Introduction to SQL

Displaying Data from Multiple Tables (JOIN)

By Kanokwan Atchariyachanvanich

Faculty of Information Technology

KMITL

Database System Concepts

Objective

- 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

Types of Joins

- Joins that are compliant with the SQL:1999 standard include the following:
  1. Cross joins (ผลลัพธ์เหมือนกับ Cartesian product)
  2. Equijoin (Old-style join)
  3. Natural joins
  4. Join with ON clause
  5. Join with USING clause
  6. Self-Joins Using the ON Clause
  7. Full (or two-sided) outer joins

INNER VERSUS OUTER JOINS

- In SQL:1999, the join of two tables returning only matched rows is called an **inner join**. Inner Join consists of :
  - Natural join
  - Join with On clause
  - Join with Using clause
  - Equijoin (Old-style join)
- A join between two tables that returns the results of an inner join as well as the results of unmatched rows is **outer join**.
  - Left outer join
  - Right outer join
  - Full outer join

1. 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  *
FROM        employees
CROSS JOIN  departments  ;
```

Cartesian product

```
SELECT  *
FROM        employees, departments  ;
```

RECALL: CARTESIAN PRODUCT

*** Attributes of both relations have distinct names

R

P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	$5.26
123457	Lamp	$25.15
123458	Box Fan	$10.99
213345	9v battery	$1.92
254467	100W bulb	$1.47
311452	Powerdrill	$34.99

6 rows

PRODUCT

S

STORE	AISLE	SHELF
23	W	5
24	K	9
25	Z	6

3 rows

yields

C

P_CODE	P_DESCRIPT	PRICE	STORE	AISLE	SHELF
123456	Flashlight	$5.26	23	W	5
123456	Flashlight	$5.26	24	K	9
123456	Flashlight	$5.26	25	Z	6
123457	Lamp	$25.15	23	W	5
123457	Lamp	$25.15	24	K	9
123457	Lamp	$25.15	25	Z	6
123458	Box Fan	$10.99	23	W	5
123458	Box Fan	$10.99	24	K	9
123458	Box Fan	$10.99	25	Z	6
213345	9v battery	$1.92	23	W	5
213345	9v battery	$1.92	24	K	9
213345	9v battery	$1.92	25	Z	6
311452	Powerdrill	$34.99	23	W	5
311452	Powerdrill	$34.99	24	K	9
311452	Powerdrill	$34.99	25	Z	6
254467	100W bulb	$1.47	23	W	5
254467	100W bulb	$1.47	24	K	9
254467	100W bulb	$1.47	25	Z	6

```
SELECT  *
FROM  R, S ;
```

18 rows

Generating a Cartesian Product

EMPLOYEES (107 rows)

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT	MANAGER_ID	DEPARTMENT_ID
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000			90
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000		100	90
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000		100	90
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000		102	60
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	6000		103	60
105	David	Austin	DAUSTIN	590.423.4569	25-JUN-97	IT_PROG	4800		103	60
106	Valli	Pataballa	VPATABAL	590.423.4560	05-FEB-98	IT_PROG	4800		103	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	4200		103	60
108	Nancy	Greenberg	NGREENBE	515.124.4569	17-AUG-94	FI_MGR	12000		101	100
109	Daniel	Faviet	DFAVIET	515.124.4169	16-AUG-94	FI_ACCOUNT	9000		108	100
110	John	Chen	JCHEN	515.124.4269	28-SEP-97	FI_ACCOUNT	8200		108	100

DEPARTMENTS (27 rows)

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	1700
20	Marketing	201	1800
30	Purchasing	114	1700
40	Human Resources	203	2400
50	Shipping	121	1500
60	IT	103	1400
70	Public Relations	204	2700
80	Sales	145	2500
90	Executive	100	1700
100	Finance	108	1700
110	Accounting	205	1700
120	Treasury		1700
130	Corporate Tax		1700
140	Control And Credit		1700
150	Shareholder Services		1700
160	Benefits		1700
170	Manufacturing		1700
180	Construction		1700
190	Contracting		1700
200	Operations		1700

```
SELECT  *
FROM    employees, departments;
```

Cartesian Product:
107 x 27 = 2889 rows

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT	MANAGER_ID	DEPARTMENT_ID
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000			90
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000		100	90
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000		100	90
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000		102	60
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	6000		103	60
105	David	Austin	DAUSTIN	590.423.4569	25-JUN-97	IT_PROG	4800		103	60
106	Valli	Pataballa	VPATABAL	590.423.4560	05-FEB-98	IT_PROG	4800		103	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	4200		103	60
108	Nancy	Greenberg	NGREENBE	515.124.4569	17-AUG-94	FI_MGR	12000		101	100
109	Daniel	Faviet	DFAVIET	515.124.4169	16-AUG-94	FI_ACCOUNT	9000		108	100
110	John	Chen	JCHEN	515.124.4269	28-SEP-97	FI_ACCOUNT	8200		108	100
111	Ismael	Sciarra	ISCIARRA	515.124.4369	30-SEP-97	FI_ACCOUNT	7700		108	100

2889 rows selected.

Generating a Cross Join

EMPLOYEES (107 rows)

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT	MANAGER_ID	DEPARTMENT_ID
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000			90
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000		100	90
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000		100	90
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000		102	60
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	6000		103	60
105	David	Austin	DAUSTIN	590.423.4569	25-JUN-97	IT_PROG	4800		103	60
106	Valli	Pataballa	VPATABAL	590.423.4560	05-FEB-98	IT_PROG	4800		103	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	4200		103	60
108	Nancy	Greenberg	NGREENBE	515.124.4569	17-AUG-94	FI_MGR	12000		101	100
109	Daniel	Faviet	DFAVIET	515.124.4169	16-AUG-94	FI_ACCOUNT	9000		108	100
110	John	Chen	JCHEN	515.124.4269	28-SEP-97	FI_ACCOUNT	8200		108	100

```
SELECT      *
FROM        employees
CROSS JOIN  departments;
```

DEPARTMENTS (27 rows)

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	1700
20	Marketing	201	1800
30	Purchasing	114	1700
40	Human Resources	203	2400
50	Shipping	121	1500
60	IT	103	1400
70	Public Relations	204	2700
80	Sales	145	2500
90	Executive	100	1700
100	Finance	108	1700
110	Accounting	205	1700
120	Treasury		1700
130	Corporate Tax		1700
140	Control And Credit		1700
150	Shareholder Services		1700
160	Benefits		1700
170	Manufacturing		1700
180	Construction		1700
190	Contracting		1700
200	Operations		1700

Cartesian Product:
107 x 27 = 2889 rows

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT	MANAGER_ID	DEPARTMENT_ID
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000			90
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000		100	90
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000		100	90
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000		102	60
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	6000		103	60
105	David	Austin	DAUSTIN	590.423.4569	25-JUN-97	IT_PROG	4800		103	60
106	Valli	Pataballa	VPATABAL	590.423.4560	05-FEB-98	IT_PROG	4800		103	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	4200		103	60
108	Nancy	Greenberg	NGREENBE	515.124.4569	17-AUG-94	FI_MGR	12000		101	100
109	Daniel	Faviet	DFAVIET	515.124.4169	16-AUG-94	FI_ACCOUNT	9000		108	100
110	John	Chen	JCHEN	515.124.4269	28-SEP-97	FI_ACCOUNT	8200		108	100
111	Ismael	Sciarra	ISCIARRA	515.124.4369	30-SEP-97	FI_ACCOUNT	7700		108	100

2889 rows selected.

Obtaining Data from Multiple Tables

EMPLOYEES

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
100	King	90
101	Kochhar	90
...		
202	Fay	20
205	Higgins	110
206	Gietz	110

DEPARTMENTS

DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
10	Administration	1700
20	Marketing	1800
50	Shipping	1500
60	IT	1400
80	Sales	2500
90	Executive	1700
110	Accounting	1700
190	Contracting	1700

EMPLOYEE_ID	DEPARTMENT_ID	DEPARTMENT_NAME
200	10	Administration
201	20	Marketing
202	20	Marketing
...		
102	90	Executive
205	110	Accounting
206	110	Accounting

2. Equijoin (old-style join)

- used to combine rows from two or more tables, based on a related column between them.
- Cartesian product with condition WHERE

```
SELECT  table1_name.column_name, table2_name.column_name
FROM    table1_name, table2_name
WHERE   table1_name.column_name = table2_name.column_name ;
```

Cartesian product

EXAMPLE: EQUIJOIN

Query: Find all orders with their product names and price.

ORDER

ORDER_NO	CUSTOMER_NO	P_CODE
1	C001	111110
2	C002	222220

PRODUCT

P_CODE	P_NAME	PRICE
222220	คอมพิวเตอร์	30000
111110	สมุด	120
333330	ปากกา	500

```
SELECT  *
FROM    ORDER, PRODUCT
WHERE
ORDER.P_CODE = PRODUCT.P_CODE ;
```

EXAMPLE : EQUIJOIN

ORDER

ORDER_NO	CUSTOMER_NO	ORDER.P_CODE
1	C001	111110
2	C002	222220

PRODUCT

PRODUCT.P_CODE	P_NAME	PRICE
222220	คอมพิวเตอร์	30000
111110	สมุด	120
333330	ปากกา	500

Automatically rename

Step 1: Cartesian Product

ORDER_NO	CUSTOMER_NO	ORDER.P_CODE	PRODUCT.P_CODE	P_NAME	PRICE
1	C001	111110	222220	คอมพิวเตอร์	30000
1	C001	111110	111110	สมุด	120
1	C001	111110	333330	ปากกา	500
2	C002	222220	222220	คอมพิวเตอร์	30000
2	C002	222220	111110	สมุด	120
2	C002	222220	333330	ปากกา	500

EXAMPLE : EQUIJOIN

Step 2 : Select Join attribute **P_CODE values are equal**

ORDER_NO	CUSTOMER_NO	ORDER.P_CODE	PRODUCT.P_CODE	P_NAME	PRICE
~~1~~	~~C001~~	~~111110~~	~~222220~~	~~คอมพิวเตอร์~~	~~30000~~
1	C001	111110	111110	สมุด	120
~~1~~	~~C001~~	~~111110~~	~~333330~~	~~ปากกา~~	~~500~~
2	C002	222220	222220	คอมพิวเตอร์	30000
~~2~~	~~C002~~	~~222220~~	~~111110~~	~~สมุด~~	~~120~~
~~2~~	~~C002~~	~~222220~~	~~333330~~	~~ปากกา~~	~~500~~

ORDER_NO	CUSTOMER_NO	ORDER.P_CODE	PRODUCT.P_CODE	P_NAME	PRICE
1	C001	111110	111110	สมุด	120
2	C002	222220	222220	คอมพิวเตอร์	30000

EXAMPLE : EQUIJOIN

Step 3 : use a Projection to eliminate the duplicate attributes

ORDER_NO	CUSTOMER_NO	ORDER.P_CODE	PRODUCT.P_CODE	P_NAME	PRICE
1	C001	111110	111110	สมุด	120
2	C002	222220	222220	คอมพิวเตอร์	30000

```
SELECT  *
FROM    ORDER, PRODUCT
WHERE
ORDER.P_CODE = PRODUCT.P_CODE ;
```

ORDER_NO	CUSTOMER_NO	P_CODE	P_NAME	PRICE
1	C001	111110	สมุด	120
2	C002	222220	คอมพิวเตอร์	30000

2. EQUIJOIN

Department Table

DEPARTMENT_ID	DEPARTMENT_NAME
10	Administration
20	Marketing
30	Purchasing
40	Human Resources
50	Shipping
60	IT
70	Public Relations
80	Sales
90	Executive
100	Finance
110	Accounting

Primary Key

Employees Table

EMPLOYEE_ID	DEPARTMENT_ID
100	90
101	90
102	90
103	60
104	60
105	60
106	60
107	60
108	100
109	100
110	100

Foreign Key

2. Retrieving records with Equijoin

จงเขียน SQL Query แสดงรหัสพนักงาน นามสกุล รหัสแผนก และรหัสสถานที่ของแผนกนั้นๆ

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

employee_id	last_name	department_id	location_id
103	Hunold	60	1400
104	Ernst	60	1400
105	Austin	60	1400
106	Pataballa	60	1400
107	Lorentz	60	1400

Additional Search Conditions Using the AND Operator

To display employee Matos' employee_id, department number and department name.

```
SELECT    employee_id, employees.department_id, department_name
FROM      employees, departments
WHERE     employees.department_id = departments.department_id
AND       last_name =  'Matos' ;
```

EMPLOYEE_ID	DEPARTMENT_ID	DEPARTMENT_NAME
143	50	Shipping

Using Table Aliases

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

Table Aliases

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

EMPLOYEE_ID	LAST_NAME	LOCATION_ID	DEPARTMENT_ID
200	Whalen	1700	10
201	Hartstein	1800	20
202	Fay	1800	20
114	Raphaely	1700	30
115	Khoo	1700	30
116	Baida	1700	30

....

106 rows selected.

Guidelines for Table Aliases (MySQL)

- Table aliases can be up to 256 characters in length, but shorter aliases are better than longer ones.
- If a table alias is used for a particular table name in the FROM clause, then that table alias must be substituted for the table name throughout the SELECT statement.
- Table aliases should be meaningful.
- The table alias is valid for only the current SELECT statement.
- Help keep SQL coder smaller therefore using less memory

Joining More than Two Tables

EMPLOYEES

LAST_NAME	DEPARTMENT_ID
Whalen	10
Hartstein	20
Fay	20
Raphaely	30
Khoo	30
Baida	30

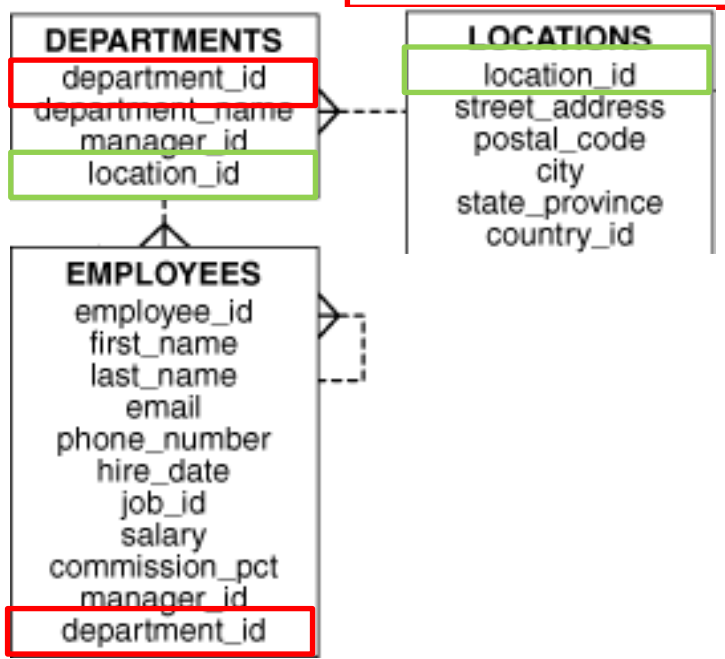
NOTE: To join n tables, you need a minimum of n-1 join conditions

DEPARTMENTS

DEPARTMENT_ID	LOCATION_ID
10	1700
20	1800
20	1800
30	1700
30	1700
30	1700

LOCATIONS

LOCATION_ID	CITY	STATE_PROVINCE
1000	Roma	
1100	Venice	
1200	Tokyo	Tokyo Prefecture
1300	Hiroshima	
1400	Southlake	Texas
1500	South San Francisco	California
1600	South Brunswick	New Jersey
1700	Seattle	Washington
1800	Toronto	Ontario



Example: Equijoin More than Two Tables

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

LAST_NAME	DEPARTMENT_NAME	CITY
King	Executive	Seattle
Kochhar	Executive	Seattle
De Haan	Executive	Seattle
Hunold	IT	Southlake
Ernst	IT	Southlake
Austin	IT	Southlake
Pataballa	IT	Southlake
Lorentz	IT	Southlake
Greenberg	Finance	Seattle
....		
Baer	Public Relations	Munich
Higgins	Accounting	Seattle
Gietz	Accounting	Seattle

106 rows selected.

EXERCISE # 1- EQUI-JOIN (OLD-JOIN)

จงเขียน SQL Query ที่แสดงชื่อ นามสกุล รหัสแผนก (department_id) และ ชื่อแผนก (department_name) ของพนักงานที่ทำงานในแผนก Shipping (ใช้ Equijoin)

ตั้ง Table alias สำหรับ employees คือ e , departments คือ d

```
SELECT    first_name,          last_name,
          e.department_id,     department_name
FROM      Employees e,         departments d
WHERE     e.department_id =    d.department_id
AND       department_name = 'Shipping';
```

INNER VERSUS OUTER JOINS

- In SQL:1999, the join of two tables returning only matched rows is called an **inner join**. Inner Join consists of :
  - Natural join
  - Join with On clause
  - Join with Using clause
  - Equijoin (Old-style join)
- A join between two tables that returns the results of an inner join as well as the results of unmatched rows is **outer join**.
  - Left outer join
  - Right outer join
  - Full outer join

3. Creating Natural Joins

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

- Natural join will perform the following tasks:
  - ตรวจสอบ common attribute โดยมองหา attribute ที่ชื่อเหมือนกันและมีชนิดข้อมูลเดียวกัน (ปกติคือ foreign key)
  - เลือกแถวจากทั้งสองตารางที่มีค่าเหมือนกันในทุกคอลัมน์ที่เป็น common attribute
  - เชื่อมตารางโดยเลือกเฉพาะแถวที่มีค่าเหมือนกันของattributeที่ชื่อเดียวกัน (common attribute)
  - เงื่อนไขการเชื่อมตารางสำหรับ Natural join คือการทำ equijoin ของทุกคอลัมน์ด้วยชื่อคอลัมน์ที่เหมือนกัน
  - If there are no common attributes, return the relational product of the two tables.
  - If the columns having the same names have different data types, an error is returned.

3. Creating Natural Joins

- The NATURAL JOIN clause is based on all columns in the two tables that have the same name.
- NATURAL JOIN is structured in such a way that, columns with the same name of associate tables will appear once only.
- เงื่อนไขการเชื่อมตารางสำหรับ Natural join คือการทำ equijoin ของทุกคอลัมน์ด้วยชื่อคอลัมน์ที่เหมือนกัน

```
SELECT          * |[column_name]
FROM            table1_name
NATURAL JOIN    table2_name ;
```

EXAMPLE : NATURAL JOIN

Query: Find all customers with their agent code and agent phone.

```
SELECT          *
FROM            CUSTOMER
NATURAL JOIN    AGENT ;
```

Table name: CUSTOMER

CUS_CODE	CUS_LNAME	CUS_ZIP	AGENT_CODE
1132445	Walker	32145	231
1217782	Adares	32145	125
1312243	Rakowski	34129	167
1321242	Rodriguez	37134	125
1542311	Smithson	37134	421
1657399	Vanloo	32145	231

Table name: AGENT

AGENT_CODE	AGENT_PHONE
125	6152439887
167	6153426778
231	6152431124
333	9041234445

Example : Natural Join

Table name: CUSTOMER

CUS_CODE	CUS_LNAME	CUS_ZIP	AGENT_CODE
1132445	Walker	32145	231
1217782	Adares	32145	125
1312243	Rakowski	34129	167
1321242	Rodriguez	37134	125
1542311	Smithson	37134	421
1657399	Vanloo	32145	231

Table name: AGENT

AGENT_CODE	AGENT_PHONE
125	6152439887
167	6153426778
231	6152431124
333	9041234445

Step 1: Cartesian Product

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1132445	Walker	32145	231	125	6152439887
1132445	Walker	32145	231	167	6153426778
1132445	Walker	32145	231	231	6152431124
1132445	Walker	32145	231	333	9041234445
1217782	Adares	32145	125	125	6152439887
1217782	Adares	32145	125	167	6153426778
1217782	Adares	32145	125	231	6152431124
1217782	Adares	32145	125	333	9041234445
1312243	Rakowski	34129	167	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1312243	Rakowski	34129	167	231	6152431124
1312243	Rakowski	34129	167	333	9041234445
1321242	Rodriguez	37134	125	125	6152439887
1321242	Rodriguez	37134	125	167	6153426778
1321242	Rodriguez	37134	125	231	6152431124
1321242	Rodriguez	37134	125	333	9041234445
1542311	Smithson	37134	421	125	6152439887
1542311	Smithson	37134	421	167	6153426778
1542311	Smithson	37134	421	231	6152431124
1542311	Smithson	37134	421	333	9041234445
1657399	Vanloo	32145	231	125	6152439887
1657399	Vanloo	32145	231	167	6153426778
1657399	Vanloo	32145	231	231	6152431124
1657399	Vanloo	32145	231	333	9041234445

EXAMPLE : NATURAL JOIN

Step 2 : Select Join attribute **AGENT_CODE values are equal**

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1132445	Walker	32145	231	125	6152439887
1132445	Walker	32145	231	167	6153426778
1132445	Walker	32145	231	231	6152431124
1132445	Walker	32145	231	333	9041234445
1217782	Adares	32145	125	125	6152439887
1217782	Adares	32145	125	167	6153426778
1217782	Adares	32145	125	231	6152431124
1217782	Adares	32145	125	333	9041234445
1312243	Rakowski	34129	167	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1312243	Rakowski	34129	167	231	6152431124
1312243	Rakowski	34129	167	333	9041234445
1321242	Rodriguez	37134	125	125	6152439887
1321242	Rodriguez	37134	125	167	6153426778
1321242	Rodriguez	37134	125	231	6152431124
1321242	Rodriguez	37134	125	333	9041234445
1542311	Smithson	37134	421	125	6152439887
1542311	Smithson	37134	421	167	6153426778
1542311	Smithson	37134	421	231	6152431124
1542311	Smithson	37134	421	333	9041234445
1657399	Vanloo	32145	231	125	6152439887
1657399	Vanloo	32145	231	167	6153426778
1657399	Vanloo	32145	231	231	6152431124
1657399	Vanloo	32145	231	333	9041234445

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1217782	Adares	32145	125	125	6152439887
1321242	Rodriguez	37134	125	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1132445	Walker	32145	231	231	6152431124
1657399	Vanloo	32145	231	231	6152431124

Example : Natural Join

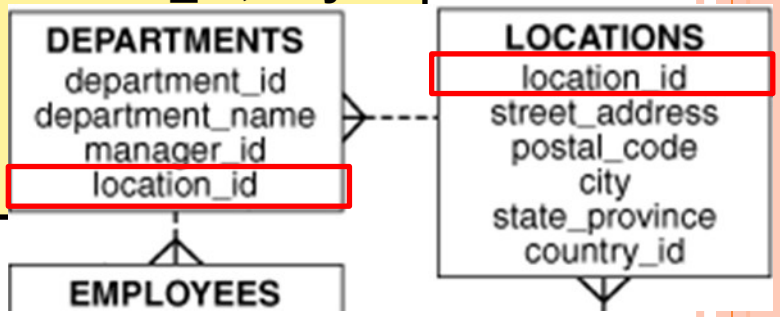
Step 3 : use a Projection to eliminate the duplicate attributes

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1217782	Adares	32145	125	125	6152439887
1321242	Rodriguez	37134	125	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1132445	Walker	32145	231	231	6152431124
1657399	Vanloo	32145	231	231	6152431124

CUS_CODE	CUS_LNAME	CUS_ZIP	AGENT_CODE	AGENT_PHONE
1217782	Adares	32145	125	6152439887
1321242	Rodriguez	37134	125	6152439887
1312243	Rakowski	34129	167	6153426778
1132445	Walker	32145	231	6152431124
1657399	Vanloo	32145	231	6152431124

3. Retrieving Records with Natural Joins (2 tables)

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



DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY
60	IT	1400	Southlake
50	Shipping	1500	South San Francisco
10	Administration	1700	Seattle
30	Purchasing	1700	Seattle
90	Executive	1700	Seattle
100	Finance	1700	Seattle
110	Accounting	1700	Seattle
120	Treasury	1700	Seattle
130	Corporate Tax	1700	Seattle
140	Control And Credit	1700	Seattle
150	Shareholder Services	1700	Seattle
160	Benefits	1700	Seattle
170	Manufacturing	1700	Seattle
180	Construction	1700	Seattle
190	Contracting	1700	Seattle
200	Operations	1700	Seattle
210	IT Support	1700	Seattle
220	NOC	1700	Seattle
230	IT Helpdesk	1700	Seattle
240	Government Sales	1700	Seattle
250	Retail Sales	1700	Seattle
260	Recruiting	1700	Seattle
270	Payroll	1700	Seattle
20	Marketing	1800	Toronto
40	Human Resources	2400	London
80	Sales	2500	Oxford
70	Public Relations	2700	Munich

27 rows selected.

Note: number of rows equal to number of rows from the common attribute (location_id) between DEPARTMENTS and LOCATIONS.

3. Natural Joins (2 tables) with 2 common attributes


```
SELECT  employee_id, last_name, department_id,
        manager_id, location_id
FROM    employees
NATURAL JOIN  departments ;
```

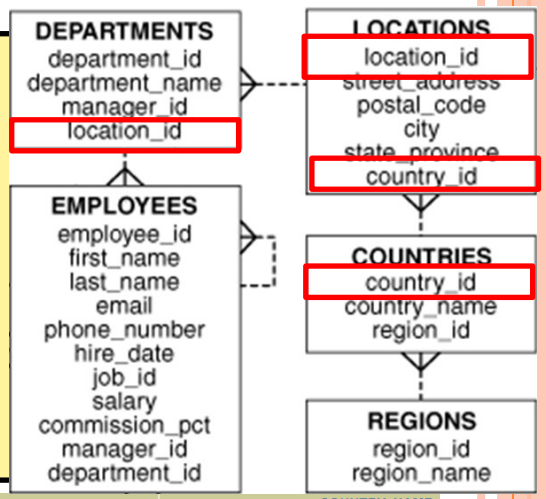
employee_id	last_name	department_id	manager_id	location_id
202	Fay	20	201	1800
115	Khoo	30	114	1700
116	Baida	30	114	1700
117	Tobias	30	114	1700
118	Himuro	30	114	1700
119	Colmenares	30	114	1700
129	Bissot	50	121	1500
130	Atkinson	50	121	1500
131	Marlow	50	121	1500
132	Olson	50	121	1500

```
SELECT employee_id,last_name, employees.department_id, employees.manager_id, location_id
FROM   employees,departments
WHERE  employees.manager_id=departments.manager_id
AND    employees.department_id=departments.department_id
```

Note: number of rows equal to <u>number of rows from EMPLOYEES and DEPARTMENTS that have equal values in all matched columns (department_id, manager_id) .</u>

3. Retrieving Records with Natural Joins (3 tables)

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



DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY	COUNTRY_NAME
60	IT	1400	Southlake	United States of America
50	Shipping	1500	South San Francisco	United States of America
10	Administration	1700	Seattle	United States of America
30	Purchasing	1700	Seattle	United States of America
90	Executive	1700	Seattle	United States of America
100	Finance	1700	Seattle	United States of America
110	Accounting	1700	Seattle	United States of America
120	Treasury	1700	Seattle	United States of America
130	Corporate Tax	1700	Seattle	United States of America
140	Control And Credit	1700	Seattle	United States of America
150	Shareholder Services	1700	Seattle	United States of America
160	Benefits	1700	Seattle	United States of America
170	Manufacturing	1700	Seattle	United States of America
180	Construction	1700	Seattle	United States of America
190	Contracting	1700	Seattle	United States of America
200	Operations	1700	Seattle	United States of America
210	IT Support	1700	Seattle	United States of America
220	NOC	1700	Seattle	United States of America
230	IT Helpdesk	1700	Seattle	United States of America
240	Government Sales	1700	Seattle	United States of America
250	Retail Sales	1700	Seattle	United States of America
260	Recruiting	1700	Seattle	United States of America
270	Payroll	1700	Seattle	United States of America
20	Marketing	1800	Toronto	Canada
40	Human Resources	2400	London	United Kingdom
80	Sales	2500	Oxford	United Kingdom
70	Public Relations	2700	Munich	Germany

27 rows selected.

Note: number of rows equal to number of rows from the common attribute (location_id) between DEPARTMENTS and LOCATIONS.

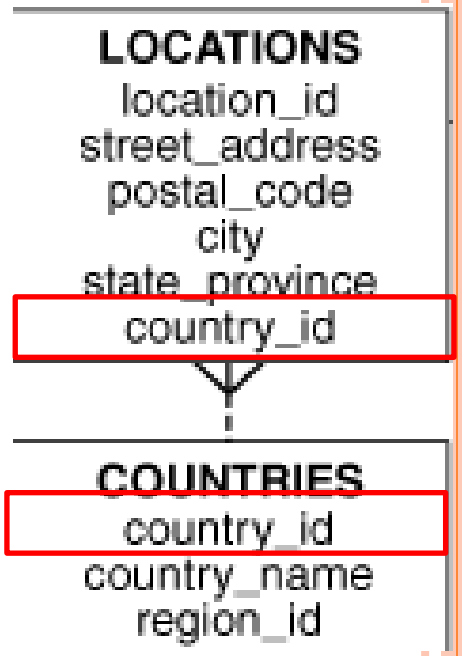
3. Natural Joins with a WHERE Clause

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

DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY
20	Marketing	1800	Toronto
50	Shipping	1500	South San Francisco

EXERCISE # 2

1. จงเขียน Query เพื่อแสดง รหัสที่ตั้ง,ชื่อถนนและที่อยู่, เมือง, รัฐ/จังหวัด และ ชื่อประเทศ จากตาราง locations และ countries (ใช้ NATURAL JOIN)




```
SELECT      location_id,   street_address,
            city,   state_province,   country_name
FROM        countries
NATURAL JOIN   locations   ;
```

4. Creating Joins with the ON Clause

- ถ้า ใช้ join โดยไม่มี on คือการทำ Cartesian product หรือ cross join
- แต่ใช้ ON clause เพื่อ<u>ระบุเงื่อนไขอื่นหรือระบุคอลัมน์ที่มีชื่อต่างกันเพื่อเชื่อมตาราง</u>
- ON clause จำเป็นต้องมี ชื่อตารางหรือนามแฝงของตาราง สำหรับ common attribute

```
SELECT   *
FROM     table1_name นามแฝง1
JOIN     table2_name นามแฝง2
ON       (นามแฝง1.column_name = นามแฝง2.column_name)   ;
```

= SELECT *
FROM table1_name t1, table2_name t2;

4. Retrieving Records with the ON Clause

```
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) ;
```

employee_id	last_name	department_id	location_id
103	Hunold	60	1400
104	Ernst	60	1400
105	Austin	60	1400
106	Pataballa	60	1400
107	Lorentz	60	1400
120	Weiss	50	1500
121	Fripp	50	1500
122	Kaufling	50	1500
123	Vollman	50	1500
124	Mourgos	50	1500

Showing 1 to 10 of 106 entries Previous 1 2 3 4 5 ... 11

4. Retrieving Records with the ON Clause

```
SELECT    e. employee_id,   e. last_name, e.department_id,
          d.manager_id
FROM      employees  e
JOIN      departments  d
ON        (e.employee_id < d.manager_id)  ;
```

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	MANAGER_ID
100	King	90	103
100	King	90	108
100	King	90	114
100	King	90	121
100	King	90	145
100	King	90	200
100	King	90	201
100	King	90	203
100	King	90	204
100	King	90	205
101	Kochhar	90	103
101	Kochhar	90	108
101	Kochhar	90	114
101	Kochhar	90	121
101	Kochhar	90	145
101	Kochhar	90	200
101	Kochhar	90	201
101	Kochhar	90	203

Applying Additional Conditions to a Join

- displays only employees who have a manager ID of 149.

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

employee_id	last_name	department_id	location_id
174	Abel	80	2500
175	Hutton	80	2500
176	Taylor	80	2500
177	Livingston	80	2500
179	Johnson	80	2500

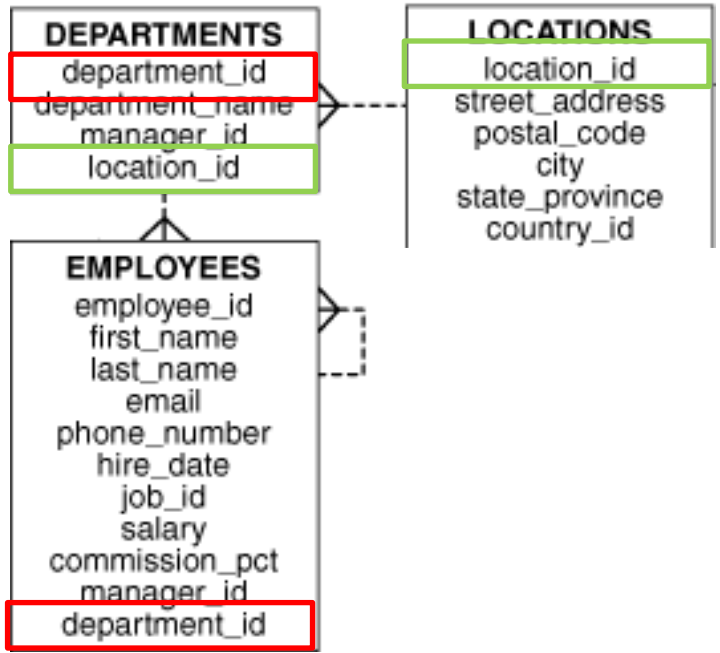
Showing 1 to 5 of 5 entries

Previous 1

Remark: You can use a WHERE clause instead of AND clause

Creating Three-Way Joins with the ON Clause

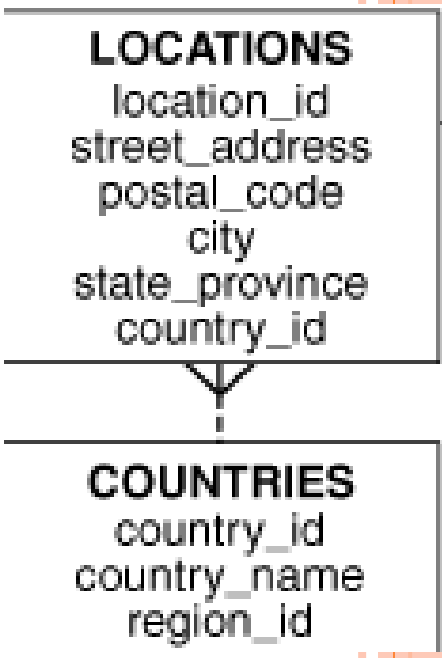
```
SELECT      employee_id, city, department_name
FROM        employees  e
JOIN        departments  d
ON          (e.department_id = d.department_id)
JOIN        locations l
ON          (d.location_id = l.location_id) ;
```



EMPLOYEE_ID	CITY	DEPARTMENT_NAME
100	Seattle	Executive
101	Seattle	Executive
102	Seattle	Executive
103	Southlake	IT
104	Southlake	IT
105	Southlake	IT
106	Southlake	IT
107	Southlake	IT
108	Seattle	Finance
109	Seattle	Finance
110	Seattle	Finance

EXERCISE # 3 –JOIN ON CLAUSE

จงเขียน Query เพื่อแสดง รหัสที่ตั้ง, ชื่อถนนและที่อยู่, เมือง, รัฐ/จังหวัด และ ชื่อประเทศ โดยแสดงเฉพาะผลลัพธ์ที่ตั้งอยู่ที่ประะเทศมีลำดับมาก่อน India และเรียงลำดับตามชื่อประเทศจาก A-Z




```
SELECT      location_id, street_address, city,
            state_province, country_name
FROM        locations l
JOIN        countries c
ON          (l.country_id = c.country_id)
WHERE       c.country_name < 'India'
ORDER BY    country_name ASC;
```

5. Creating Joins with the USING Clause

- สำหรับ Natural Join, เชื่อมตารางโดยเลือกเฉพาะแถวที่มีค่าเหมือนกันของ attributeที่ชื่อเดียวกัน (common attributes)
- ถ้าการเชื่อมตาราง มี common attributes มากกว่า 1 ตัว สามารถใช้ join โดยเพิ่ม USING clause เพื่อระบุคอลัมน์ที่ต้องการเชื่อมกันเท่านั้น
- สรุป ใช้ USING clause เพื่อจับคู่เพียง 1 คอลัมน์เมื่อมี common attribute มากกว่า 1 ห้ามใช้ นามแฝงของตาราง

```
SELECT   *
FROM     table1_name
JOIN     table2_name
USING    (common attribute)  ;
```

5. Retrieving Records with the USING Clause

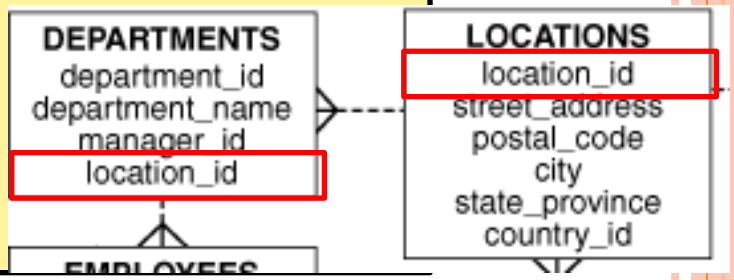
```
SELECT employee_id, last_name,
       location_id, department_id
FROM   employees
JOIN   departments
USING  (department_id) ;
```

EMPLOYEE_ID	LAST_NAME	LOCATION_ID	DEPARTMENT_ID
200	Whalen	1700	10
201	Hartstein	1800	20
202	Fay	1800	20
114	Raphaely	1700	30
115	Khoo	1700	30
116	Baida	1700	30
119	Colmenares	1700	30
118	Himuro	1700	30
117	Tobias	1700	30
203	Mavris	2400	40
120	Weiss	1500	50
121	Fripp	1500	50
123	Vollman	1500	50
132	Olson	1500	50
131	Marlow	1500	50

106 row selected

5. Retrieving Records with the USING Clause

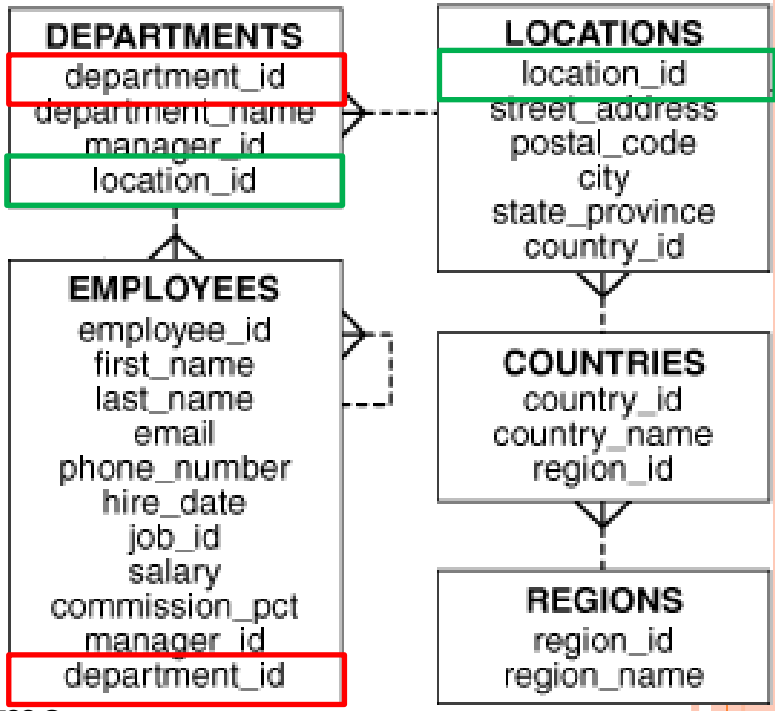
```
SELECT department_id, department_name, location_id, city
FROM   locations
JOIN   departments
USING  (location_id) ;
```



DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY
60	IT	1400	Southlake
50	Shipping	1500	South San Francisco
10	Administration	1700	Seattle
30	Purchasing	1700	Seattle
90	Executive	1700	Seattle
100	Finance	1700	Seattle
110	Accounting	1700	Seattle
120	Treasury	1700	Seattle
130	Corporate Tax	1700	Seattle
140	Control And Credit	1700	Seattle
150	Shareholder Services	1700	Seattle
160	Benefits	1700	Seattle
170	Manufacturing	1700	Seattle
180	Construction	1700	Seattle
190	Contracting	1700	Seattle
200	Operations	1700	Seattle
210	IT Support	1700	Seattle
220	NOC	1700	Seattle
230	IT Helpdesk	1700	Seattle
240	Government Sales	1700	Seattle
250	Retail Sales	1700	Seattle
260	Recruiting	1700	Seattle
270	Payroll	1700	Seattle
20	Marketing	1800	Toronto
40	Human Resources	2400	London
80	Sales	2500	Oxford
70	Public Relations	2700	Munich

27 row selected

EXERCISE # 4 JOIN- USING CLAUSE

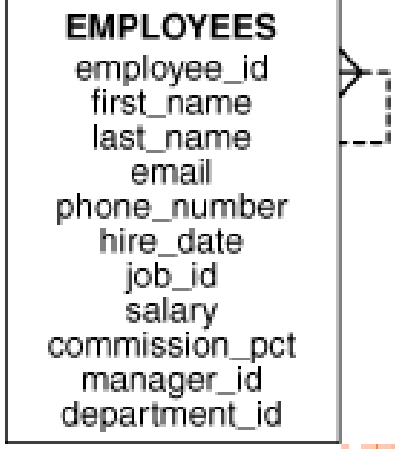


จงเขียน SQL Query ที่แสดงชื่อ นามสกุล รหัสงาน รหัสแผนก และชื่อแผนกของพนักงานทุกคนที่ทำงานในเมืองโตรอนโต้ (Toronto) (ใช้ USING clause)

```
SELECT    first_name, last_name, job_id,
          department_id, department_name
FROM      employees
JOIN      departments
USING     (department_id)
JOIN      locations
USING     (location_id)
WHERE     city = 'Toronto' ;
```

6. Self-Joins Using the ON Clause

- ต้องการทราบชื่อผู้จัดการของพนักงานแต่ละคน



EMPLOYEES

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	MANAGER_ID
100	Steven	King	
101	Neena	Kochhar	100
102	Lex	De Haan	100
103	Alexander	Hunold	102
104	Bruce	Ernst	103
105	David	Austin	103
106	Valli	Pataballa	103
107	Diana	Lorentz	103
108	Nancy	Greenberg	101
109	Daniel	Faviet	108
110	John	Chen	108

EMPLOYEES (MANAGER)

EMPLOYEE_ID	FIRST_NAME	LAST_NAME
100	Steven	King
101	Neena	Kochhar
102	Lex	De Haan
103	Alexander	Hunold
104	Bruce	Ernst
105	David	Austin
106	Valli	Pataballa
107	Diana	Lorentz
108	Nancy	Greenberg
109	Daniel	Faviet
110	John	Chen

```
SELECT    attribute1, attribute2
FROM      employees  e
JOIN      employees  m
ON        (e.manager_id = m.employee_id)  ;
```

MANAGER_ID in the EMPLOYEES table is equal to EMPLOYEES _ID in the MANAGER table.

6. Self-Joins Using the ON Clause

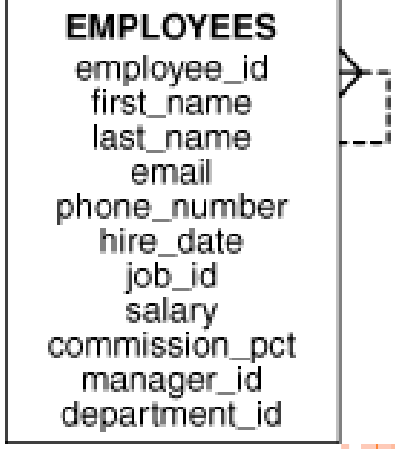
- เพื่อหาชื่อผู้จัดการของพนักงานแต่ละคน จำเป็นต้องทำการเชื่อมตาราง EMPLOYEE กับตัวมันเอง เรียกว่า SELF JOIN

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

MANAGER_ID in the EMPLOYEES table is equal to EMPLOYEES _ID in the MANAGER table.

EMP	MGR
Hartstein	King
Zlotkey	King
Cambrault	King
Errazuriz	King
Partners	King
Russell	King
Mourgos	King
Vollman	King
Kaufling	King
Fripp	King
Weiss	King
Raphaely	King
De Haan	King
Kochhar	King
Higgins	Kochhar

EXERCISE # 5 SELF-JOIN

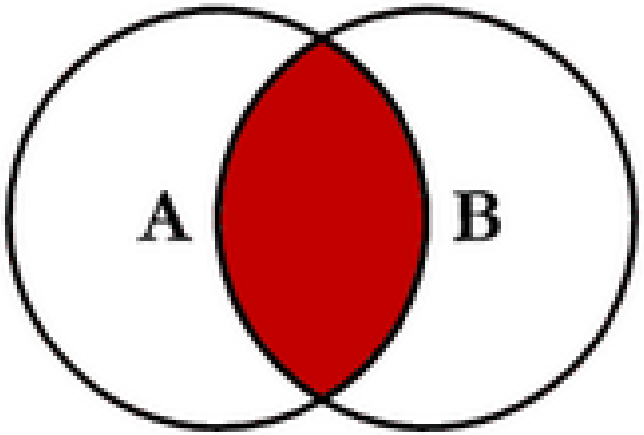


จงแสดงชื่อ นามสกุล วันที่เริ่มทำงานของพนักงาน พร้อมกับ ชื่อ นามสกุล วันที่เริ่มทำงานของผู้จัดการของพนักงานคนนั้นๆ (ตั้งชื่อคอลัมน์ของผู้จัดการคือ Mgr First Name, Mgr Last Name, Mgr Hired)

แสดงเฉพาะผลลัพธ์ที่มีวันเริ่มทำงานของพนักงาน เริ่มก่อนวันเริ่มทำงานของผู้จัดการของตนเอง

```
SELECT    e. first_name , e.last_name, e.hire_date,
          m.first_name 'Mgr First Name',
          m.last_name 'Mgr Last Name', m.hire_date 'Mgr Hired'
FROM      employees  e
JOIN      employees  m
ON        (e.manager_id = m.employee_id)
Where     e.hire_date < m.hire_date;
```

SQL JOINS




```
SELECT <select_list>
FROM TableA A
INNER JOIN TableB B
ON A.Key = B.Key
```