is RIGHT OUTER JOIN
- A join between two tables that return rows that match the join condition and returns unmatched rows of both left and right table is a full outer join

# LEFT, RIGHT & FULL Outer Join - Example

Example 1: Display student & department details and also thos departments who do have students

```
SELECT s.student_code, s.dept_code, d.dept_name
FROM student_master s
RIGHT OUTER JOIN department_master d
ON (s.dept_code = d.dept_code);
```

Example 2 Display student & department details, also those students who are not assigned to any department

```
 SELECT s.student_code, s.dept_code, d.dept_name
 FROM student_master s
 LEFT OUTER JOIN department_master d
ON (s.dept_code = d.dept_code);
```

# LEFT, RIGHT & FULL Outer Join - Example

Example 3: Display student & department details. Also those departments who do have students and students who are not assigned to any department

```
SELECT s.student_code,s.dept_code,d.dept_name
FROM student_master s
FULL OUTER JOIN department_master d
ON (s.dept_code = d.dept_code );
```

# What is a SubQuery?

- A sub-query is a form of an SQL statement that appears inside another SQL statement.
  - It is also called as a “nested query”.
- The statement, which contains the sub-query, is called the “parent statement”.
- The “parent statement” uses the rows returned by the sub-query.

# Subquery - Examples

Example 1: To display name of students from “Mechanics” department.

Method 1:

```
SELECT Dept_Code FROM Department_Master
WHERE Dept_name = 'Mechanics';
```

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```
SELECT student_code,student_name FROM student_master
WHERE dept_code=40;
```

# Subquery - Examples

Example 1 (contd.):

Method 2: Using sub-query

```
        SELECT student_code, student_name
FROM student_master
WHERE dept_code = (SELECT dept_code
                       FROM department_master
                        WHERE dept_name = ’Mechanics’);
```

# Where to use Subqueries?

- Subqueries can be used for the following purpose :
  - To insert records in a target table.
  - To create tables and insert records in the table created.
  - To update records in the target table.
  - To create views.
  - To provide values for conditions in the clauses, like WHERE, HAVING, IN, etc., which are used with SELECT, UPDATE and DELETE statements.

# Comparison Operators for Subqueries

- Types of SubQueries
  - Single Row Subquery
  - Multiple Row Subquery.
- Some comparison operators for subqueries:

| **Operator** | **Description** |
|---|---|
| IN | Equals to any member of |
| NOT IN | Not equal to any member of |
| *ANY | compare value to every value returned by sub-query using operator * |
| *ALL | compare value to all values returned by sub-query using operator * |

# Using Comparison Operators - Examples

Example 1: To display all staff details of who earn salary least Salary

```
SELECT staff_name, staff_code, staff_sal
FROM staff_master
WHERE staff_sal  = (SELECT MIN(staff_sal)
        FROM staff_master) ;
```

Example 2: To display staff details who earn salary greater than average salary earned in dept 10

```
SELECT staff_code,staff_sal FROM staff_master
WHERE staff_sal > ANY(SELECT AVG(staff_sal)
FROM staff_master WHERE dept_code=10);
```

# What is a Co-related Subquery?

- A sub-query becomes "co-related", when the sub-query references a column from a table in the "parent query".
  - A co-related sub-query is evaluated once for each row processed by the "parent statement", which can be either SELECT, UPDATE, or DELETE statement.
  - A co-related sub-query is used whenever a sub-query must return a "different result" for each "candidate row" considered by the "parent query".

# Co-related Subquery -Examples

- Example 2: To display staff details whose salary is greater than the average salary in their own department:

```
SELECT staff_name, staff_sal , dept_code
 FROM staff_Master  s
 WHERE  staff_sal > (SELECT AVG(staff_sal)
  FROM staff_Master m
 WHERE  s.dept_code  = m.dept_code );
```

# EXISTS/ NOT EXISTS Operator

- The EXISTS / NOT EXISTS operator enables to test whether a value retrieved by the Outer query exists in the result-set of the values retrieved by the Inner query.
  - The EXISTS / NOT EXISTS operator is usually used with a co-related sub-query.
    - If the query returns at least one row, the operator returns TRUE.
    - If the value does not exist, it returns FALSE.
  - The NOT EXISTS operator enables to test whether a value retrieved by the Outer query is not a part of the result-set of the values retrieved by the Inner query.

# EXISTS/ NOT EXISTS Operator - Examples

- Example 1: To display details of employees who have some other employees reporting to them.

```
SELECT staff_code, staff_name FROM staff_master staff
WHERE  EXISTS (SELECT mgr_code FROM staff_master mgr WHERE
mgr.mgr_code = staff.staff_code) ;
```

- Example 2: To display details of departments which have employees working in it.

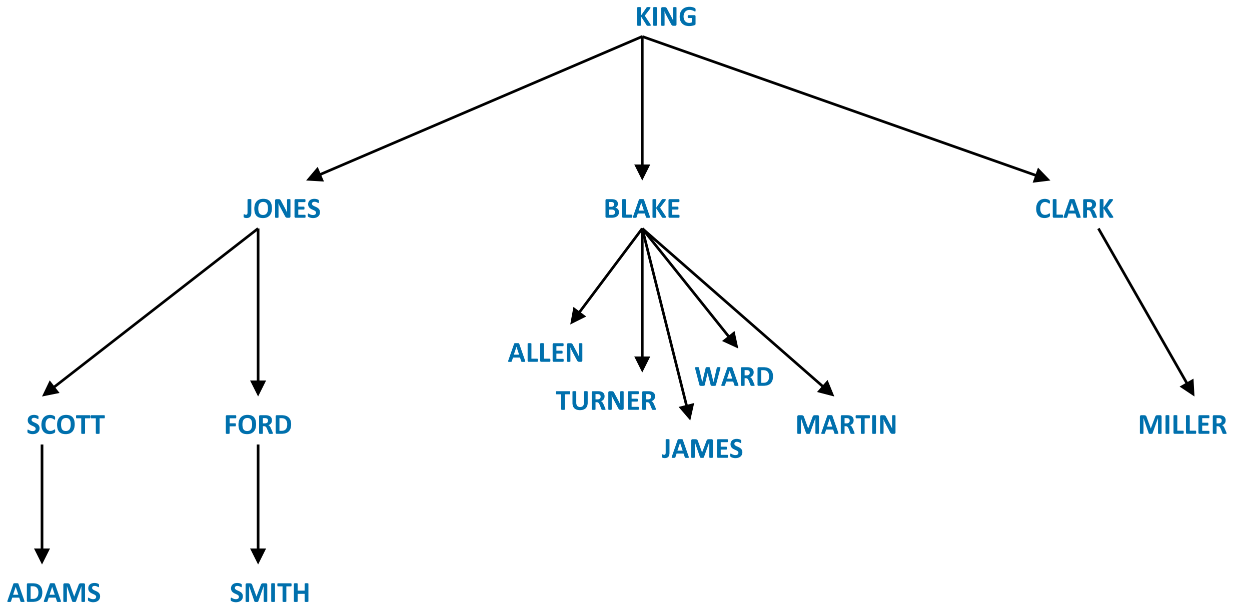
```
SELECT dept_code,dept_name FROM department_master
WHERE  EXISTS ( SELECT dept_code FROM staff_master
                WHERE staff_master.dept_code =
                    department_master.dept_code) ;
```

# CONNECT BY and START WITH Clauses

- The START WITH .. CONNECT BY clause can be used to select data that has a hierarchical relationship
  - Usually, they have some sort of parent-child relationship.
  - They are used to retrieve rows, which are connected to each other through a tree-like structure.

# CONNECT BY and START WITH Clauses

- The earliest ancestor in the tree is called the root-node called as a trunk. Extending from the trunk are branches, which have other branches.



# CONNECT BY and START WITH Clauses

- The restrictions on SELECT statements performing hierarchical queries are as follows :
  - A SELECT statement that performs a hierarchical query cannot perform a JOIN.
  - If an ORDER BY clause is used in a hierarchical query, then Oracle orders rows using the ORDER BY clause rather than in a hierarchical fashion.

# CONNECT BY,START WITH Clauses-Examples

- Example 1: To list “Allen” and his subordinates

```
SELECT staff_name, staff_code, mgr_code
FROM staff_master
CONNECT BY PRIOR staff_code = mgr_code
START WITH staff_name = 'Allen`;
```

Note: If START WITH clause is omitted, then the tree structure is generated for each of the rows in the EMP table.

6.5: Tips and Tricks

# Quick Guidelines

- For Using Subqueries
  - Should be enclosed in parenthesis
  - They should be placed on the right side of the comparison condition
  - Cannot use ORDER By clause in subquery unless performing top-n analysis
  - Use operator carefully. Single Row operators for Single Row Subquery and Multiple Row operator for Multiple Row Subquery

# Quick Guidelines

- Restrict using the NOT IN clause, which offers poor performance because the optimizer has to use a nested table scan to perform this activity.
- Instead try to use one of the following options, all of which offer better performance:
  - Use EXISTS or NOT EXISTS
  - Use IN
  - Perform a LEFT OUTER JOIN and check for a NULL condition

# Quick Guidelines

- If you have a choice of using the IN or the EXISTS clauses in your SQL, use the EXISTS clause as it is usually more efficient and performs faster.
  - Consider EXISTS in place of table joins.
  - Consider NOT EXISTS in place of NOT IN.

# Summary

- In this lesson, you have learnt:
  - Joins
  - Oracle Proprietary Joins
  - SQL: 1999 Compliant Joins
- Sub-queries
  - Co-related sub-query
  - Exists / Non-Exists Operators
- CONNECT BY and START WITH clauses

# Review – Match the Following

| | |
|---|---|
| 1. Equi Join | a. is based on any other operator other than equality |
| 2. Non-equijoin | b. Is based on equality operator |
| 3. Outer Join | c. Joins the table to itself |
| 4. Self Join | d. includes a “+” operator with equality operator |

# Review – Questions

- Question 1: The SQL compliant join which is same as EquiJoin.
  - Option 1: Cross Join
  - Option 2: Natural Join
  - Option 3: Full Outer Join

- Question 2: A sub-query is also sometimes termed as ____.

# Review – Questions

- Question 3: A sub-query can be used for creating and inserting records.
  - True / False

- Question 4: If a sub-query returns multiple values, then the valid operators is/are ____.
  - Option 1: =
  - Option 2: IN
  - Option 3: >
  - Option 4: Any