ORACLE

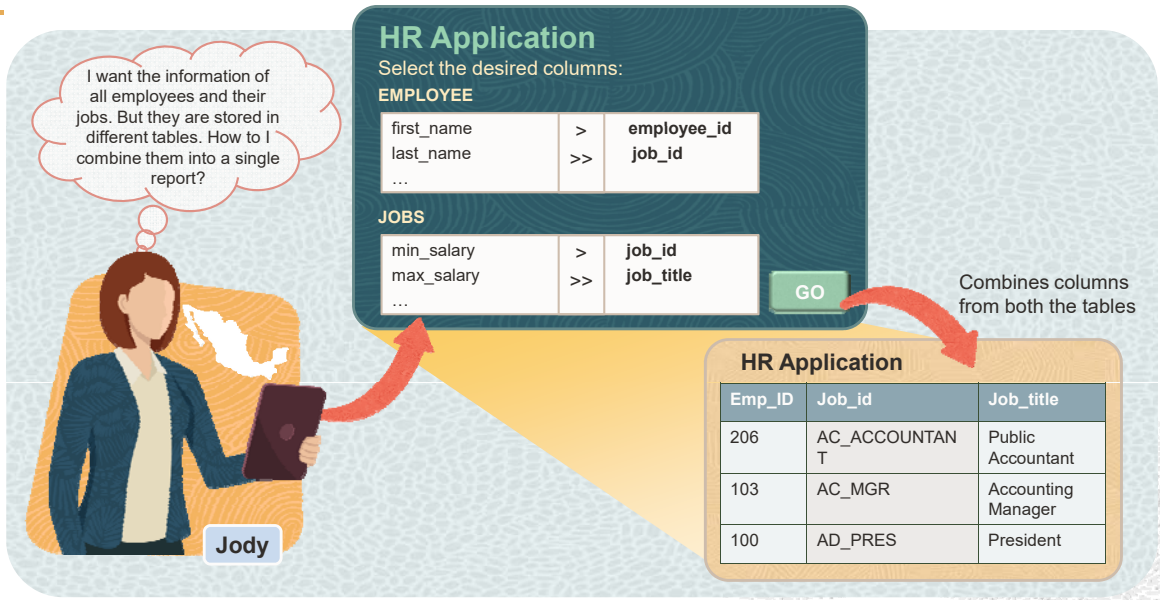
7

Displaying Data from Multiple Tables Using Joins

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
- Cartesian product

Why Join?



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

...

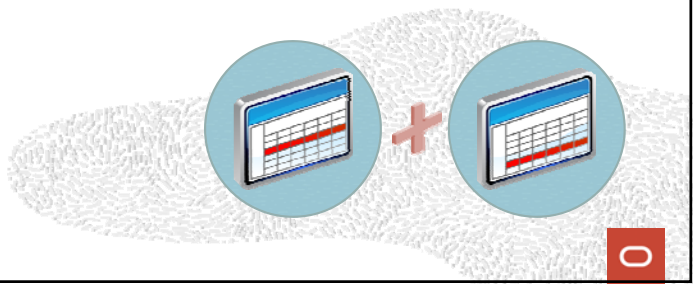
	EMPLOYEE_ID	JOB_ID	JOB_TITLE
1	206	AC_ACCOUNT	Public Accountant
2	205	AC_MGR	Accounting Manager
3	200	AD_ASST	Administration Assistant
4	100	AD_PRES	President
5	101	AD_VP	Administration Vice President
6	102	AD_VP	Administration Vice President
7	109	FI_ACCOUNT	Accountant

...

Types of Joins

Joins that are compliant with the ANSI standard:

- Natural join with the NATURAL JOIN clause
- Join with the USING clause
- Join with the ON clause
- OUTER joins
- Cross joins



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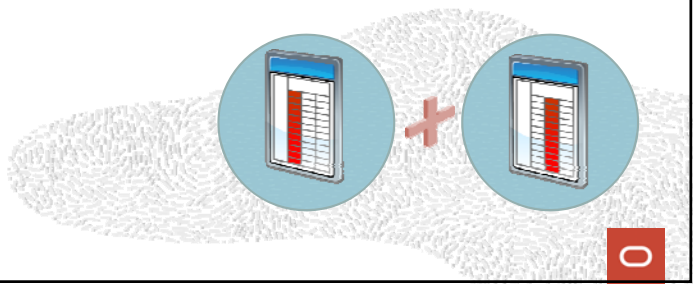
Creating Natural Joins

- 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

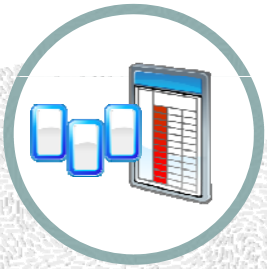
```
SELECT employee_id, first_name, job_id, job_title
from employees NATURAL JOIN jobs;
```

EMPLOYEE_ID	FIRST_NAME	JOB_ID	JOB_TITLE
1	206 William	AC_ACCOUNT	Public Accountant
2	205 Shelley	AC_MGR	Accounting Manager
3	200 Jennifer	AD_ASST	Administration Assistant
4	100 Steven	AD_PRES	President
5	102 Lex	AD_VP	Administration Vice President
6	101 Neena	AD_VP	Administration Vice President
7	103 Alexander	IT_PROG	Programmer
8	104 Bruce	IT_PROG	Programmer
9	107 Diana	IT_PROG	Programmer
10	201 Michael	MK_MAN	Marketing Manager
11	202 Pat	MK_REP	Marketing Representative
12	149 Eleni	SA_MAN	Sales Manager
13	174 Ellen	SA_REP	Sales Representative
14	178 Kimberely	SA_REP	Sales Representative
15	176 Jonathon	SA_REP	Sales Representative
16	143 Randall	ST_CLERK	Stock Clerk
17	142 Curtis	ST_CLERK	Stock Clerk
18	141 Trenna	ST_CLERK	Stock Clerk
19	144 Peter	ST_CLERK	Stock Clerk
20	124 Kevin	ST_MAN	Stock Manager

#	employee_id	first_name	job_id	job_title
1	206	William	AC_ACC…	Public Accountant
2	205	Shelley	AC_MGR	Accounting Manager
3	200	Jennifer	AD_ASST	Administration Assistant
4	100	Steven	AD_PRES	President
5	101	Neena	AD_VP	Administration Vice President
6	102	Lex	AD_VP	Administration Vice President
7	103	Alexander	IT_PROG	Programmer
8	104	Bruce	IT_PROG	Programmer
9	107	Diana	IT_PROG	Programmer
10	201	Michael	MK_MAN	Marketing Manager
11	202	Pat	MK_REP	Marketing Representative
12	149	Eleni	SA_MAN	Sales Manager
13	174	Ellen	SA_REP	Sales Representative
14	176	Jonathon	SA_REP	Sales Representative
15	178	Kimberely	SA_REP	Sales Representative
16	141	Trenna	ST_CLERK	Stock Clerk
17	142	Curtis	ST_CLERK	Stock Clerk
18	143	Randall	ST_CLERK	Stock Clerk
19	144	Peter	ST_CLERK	Stock Clerk
20	124	Kevin	ST_MAN	Stock Manager

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

...

Foreign key

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

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	144	Vargas	1500	50
5	143	Matos	1500	50
6	142	Davies	1500	50
7	141	Rajs	1500	50
8	124	Mourgos	1500	50

...

18	206	Gietz	1700	110
19	205	Higgins	1700	110

#	employee_ic	last_name	location_ic	department_ic
1	103	Hunold	1400	60
2	104	Ernst	1400	60
3	107	Lorentz	1400	60
4	124	Mourgos	1500	50
5	141	Rajs	1500	50
6	142	Davies	1500	50
7	143	Matos	1500	50
8	144	Vargas	1500	50

...

18	174	Abel	2500	80
19	176	Taylor	2500	80

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.
- Use column aliases to distinguish columns that have identical names but reside in different tables.

Using Table Aliases with the USING Clause in Oracle

- Do not qualify a column that is used in the NATURAL join or a join with a 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;
```

```
ORA-25154: column part of USING clause cannot have qualifier
25154. 00000 - "column part of USING clause cannot have qualifier"
*Cause:    Columns that are used for a named-join (either a NATURAL join
           or a join with a USING clause) cannot have an explicit qualifier.
*Action:   Remove the qualifier.
Error at Line: 4 Column: 6
```

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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.

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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
11	103	Hunold	60	60	1400

...

#	employee_ic	last_name	department_	department_ic	location_ic
1	103	Hunold	60	60	1400
2	104	Ernst	60	60	1400
3	107	Lorentz	60	60	1400
4	124	Mourgos	50	50	1500
5	141	Rajs	50	50	1500
6	142	Davies	50	50	1500
7	143	Matos	50	50	1500
8	144	Vargas	50	50	1500
9	200	Whalen	10	10	1700
10	100	King	90	90	1700
11	101	Kochhar	90	90	1700

...

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

...

#	employee_ic	city	department_nam
1	149	Oxford	Sales
2	174	Oxford	Sales
3	176	Oxford	Sales
4	200	Seattle	Administration
5	100	Seattle	Executive
6	101	Seattle	Executive
7	102	Seattle	Executive
8	205	Seattle	Accounting
9	206	Seattle	Accounting

...

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 ;
```

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Lesson Agenda

- Types of JOINS and their syntax
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Joining a Table to Itself

EMPLOYEES (WORKER)

EMPLOYEE_ID	LAST_NAME	MANAGER_ID
200	Whalen	101
201	Hartstein	100
202	Fay	201
205	Higgins	101
206	Gietz	205
100	King	(null)
101	Kochhar	100
102	De Haan	100
103	Hunold	102
104	Ernst	103

...

EMPLOYEES (MANAGER)

EMPLOYEE_ID	LAST_NAME
200	Whalen
201	Hartstein
202	Fay
205	Higgins
206	Gietz
100	King
101	Kochhar
102	De Haan
103	Hunold
104	Ernst

...

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

...

#	emp	mgr
1	Kochhar	King
2	De Haan	King
3	Hunold	De Haan
4	Ernst	Hunold
5	Lorentz	Hunold
6	Mourgos	King
7	Rajs	Mourgos
8	Davies	Mourgos

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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
...		
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 based on his salary.

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

#	last_name	salary	grade_level
1	King	24000.00	E
2	Kochhar	17000.00	E
3	De Haan	17000.00	E
4	Hunold	9000.00	C
5	Ernst	6000.00	C
6	Lorentz	4200.00	B
7	Mourgos	5800.00	B
8	Rajs	3500.00	B
9	Davies	3100.00	B
10	Matos	2600.00	A

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Returning Records with No Direct Match Using OUTER Joins

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

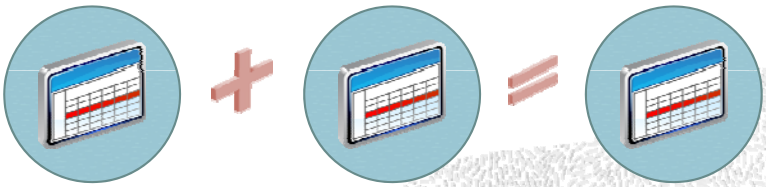
	DEPARTMENT_ID	LAST_NAME
1	10	Whalen
2	20	Hartstein
3	20	Fay
4	110	Higgins
5	110	Gietz
6	90	King
7	90	Kochhar
8	90	De Haan
9	60	Hunold
10	60	Ernst
...		
18	80	Abel
19	80	Taylor

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

- 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.
- In Oracle, 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	Fay	20	Marketing
3	Hartstein	20	Marketing
4	Vargas	50	Shipping
5	Matos	50	Shipping
...			
16	Kochhar	90	Executive
17	King	90	Executive
18	Gietz	110	Accounting
19	Higgins	110	Accounting
20	Grant	(null)	(null)

#	last_name	department_i	department_nam
1	King	90	Executive
2	Kochhar	90	Executive
3	De Haan	90	Executive
4	Hunold	60	IT
5	Ernst	60	IT
...			
14	Taylor	80	Sales
15	Grant	NULL	NULL
16	Whalen	10	Administration
17	Hartstein	20	Marketing
18	Fay	20	Marketing
19	Higgins	110	Accounting
20	Gietz	110	Accounting

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) ;
```

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing
4	Davies	50	Shipping
5	Vargas	50	Shipping
6	Rajs	50	Shipping
7	Mourgos	50	Shipping
8	Matos	50	Shipping
...			
18	Higgins	110	Accounting
19	Gietz	110	Accounting
20	(null)	190	Contracting

#	last_name	department_i	department_nam
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing
4	Mourgos	50	Shipping
5	Rajs	50	Shipping
6	Davies	50	Shipping
7	Matos	50	Shipping
8	Vargas	50	Shipping
...			
18	Higgins	110	Accounting
19	Gietz	110	Accounting
20	NULL	190	Contracting

FULL OUTER JOIN in Oracle

```
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	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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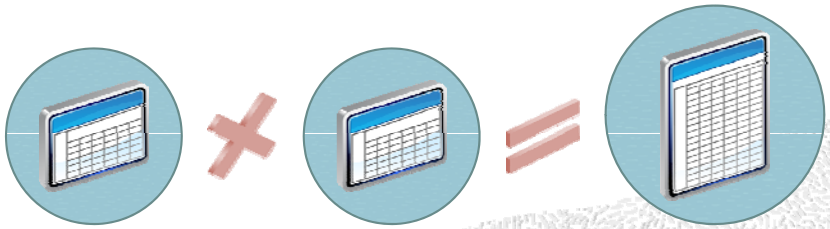
Cartesian Products

A Cartesian product:

- Is 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
3	202	Fay	20
4	205	Higgins	110
...			
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	200	10	1700
2	201	20	1700
...			
21	200	10	1800
22	201	20	1800
...			
159	176	80	1700
160	178	(null)	1700

Creating Cross Joins

- A `CROSS JOIN` is a `JOIN` operation that produces a Cartesian product of two tables.
- To create a Cartesian product, specify `CROSS JOIN` in your `SELECT` statement.

```
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
...		
158	Vargas	Contracting
159	Whalen	Contracting
160	Zlotkey	Contracting

#	last_name	department_name
1	Abel	Administration
2	Abel	Marketing
3	Abel	Shipping
4	Abel	IT
5	Abel	Sales
...		
156	Zlotkey	IT
157	Zlotkey	Sales
158	Zlotkey	Executive
159	Zlotkey	Accounting
160	Zlotkey	Contracting

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