Displaying data from multiple tables

Objective

After the completion of this exercise, the students will be able to do the following:
• Write SELECT statements to access data from more than one table using equality and nonequality joins
• View data that generally does not meet a join condition by using outer joins
• Join a table to itself by using a self join
Sometimes you need to use data from more than one table.

Cartesian Products

• A Cartesian product is formed when:
– A join condition is omitted
– A join condition is invalid
– All rows in the first table are joined to all rows in the second table
• To avoid a Cartesian product, always include a valid join condition in a WHERE clause.
A Cartesian product tends to generate a large number of rows, and the result is rarely useful. You should always include a valid join condition in a WHERE clause, unless you have a specific need to combine all rows from all tables.
Cartesian products are useful for some tests when you need to generate a large number of rows to simulate a reasonable amount of data.

Example:

To displays employee last name and department name from the EMPLOYEES and DEPARTMENTS tables.

```
SELECT last_name, department_name dept_name
FROM  employees, departments;
```

Types of Joins

• Equijoin
• Non-equijoin
• Outer join
• Self join
• Cross joins
• Natural joins
• Using clause
• Full or two sided outer joins
• Arbitrary join conditions for outer joins

Joining Tables Using Oracle Syntax

```
SELECT table1.column, table2.column
FROM table1, table2
WHERE table1.column1 = table2.column2;
```

Write the join condition in the WHERE clause.
• Prefix the column name with the table name when the same column name appears in more than one table.

Guidelines
• When writing a SELECT statement that joins tables, precede the column name with the table name for clarity and to enhance database access.
• If the same column name appears in more than one table, the column name must be prefixed with the table name.
• To join n tables together, you need a minimum of n-1 join conditions. For example, to join four tables, a minimum of three joins is required. This rule may not apply if your table has a concatenated primary key, in which case more than one column is required to uniquely identify each row

What is an Equijoin?
To determine an employee's department name, you compare the value in the DEPARTMENT_ID column in the EMPLOYEES table with the DEPARTMENT_ID values in the DEPARTMENTS table.
The relationship between the EMPLOYEES and DEPARTMENTS tables is an equijoin—that is, values
in the DEPARTMENT_ID column on both tables must be equal. Frequently, this type of join involves
primary and foreign key complements.
Note: Equijoins are also called simple joins or inner joins
SELECTemployees.employee_id,employees.last_name,employees.department_id,
departments.department_id,departments.location_id
FROM   employees, departments
WHERE   employees.department_id = departments.department_id;

Additional Search Conditions
Using the AND Operator
Example:

To display employee Matos'department number and department name, you need an additional condition in the WHERE clause.

SELECT last_name, employees.department_id,
department_name
FROM   employees, departments
WHERE   employees.department_id = departments.department_id AND   last_name = 'Matos';
Qualifying Ambiguous
Column Names
• Use table prefixes to qualify column names that are in multiple tables.
• Improve performance by using table prefixes.
• Distinguish columns that have identical names but reside in different tables by using column aliases.

Using Table Aliases
• Simplify queries by using table aliases.
• Improve performance by using table prefixes
Example:

SELECT e.employee_id, e.last_name, e.department_id,
d.department_id, d.location_id
FROM   employees e , departments d
WHERE   e.department_id = d.department_id;

Joining More than Two Tables
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WHERE e.department_id = d.department_id;

Joining More than Two Tables
To join n tables together, you need a minimum of n-1 join conditions. For example, to join three

tables, a minimum of two joins is required.
Example:

To display the last name, the department name, and the city for each employee, you have to join the EMPLOYEES, DEPARTMENTS, and LOCATIONS tables.

```
SELECT e.last_name, d.department_name, l.city
FROM  employees e, departments d, locations l
WHERE e.department_id = d.department_id
AND   d.location_id = l.location_id;
```

Non-Equijoins

A non-equijoin is a join condition containing something other than an equality operator. The relationship between the EMPLOYEES table and the JOB_GRADES table has an example of a non-equijoin. A relationship between the two tables is that the SALARY column in the EMPLOYEES table must be between the values in the LOWEST_SALARY and HIGHEST_SALARY columns of the JOB_GRADES table. The relationship is obtained using an operator other than equals (=).
Example:

```
SELECT e.last_name, e.salary, j.grade_level
FROM  employees e, job_grades j
WHERE  e.salary
BETWEEN j.lowest_sal AND j.highest_sal;
```

Outer Joins
Syntax
- You use an outer join to also see rows that do not meet the join condition.
- The Outer join operator is the plus sign (+).

```
SELECT table1.column, table2.column
FROM table1, table2
WHERE table1.column(+) = table2.column;
SELECT table1.column, table2.column
FROM table1, table2
WHERE table1.column = table2.column(+);
```

The missing rows can be returned if an outer join operator is used in the join condition. The operator is a plus sign enclosed in parentheses (+), and it is placed on the "side" of the join that is deficient in information. This operator has the effect of creating one or more null rows, to which one or more rows
from the nondeficient table can be joined.
Example:

```
SELECT e.last_name, e.department_id, d.department_name
FROM  employees e, departments d
WHERE  e.department_id(+) = d.department_id ;
```

Outer Join Restrictions
- The outer join operator can appear on only one side of the expression—the side that has information missing. It returns those rows from one table that have no direct match in the other table.
- A condition involving an outer join cannot use the IN operator or be linked to another condition by the OR operator

Self Join
Sometimes you need to join a table to itself.

Example:
To find the name of each employee's manager, you need to join the EMPLOYEES table to itself, or perform a self join.

```
SELECT worker.last_name || ' works for '
|| manager.last_name
FROM   employees worker, employees manager
WHERE  worker.manager_id = manager.employee_id ;
```

Use a join to query data from more than one table.
```
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)];
```

In the syntax:
table1.column Denotes the table and column from which data is retrieved
CROSS JOIN Returns a Cartesian product from the two tables
NATURAL JOIN Joins two tables based on the same column name
JOIN table USING column_name Performs an equijoin based on the column name
JOIN table ON table1.column_name Performs an equijoin based on the condition in the ON clause
= table2.column_name

LEFT/RIGHT/FULL OUTER

Creating Cross Joins
• The CROSS JOIN clause produces the crossproduct of two tables.
• This is the same as a Cartesian product between the two tables.

Example:

```
SELECT last_name, department_name
FROM   employees
CROSS JOIN departments ;
SELECT last_name, department_name
FROM   employees, departments;
```

Creating Natural Joins
• The NATURAL JOIN clause is based on all columns in the two tables that have the same name.
• It selects rows from the two tables that have equal values in all matched columns.
• If the columns having the same names have different data types, an error is returned.
Example:

```
SELECT department_id, department_name,
location_id, city
FROM  departments
NATURAL JOIN locations ;
```

LOCATIONS table is joined to the DEPARTMENT table by the LOCATION_ID column, which is the only column of the same name in both tables. If other common columns were present, the join would have used them all.

Example:

```
SELECT department_id, department_name,
location_id, city
FROM    departments
NATURAL JOIN locations
WHERE   department_id IN (20, 50);
```

Creating Joins with the USING Clause

• If several columns have the same names but the data types do not match, the NATURAL JOIN clause can be modified with the USING clause to specify the columns that should be used for an equijoin.
• Use the USING clause to match only one column when more than one column matches.
• Do not use a table name or alias in the referenced columns.
• The NATURAL JOIN and USING clauses are mutually exclusive.

Example:

```
SELECT l.city, d.department_name
FROM  locations l JOIN departments d USING (location_id)
WHERE  location_id = 1400;
```
EXAMPLE:

```
SELECT e.employee_id, e.last_name, d.location_id
FROM  employees e JOIN departments d
USING (department_id) ;
```

Creating Joins with the ON Clause

• The join condition for the natural join is basically an equijoin of all columns with the same name.
• To specify arbitrary conditions or specify columns to join, the ON clause is used.
• The join condition is separated from other searchconditions.
• The ON clause makes code easy to understand.

Example:

```
SELECT e.employee_id, e.last_name, e.department_id,
d.department_id, d.location_id
FROM  employees e JOIN departments d
ON    (e.department_id = d.department_id);
```
EXAMPLE:

```
SELECT e.last_name emp, m.last_name mgr
FROM   employees e JOIN employees m
ON    (e.manager_id = m.employee_id);
```
INNER Versus OUTER Joins

This query retrieves all rows in the EMPLOYEES table, even if there is no match in the DEPARTMENTS table. It alslso retrieves all rows in the DEPARTMENTS table, even if there is no match in the EMPLOYEES table.

Find the Solution for the following:

1. Write a query to display the last name, department number, and department name for all employees.

```
SELECT e.last_name, e.department_id, d.department_name
FROM employees e
JOIN departments d ON e.department_id = d.department_id;
```

2. Create a unique listing of all jobs that are in department 80. Include the location of the department in the output.

```
SELECT DISTINCT e.job_id, l.location_id, l.city
FROM employees e
JOIN departments d ON e.department_id = d.department_id
JOIN locations l ON d.location_id = l.location_id
WHERE e.department_id = 80;
```

3. Write a query to display the employee last name, department name, location ID, and city of all employees who earn a commission

```
SELECT e.last_name, d.department_name, l.location_id, l.city
FROM employees e
JOIN departments d ON e.department_id = d.department_id
JOIN locations l ON d.location_id = l.location_id
WHERE e.commission_pct IS NOT NULL;
```

8.   Display the employee last name and department name for all employees who have an a(lowercase) in their last names. P

```
SELECT e.last_name, d.department_name
FROM employees e
JOIN departments d ON e.department_id = d.department_id
WHERE e.last_name LIKE '%a%';
```

5. Write a query to display the last name, job, department number, and department name for all employees who work in Toronto.

```
SELECT e.last_name, e.job_id, e.department_id, d.department_name
```

```
FROM employees e
JOIN departments d ON e.department_id = d.department_id
JOIN locations l ON d.location_id = l.location_id
WHERE l.city = 'Toronto';
```

6. Display the employee last name and employee number along with their manager's last name and manager number. Label the columns Employee, Emp#, Manager, and Mgr#, Respectively

```
SELECT e.last_name AS "Employee", e.employee_id AS "Emp#",
    m.last_name AS "Manager", m.employee_id AS "Mgr#"
FROM employees e
LEFT JOIN employees m ON e.manager_id = m.employee_id;
```

7. Modify lab4_6.sql to display all employees including King, who has no manager. Order the results by the employee number.

```
SELECT e.last_name AS "Employee", e.employee_id AS "Emp#",
    m.last_name AS "Manager", m.employee_id AS "Mgr#"
FROM employees e
LEFT JOIN employees m ON e.manager_id = m.employee_id
ORDER BY e.employee_id;
```

8. Create a query that displays employee last names, department numbers, and all the employees who work in the same department as a given employee. Give each column an appropriate label

```
SELECT e1.last_name AS "Employee", e1.department_id AS "Dept#",
    e2.last_name AS "Colleague"
FROM employees e1
JOIN employees e2 ON e1.department_id = e2.department_id
WHERE e1.employee_id <> e2.employee_id
ORDER BY e1.last_name;
```

9. Show the structure of the JOB_GRADES table. Create a query that displays the name, job, department name, salary, and grade for all employees

```
DESC job_grades;
```

10. Create a query to display the name and hire date of any employee hired after employee Davies.

```
SELECT last_name, hire_date
FROM employees
WHERE hire_date > (
    SELECT hire_date
    FROM employees
    WHERE last_name = 'Davies'
);
```

11. Display the names and hire dates for all employees who were hired before their managers, along with their manager's names and hire dates. Label the columns Employee, Emp Hired, Manager, and Mgr Hired, respectively.

```
SELECT e.last_name AS "Employee", e.hire_date AS "Emp Hired",
    m.last_name AS "Manager", m.hire_date AS "Mgr Hired"
FROM employees e
```

```sql
JOIN employees m ON e.manager_id = m.employee_id
WHERE e.hire_date < m.hire_date;
```