

Chapter 6.

Basic SQL

SQL

- The standard language for commercial relational DBMSs
 - SQL-86 or SQL1
 - A joint effort by ANSI and ISO
 - SQL2 (SQL-92)
 - SQL3 (SQL:1999) = core specification + extensions
 - extend SQL with object-oriented and other recent database concepts
 - SQL:2003, SQL:2006, SQL:2008, SQL:2011
 - add XML, object database features

ANSI (the American National Standards Institute)

ISO (the International Standards Organization)

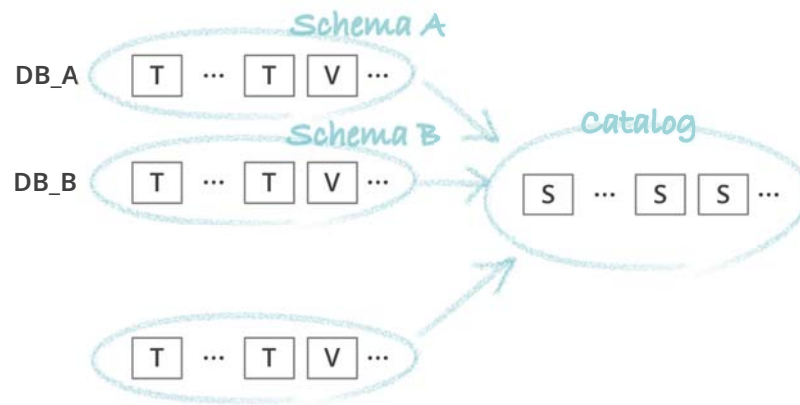
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- SQL is a comprehensive database language
 - Statements for data definition, query, and update (DDL and DML)
 - Facilities for
 - defining views on the database
 - specifying security and authorization
 - defining integrity constraints
 - specifying transaction controls
 - Rules for embedding SQL statements into a general-purpose PL such as Java or C/C++

SQL Data Definition and Data Types

- SQL uses the terms **table**, **row**, and **column** for relation, tuple, and attribute, respectively
- SQL DDL : **CREATE**, **ALTER**, and **DROP**
- The **schema evolution** commands in SQL
 - alter the schema by adding or dropping tables, attributes, and constraints

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Schema and Catalog Concepts in SQL

■ Schema

- Tables and other constructs that belong to the same DB application
- Schema name, authorization ID, descriptors for each element
- Schema elements
 - tables, constraints, views, domains, and other constructs (such as authorization grants)

`CREATE SCHEMA COMPANY AUTHORIZATION 'Jsmith';`

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■ Catalog

- A named collection of schemas in an SQL environment
- A catalog always contains a special schema called **INFORMATION_SCHEMA**
 - provides information on all the element descriptors of all the schemas in the catalog to authorized users

CREATE TABLE Command

- Specify a new relation by giving it a name and specifying its attributes and constraints

`CREATE TABLE COMPANY.EMPLOYEE ...`
schema name

`CREATE TABLE EMPLOYEE ...`

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Data Types

- **Numeric** : INTEGER, SMALLINT, FLOAT or REAL, DOUBLE PRECISION, DECIMAL(i, j) or DEC(i,j) or NUMERIC(i, j)
- **Character string** : CHAR(n), VARCHAR(n) or CHAR VARYING(n), CLOB(Character Large Object)
- **Bit string** : BIT(n), BIT VARYING(n), BLOB(Binary Large Object)
e.g., BLOB(30G) – *specifies maximum length of 30 gigabits*
- **Boolean**

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Data Types (cont')

- **Date and Time** :
 - **DATE (YYYY-MM-DD), TIME (HH:MM:SS)**
 - DATE'2013-10-01' or TIME'09:12:47'
 - **TIMESTAMP (WITH TIME ZONE), INTERVAL**
 - **TIMESTAMP** : DATE + TIME + fractions + time zone
 - TIMESTAMP'2013-10-01 09:12:47.648302' UTC
 - INTERVAL : YEAR/MONTH interval, DAY/TIME interval

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Domain

CREATE DOMAIN SSN_TYPE AS CHAR(9);

- an optional default specification via a **DEFAULT** clause

Notice that domains may not be available in some implementations of SQL.

In SQL, there is also a **CREATE TYPE** command, which can be used to create user defined types or UDTs.

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EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
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CREATE TABLE EMPLOYEE

```
(  Fname  VARCHAR(15)      NOT NULL,
   Minit  CHAR,
   Lname  VARCHAR(15)      NOT NULL,
   Ssn    CHAR(9)          NOT NULL,
   Bdate  DATE,
   Address VARCHAR(30),
   Sex    CHAR,
   Salary DECIMAL(10, 2),
   Super_ssn CHAR(9),
   Dno    INT              NOT NULL,
```

PRIMARY KEY (Ssn),

FOREIGN KEY (Super_ssn) REFERENCES EMPLOYEE(Ssn),

FOREIGN KEY (Dno) REFERENCES DEPARTMENT(Dnumber)) ;

DEPARTMENT			
Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS	
<u>Dnumber</u>	<u>Dlocation</u>

CREATE TABLE DEPARTMENT

```
(  Dname          VARCHAR(15)  NOT NULL,
   Dnumber         INT          NOT NULL,
   Mgr_ssn         CHAR(9)     NOT NULL,
   Mgr_start_date  DATE,
```

PRIMARY KEY (Dnumber),

UNIQUE (Dname),

FOREIGN KEY (Mgr_ssn) REFERENCES EMPLOYEE (Ssn)) ;

alternate key

CREATE TABLE DEPT_LOCATIONS

```
(  Dnumber         INT          NOT NULL,
   Dlocation       VARCHAR(15)  NOT NULL,
```

PRIMARY KEY (Dnumber, Dlocation),

FOREIGN KEY (Dnumber) REFERENCES DEPARTMENT(Dnumber));

PROJECT			
Pname	<u>Pnumber</u>	Plocation	Dnum

WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
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CREATE TABLE PROJECT

```
(  Pname          VARCHAR(15)  NOT NULL,
   Pnumber        INT          NOT NULL,
   Plocation      VARCHAR(15),
   Dnum           INT          NOT NULL,
```

PRIMARY KEY (Pnumber),

UNIQUE (Pname),

FOREIGN KEY (Dnum) REFERENCES DEPARTMENT (Dnumber)) ;

CREATE TABLE WORKS_ON

```
(  Essn          CHAR(9)       NOT NULL,
   Pno           INT          NOT NULL,
   Hours         DECIMAL(3,1)  NOT NULL,
```

PRIMARY KEY (Essn, Pno),

FOREIGN KEY (Essn) REFERENCES EMPLOYEE (Ssn),

FOREIGN KEY (Pno) REFERENCES PROJECT (Pnumber)) ;

DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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CREATE TABLE DEPENDENT

```
(  Essn           CHAR(9)       NOT NULL,
   Dependent_name VARCHAR(15)  NOT NULL,
   Sex            CHAR,
   Bdate          DATE,
   Relationship    VARCHAR(8),
```

PRIMARY KEY (Essn, Dependent_name),

FOREIGN KEY (Essn) REFERENCES EMPLOYEE (Ssn)) ;

DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
-------------	-----------------------	-----	-------	--------------

CREATE TABLE DEPENDENT

```
(  Essn           CHAR(9)       NOT NULL,
   Dependent_name VARCHAR(15)  NOT NULL,
   Sex            CHAR,
   Bdate          DATE,
   Relationship    VARCHAR(8),
```

PRIMARY KEY (Essn, Dependent_name),

FOREIGN KEY (Essn) REFERENCES EMPLOYEE (Ssn)) ;

Specifying Attribute Constraints and Attribute Defaults

- **NOT NULL**
 - NULL is not permitted for a particular attribute
 - always implicitly specified for the attributes that are part of the primary key of each relation
- **DEFAULT <value>**
- **CHECK** clause

(Pin icon)

```
Dnumber INT NOT NULL
CHECK (Dnumber>0 AND Dnumber<21),
CREATE DOMAIN D_num AS INTEGER
CHECK (D_num>0 AND D_num<21);
```

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Specifying Key and Referential Integrity Constraints

- **PRIMARY KEY** clause
 - `Dno INT PRIMARY KEY` *(if PK has a single attribute)*
- **UNIQUE** clause - specifies alternate (or secondary) keys
 - `Dname VARCHAR(15) UNIQUE` *(if 2nd key is a single attribute)*
- **FOREIGN KEY** clause - referential integrity
- Constraint name - unique name within a particular schema

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CREATE TABLE EMPLOYEE

(. . . .

Dno INT NOT NULL DEFAULT 1,

CONSTRAINT EMPFK ← constraint name

PRIMARY KEY (Ssn),

CONSTRAINT EMPSUPERFK

FOREIGN KEY (Super_ssn) REFERENCES EMPLOYEE (Ssn)

ON DELETE SET NULL ON UPDATE CASCADE,

CONSTRAINT EMPDEPTFK

FOREIGN KEY (Dno) REFERENCES DEPARTMENT (Dnumber)

ON DELETE SET DEFAULT ON UPDATE CASCADE);

referential triggered action

Figure 6.2
Example illustrating how default attribute values and referential integrity triggered actions are specified in SQL.

Referential Integrity

- Attaching a **referential triggered action** clause to any foreign key constraint
- Options: **SET NULL**, **CASCADE**, and **SET DEFAULT**
 - An option must be qualified with either **ON DELETE** or **ON UPDATE**



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FOREIGN KEY (Dno) REFERENCES DEPARTMENT (Dnumber)
ON DELETE SET DEFAULT ON UPDATE CASCADE)

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	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	1
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	1
Ramesh	K	Narayn	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	1
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	6	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-0619

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Specifying Constraints on Tuples Using CHECK

■ CHECK

- Specify **table constraints (row-based constraints)**
 - apply to each row individually
 - checked whenever a row is inserted or modified

CREATE TABLE DEPARTMENT

(.....
Dept_create_date DATE,
Mgr_start_date DATE,

CONSTRAINT DEPTMGRFK
FOREIGN KEY

CHECK (Dept_create_date <= Mgr_start_date));

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Schema Change Statements in SQL (Chap 7, Sec 7.4)

■ DROP Command

DROP TABLE DEPENDENT CASCADE;

- RESTRICT**: a table is dropped only if it is not referenced in any constraints (e.g., by foreign key definitions in another relation) or views
- CASCADE**: all such constraints and views are dropped automatically from the schema, along with the table itself

DROP SCHEMA COMPANY CASCADE;

- RESTRICT**: the schema is dropped only if it has no elements in it
- CASCADE**

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Schema Change Statements in SQL (Chap 7, Sec 7.4)

■ ALTER command

- adding or dropping a column (attribute), changing a column definition, and adding or dropping table constraints

ALTER TABLE COMPANY.EMPLOYEE ADD Job VARCHAR(12);

ALTER TABLE COMPANY.EMPLOYEE DROP Address CASCADE;

ALTER TABLE COMPANY.DEPARTMENT ALTER Mgr_ssn
DROP DEFAULT;

ALTER TABLE COMPANY.DEPARTMENT ALTER Mgr_ssn
SET DEFAULT "333445555";

ALTER TABLE COMPANY.EMPLOYEE
DROP CONSTRAINT EMPSUPERFK CASCADE;

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Basic Queries in SQL

- One basic statement for retrieving : **SELECT**
- Distinctions between SQL and the formal relational model
 - SQL allows a table to have two or more identical tuples
 - **multiset** (called a **bag**) of tuples
 - Some SQL relations are constrained to be sets
 - a **key constraint** has been declared or
 - the **DISTINCT** option has been used with the SELECT statement

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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



Fname	Lname	Salary
John	Smith	30000
Franklin	Wong	40000
Ramesh	Narayan	38000
Joyce	English	25000

SELECT Fname, Lname, Salary
FROM EMPLOYEE
WHERE Dno=5;

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The SELECT-FROM-WHERE Structure

- The basic form of the SELECT statement, sometimes called a **mapping** or a **select-from-where block**

SELECT <attribute list>
FROM <table list>
WHERE <condition>;

- <attribute list> is a list of attribute names to be retrieved by the query
- <table list> is a list of the relation names required to process the query
- <condition> is a conditional (Boolean) expression that identifies the tuples to be retrieved by the query

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■ QUERY 0

Retrieve the birth date and address of the employee(s) whose name is 'John B. Smith'

FROM 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

WHERE

Fname='John' AND
Minit='B' AND
Lname='Smith';

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■ QUERY 0

Retrieve the birth date and address of the employee(s) whose name is 'John B. Smith'

■ Q0:

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

Bdate	Address
1965-01-09	731 Fondren, Houston, TX

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3 SELECT
1 FROM
2 WHERE

Bdate, Address
EMPLOYEE
Fname='John' AND Minit='B' AND Lname='Smith';

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	1968-07-19	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	Narayn	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

Bdate	Address
1965-01-09	731 Fondren, Houston, TX

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🔑 QUERY 0-a

Retrieve the name and salary of all employees who work for the department number 5.

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	1968-07-19	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	Narayn	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

SELECT Fname, Lname, Salary

WHERE Dno=5;

SELECT Fname, Lname, Salary
FROM EMPLOYEE
WHERE Dno=5;

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🔑 QUERY 0-b

Retrieve the last name and salary of the employee(s) whose sex is male or salary is greater than 35,000.

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	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4

SELECT Lname, Salary
FROM EMPLOYEE
WHERE Sex='M' OR Salary>35000

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■ QUERY 1

Retrieve the name and address of all employees who work for the 'Research' department. ?

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

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

Dname='Research'

DEPARTMENT.Dnumber
=EMPLOYEE.Dno

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■ QUERY 1

Retrieve the name and address of all employees who work for the 'Research' department.

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

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

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

Dname='Research'

DEPARTMENT.Dnumber
=EMPLOYEE.Dno

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Q1

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
-------	-------	-------	-----	-------	---------	-----	--------	-----------	-----

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
-------	---------	---------	----------------

'Research'

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

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

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SELECT Fname, Lname, Dname FROM EMPLOYEE, DEPARTMENT
WHERE Dno=Dnumber;

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	1968-07-19	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

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

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno	Dname	Dnumber	Mgr_ssn	M_s_date
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5	Research	5	333445555	1988-05-22
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5	Research	5	333445555	1988-05-22
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5	Research	5	333445555	1988-05-22
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5	Research	5	333445555	1988-05-22
Alicia	J	Zelaya	999887777	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4	Administration	4	987654321	1995-01-01
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4	Administration	4	987654321	1995-01-01
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4	Administration	4	987654321	1995-01-01
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1	Headquarters	1	888665555	1981-06-19

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■ QUERY 2

For every project located in 'Stafford',
list the project number, the controlling department number,
and the department manager's last name, address, and birth date

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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	Zelava	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birth date

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

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

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

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Q2

For every project located in 'Stafford',
list the project number, the controlling department number, and
the department manager's last name, address, and birthdate

PROJECT

Pname	Pnumber	Plocation	Dnum
-------	---------	-----------	------

Plocation='Stafford'

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
-------	---------	---------	----------------

Dnum=Dnumber

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex
-------	-------	-------	-----	-------	---------	-----

Mgr_ssn=Ssn

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controlling department department manager

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

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

...	Lname	Ssn	Bdate	Address	...
...	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	...
...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
...	Zelava	999887777	1968-07-19	3321 Castle, Spring, TX	...
...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...
...	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	...
...	English	453453453	1972-07-31	5631 Rice, Houston, TX	...
...	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	...
...	Borg	888665555	1937-11-10	450 Stone, Houston, TX	...

PROJECT.Dnum=DEPARTMENT.Dnumber

Pname	Pnumber	Plocation	Dnum	Dname	Dnumber	Mgr_ssn	Mgr_start_date
ProductX	1	Bellaire	5	Research	5	333445555	1988-05-22
ProductY	2	Sugarland	5	Research	5	333445555	1988-05-22
ProductZ	3	Houston	5	Research	5	333445555	1988-05-22
Computerization	10	Stafford	4	Administration	4	987654321	1995-01-01
Reorganization	20	Houston	1	Headquarters	1	888665555	1981-06-19
Newbenefits	30	Stafford	4	Administration	4	987654321	1995-01-01

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PROJECT.Dnum=DEPARTMENT.Dnumber

Pname	Pnumber	Plocation	Dnum	Dname	Dnumber	Mgr_ssn	Mgr_start_date
ProductX	1	Bellaire	5	Research	5	333445555	1988-05-22
ProductY	2	Sugarland	5	Research	5	333445555	1988-05-22
ProductZ	3	Houston	5	Research	5	333445555	1988-05-22
Computerization	10	Stafford	4	Administration	4	987654321	1995-01-01
Reorganization	20	Houston	1	Headquarters	1	888665555	1981-06-19
Newbenefits	30	Stafford	4	Administration	4	987654321	1995-01-01

EMPLOYEE

...	Lname	Ssn	Bdate	Address	...
...	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	...
...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
...	Zelaya	999887777	1968-07-19	3321 Castle, Spring, TX	...
...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...
...	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	...
...	English	453453453	1972-07-31	5631 Rice, Houston, TX	...
...	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	...
...	Borg	888665555	1937-11-10	450 Stone, Houston, TX	...

(PROJECT.Dnum=DEPARTMENT.Dnumber).Mgr_ssn=EMPLOYEE.Ssn

Pname	Pnumber	Plocation	Dnum	Dname	Dnumber	Mgr_ssn	Mgr_start_date	...	Lname	Ssn	Bdate	Address	...
ProductX	1	Bellaire	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
ProductY	2	Sugarland	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
ProductZ	3	Houston	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
Computerization	10	Stafford	4	Administration	4	987654321	1995-01-01	...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...
Reorganization	20	Houston	1	Headquarters	1	888665555	1981-06-19	...	Borg	888665555	1937-11-10	450 Stone, Houston, TX	...
Newbenefits	30	Stafford	4	Administration	4	987654321	1995-01-01	...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...

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SELECT
FROM
WHERE

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

(PROJECT.Dnum=DEPARTMENT.Dnumber).Mgr_ssn=EMPLOYEE.Ssn

Pname	Pnumber	Plocation	Dnum	Dname	Dnumber	Mgr_ssn	Mgr_start_date	...	Lname	Ssn	Bdate	Address	...
ProductX	1	Bellaire	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
ProductY	2	Sugarland	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
ProductZ	3	Houston	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
Computerization	10	Stafford	4	Administration	4	987654321	1995-01-01	...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...
Reorganization	20	Houston	1	Headquarters	1	888665555	1981-06-19	...	Borg	888665555	1937-11-10	450 Stone, Houston, TX	...
Newbenefits	30	Stafford	4	Administration	4	987654321	1995-01-01	...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...

Pnumber	Dnum	Lname	Address	Bdate
10	4	Wallace	291 Berry, Bellaire, TX	1941-06-20
30	4	Wallace	291 Berry, Bellaire, TX	1941-06-20

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■ QUERY 2

For every project located in 'Stafford',
list the project number, the controlling department number, and
the department manager's last name, address, and birthdate

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

Pnumber	Dnum	Lname	Address	Bdate
10	4	Wallace	291 Berry, Bellaire, TX	1941-06-20
30	4	Wallace	291 Berry, Bellaire, TX	1941-06-20

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Ambiguous Attribute Names, Aliasing, and Tuple Variables

- Qualifying the attribute name with the relation name, to prevent ambiguity

■ Q1A:

SELECT Fname, EMPLOYEE.Name, Address
FROM EMPLOYEE, DEPARTMENT
WHERE DEPARTMENT.Name='Research' AND
DEPARTMENT.Dnumber=EMPLOYEE.Dnumber;

tuple variable

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Renaming (Aliasing)

■ QUERY 8

For each employee,
retrieve the employee's first and last name and
the first and last name of his or her immediate supervisor

EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
-------	-------	-------	------------	-------	---------	-----	--------	-----------	-----

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EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	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	1968-07-19	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	Narayn	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

EMPLOYEE		SUPERVISOR	
Fname	Lname	Fname	Lname
John	Smith	Franklin	Wong

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EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	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	1968-07-19	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	Narayn	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

EMPLOYEE		SUPERVISOR	
Fname	Lname	Fname	Lname
John	Smith	Franklin	Wong
Franklin	Wong	James	Borg

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EMPLOYEE (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	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-07-19	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

EMPLOYEE (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	1968-07-19	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

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Renaming (Aliasing)

■ QUERY 8

For each employee, retrieve the employee's first and last name and the first and last name of his or her immediate supervisor

■ Q8: **SELECT** E.Fname, E.Lname, S.Fname, S.Lname
FROM EMPLOYEE **AS** E, EMPLOYEE **AS** S
WHERE E.Super_ssn=S.Ssn;

• FROM EMPLOYEE **AS** E(Fn, Mi, Ln, Ssn, Bd, Addr, Sex, Sal, Sssn, Dno)

■ Q1B: **SELECT** E.Fname, E.Name, E.Address
FROM EMPLOYEE E, DEPARTMENT D
WHERE D.Name= 'Research' AND
D.Dnumber=E.Dnumber;

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Unspecified WHERE-Clause

■ QUERIES 9 and 10

Select all EMPLOYEE Ssns (Q9), and
all combinations of EMPLOYEE Ssn and DEPARTMENT Dname (Q10)
in the database

■ Q9: **SELECT** Ssn
FROM EMPLOYEE;

■ Q10: **SELECT** Ssn, Dname
FROM EMPLOYEE, DEPARTMENT;

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Q9

Ssn
123456789
333445555
999887777
987654321
666884444
453453453
987987987
888665555

Q10

Ssn	Dname
123456789	Research
333445555	Research
999887777	Research
987654321	Research
666884444	Research
453453453	Research
987987987	Research
888665555	Research
123456789	Administration
333445555	Administration
999887777	Administration
987654321	Administration
666884444	Administration
453453453	Administration
987987987	Administration
888665555	Administration
123456789	Headquarters
333445555	Headquarters
999887777	Headquarters
987654321	Headquarters
666884444	Headquarters
453453453	Headquarters
987987987	Headquarters
888665555	Headquarters

■ Q9: **SELECT** Ssn
FROM EMPLOYEE;

■ Q10: **SELECT** Ssn, Dname
FROM EMPLOYEE, DEPARTMENT;

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Use of Asterisk (*)

■ Q1C: **SELECT** *Fname, Minit, Lname, Ssn, Bdate, Address, Sex, Salary, Super_ssn, Dno*
FROM **EMPLOYEE**
WHERE **Dno=5;**

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	Narayn	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

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Use of Asterisk (*)

■ Q1D: **SELECT** *****
FROM **EMPLOYEE, DEPARTMENT**
WHERE **Dname='Research' AND Dno=Dnumber;**

■ Q10A: **SELECT** *****
FROM **EMPLOYEE, DEPARTMENT;**

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SELECT *****
FROM **EMPLOYEE, DEPARTMENT;**

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	1968-07-19	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	Narayn	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

DEPARTMENT

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

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Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno	Dname	Dnumber	Mgr_ssn	M_s_date
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5	Research	5	333445555	1988-05-22
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5	Research	5	333445555	1988-05-22
Alicia	J	Zelaya	999887777	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4	Research	5	333445555	1988-05-22
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4	Research	5	333445555	1988-05-22
Ramesh	K	Narayn	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5	Research	5	333445555	1988-05-22
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5	Research	5	333445555	1988-05-22
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4	Research	5	333445555	1988-05-22
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1	Research	5	333445555	1988-05-22
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5	Administration	4	987654321	1995-01-01
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5	Administration	4	987654321	1995-01-01
Alicia	J	Zelaya	999887777	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4	Administration	4	987654321	1995-01-01
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4	Administration	4	987654321	1995-01-01
Ramesh	K	Narayn	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5	Administration	4	987654321	1995-01-01
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5	Administration	4	987654321	1995-01-01
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4	Administration	4	987654321	1995-01-01
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1	Administration	4	987654321	1995-01-01
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5	Headquarters	1	888665555	1981-06-19
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5	Headquarters	1	888665555	1981-06-19
Alicia	J	Zelaya	999887777	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4	Headquarters	1	888665555	1981-06-19
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4	Headquarters	1	888665555	1981-06-19
Ramesh	K	Narayn	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5	Headquarters	1	888665555	1981-06-19
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5	Headquarters	1	888665555	1981-06-19
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4	Headquarters	1	888665555	1981-06-19
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1	Headquarters	1	888665555	1981-06-19

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

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Tables as Sets in SQL

- Why SQL does not automatically eliminate duplicate tuples in the results of queries
 - Duplicate elimination is an expensive operation
 - sort the tuples and then eliminate duplicates
 - The user may want to see duplicate tuples in the result of a query
 - When an aggregate function is applied to tuples, in most cases we do not want to eliminate duplicates

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- QUERY 11
Retrieve the salary of every employee (Q11) and all distinct salary values (Q11A).

■ Q11: `SELECT ALL Salary
FROM EMPLOYEE;`

Salary
30000
40000
25000
43000
38000
25000
25000
55000



■ Q11A: `SELECT DISTINCT Salary
FROM EMPLOYEE;`

Salary
30000
40000
25000
43000
38000
55000

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■ Set operations

- **UNION**, **EXCEPT**(difference), **INTERSECT**
- **UNION ALL**, **EXCEPT ALL**, **INTERSECT ALL**
 - multiset operations

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(a) STUDENT

Fn	Ln
Susan	Yao
Ramesh	Shah
Johnny	Kohler
Barbara	Jones
Amy	Ford
Jimmy	Wang
Ernest	Gilbert

INSTRUCTOR

Fname	Lname
John	Smith
Ricardo	Browne
Susan	Yao
Francis	Johnson
Ramesh	Shah

(b)

Fn	Ln
Susan	Yao
Ramesh	Shah
Johnny	Kohler
Barbara	Jones
Amy	Ford
Jimmy	Wang
Ernest	Gilbert
John	Smith
Ricardo	Browne
Francis	Johnson

(`SELECT Fn, Ln
FROM STUDENT`)

UNION

(`SELECT I.Fn, I.Ln
FROM INSTRUCTOR AS I (Fn, Ln));`

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```
SELECT Pname
FROM PROJECT
WHERE Pnumber=1 OR
Pnumber=2;
```

```
( SELECT Pname
  FROM PROJECT
  WHERE Pnumber=1 )
UNION
( SELECT Pname
  FROM PROJECT
  WHERE Pnumber=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

Pname	Pname
ProductX	ProductY



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```
SELECT Pname
FROM PROJECT
WHERE Pnumber=1 OR Pnumber=2;
```

```
( SELECT Pname
  FROM PROJECT
  WHERE Pnumber=1 )
UNION
( SELECT Pname
  FROM PROJECT
  WHERE Pnumber=2 )
```

```
SELECT Pname
FROM PROJECT
WHERE Pnumber IN (1,2);

WHERE Pnumber
NOT IN (1,2);
```



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```
SELECT Pname
FROM PROJECT
WHERE Pnumber=1 OR
Pnumber=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



```
SELECT Pname
FROM PROJECT
WHERE Pnumber NOT IN (1, 2);
```

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■ QUERY 4'

Make a list of all project numbers for projects that involve an employee whose last name is 'Wong', either as a worker or as a manager of the department that controls the project

```
■ Q4: ( SELECT DISTINCT Pno
        FROM WORKS_ON, EMPLOYEE
        WHERE Essn=Ssn AND Lname='Wong')
UNION
( SELECT DISTINCT Pnumber
  FROM PROJECT, DEPARTMENT, EMPLOYEE
  WHERE Dnum=Dnumber AND Mgr_ssn=Ssn AND
        Lname='Wong' );
```

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■ QUERY 4'

Make a list of all project numbers for projects that involve an employee whose last name is 'Wong', either **as a worker** or as a manager of the department that controls the project.

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 Ca				4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry				4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire				5
Joyce	A	English	453453453	1972-07-31	5631 Rice				5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dall				4
James	E	Borg	888665555	1937-11-10	450 Stone				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
888665555	0	0.0

SELECT DISTINCT Pno
FROM WORKS_ON, EMPLOYEE
WHERE Essn=Ssn AND Lname='Wong'

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WORKS_ON

Essn	Pno	Hours
...
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
...

Pno
2
3
10
20

EMPLOYEE

Fname	Minit	Lname	Ssn	...	Salary	Super_ssn	Dno
John	B	Smith	123456789	...	30000	333445555	5
Franklin	T	Wong	333445555	...	40000	888665555	5
Alicia	J	Zelaya	999887777	...	25000	987654321	4
Joyce	A	English	453453453	...	25000	333445555	5
...

SELECT DISTINCT Pno
FROM WORKS_ON, EMPLOYEE
WHERE Essn=Ssn AND Lname='Wong'

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■ QUERY 4'

Make a list of all project numbers for projects that involve an employee whose last name is 'Wong', either as a worker or **as a manager of the department that controls the project.**

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	99						
Jennifer	S	Wallace	98						
Ramesh	K	Narayan	66						
Joyce	A	English	45						
Ahmad	V	Jabbar	98						
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

SELECT DISTINCT Pnumber
FROM PROJECT, DEPARTMENT, EMPLOYEE
WHERE Dnum=Dnumber AND Mgr_ssn=Ssn AND Lname='Wong'

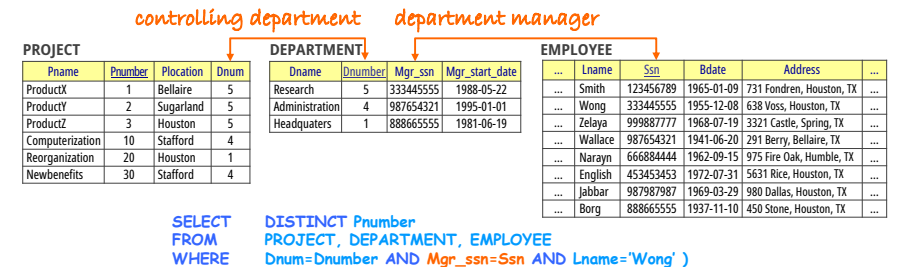
DEPARTMENT

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

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

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Pname	Pnumber	Plocation	Dnum	Dname	Dnumber	Mgr_ssn	Mgr_start_date	...	Lname	Ssn	Bdate	Address	...
ProductX	1	Bellaire	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
ProductY	2	Sugarland	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
ProductZ	3	Houston	5	Research	5	333445555	1988-05-22	...	Wong	333445555	1955-12-08	638 Voss, Houston, TX	...
Computerization	10	Stafford	4	Administration	4	987654321	1995-01-01	...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...
Reorganization	20	Houston	1	Headquarters	1	888665555	1981-06-19	...	Borg	888665555	1937-11-10	450 Stone, Houston, TX	...
Newbenefits	30	Stafford	4	Administration	4	987654321	1995-01-01	...	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	...

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Substring Pattern Matching and Arithmetic Operators

■ QUERY 12

Retrieve the names of all employees whose address is in Houston, Texas.

Q12: **SELECT** Fname, Lname
 FROM EMPLOYEE
 WHERE Address **LIKE** '%Houston,TX%';

■ QUERY 12A

Find all employees who were born during the 1950s.

Q12A: **SELECT** Fname, Lname
 FROM EMPLOYEE
 WHERE Bdate **LIKE** '_ _5 _ _ _ _ _';

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■ QUERY 13

Show the resulting salaries if every employee working on the 'ProductX' project is given a 10 percent raise.

■ Q13:

SELECT Fname, Lname, 1.1*Salary **AS** INCREASED_SAL
FROM EMPLOYEE, WORKS_ON, PROJECT
WHERE Ssn=Essn AND Pno=Pnumber AND
 Pname= 'ProductX';

Fname	Lname	INCREASED_SAL
-------	-------	---------------

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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
				1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
				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

SELECT Fname, Lname, 1.1*Salary **AS** INCREASED_SAL
FROM EMPLOYEE, WORKS_ON, PROJECT
WHERE Ssn=Essn AND Pno=Pnumber AND
 Pname= 'ProductX';

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

Fname	Lname	INCREASED_SAL
John	Smith	33000
Joyce	English	27500

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■ string

- concatenate operator '||'

■ date, time, timestamp, and interval data types

- incrementing ('+') or decrementing ('-') a date, time, or timestamp by an interval
- interval value : the result of the difference between two date, time, or timestamp values

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Ordering of Query Results

■ QUERY 14

Retrieve all employees in department 5 whose salary is between \$30,000 and \$40,000.

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

≡ (Salary >= 30000 AND Salary <= 40000)

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- Retrieve the first and last names and Dno of all employees, ordered by department number and, within each department, ordered alphabetically by last name, first name.

```
SELECT      Fname, Lname, Dno
FROM        EMPLOYEE
ORDER BY    Dno, Lname, Fname;
```

Fname	Lname	Dno
James	Borg	1
Ahmad	Jabbar	4
Jennifer	Wallace	4
Alicia	Zelaya	4
Joyce	English	5
John	Smith	5
Ramesh	Smith	5
Franklin	Wong	5

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Ordering of Query Results

■ QUERY 15

Retrieve a list of employees and the projects they are working on, ordered by department and, within each department, ordered alphabetically by last name, first name.

```
SELECT      Dname, Lname, Fname, Pname
FROM        DEPARTMENT, EMPLOYEE, WORKS_ON, PROJECT
WHERE       Dnumber=Dno AND Ssn=Essn AND
           Pno=Pnumber
ORDER BY    Dname, Lname, Fname;
```

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■ Ordering

- ♦ The default order is in ascending order(**ASC**) of values
- ♦ **DESC**: descending order of values
- ♦ *e.g.*,

ORDER BY Dname **DESC**, Lname **ASC**, Fname **ASC**

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INSERT Command

■ U1:

```
INSERT INTO EMPLOYEE
VALUES ('Richard', 'K', 'Marini', '653298653', '1962-12-30', '98
Oak Forest, Katy, TX', 'M', 37000, '987654321', 4);
```

■ U1A:

```
INSERT INTO EMPLOYEE (Fname, Lname, Dno, Ssn)
VALUES ('Richard', 'Marini', 4, '653298653');
```

- Attributes not specified in U1A are set to their **DEFAULT** or to **NULL**,
- the values are listed in the same order as the attributes are listed in the INSERT command itself
- It is also possible to insert into a relation multiple tuples separated by commas in a single INSERT command

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■ U2: INSERT INTO EMPLOYEE (Fname, Lname, Ssn, Dno) VALUES ('Robert', 'Hatcher', '980760540', 2);

- U2 is rejected if referential integrity checking is provided by DBMS

■ U2A: INSERT INTO EMPLOYEE (Fname, Lname, Dno) VALUES ('Robert', 'Hatcher', 5);

Ssn ?

- U2A is rejected if **NOT NULL** checking is provided by DBMS

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DELETE Command

■ U3A: CREATE TABLE WORKS_ON_INFO (Emp_name VARCHAR(15), Proj_name VARCHAR(15), Hours_per_week DECIMAL(3,1));

■ U3B: INSERT INTO WORKS_ON_INFO (Emp_name, Proj_name, Hours_per_week) SELECT E.Lname, P.Pname, W.Hours FROM PROJECT P, WORKS_ON W, EMPLOYEE E WHERE P.Pnumber=W.Pno AND W.Essn=E.Ssn;

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■ U4A: DELETE FROM EMPLOYEE WHERE Lname='Brown';

■ U4B: DELETE FROM EMPLOYEE WHERE Ssn='123456789';

■ U4C: DELETE FROM EMPLOYEE WHERE Dno = 5;

■ U4D: DELETE FROM EMPLOYEE;

- ✓ **Propagated deletion – referential triggered actions**

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UPDATE Command

■ U5: `UPDATE PROJECT`
`SET Plocation = 'Bellaire', Dnum = 5`
`WHERE Pnumber = 10;`

■ U6: `UPDATE EMPLOYEE`
`SET Salary = Salary * 1.1`
`WHERE Dno = 5;`

- possible to specify **NULL** or **DEFAULT** as the new attribute value

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“Chapter 6”

Basic SQL

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