6

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 by 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

Course Roadmap

Lesson 1: Introduction

Unit 1: Retrieving, Restricting, and Sorting Data

Unit 2: Joins, Subqueries, and Set Operators

Unit 3: DML and DDL

Lesson 6: Reporting Aggregated Data Using Group Functions

Lesson 7: Displaying Data from Multiple Tables Using Joins

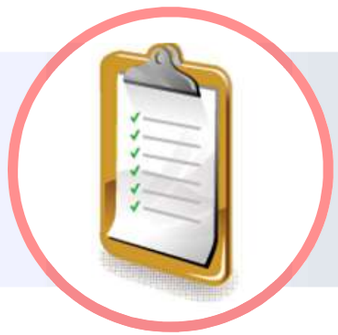
You are here!

Lesson 8: Using Subqueries to Solve Queries

Lesson 9: Using Set Operators

Lesson Agenda

- Types of JOINS and their syntax
- Natural join
- Join with the USING clause
- Join with the ON clause
- Self-join
- Nonequijoins
- OUTER join:
  - LEFT OUTER JOIN
  - RIGHT OUTER JOIN
  - FULL OUTER JOIN
- Cartesian product
  - Cross join



Why Join?

I want the information of all employees and their jobs. But they are stored in different tables. How to I combine them into a single report?

Jody

HR Application

Select the desired columns:

EMPLOYEE

first_name last_name ...	> >>	**employee_id** **job_id**

JOBS

min_salary max_salary ...	> >>	**job_id** **job_title**

GO

Combines columns from both the tables

HR Application

Emp_ID	Job_id	Job_title
206	AC_ACCOUNTANT	Public Accountant
103	AC_MGR	Accounting Manager
100	AD_PRES	President

...

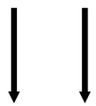
Obtaining Data from Multiple Tables

EMPLOYEES

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	200	Whalen	10
2	201	Hartstein	20
3	202	Fay	20
4	205	Higgins	110
...			
18	174	Abel	80
19	176	Taylor	80
20	178	Grant	(null)

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	100	90	Executive
2	101	90	Executive
...			
17	202	20	Marketing
18	205	110	Accounting
19	206	110	Accounting

Obtaining Data from Multiple Tables

EMPLOYEES

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	JOB_ID
1	100	Steven	King	AD_PRES
2	101	Neena	Kochhar	AD_VP
3	102	Lex	De Haan	AD_VP
4	103	Alexander	Hunold	AC_MGR
5	104	Bruce	Ernst	IT_PROG
6	107	Diana	Lorentz	IT_PROG
7	124	Kevin	Mourgos	ST_MAN
8	141	Trenna	Rajs	ST_CLERK
9	142	Curtis	Davies	ST_CLERK
10	143	Randall	Matos	ST_CLERK

...

JOBS

	JOB_ID	JOB_TITLE
1	AD_PRES	President
2	AD_VP	Administration Vice President
3	AD_ASST	Administration Assistant
4	FI_MGR	Finance Manager
5	FI_ACCOUNT	Accountant
6	AC_MGR	Accounting Manager
7	AC_ACCOUNT	Public Accountant
8	SA_MAN	Sales Manager
9	SA_REP	Sales Representative

...

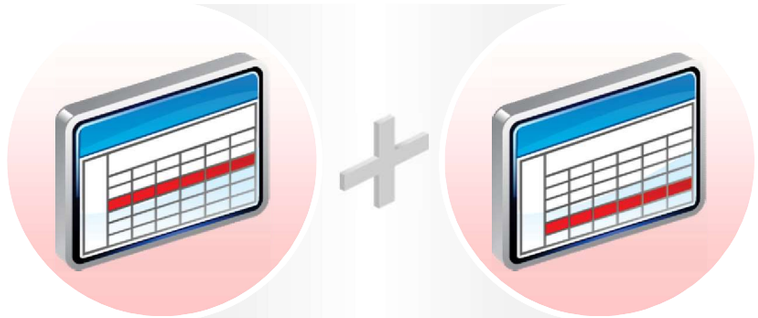
	EMPLOYEE_ID	JOB_ID	JOB_TITLE
1	206	AC_ACCOUNT	Public Accountant
2	205	AC_MGR	Accounting Manager
3	200	AD_ASST	Administration Assistant
4	100	AD_PRES	President
5	101	AD_VP	Administration Vice President
6	102	AD_VP	Administration Vice President
7	109	FI_ACCOUNT	Accountant

...

Types of Joins

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

- Natural join with the `NATURAL JOIN` clause
- Join with the `USING` clause
- Join with the `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];
```

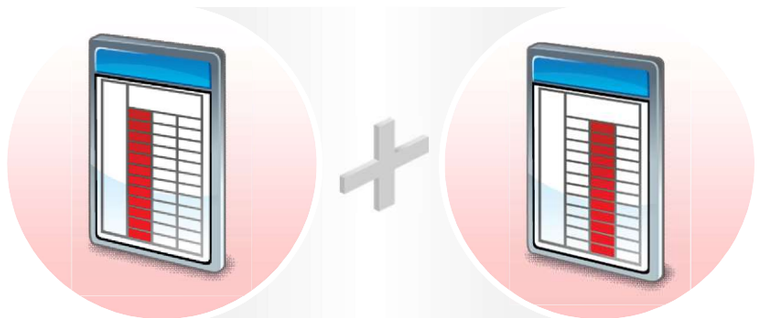
Lesson Agenda

- Types of JOINS and their syntax
- Natural join
- Join with the USING clause
- Join with the ON clause
- Self-join
- Nonequijoins
- OUTER join:
  - LEFT OUTER JOIN
  - RIGHT OUTER JOIN
  - FULL OUTER JOIN
- Cartesian product
  - Cross join

Creating Natural Joins

- The `NATURAL JOIN` clause is based on all the columns that have the same name in two tables.
- 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.

```
SELECT * FROM table1 NATURAL JOIN table2;
```



Retrieving Records with Natural Joins

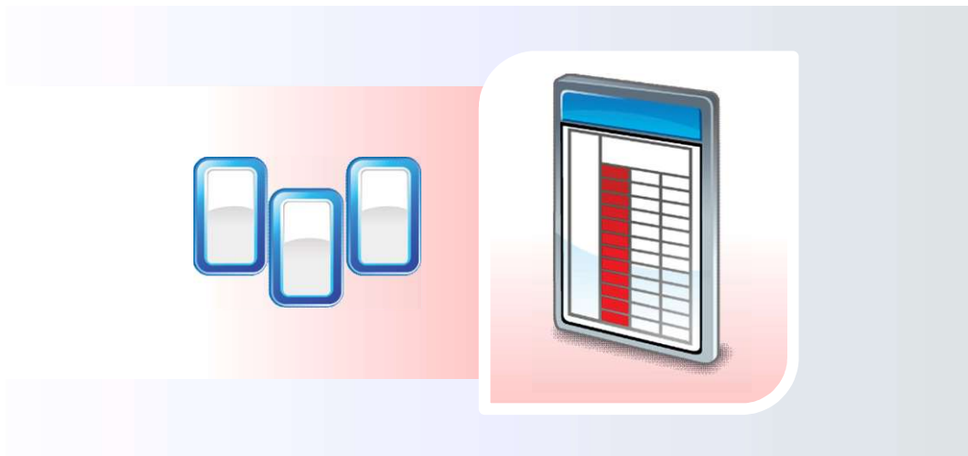
```
SELECT department_id, department_name,
       location_id, city
FROM   departments
NATURAL JOIN locations ;
```

	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

When should you use 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.



Joining Column Names

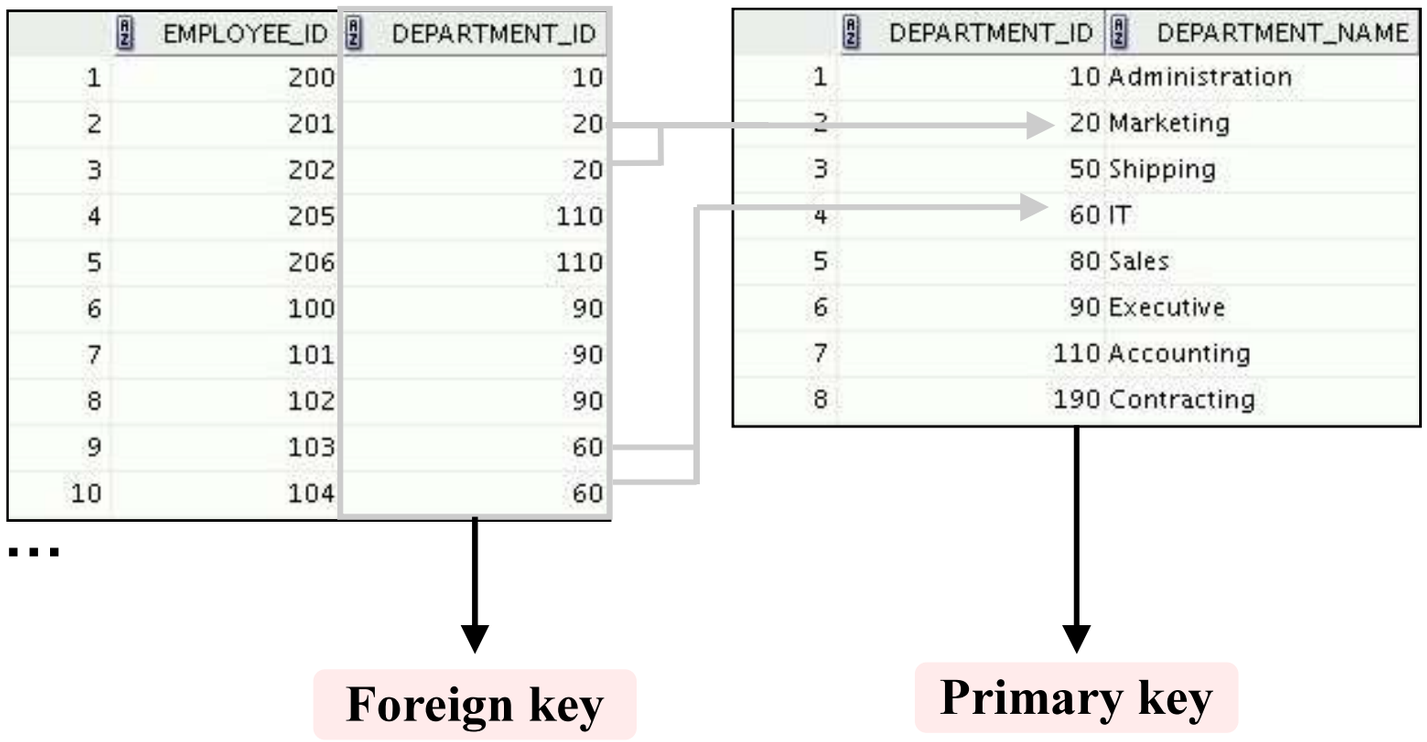
EMPLOYEES

	EMPLOYEE_ID	DEPARTMENT_ID
1	200	10
2	201	20
3	202	20
4	205	110
5	206	110
6	100	90
7	101	90
8	102	90
9	103	60
10	104	60

...

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



Retrieving Records with the USING Clause

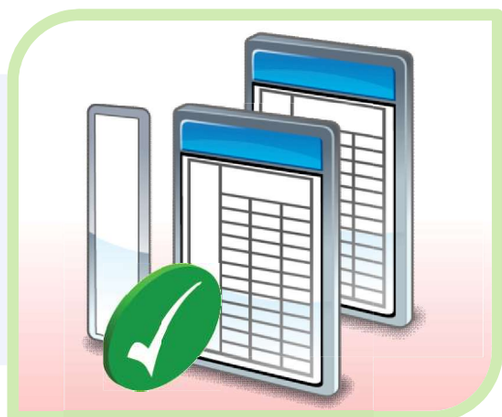
```
SELECT employees.employee_id, employees.last_name,
       departments.location_id, department_id
FROM   employees JOIN departments
USING (department_id) ;
```

	EMPLOYEE_ID	LAST_NAME	LOCATION_ID	DEPARTMENT_ID
1	200	Whalen	1700	10
2	201	Hartstein	1800	20
3	202	Fay	1800	20
4	205	Higgins	1700	110
5	206	Gietz	1700	110
6	100	King	1700	90
7	101	Kochhar	1700	90
8	102	De Haan	1700	90
9	103	Hunold	1400	60
10	104	Ernst	1400	60

...

Qualifying Ambiguous Column Names

- Use table prefixes to:
  - Qualify column names that are in multiple tables
  - Increase the speed of parsing of a statement
- 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.



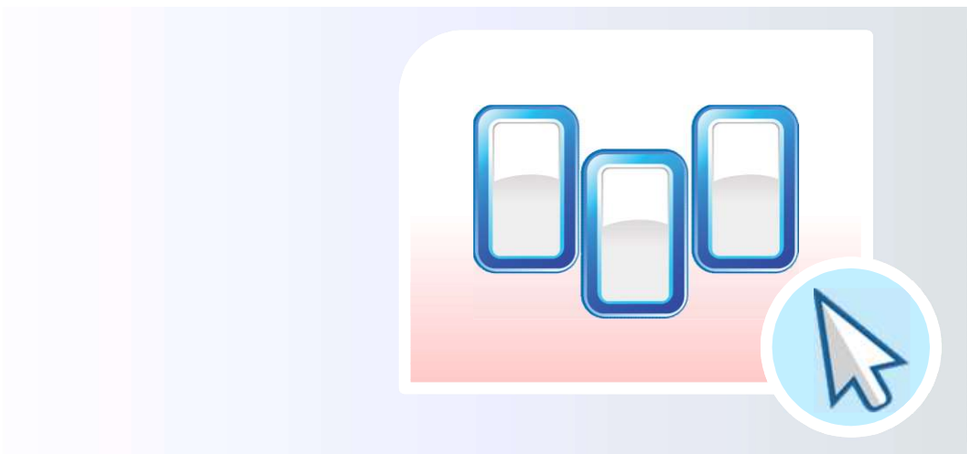
Using Table Aliases

- Use table aliases to simplify queries.
- Use table aliases to improve performance.

```
SELECT e.employee_id, e.last_name,
       d.location_id, department_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.
- Use the ON clause to specify arbitrary conditions or specify the columns to join.
- Use the ON clause to separate the join condition 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	205	Higgins	110	110	1700
5	206	Gietz	110	110	1700
6	100	King	90	90	1700
7	101	Kochhar	90	90	1700
8	102	De Haan	90	90	1700
9	103	Hunold	60	60	1400
10	104	Ernst	60	60	1400

...

Creating Three-Way Joins

```
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
9	142	South San Francisco	Shipping

Applying 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 ;
```

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_ID_1	LOCATION_ID
1	174	Abel	80	80	2500
2	176	Taylor	80	80	2500

Lesson Agenda

- Types of JOINS and their syntax
- Natural join
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- Self-join
- Nonequijoins
- OUTER join:
  - LEFT OUTER JOIN
  - RIGHT OUTER JOIN
  - FULL OUTER JOIN
- Cartesian product
  - Cross join

Self-Joins Using the ON Clause

EMPLOYEES (WORKER)

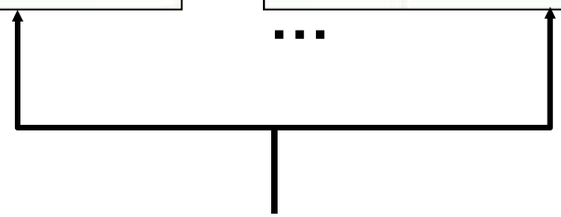
	EMPLOYEE_ID	LAST_NAME	MANAGER_ID
1	100	King	(null)
2	101	Kochhar	100
3	102	De Haan	100
4	103	Hunold	102
5	104	Ernst	103
6	107	Lorentz	103
7	124	Mourgos	100
8	141	Rajs	124
9	142	Davies	124
10	143	Matos	124

...

EMPLOYEES (MANAGER)

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

...



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

Self-Joins Using the ON Clause

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

	EMP	MGR
1	Abel	Zlotkey
2	Davies	Mourgos
3	De Haan	King
4	Ernst	Hunold
5	Fay	Hartstein
6	Gietz	Higgins
7	Grant	Zlotkey
8	Hartstein	King

...

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Nonequijoins

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

...

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

Salary in the EMPLOYEES table must be between lowest salary and highest salary in the JOB_GRADES table.

Retrieving Records

```
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

...

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Returning Records with No Direct Match Using OUTER

DEPARTMENTS

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

There are no employees in department 190.

Equijoin with EMPLOYEES

	DEPARTMENT_ID	LAST_NAME
1	10	Whalen
2	20	Hartstein
3	20	Fay
4	110	Higgins
5	110	Gietz
6	90	King
7	90	Kochhar
8	90	De Haan
9	60	Hunold
10	60	Ernst
...		
18	80	Abel
19	80	Taylor

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

Therefore, the above two records do not appear in the equijoin result.

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.

A B AB (Matched & Unmatched rows)

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	Hartstein	20	Marketing
3	Fay	20	Marketing
4	Higgins	110	Accounting

...

18	Abel	80	Sales
19	Taylor	80	Sales
20	Grant	(null)	(null)

RIGHT OUTER JOIN

```
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) ;
```

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing

...

18	Higgins	110	Accounting
19	Gietz	110	Accounting
20	(null)	(null)	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) ;
```

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing
...			
18	Abel	80	Sales
19	Taylor	80	Sales
20	Grant	(null)	(null)
21	(null)	190	Contracting

Lesson Agenda

- Types of JOINS and their syntax
- Natural join
- Join with the USING clause
- Join with the ON clause
- Self-join
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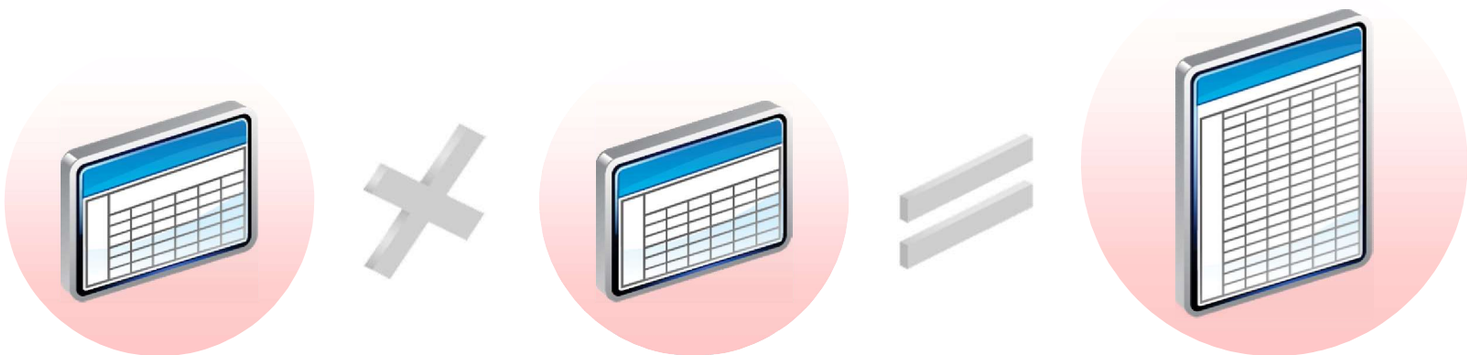
- OUTER join:
  - LEFT OUTER JOIN
  - RIGHT OUTER JOIN
  - FULL OUTER JOIN
- Cartesian product
  - Cross join

Cartesian Products

- A Cartesian product:
  - Is a join of every row of one table to every row of another table
  - Generates a large number of rows and the result is rarely useful



Generating a Cartesian Product

EMPLOYEES (20 rows)

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	200	Whalen	10
2	201	Hartstein	20

...

19	176	Taylor	80
20	178	Grant	(null)

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	10	1700
2	101	10	1700

...

156	200	190	1700
157	201	190	1700
158	202	190	1700
159	205	190	1700
160	206	190	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

...

159	Whalen	Contracting
160	Zlotkey	Contracting

Quiz

If you join a table to itself, what kind of join are you using?

a. Nonequijoin
b. Left `OUTER` join
c. Right `OUTER` join
d. Full `OUTER` join
e. Self-join
f. Natural join
g. Cartesian products

Summary

In this lesson, you should have learned how to :

- 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 tables

Practice 5: Overview

This practice covers the following topics:

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