Displaying Data from Multiple Tables Using Joins

Practical 8

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Lesson Objectives

- Learn how to create SQL queries that join multiple tables.

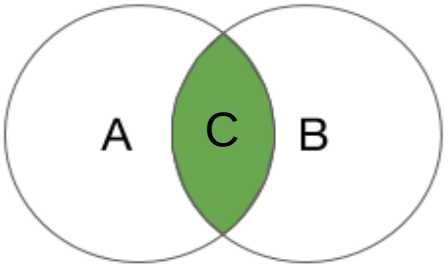
*Run **Northwoods.sql and HR.sql**

Types of Join

- **Cross Join / Cartesian Product**
- **Inner Join / Natural Join / Equijoin**
- Outer Join
  - Left Outer Join
  - Right Outer Join
  - Full Outer Join
- Self Join
- Non-Equijoin

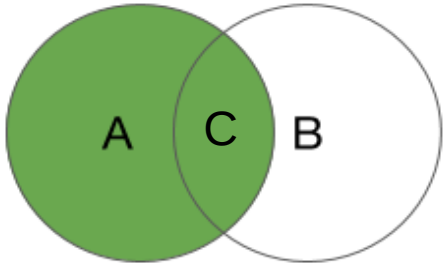
Types of Join

(Select C only)



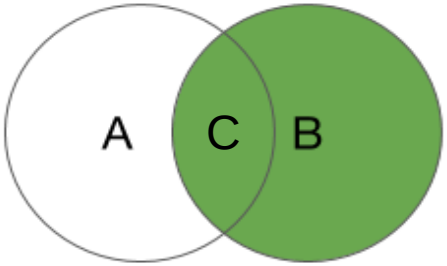
INNER JOIN

(Select A and C only)



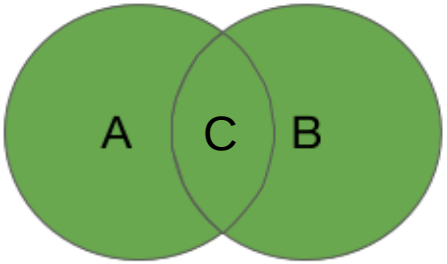
LEFT OUTER JOIN

(Select B and C only)



RIGHT OUTER JOIN

(Select A, B and C)



FULL OUTER JOIN

Cross Join / Cartesian Product

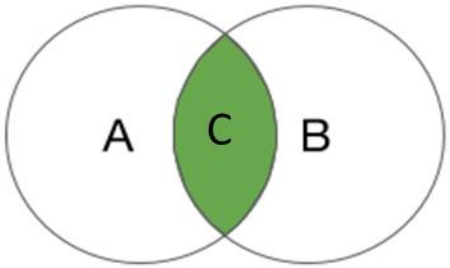
- **Cross Join** or **Cartesian Product** makes every row in one table joined with every row in the other table.

```
SELECT COUNT(*)
FROM employees;

SELECT COUNT(*)
FROM departments;

SELECT last_name, department_name
FROM employees
CROSS JOIN departments;

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

Inner Join

- **Inner Join** is the simplest type of join that occurs when you join two tables based on values in one table being equal to values in another table.
- The NATURAL JOIN clause is based on all the columns in the two tables that have the same name.
- It selects rows from the two tables that have equal values in all matched column.
- If the columns having the same names have different data types, an error is returned.

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



Using Table Alias

- **Table Alias** is an alternate name that you assign to the table in the FROM clause of the query.
- It helps to keep SQL code smaller. Therefore, less memory is used and performance is improved.

```
SELECT l.city, d.department_name
FROM locations l NATURAL JOIN departments d;
```

Creating Joins with the USING Clause

- If several columns have the same names but the data type do not match, use the USING clause to specify the column for the equijoin.
- Use the USING clause to match only one column when more than one column matches.
- The NATURAL JOIN and USING clauses are mutually exclusive.

Creating Joins with the USING Clause

- Do not qualify a column that is used in the USING clause
- If the same column is used elsewhere in the SQL statement, do not alias it.

```
SQL> SELECT l.city, d.department_name
2       FROM locations l JOIN departments d
3       USING (location_id)
4       WHERE d.location_id = 1400;
```

ERROR at line 4:

ORA-25154: column part of USING clause cannot have qualifier

Creating Joins with the USING Clause

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

CITY	DEPARTMENT_NAME
Southlake	IT

Creating Joins with the USING Clause

- Only simple column name is allowed to be used in the USING clause.

```
SELECT first_name, department_name, d.manager_id
FROM employees e JOIN departments d
USING (d.department_id)
WHERE department_id = 50;
```

```
USING (d.department_id)
       *
ERROR at line 3:
ORA-01748: only simple column
names allowed here
```

```
SELECT first_name, department_name, d.manager_id
FROM employees e JOIN departments d
USING (department_id)
WHERE department_id = 50;
```

Creating Joins with the USING Clause

- If the same column is used elsewhere in the SQL statement, do not alias it.

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

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

Creating Joins with the USING Clause

- The column that is common in both tables, but not used in the USING clause, must be prefix with a table alias.

```
SELECT first_name, department_name, manager_id
FROM employees e JOIN departments d
USING (department_id)
WHERE department_id = 50;
```

```
SELECT first_name,
department_name, manager_id

*
ERROR at line 1:
ORA-00918: column ambiguously
defined
```

```
SELECT first_name, department_name, d.manager_id
FROM employees e JOIN departments d
USING (department_id)
WHERE department_id = 50;
```

Creating Joins with the ON Clause

- Use the ON clause to specify arbitrary conditions or specific column to join.
- The join condition is separated from other search conditions.
- The ON clause makes code easy to understand.

SQL 1999 vs. Oracle

SQL 1999:

```
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;
```

Oracle:

```
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;
```

Practice 8.1

Write the following questions using Natural join, Using clause, On clause and Oracle:

1. Identify the city of every departments.
2. List all employee last name with their respective job title.
3. List all countries name with their respective regions name.

Joining More Than 2 Tables

SQL 1999:

```
SELECT employee_id, department_name, city
FROM employees e
JOIN departments d
ON e.department_id = d.department_id
JOIN locations l
ON d.location_id = l.location_id;
```

Oracle:

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

Applying Additional Conditions to Join

SQL 1999:

```
SELECT e.employee_id, e.last_name, e.department_id, d.location_id
FROM employees e JOIN departments d
ON e.department_id = d.department_id
WHERE e.manager_id = 149;
```

Oracle:

```
SELECT e.employee_id, e.last_name, e.department_id, d.location_id
FROM employees e, departments d
WHERE e.department_id = d.department_id
AND e.manager_id = 149;
```

Practice 8.2

Write the following questions using Using clause, On clause and Oracle:

1. List the location_id, city and departments name that have location_id 1400.
2. List the address for all department include department name, postal code, city, and country name.
3. List all employees first name and department name from department_id 50 as well as their respective manager_id.

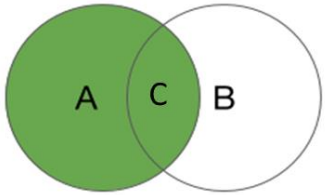
Practice 8.3

Why the following statements yield different results?

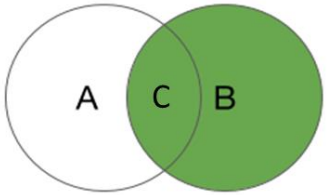
```
SELECT e.employee_id, e.last_name, e.department_id
FROM employees e JOIN departments d
ON e.department_id = d.department_id;

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

SELECT employee_id, department_name
FROM employees e
NATURAL JOIN departments d;
```

INNER Join vs Outer Join

- Inner Join returns rows only if values exist in all tables that are joined. If no values exist for a row in one of the joined tables, the inner join does not retrieve the row.
- **Outer Join** returns all rows from one table, and also retrieves matching rows from a second table.
- The outer join operator (+) inserts a NULL value for the columns that do not have matching rows. (Oracle syntax)



LEFT OUTER JOIN



RIGHT OUTER JOIN

Employee(s) who doesn’t belong to any department

```
SELECT first_name, last_name
FROM employees
WHERE department_id IS NULL;
```

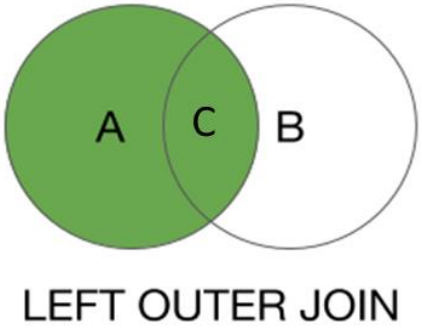
```
FIRST_NAME           LAST_NAME
-------------------  -------------------
Kimberely            Grant
```

Department which does not have employee

```
SELECT department_name, department_id
FROM departments
WHERE NOT EXISTS (SELECT * FROM employees
WHERE departments.department_id = employees.department_id)
```

DEPARTMENT_NAME	DEPARTMENT_ID
Contracting	190
IT Helpdesk	230

Left Outer Join



- **Left Outer Join** shows all the rows from the left table even though there are no matching rows.

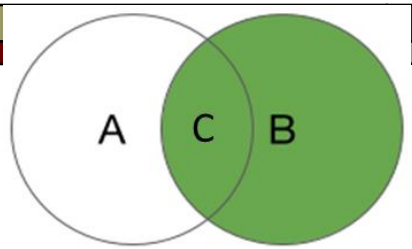
SQL 1999

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

Oracle

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

Right Outer Join



RIGHT OUTER JOIN

- **Right Outer Join** shows all the rows from the right table even though there are no matching rows.

SQL 1999

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

Oracle

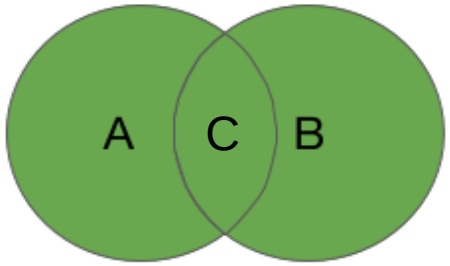
```
SELECT e.last_name, e.department_id, d.department_name
FROM employees e, departments d
WHERE e.department_id(+) = d.department_id;
```

Full Outer Join

- **Full Outer Join** shows all the rows from both tables even though there are no matching rows.

SQL 1999

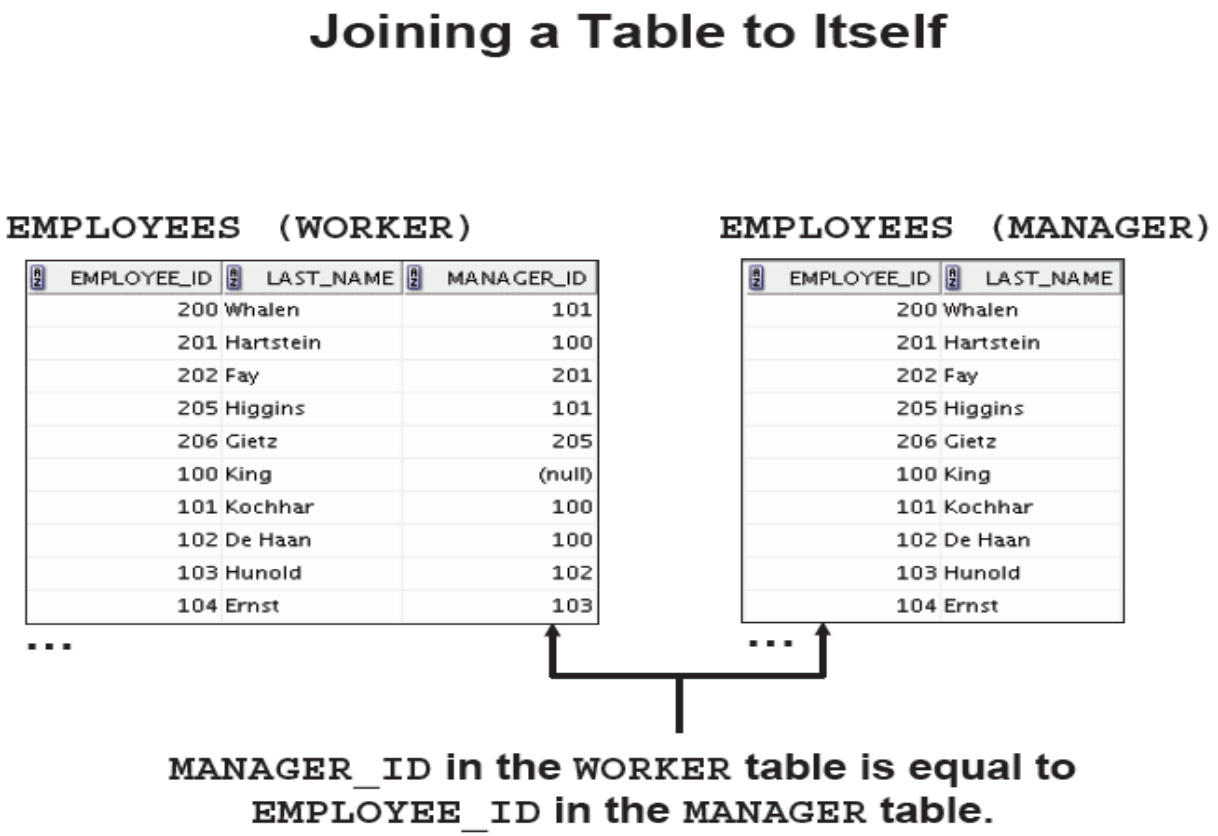
```
SELECT e.last_name, e.department_id, d.department_name
FROM employees e FULL OUTER JOIN departments d
ON (e.department_id = d.department_id);
```



FULL OUTER JOIN

Self Join

- When you create a query that joins a table to itself, you create a **Self Join**.



Self Join

SQL 1999

```
SELECT worker.last_name emp, manager.last_name mgr
FROM employees worker JOIN employees manager
ON (worker.manager_id = manager.employee_id);
```

Oracle

```
SELECT worker.last_name emp, manager.last_name mgr
FROM employees worker, employees manager
WHERE worker.manager_id = manager.employee_id;
```

Non-Equi Join

- **Non-Equi Join** is a join condition that contains something other than an equality operator.

EMPLOYEES

	LAST_NAME	SALARY
1	Whalen	4400
2	Hartstein	13000
3	Fay	6000
4	Higgins	12000
5	Gietz	8300
6	King	24000
7	Kochhar	17000
8	De Haan	17000
9	Hunold	9000
10	Ernst	6000
...		
19	Taylor	8600
20	Grant	7000

JOB_GRADES

	GRADE_LEVEL	LOWEST_SAL	HIGHEST_SAL
1	A	1000	2999
2	B	3000	5999
3	C	6000	9999
4	D	10000	14999
5	E	15000	24999
6	F	25000	40000

The `JOB_GRADES` table defines the `LOWEST_SAL` and `HIGHEST_SAL` range of values for each `GRADE_LEVEL`. Therefore, the `GRADE_LEVEL` column can be used to assign grades to each employee.

Non-Equi Join

SQL 1999

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

Oracle

```
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;
```

Practice 8.4

- List the number of course section offered in each term

Term	Section Offered
Fall 2006	4
Spring 2007	6
Summer 2007	3

Practice 8.5

Write a query to list all the subjects and the number of students who had taken the course.

Subject	#
Database Management	4
Intro. to Info. Systems	6
Web-Based Systems	3
Systems Analysis	6

Practice 8.6

Modify practice 8.5, include only those subjects which is taken by more than 4 students.

Subject	#
Database Management	4
Intro. to Info. Systems	6
Systems Analysis	6

Do it yourself

- List all employee id with the respective department names and city.
- List the information of students; include the student last name and their enrollment subject.
- List all the call id and course name which are offered in Summer 2007, together with the faculty member name who taught the courses.

- Try the exercise given.