Database Systems

Data manipulation with DML

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SQL language

- SQL language
  - Standard database language for relational database management
  - Considered one of the major reasons for the commercial success of relational databases.
  - Each statement in SQL ends with a semicolon.
- **SQL**
  - **Structured Query Language**
  - Statements for **data definitions, queries,** and **updates** (both DDL and DML)
  - **Core specification**
  - Plus specialized **extensions**

SQL language (cont'd.)

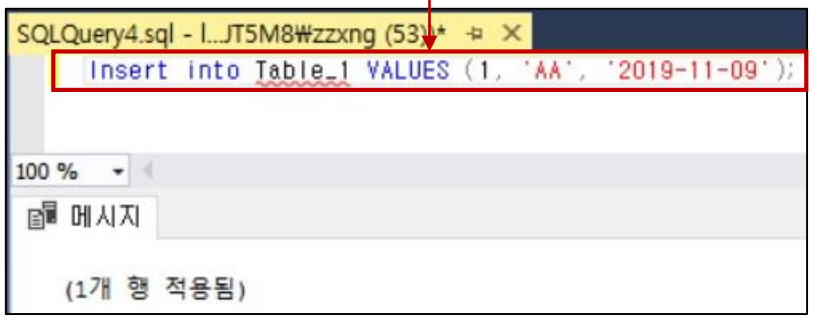
- **Data Definition Language (DDL)**
  - Defines the schemas (databases).
  - Create, drop, and alter of schema, table, integrity, view, and index.
  - Used by only DBA to prevent ill-uses
- **Data Manipulation Language (DML)**
  - Manipulates instances in table.
  - Insert, update, delete or query instances from tables.
  - Used by application programmers or interactive users.
- **Data Control Language (DCL)**
  - Controls access privileges and backup/restore.
  - Grant, and revoke
  - Used by DBA.

Insert Statement

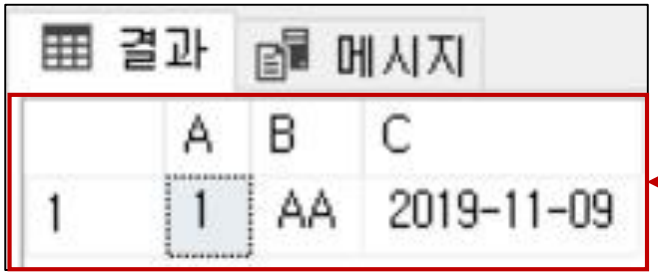
INSERT INTO [table_name] VALUES ('data1', 'data2', ...);
// 테이블 생성시의 Attribute 순서와 dataType에 맞게 입력

INSERT INTO [table_name] (attr1, attr2, ...) VALUES ('data1', ...);
// 전체 Attribute가 아닌 특정 Attribute 에만 입력 할 경우 사용

① Type to insert instances



② You can see inserted instances



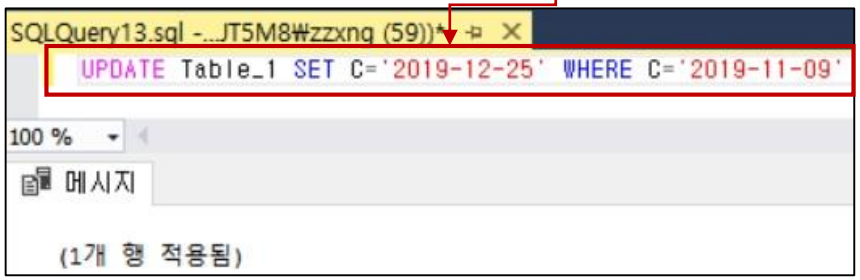
Update Statement

```
UPDATE
      { table_name WITH ( < table_hint_limited > [ ...n ] )
        | view_name
        | rowset_function_limited }
        SET
       { column_name = { expression | DEFAULT | NULL }
       | @variable = expression
       | @variable = column = expression } [ ,...n ]
      { { [ FROM { < table_source > } [ ,...n ] ]
        [ WHERE
            < search_condition > ] }
       |
       [ WHERE CURRENT OF
        { { [ GLOBAL ] cursor_name } | cursor_variable_name }
       ] }
        [ OPTION ( < query_hint > [ ,...n ] ) ]
```

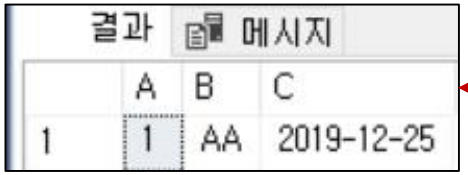
대체할 서브 SELECT문 또는 디폴트값이 기존값을 대체할지 여부 설정

업데이트 작업의 기준이 되는 테이블/뷰 지정

① Type to update instances



② You can see updated instances



Delete Statement

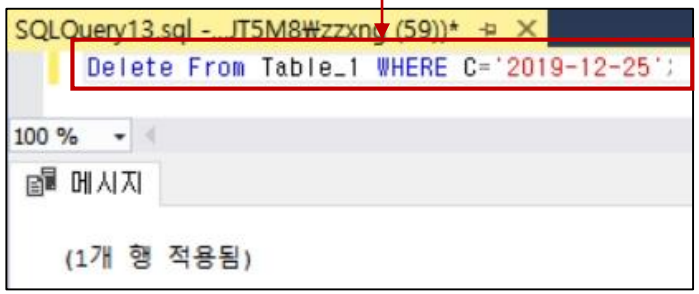
```
DELETE
    [ FROM ]
        { table_name WITH ( < table_hint_limited > [ ...n ] )
        | view_name
        | rowset_function_limited }

        [ FROM { < table_source > } [ ,...n ] ]

    [ WHERE
        { < search_condition >
        | { [ CURRENT OF
                { { [ GLOBAL ] cursor_name }
                    | cursor_variable_name }
            ] }
      } ]
    [ OPTION ( < query_hint > [ ,...n ] ) ]
```

행을 제거할 테이블의 이름 지정

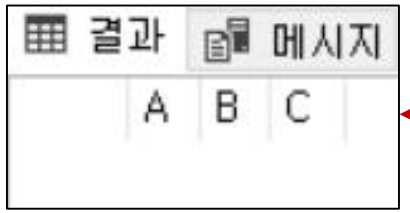
FROM 절을 추가로 지정
<table_sources>에서 데이터를 지정하고 첫 번째 FROM 절에 있는 테이블에서 해당행을 삭제

삭제될 행을 제한하는 조건 지정

① Type to delete instances



② You can see deleted instances



Company DB Instance

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	10.0

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

Select Statement

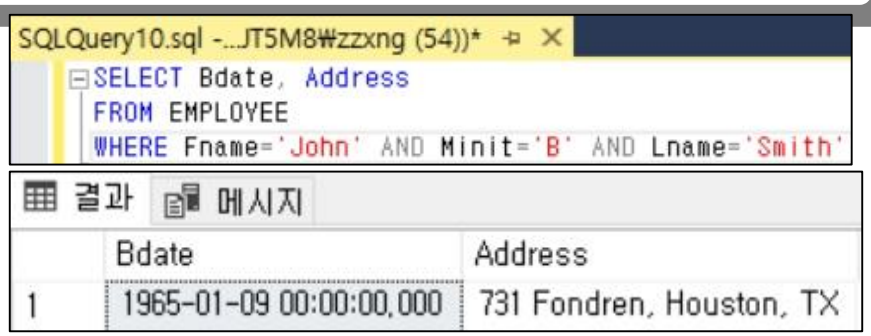
```
SELECT   column_list          -- 타켓 속성 목록
FROM     table_list           -- 입력 테이블 지정
[WHERE conditional_expression]     -- 선택 및 조인 조건
[GROUP BY   group_by_column_list]-- Grouping  속성
[HAVING     conditional_expression]     -- Group의 검색 조건
[ORDER BY   order_by_column_list] -- 출력 순서 결정 속성
```

SELECT문의 기본 질의

이름이 'John B. Smith'인 사원(들)의 생년월일(Bdate)과 주소(Address)를 검색하라.

```
SELECT    Bdate, Address
FROM      EMPLOYEE
WHERE     Fname='John' AND Minit='B' AND Lname='Smith';
```

FROM 절에 표시된 EMPLOYEE 릴레이션만 검색
질의가 WHERE 절의 조건을 만족하는 EMPLOYEE 투플들을 검색하면, SELECT 절에 열거된 Bdate와 Address 애트리뷰트들을 기반으로 결과를 프로젝트



EMPLOYEE

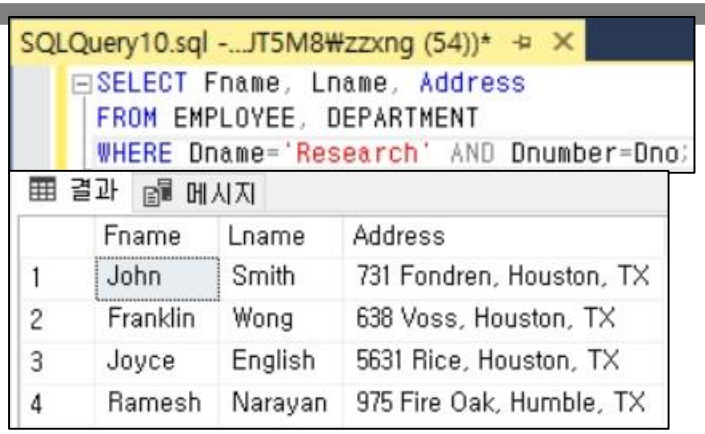
Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

셀렉트-프로젝트-조인 질의

'Research' 부서에서 근무하는 모든 사원의 이름(Fname, Lname)과 주소(Address)를 검색하라.

```
SELECT      Fname, Lname, Address
FROM        EMPLOYEE, DEPARTMENT
WHERE       Dname='Research' AND Dnumber=Dno;
```

셀렉트-프로젝트-조인 질의
Dnumber = Dno는 관계 대수의 JOIN 조건에 해당되는 조인 조건



	Fname	Lname	Address
1	John	Smith	731 Fondren, Houston, TX
2	Franklin	Wong	638 Voss, Houston, TX
3	Joyce	English	5631 Rice, Houston, TX
4	Ramesh	Narayan	975 Fire Oak, Humble, TX

JOIN 조건

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

EMPLOYEE

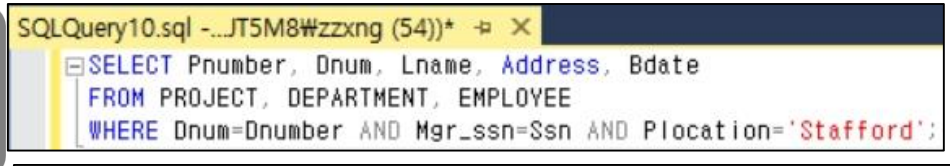
Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

2개의 조인 조건을 갖는 셀렉트 -프로젝트 조인 질의

'Stafford'에 위치한 모든 프로젝트에 대해서 프로젝트 번호(Pnumber), 담당 부서 번호(Dnum), 부서 관리자의 성(Lname), 주소(Address), 생년월일(Bdate)을 검색하라.

```
SELECT      Pnumber, Dnum, Lname, Address, Bdate
FROM        PROJECT, DEPARTMENT, EMPLOYEE
WHERE       Dnum=Dnumber AND Mgr_ssn=Ssn AND
            Plocation='Stafford';
```

조인 조건 Dnum=Dnumber는 프로젝트와 담당 부서를 연결
조인 조건 Mgr_ssn=Ssn은 담당 부서의 관리자를 연결



결과 | 메시지

	Pnumber	Dnum	Lname	Address	Bdate
1	10	4	Wallace	291 Berry Bellaire, TX	1941-06-20 00:00:00.000
2	30	4	Wallace	291 Berry Bellaire, TX	1941-06-20 00:00:00.000

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

JOIN 조건 2

PROJECT

JOIN 조건 1

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

별칭

각 사원에 대해 사원의 이름(Fname)과 성(Lname), 직속 상사의 이름(Fname)과 성(Lname)을 검색하라.

```
SELECT   E.Fname, E.Lname, S.Fname, S.Lname
FROM     EMPLOYEE AS E, EMPLOYEE AS S
WHERE    E.Super_ssn=S.Ssn;
```

SQLQuery10.sql -...JT5M8₩zzxng (54))*

```
SELECT E.Fname, E.Lname, S.Fname, S.Lname
FROM EMPLOYEE AS E, EMPLOYEE AS S
WHERE E.Super_ssn=S.Ssn;
```

같은 릴레이션을 두 번 참조하는 질의에서 모호함 발생
이런 경우 해당 릴레이션에 별칭 또는 투플 변수라고 부르는 또다른 릴레이션 이름 선언하여 사용
릴레이션 이름 바로 다음에 오거나, 키워드 AS 다음에 별칭 명시

결과 | 메시지

	Fname	Lname	Fname	Lname
1	John	Smith	Franklin	Wong
2	Franklin	Wong	James	Borg
3	Joyce	English	Franklin	Wong
4	Ramesh	Narayan	Franklin	Wong
5	Jennifer	Wallace	James	Borg
6	Ahmad	Jabbar	Jennifer	Wallace
7	Alicia	Zelaya	Jennifer	Wallace

E (By "EMPLOYEE AS E")

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333	
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888	
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987	
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888	
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333	
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333	
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987	
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NU	

JOIN 조건

S (BY "EMPLOYEE AS S")

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

별칭

'Research' 부서에서 근무하는 모든 사원의 이름(Fname, Lname)과 주소(Address)를 검색하라.

```
SELECT    E.Fname, E.Lname, E.Address
FROM      EMPLOYEE E, DEPARTMENT D
WHERE     D.Dname='Research'
          AND D.Dnumber=E.DNO;
```

```
SELECT E.Fname, E.Lname, E.Address
FROM EMPLOYEE E, DEPARTMENT D
WHERE D.Dname='Research' AND D.Dnumber=E.DNO;
```

결과 | 메시지

	Fname	Lname	Address
1	John	Smith	731 Fondren, Houston, TX
2	Franklin	Wong	638 Voss, Houston, TX
3	Joyce	English	5631 Rice, Houston, TX
4	Ramesh	Narayan	975 Fire Oak, Humble, TX

두개 이상의 릴레이션을 참조하는 경우에도 가독성을 향상시키기 위해 별칭을 이용

Dname → **DEPARTMENT**

Name	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

Lname → **EMPLOYEE**

Dno

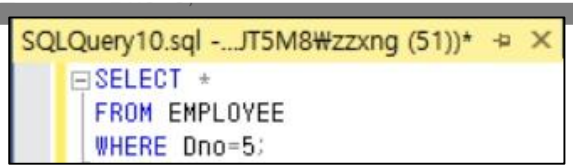
Fname	Minit	Name	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dnumber
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

JOIN 조건

'*'의 사용

5번 부서에서 근무하는 모든 사원(Q1) / 'Research' 부서에서 일하는 모든 사원(Q2) /
릴레이션 EMPLOYEE와 DEPARTMENT의 카티지안 곱(Q3)를 각각 검색하라.

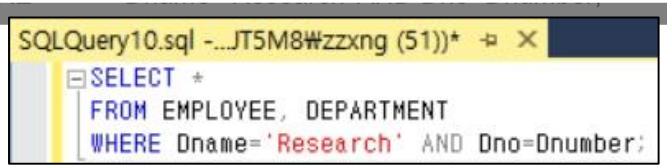
```
-- Q1
SELECT      *
FROM        EMPLOYEE
WHERE       Dno=5;
```



결과 메시지

	Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	DNO
1	John	B	Smith	123456789	1965-01-09 00:00:00.000	731 Fondren, Houston, TX	M	30000.00	333445555	5
2	Franklin	T	Wong	333445555	1955-12-08 00:00:00.000	638 Voss, Houston, TX	M	40000.00	888665555	5
3	Joyce	A	English	453453453	1972-07-31 00:00:00.000	5631 Rice, Houston, TX	F	25000.00	333445555	5
4	Ramesh	K	Narayan	666884444	1962-09-15 00:00:00.000	975 Fire Oak, Humble, TX	M	38000.00	333445555	5

```
-- Q2
SELECT      *
FROM        EMPLOYEE, DEPARTMENT
WHERE       Dname='Research' AND Dno=Dnumber;
```

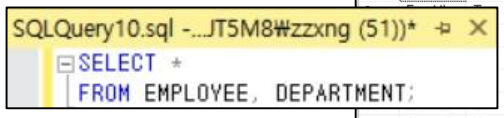


결과 메시지

	Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	DNO	Dname	Dr
1	John	B	Smith	123456789	1965-01-09 00:00:00.000	731 Fondren, Houston, TX	M	30000.00	333445555	5	Research	5
2	Franklin	T	Wong	333445555	1955-12-08 00:00:00.000	638 Voss, Houston, TX	M	40000.00	888665555	5	Research	5
3	Joyce	A	English	453453453	1972-07-31 00:00:00.000	5631 Rice, Houston, TX	F	25000.00	333445555	5	Research	5
4	Ramesh	K	Narayan	666884444	1962-09-15 00:00:00.000	975 Fire Oak, Humble, TX	M	38000.00	333445555	5	Research	5

```
-- Q3
SELECT      *
FROM        EMPLOYEE, DEPARTMENT;
```

선택된 투플들의 모든 애트리부트 값을 검색하려면 SELECT 절에 '*' 명시



결과 메시지

	Fname	Minit	Lname	Ssn	Bdate	Address
1	John	B	Smith	123456789	1965-01-09 00:00:00.000	731 Fondren, Houston, TX
2			Wong	33		
3			English	45		
4			Narayan	66		
5			Borg	88		
6			Wallace	98		
7	Ahmad	V	Jabbar	98		
8	Alicia	J	Zelaya	99		
9	John	B	Smith	12		
10	Franklin	T	Wong	33		
11	Joyce	A	English	45		

결과 메시지

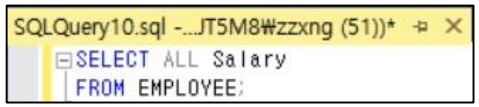
	Fname	Minit	Lname	Ssn	Bdate	Address
14	Jennifer	S	Wallace	987654321	1941-06-20 00:00:00.000	291 Berry Bellaire, TX
15	Ahmad	V	Jabbar	987987987	1969-03-29 00:00:00.000	980 Dallas, Houston, TX
16	Alicia	J	Zelaya	999887777	1968-01-19 00:00:00.000	3321 Castle Spring, TX
17	John	B	Smith	123456789	1965-01-09 00:00:00.000	731 Fondren, Houston, TX
18	Franklin	T	Wong	333445555	1955-12-08 00:00:00.000	638 Voss, Houston, TX
19	Joyce	A	English	453453453	1972-07-31 00:00:00.000	5631 Rice, Houston, TX
20	Ramesh	K	Narayan	666884444	1962-09-15 00:00:00.000	975 Fire Oak, Humble, TX
21	James	E	Borg	888665555	1937-11-10 00:00:00.000	450 Stone, Houston, TX
22	Jennifer	S	Wallace	987654321	1941-06-20 00:00:00.000	291 Berry Bellaire, TX
23	Ahmad	V	Jabbar	987987987	1969-03-29 00:00:00.000	980 Dallas, Houston, TX
24	Alicia	J	Zelaya	999887777	1968-01-19 00:00:00.000	3321 Castle Spring, TX

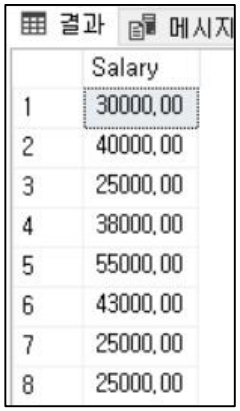
All / DISTINCT

모든 사원의 급여(Salary)를 검색(Q1)하고, 구별되는 급여를 모두 검색(Q2)하라.

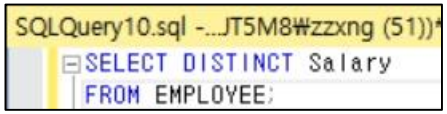
```
-- Q1
SELECT      ALL Salary
FROM        EMPLOYEE;
```

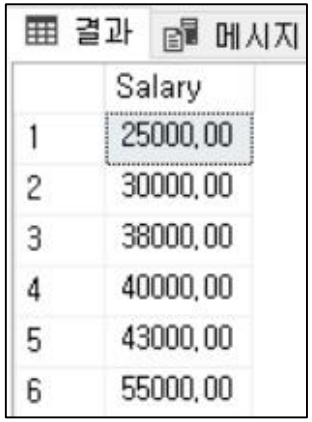
```
-- Q2
SELECT      DISTINCT Salary
FROM        EMPLOYEE;
```





	Salary
1	30000,00
2	40000,00
3	25000,00
4	38000,00
5	55000,00
6	43000,00
7	25000,00
8	25000,00





	Salary
1	25000,00
2	30000,00
3	38000,00
4	40000,00
5	43000,00
6	55000,00

일반적으로 중복 투플이 테이블과 질의의 결과에서 하나 이상 나타날 수 있다.

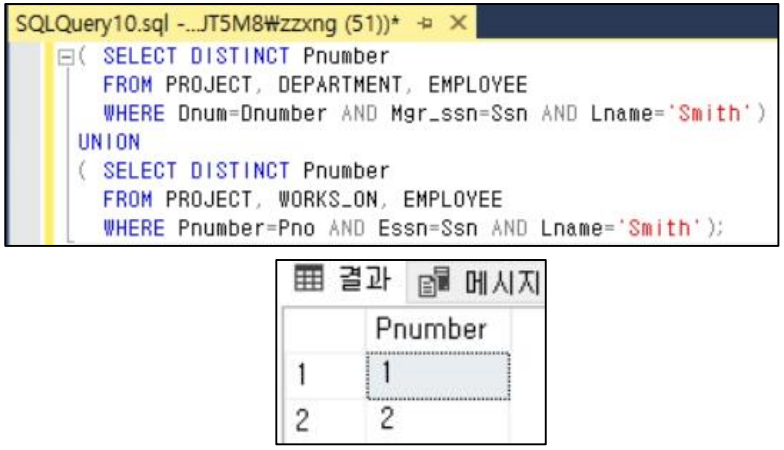
SELECT ALL – SQL 질의 결과를 그대로 나타냄
SELECT DISTINCT – SQL 질의 결과에서 중복된 투플들을 삭제

ALL 이나 DISTINCT가 없는 SELECT는 SELECT ALL과 같다.

UNION

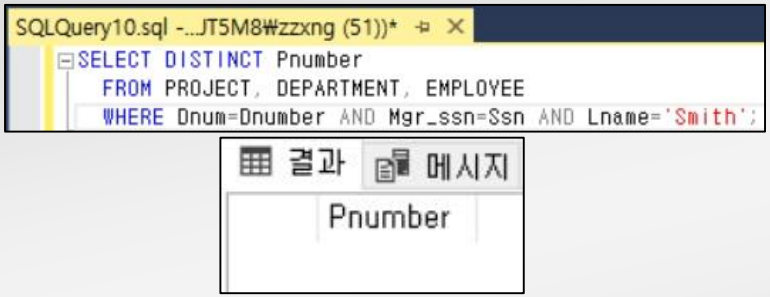
일반 직원이든 프로젝트를 담당하는 부서의 관리자이든 간에 성(Lname)이 'Smith'인 사원을 포함하는 모든 프로젝트에 대해서 프로젝트 번호(Pnumber)의 리스트를 검색하라.

```
( SELECT    DISTINCT Pnumber
  FROM      PROJECT, DEPARTMENT, EMPLOYEE
  WHERE     Dnum=Dnumber AND Mgr_ssn=Ssn
            AND Lname='Smith')
UNION
( SELECT    DISTINCT Pnumber
  FROM      PROJECT, WORKS_ON, EMPLOYEE
  WHERE     Pnumber=Pno AND Essn=Ssn AND Lname='Smith');
```



SQL은 관계 대수의 집합 연산들 중 합집합(UNION) 연산 수용

차집합(EXCEPT), 교집합(INTERSECT)



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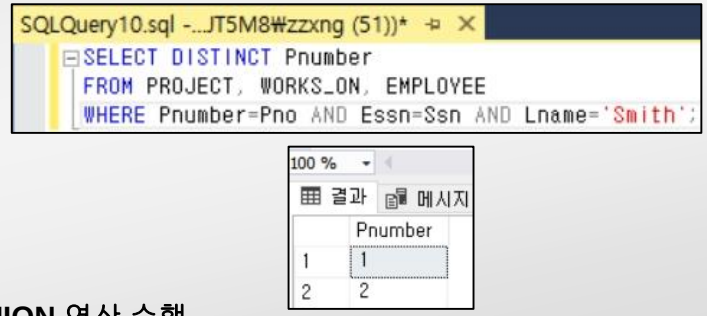
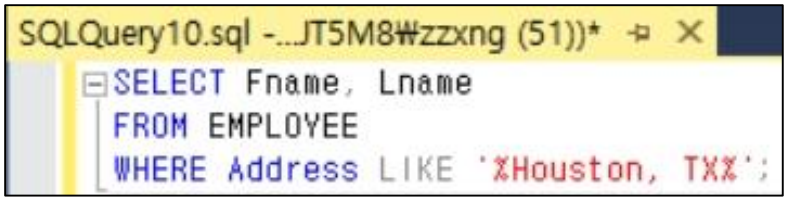


각 질의의 결과에 대해서 **UNION** 연산 수행

부분 문자열 패턴 비교 (%)

주소에 'Houston, TX'가 포함되는 모든 사원을 검색하라.

```
SELECT      Fname, Lname
FROM        EMPLOYEE
WHERE       Address LIKE '%Houston, TX%';
```



LIKE 비교 연산자를 사용하여 문자열 일부에 대해서 비교 조건 명시

부분 문자열은 두 개의 예약된 문자를 사용 (% , _)
- '%'는 0보다 큰 임의의 개수의 문자로 대체
- '_'는 임의의 한 개의 문자로 대체

	Fname	Lname
1	John	Smith
2	Franklin	Wong
3	Joyce	English
4	James	Borg
5	Ahmad	Jabbar

EMPLOYEE

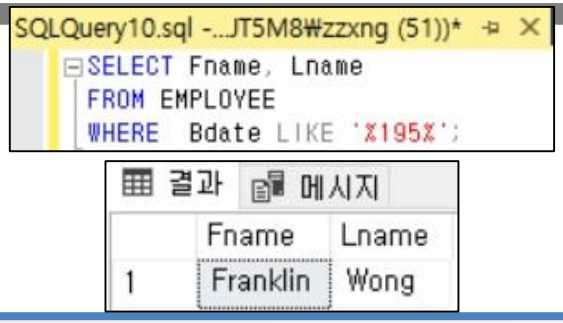
Fname	Minit	Name	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dnumber
John	B	Smith	123456789	1965-01-09	731 Fondren, **Houston, TX**	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, **Houston, TX**	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Rames h	K	Naraya n	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, **Houston, TX**	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, **Houston, TX**	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, **Houston, TX**	M	55000	NULL	1

부분 문자열 패턴 비교 (_)

1950년대 태어난 모든 사원을 검색하라.

```
SELECT    Fname, Lname
FROM      EMPLOYEE
WHERE     Bdate LIKE '__5_______';
```

```
SELECT    Fname, Lname
FROM      EMPLOYEE
WHERE     Bdate LIKE '%195%';
```



Datetime 타입에 대해서는 '_' 적용이 되지 않음
1950년대 검색의 경우 위와 같이 '%' 를 이용하거나 **BETWEEN을 이용**하여 WHERE 절의 다음과 같이 대체하여 검색

WHERE Bdate BETWEEN '1950-1-1' AND '1959-12-31'

EMPLOYEE

Fname	Minit	Name	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dnumber
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

비교 연산자

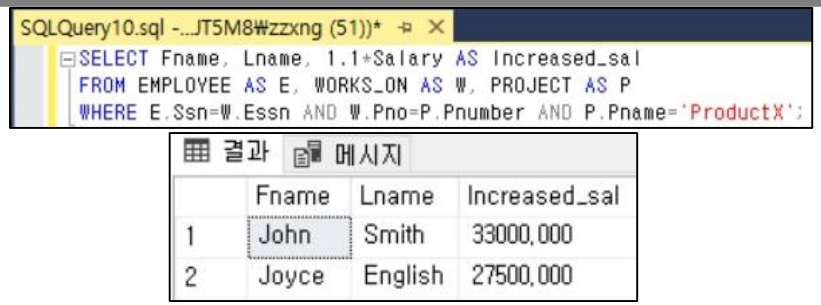
Operator	Description	Example
=	Equal to	cost = 10
>	Greater than	cost > 10
>=	Greater than or equal to	cost >= 10
<	Less than	cost < 10
<=	Less than or equal to	cost <= 10
<>	Not equal to	cost <> 10
[NOT] BETWEEN ... AND	Between the given two values	cost BETWEEN 10 AND 20
IS [NOT] NULL	Values that are null (or contain no value)	description IS NULL
[NOT] IN	Values in the given list	supplier IN ('ABC', 'XYZ')
[NOT] LIKE	Wildcard matching of values. Allowed wildcards are underscore (_) to be matched with exactly one character and percentage sign (%) to match any number of characters	Description LIKE '_BC%'
[NOT] EXISTS	Not empty set	EXISTS (nested query)

산술 연산자

'ProductX' 프로젝트에 참여하는 모든 사원의 급여를 10% 올린 경우의 급여를 구하라.

```
SELECT    Fname, Lname, 1.1*Salary AS Increased_sal
FROM      EMPLOYEE AS E, WORKS_ON AS W, PROJECT AS P
WHERE     E.Ssn=W.Essn AND W.Pno=P.Pnumber AND
                  P.Pname='ProductX';
```

질의 내에서 표준 산술 연산자(+, -, *, /)를 수치값 혹은 수치 애트리뷰트에 적용 가능



	Fname	Lname	Increased_sal
1	John	Smith	33000.000
2	Joyce	English	27500.000

JOIN 조건 2

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

JOIN 조건 1

EMPLOYEE

Fname	Minit	Name	Ssn	Bdate	Address	Sex	Salary	Increased_sal (1.1*Salary)	Super_ssn	Dnumber
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	33000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	44000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	27500	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	47300	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	41800	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	27500	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	27500	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	60500	NULL	1

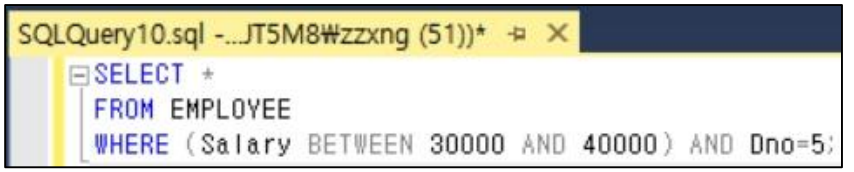
BETWEEN

급여가 30,000달러에서 40,000달러 사이에 있는 5번 부서의 모든 사원을 검색하라.

```
SELECT      *
FROM        EMPLOYEE
WHERE       (Salary BETWEEN 30000 AND 40000) AND Dno=5;
```

BETWEEN 은 일정 범위내에 해당 어트리뷰트 값이 존재하면 참을 반환하는 연산자

위 질의 WHERE 절의 조건은 다음과 동일하다.
(Salary >= 30000) AND (Salary <=40000)



결과 메시지

	Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	DNO
1	John	B	Smith	123456789	1965-01-09 00:00:00.000	731 Fondren, Houston, TX	M	30000.00	333445555	5
2	Franklin	T	Wong	333445555	1955-12-08 00:00:00.000	638 Voss, Houston, TX	M	40000.00	888665555	5
3	Ramesh	K	Narayan	666884444	1962-09-15 00:00:00.000	975 Fire Oak, Humble, TX	M	38000.00	333445555	5

EMPLOYEE

Fname	Minit	Name	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dnumber
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	**30000**	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	**40000**	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	**38000**	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

ORDER BY

사원의 모든 정보를 검색하는데, 1. 급여 순 2. 생년월일 순으로 순서대로 구하라.

```
SELECT *
FROM EMPLOYEE
ORDER BY Salary DESC, Bdate ASC;
```

SQL에서는 ORDER BY 절을 사용하여 하나 이상의 애트리뷰트를 기준으로 질의 결과에 들어 있는 투플들을 정렬하는 것이 가능

디폴트 정렬은 오름차순(ASC), 내림차순으로 보고자 하면 키워드 DESC를 명시

결과 메시지

	Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	DNO
1	James	E	Borg	888665555	1937-11-10 00:00:00.000	450 Stone, Houston, TX	M	55000.00	NULL	1
2	Jennifer	S	Wallace	98765432	1941-06-20 00:00:00.000	291 Berry Bellaire, TX	F	43000.00	888665555	4
3	Franklin	T	Wong	33344555	1955-12-08 00:00:00.000	638 Voss, Houston, TX	M	40000.00	888665555	5
4	Ramesh	K	Narayan	66688444	1962-09-15 00:00:00.000	975 Fire Oak, Humble, TX	M	38000.00	333445555	5
5	John	B	Smith	12345678	1965-01-09 00:00:00.000	731 Fondren, Houston, TX	M	30000.00	333445555	5
6	Alicia	J	Zelaya	99988777	1968-01-19 00:00:00.000	3321 Castle Spring, TX	F	25000.00	987654321	4
7	Ahmad	V	Jabbar	98798798	1969-03-29 00:00:00.000	980 Dallas, Houston, TX	M	25000.00	987654321	4
8	Joyce	A	English	45345345	1972-07-31 00:00:00.000	5631 Rice, Houston, TX	F	25000.00	333445555	5

정렬기준 2 (ASC)

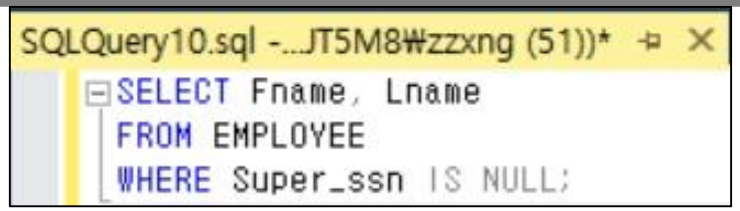
정렬기준 1 (DESC)

NULL 검사

상사가 없는 모든 사원의 이름을 검색하라.

```
SELECT      Fname, Lname
FROM        EMPLOYEE
WHERE       Super_ssn IS NULL;
```

SQL은 질의에서 애트리뷰트 값이 널인지 검사 가능
애트리뷰트를 널과 비교하기 위해서 = 또는 <>를 사용하는 대신에
IS나 IS NOT을 사용
※ SQL는 각 널값은 모든 다른 널값과는 다르다고 간주
→ 조인 조건을 명시했을 때 외부 조인이 아니면 애트리뷰트에 널값을 갖는 투플들은 결과에 나타나지 않음



EMPLOYEE

Fname	Minit	Name	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dnumber
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

Nested Queries

부양가족의 성별(Sex)과 사원의 성별이 같은 사원의 이름(Fname, Lname)을 검색하라.

```
SELECT      E.Fname, E.Lname
FROM        EMPLOYEE AS E
WHERE       E.Ssn IN ( SELECT      Essn
                       FROM        DEPENDENT
                       WHERE       E.Sex=Sex);
```

```
SQLQuery10.sql -...JT5M8₩zzxng (51))*
SELECT E.Fname, E.Lname
FROM EMPLOYEE AS E
WHERE E.Ssn IN ( SELECT Essn
                 FROM DEPENDENT
                 WHERE E.Sex=Sex);
```

결과 | 메시지

	Fname	Lname
1	John	Smith
2	Franklin	Wong

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

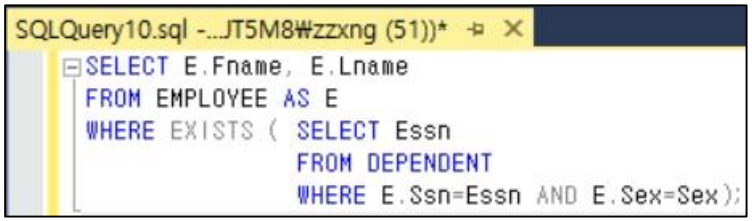
DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

EXISTS

부양가족의 성별(Sex)과 사원의 성별이 같은 사원의 이름(Fname, Lname)을 검색하라.

```
SELECT      E.Fname, E.Lname
FROM        EMPLOYEE AS E
WHERE       EXISTS ( SELECT     *
                     FROM       DEPENDENT
                     WHERE      E.Ssn=Essn AND E.Sex=Sex );
```



결과 메시지

	Fname	Lname
1	John	Smith
2	Franklin	Wong

EXISTS 함수는 상관 중첩 질의의 결과가 빈 것인지 아닌지를 검사하는데 사용

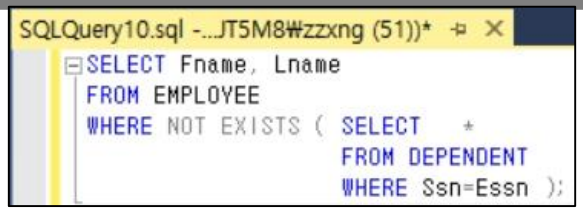
예제의 경우 각 EMPLOYEE 투플에 대해서 중첩 질의를 수행함으로써 이 EMPLYOEE 투플과 같은 Essn, Sex을 갖는 모든 DEPENDENT 투플을 구하고, 만약 중첩 질의의 결과에 최소한 하나의 투플이 존재하면(EXISTS) 그 EMPLOYEE 투플을 선택한다.

EXISTS(Q)는 질의 Q의 결과에 최소한 한 개의 투플이 있으면 참을 반환하고 그렇지 않으면 거짓을 반환

NOT EXISTS

부양가족이 없는 종업원들의 이름을 검색하라.

```
SELECT      Fname, Lname
FROM        EMPLOYEE
WHERE       NOT EXISTS ( SELECT     *
                         FROM       DEPENDENT
                         WHERE      Ssn=Essn );
```



결과 | 메시지

	Fname	Lname
1	Joyce	English
2	Ramesh	Narayan
3	James	Borg
4	Ahmad	Jabbar
5	Alicia	Zelaya

Q6의 경우 상관 중첩 질의는 특정 EMPLOYEE 투플과 관계 있는 모든 DEPENDENT 투플을 검색
만약 DEPENDENT 투플들이 존재하지 않으면 그 EMPLOYEE 투플이 선택

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

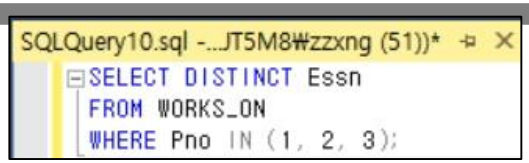
DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

명시적 집합

프로젝트 번호 1,2,3에서 일하는 사원의 주민등록번호를 검색하라.

```
SELECT DISTINCT Essn
FROM   WORKS_ON
WHERE Pno IN (1, 2, 3);
```



결과 | 메시지

	Essn
1	123456789
2	333445555
3	453453453
4	666884444

WHERE 절에 값들의 명시적 집합 사용 가능
SQL에서는 이런 집합을 괄호로 묶어 표현

예제 Q17의 WHERE 절의 경우 비교 연산자 IN을 사용하여
프로젝트 번호가 (1, 2, 3) 집합내에 포함이 되면 참을 반환

WOKRS_ON

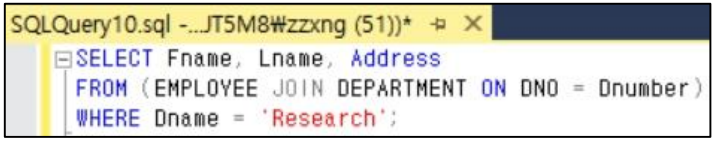
Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	10.0

JOIN

'Research' 부서에서 근무하는 사원의 이름(Fname, Lname)과 주소(Address)를 검색하라.

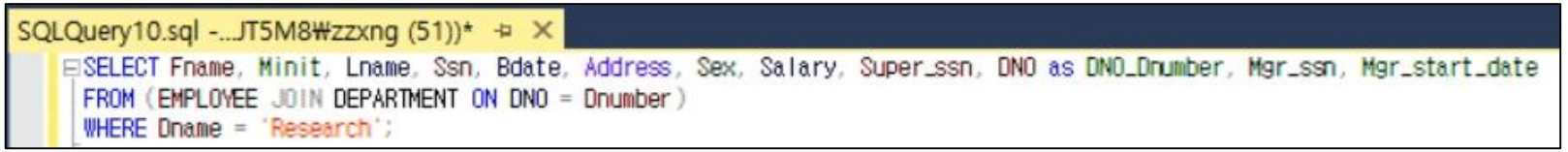
```
SELECT Fname, Lname, Address
FROM   (EMPLOYEE JOIN DEPARTMENT ON DNO = Dnumber)
WHERE Dname = 'Research';
```

JOIN 뒤의 "ON" 의 내용을 기준으로 두 테이블에 대한 JOIN을 수행



결과 메시지

	Fname	Lname	Address
1	John	Smith	731 Fondren, Houston, TX
2	Franklin	Wong	638 Voss, Houston, TX
3	Joyce	English	5631 Rice, Houston, TX
4	Ramesh	Narayan	975 Fire Oak, Humble, TX



결과 메시지

	Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	DNO_Dnumber	Mgr_ssn	Mgr_start_date
1	John	B	Smith	123456789	1965-01-09 00:00:00.000	731 Fondren, Houston, TX	M	30000.00	333445555	5	333445555	1988-05-22 00:00:00.000
2	Franklin	T	Wong	333445555	1955-12-08 00:00:00.000	638 Voss, Houston, TX	M	40000.00	888665555	5	333445555	1988-05-22 00:00:00.000
3	Joyce	A	English	453453453	1972-07-31 00:00:00.000	5631 Rice, Houston, TX	F	25000.00	333445555	5	333445555	1988-05-22 00:00:00.000
4	Ramesh	K	Narayan	666884444	1962-09-15 00:00:00.000	975 Fire Oak, Humble, TX	M	38000.00	333445555	5	333445555	1988-05-22 00:00:00.000

EMPLOYEE 테이블

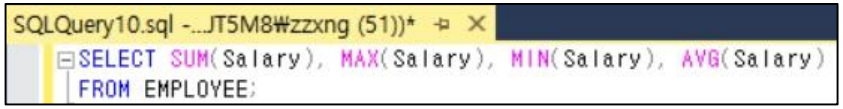
DEPARTMENT 테이블

집단함수(SUM, MAX, MIN, AVG)

사원의 급여의 합, 최고 급여, 최저 급여, 평균 급여를 구하라.

```
SELECT SUM(Salary), MAX(Salary),
       MIN(Salary), AVG(Salary)
FROM   EMPLOYEE;
```

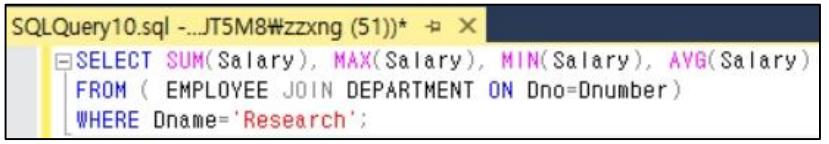
SQL은 그룹화와 집단화가 많은 데이터베이스 응용을 위한 집단 함수 지원
SUM, MAX, MIN, AVG 함수들은 숫자들의 집합이나 다중 집합에 적용되어 각각 합, 최대값, 최소값, 평균값을 산출



'Research' 부서에 근무하는 사원의 급여의 합, 최고 급여, 최소 급여, 평균 급여를 구하라.

```
SELECT SUM(Salary), MAX(Salary), MIN(Salary), AVG(Salary)
FROM   ( EMPLOYEE JOIN DEPARTMENT ON Dno=Dnumber)
WHERE Dname='Research';
```

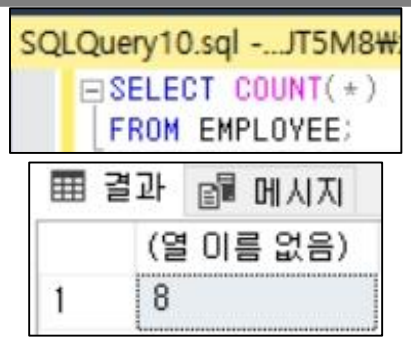
WHERE 절을 통해 대상 튜플들을 제한하여 질의 표현 가능



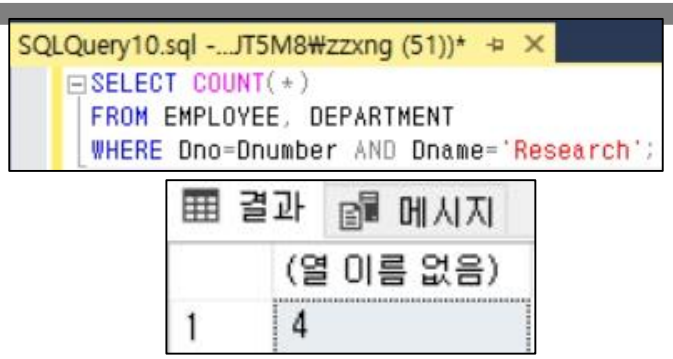
집단함수(COUNT)

회사의 총 사원수(Q1)와 'Research' 부서에서 근무하는 총 사원수(Q2)를 검색하라.

```
-- Q1
SELECT COUNT(*)
FROM   EMPLOYEE;
```




```
-- Q2
SELECT COUNT(*)
FROM   EMPLOYEE, DEPARTMENT
WHERE Dno=Dnumber AND Dname='Research';
```



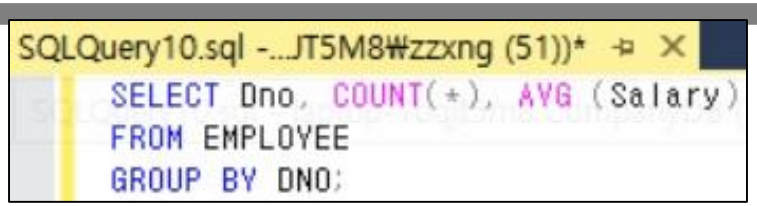
COUNT 함수는 질의에서 검색된 **투플이나 값**들의 개수를 반환
예제에서 '*'는 행(투플)들을 나타내므로 COUNT(*)는 질의 결과에 포함된 **투플**들의 수를 반환한다.

GROUP BY

각 부서에 대해서 부서번호, 부서에 소속된 사원의 수와 그들의 평균 급여를 구하라.

```
SELECT Dno, COUNT(*), AVG (Salary)
FROM EMPLOYEE
GROUP BY DNO;
```

Q24는 GROUP BY 절을 사용하는 예이다.
사원들은 같은 Dno를 갖는 그룹들끼리 나뉘어 지고
나뉜 그룹 단위로 COUNT, AVG 연산을 수행한다.



결과 메시지

	Dno	(열 이름 없음)	(열 이름 없음)
1	1	1	55000,000000
2	4	3	31000,000000
3	5	4	33250,000000

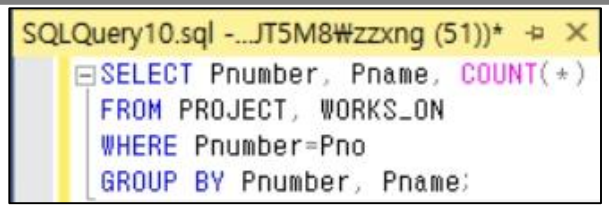
EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno	
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5	
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5	
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5	
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5	**Dno = 5인 group**
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	**4**	
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	**4**	**Dno = 4인 group**
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	**4**	
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	**1**	**Dno = 1인 group**

GROUP BY

프로젝트에 대해서 프로젝트 번호, 프로젝트 이름, 그 프로젝트에서 근무하는 사원들의 수를 검색하라.

```
SELECT Pnumber, Pname, COUNT(*)
FROM   PROJECT, WORKS_ON
WHERE Pnumber=Pno
GROUP BY      Pnumber, Pname;
```



결과 메시지

	Pnumber	Pname	(열 이름 없음)
1	10	Computerization	3
2	30	Newbenefits	3
3	1	ProductX	2
4	2	ProductY	3
5	3	ProductZ	2
6	20	Reorganization	3

Q25는 조인 조건과 함께 GROUP BY 절을 사용하는 예이다.
이런 경우에는 먼저 릴레이션을 조인한 후에 그룹화와
집단 함수가 적용된다.

JOIN 조건

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

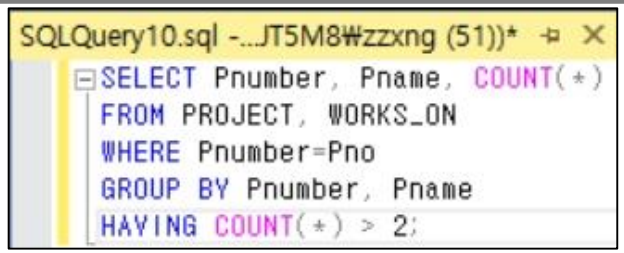
WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	10.0

GROUP BY / HAVING

두 명 이상의 사원이 근무하는 프로젝트에 대해서 프로젝트 번호, 프로젝트 이름, 그 프로젝트에서 근무하는 사원들의 수를 검색하라.

```
SELECT Pnumber, Pname, COUNT(*)
FROM   PROJECT, WORKS_ON
WHERE Pnumber=Pno
GROUP BY     Pnumber, Pname
HAVING       COUNT(*) > 2;
```



어떤 조건들을 만족하는 그룹들에 대해서만 집단 함수들의 값을 구하기 위해 GROUP BY 절과 함께 사용되는 **HAVING 절을** 제공 HAVING 절은 각 그룹에 대한 조건을 나타내며, 조건을 만족하는 그룹들만 질의의 결과로 검색된다.

결과 메시지

	Pnumber	Pname	(열 이름 없음)
1	10	Computerization	3
2	30	Newbenefits	3
3	2	ProductY	3
4	20	Reorganization	3

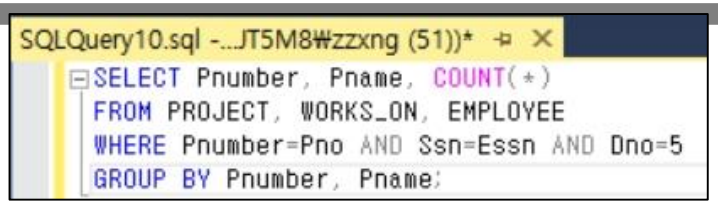
CAUTION!

그룹핑 애트리뷰트 내에 널이 존재하면 그 널값을 가진 투플들을 위한 별도의 그룹을 만든다.

그룹화에서 WHERE 절 조건 적용

프로젝트에 대해서 프로젝트 번호, 프로젝트 이름, 5번 부서에 속하면서 프로젝트에서 근무하는 사원의 수를 검색하라.

```
SELECT Pnumber, Pname, COUNT(*)
FROM   PROJECT, WORKS_ON, EMPLOYEE
WHERE Pnumber=Pno AND Ssn=Essn AND Dno=5
GROUP BY       Pnumber, Pname;
```



결과 메시지

	Pnumber	Pname	(열 이름 없음)
1	1	ProductX	2
2	2	ProductY	3
3	3	ProductZ	2
4	10	Computerization	1
5	20	Reorganization	1

WHERE 절에 있는 선택 조건은 집단 함수를 적용할 투플들을 한정하고 **HAVING 절은 집단 함수를 적용할 그룹들을 선택**하는데 사용

예제의 경우 릴레이션에 속하는 투플들은 WHERE 절에서 명시한 조건 5번 부서에 근무하는 사원들로 제한

EMPLOYEE

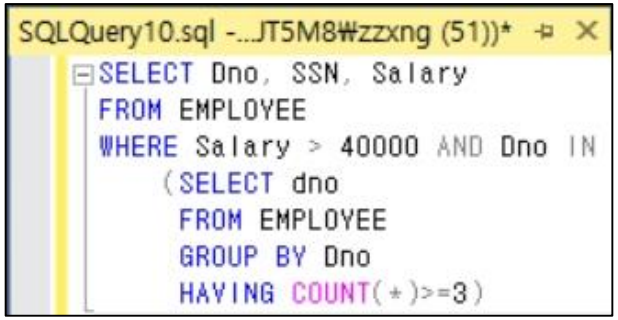
Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

5번 부서에 근무하는 사원으로 범위를 제한

WHERE 절과 HAVING 절의 조건

3명 이상의 사원이 근무하는 각 부서에 대해서 부서 번호와 40,000달러가 넘는 급여를 받는 사원의 수를 검색하라.

```
SELECT Dno, SSN, Salary
FROM   EMPLOYEE
WHERE          Salary > 40000 AND Dno IN
          (SELECT dno
           FROM EMPLOYEE
           GROUP BY Dno
           HAVING COUNT(*)>=3)
```



결과 | 메시지

	Dno	SSN	Salary
1	4	987654321	43000.00

오른쪽 아래의 질의의 경우 40,000달러 이상의 급여를 받는 사원이 3명 이상인 부서만을 선택하기 때문에 잘못된 질의이다.

각 조건이 적용되는 규칙은 **먼저 WHERE절이 실행**되어 WHERE 절을 만족하는 투플들만 검색되고, **나중에 HAVING 절이 적용**되어 투플들의 각 그룹을 선택하게 된다.
따라서 HAVING 절에 있는 함수를 적용하기 전에 이미 급여가 40,000달러를 넘는 사원 투플들만 검색된다.

```
SELECT Dname, COUNT(*)
FROM   DEPARTMENT, EMPLOYEE
WHERE Dnumber=Dno AND Salary>40000
GROUP BY       Dname
HAVING         COUNT(*)>=3;
```

THANK YOU

인하대학교