



Displaying Data from Multiple Tables

Objectives

After completing this lesson, you should be able to do the following:

- Write `SELECT` statements to access data from more than one table using equijoins and nonequijoins
- Join a table to itself by using a self-join
- View data that generally does not meet a join condition by using `OUTER` joins
- Generate a Cartesian product of all rows from two or more tables

Lesson Agenda

- Types of JOINS and its syntax
- Natural join:
 - USING clause
 - ON clause
- Self-join
- Nonequijoins
- OUTER join:
 - LEFT OUTER join
 - RIGHT OUTER join
 - FULL OUTER join
- Cartesian product
 - Cross join

Obtaining Data from Multiple Tables

EMPLOYEES

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90
...			
18	202	Fay	20
19	205	Higgins	110
20	206	Gietz	110

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
1	10	Administration	1700
2	20	Marketing	1800
3	50	Shipping	1500
4	60	IT	1400
5	80	Sales	2500
6	90	Executive	1700
7	110	Accounting	1700
8	190	Contracting	1700

	EMPLOYEE_ID	DEPARTMENT_ID	DEPARTMENT_NAME
1	200	10	Administration
2	201	20	Marketing
3	202	20	Marketing
4	124	50	Shipping
5	144	50	Shipping
...			
18	205	110	Accounting
19	206	110	Accounting

Types of Joins

Joins that are compliant with the SQL:1999 standard include the following:

- Natural joins:
 - NATURAL JOIN clause
 - USING clause
 - ON clause
- OUTER joins:
 - LEFT OUTER JOIN
 - RIGHT OUTER JOIN
 - FULL OUTER JOIN
- Cross joins

Joining Tables Using SQL:1999 Syntax

Use a join to query data from more than one table:

```
SELECT    table1.column, table2.column
FROM      table1
[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 table2];
```

Qualifying Ambiguous Column Names

- Use table prefixes to qualify column names that are in multiple tables.
- Use table prefixes to improve performance.
- Instead of full table name prefixes, use table aliases.
- Table alias gives a table a shorter name:
 - Keeps SQL code smaller, uses less memory
- Use column aliases to distinguish columns that have identical names, but reside in different tables.

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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.

Retrieving Records with Natural Joins

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

	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY
1	60	IT	1400	Southlake
2	50	Shipping	1500	South San Francisco
3	10	Administration	1700	Seattle
4	90	Executive	1700	Seattle
5	110	Accounting	1700	Seattle
6	190	Contracting	1700	Seattle
7	20	Marketing	1800	Toronto
8	80	Sales	2500	Oxford

Creating Joins with the USING Clause

- If several columns have the same names but the data types do not match, use the USING clause to specify the columns 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.

Joining Column Names

EMPLOYEES

EMPLOYEE_ID	DEPARTMENT_ID
100	90
101	90
102	90
103	60
104	60
107	60
124	50
141	50
142	50
143	50
144	50
149	80
174	80
176	80

...

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME
1	10	Administration
2	20	Marketing
3	50	Shipping
4	60	IT
5	80	Sales
6	90	Executive
7	110	Accounting
8	190	Contracting

Primary key

Foreign key

Retrieving Records with the USING Clause

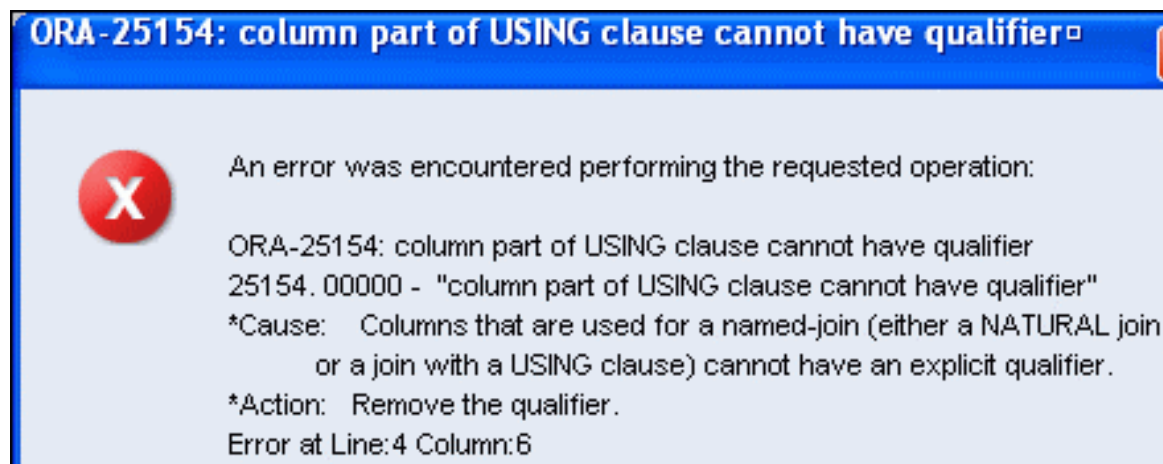
```
SELECT employee_id, last_name,  
       location_id, department_id  
FROM   employees JOIN departments  
USING (department_id) ;
```

	EMPLOYEE_ID	LAST_NAME	LOCATION_ID	DEPARTMENT_ID
1	200	Whalen	1700	10
2	201	Hartstein	1800	20
3	202	Fay	1800	20
4	124	Mourgos	1500	50
5	144	Vargas	1500	50
6	143	Matos	1500	50
7	142	Davies	1500	50
8	141	Rajs	1500	50
9	107	Lorentz	1400	60
10	104	Ernst	1400	60
...				
19	205	Higgins	1700	110

Using Table Aliases 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.

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



Creating Joins with the ON Clause

- The join condition for the natural join is basically an equijoin of all columns with the same name.
- Use the ON clause to specify arbitrary conditions or specify columns to join.
- The join condition is separated from other search conditions.
- The ON clause makes code easy to understand.

Retrieving Records with the ON Clause

```
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);
```

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_ID_1	LOCATION_ID
1	200	Whalen	10	10	1700
2	201	Hartstein	20	20	1800
3	202	Fay	20	20	1800
4	124	Mourgos	50	50	1500
5	144	Vargas	50	50	1500
6	143	Matos	50	50	1500
7	142	Davies	50	50	1500
8	141	Rajs	50	50	1500
9	107	Lorentz	60	60	1400
10	104	Ernst	60	60	1400

...

Creating Three-Way Joins with the ON Clause

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

	EMPLOYEE_ID	CITY	DEPARTMENT_NAME
1	100	Seattle	Executive
2	101	Seattle	Executive
3	102	Seattle	Executive
4	103	Southlake	IT
5	104	Southlake	IT
6	107	Southlake	IT
7	124	South San Francisco	Shipping
8	141	South San Francisco	Shipping

...

Applying Additional Conditions to a Join

Use the `AND` clause or the `WHERE` clause to apply additional conditions:

```
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)  
AND    e.manager_id = 149 ;
```

Or

```
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)  
WHERE  e.manager_id = 149 ;
```

Lesson Agenda

- Types of JOINS and its syntax
- Natural join:
 - USING clause
 - ON clause
- **Self-join**
- Nonequijoins
- OUTER join:
 - LEFT OUTER join
 - RIGHT OUTER join
 - FULL OUTER join
- Cartesian product
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Joining a Table to Itself

EMPLOYEES (WORKER)

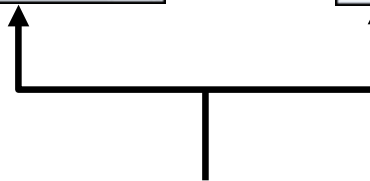
	EMPLOYEE_ID	LAST_NAME	MANAGER_ID
1	100	King	(null)
2	101	Kochhar	100
3	102	De Haan	100
4	103	Hunold	102
5	104	Ernst	103
6	107	Lorentz	103
7	124	Mourgos	100
8	141	Rajs	124
9	142	Davies	124
10	143	Matos	124

...

EMPLOYEES (MANAGER)

EMPLOYEE_ID	LAST_NAME
100	King
101	Kochhar
102	De Haan
103	Hunold
104	Ernst
107	Lorentz
124	Mourgos
141	Rajs
142	Davies
143	Matos


...



**MANAGER_ID in the WORKER table is equal to
EMPLOYEE_ID in the MANAGER table.**

Self-Joins Using the ON Clause

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

	 EMP	 MGR
1	Hunold	De Haan
2	Fay	Hartstein
3	Gietz	Higgins
4	Lorentz	Hunold
5	Ernst	Hunold
6	Zlotkey	King
7	Mourgos	King
8	Kochhar	King
9	Hartstein	King
10	De Haan	King

...

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Nonequijoins

EMPLOYEES

	R2	LAST_NAME	R2	SALARY
1		King		24000
2		Kochhar		17000
3		De Haan		17000
4		Hunold		9000
5		Ernst		6000
6		Lorentz		4200
7		Mourgos		5800
8		Rajs		3500
9		Davies		3100
10		Matos		2600
...				
19		Higgins		12000
20		Gietz		8300

JOB_GRADES

	R2	GRADE_LEVEL	R2	LOWEST_SAL	R2	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

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

Retrieving Records with Nonequijoins

```
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;
```

	LAST_NAME	SALARY	GRADE_LEVEL
1	Vargas	2500	A
2	Matos	2600	A
3	Davies	3100	B
4	Rajs	3500	B
5	Lorentz	4200	B
6	Whalen	4400	B
7	Mourgos	5800	B
8	Ernst	6000	C
9	Fay	6000	C
10	Grant	7000	C

...

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Returning Records with No Direct Match Using OUTER Joins

DEPARTMENTS

DEPARTMENT_NAME	DEPARTMENT_ID
Administration	10
Marketing	20
Shipping	50
IT	60
Sales	80
Executive	90
Accounting	110
Contracting	190

There are no employees in department 190.

Employee "Grant" has not been assigned a department ID.

Equijoin with EMPLOYEES

	DEPARTMENT_ID	LAST_NAME
1	90	King
2	90	Kochhar
3	90	De Haan
4	60	Hunold
5	60	Ernst
6	60	Lorentz
7	50	Mourgos
8	50	Rajs
9	50	Davies
10	50	Matos

...

18	110	Higgins
19	110	Gietz

INNER Versus OUTER Joins

- In SQL:1999, the join of two tables returning only matched rows is called an `INNER` join.
- A join between two tables that returns the results of the `INNER` join as well as the unmatched rows from the left (or right) table is called a left (or right) `OUTER` join.
- A join between two tables that returns the results of an `INNER` join as well as the results of a left and right join is a `full OUTER` join.

LEFT OUTER JOIN

```
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) ;
```

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Fay	20	Marketing
3	Hartstein	20	Marketing
4	Vargas	50	Shipping
5	Matos	50	Shipping

...

17	King	90	Executive
18	Gietz	110	Accounting
19	Higgins	110	Accounting
20	Grant	(null)	(null)

RIGHT OUTER JOIN

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

	A 2	LAST_NAME	A 2	DEPARTMENT_ID	A 2	DEPARTMENT_NAME
1		Whalen		10		Administration
2		Hartstein		20		Marketing
3		Fay		20		Marketing
4		Mourgos		50		Shipping

...

18		Gietz		110		Accounting
19		Higgins		110		Accounting
20		(null)		190		Contracting

FULL OUTER JOIN

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

	R2 LAST_NAME	R2 DEPARTMENT_ID	R2 DEPARTMENT_NAME
1	King	90	Executive
2	Kochhar	90	Executive
3	De Haan	90	Executive
4	Hunold	60	IT

...

15	Grant	(null)	(null)
16	Whalen	10	Administration
17	Hartstein	20	Marketing
18	Fay	20	Marketing
19	Higgins	110	Accounting
20	Gietz	110	Accounting
21	(null)	190	Contracting

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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.

Generating a Cartesian Product

EMPLOYEES (20 rows)

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90
4	103	Hunold	60
...			
19	205	Higgins	110
20	206	Gietz	110

DEPARTMENTS (8 rows)

	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
1	10	Administration	1700
2	20	Marketing	1800
3	50	Shipping	1500
4	60	IT	1400
5	80	Sales	2500
6	90	Executive	1700
7	110	Accounting	1700
8	190	Contracting	1700

**Cartesian product:
20 x 8 = 160 rows**

	EMPLOYEE_ID	DEPARTMENT_ID	LOCATION_ID
1	100	90	1700
2	101	90	1700
3	102	90	1700
4	103	60	1700
...			
159	205	110	1700
160	206	110	1700

Creating Cross Joins

- The CROSS JOIN clause produces the cross-product of two tables.
- This is also called a Cartesian product between the two tables.

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

	LAST_NAME	DEPARTMENT_NAME
1	Abel	Administration
2	Davies	Administration
3	De Haan	Administration
4	Ernst	Administration
5	Fay	Administration
...		
159	Whalen	Contracting
160	Zlotkey	Contracting

Quiz

The SQL:1999 standard join syntax supports the following types of joins. Which of these join types does Oracle join syntax support?

1. Equijoins
2. Nonequijoins
3. Left OUTER join
4. Right OUTER join
5. Full OUTER join
6. Self joins
7. Natural joins
8. Cartesian products

Summary

In this lesson, you should have learned how to use joins to display data from multiple tables by using:

- Equijoins
- Nonequijoins
- OUTER joins
- Self-joins
- Cross joins
- Natural joins
- Full (or two-sided) OUTER joins

Practice 6: Overview

This practice covers the following topics:

- Joining tables using an equijoin
- Performing outer and self-joins
- Adding conditions