CS4.301 Data & Applications

Ponnurangam Kumaraguru (“PK”)
#ProfGiri @ IIIT Hyderabad

 pk.profgiri  /in/ponguru  @ponguru  Ponnurangam.kumaraguru

SQL Data Definition, Data Types, Standards

Terminology:

- **Table**, **row**, and **column** used for relational model terms relation, tuple, and attribute

`CREATE` statement

- Main SQL command for data definition

Schema and Catalog Concepts in SQL (cont'd.)

`CREATE SCHEMA` statement

```
CREATE SCHEMA COMPANY AUTHORIZATION 'Jsmith';
```

Catalog

Named collection of schemas in an SQL environment

SQL also has the concept of a cluster of catalogs

Authorization is to make the owner of the Schema

The CREATE TABLE Command in SQL

Specifying a new relation

- Provide name of table
- Specify attributes, their types and initial constraints

Can optionally specify schema:

```
CREATE TABLE COMPANY.EMPLOYEE ...
```

or

```
CREATE TABLE EMPLOYEE ...
```

SQL CREATE TABLE data definition statements for defining the COMPANY schema from Figure 5.7 (Fig. 6.1)

```
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),
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) );
CREATE TABLE DEPT_LOCATIONS
        ( Dnumber               INT                     NOT NULL,
          Dlocation             VARCHAR(15)             NOT NULL,
        PRIMARY KEY (Dnumber, Dlocation),
        FOREIGN KEY (Dnumber) REFERENCES DEPARTMENT(Dnumber) );
```

continued on next slide

SQL CREATE TABLE data definition statements for defining the COMPANY schema from Figure 5.7 (Fig. 6.1)-continued

```
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) );
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) );
```

Lets look at all data types

Data type	Description
CHAR(size)	A FIXED length string (can contain letters, numbers, and special characters). The *size* parameter specifies the column length in characters - can be from 0 to 255. Default is 1
VARCHAR(size)	A VARIABLE length string (can contain letters, numbers, and special characters). The *size* parameter specifies the maximum string length in characters - can be from 0 to 65535
BINARY(size)	Equal to CHAR(), but stores binary byte strings. The *size* parameter specifies the column length in bytes. Default is 1
VARBINARY(size)	Equal to VARCHAR(), but stores binary byte strings. The *size* parameter specifies the maximum column length in bytes.
TINYBLOB	For BLOBs (Binary Large Objects). Max length: 255 bytes
TINYTEXT	Holds a string with a maximum length of 255 characters
TEXT(size)	Holds a string with a maximum length of 65,535 bytes

https://www.w3schools.com/sql/sql_datatypes.asp

String Data Types

Data type	Description
CHAR(size)	A FIXED length string (can contain letters, numbers, and special characters). The *size* parameter specifies the column length in characters - can be from 0 to 255. Default is 1
VARCHAR(size)	A VARIABLE length string (can contain letters, numbers, and special characters). The *size* parameter specifies the maximum string length in characters - can be from 0 to 65535
BINARY(size)	Equal to CHAR(), but stores binary byte strings. The *size* parameter specifies the column length in bytes. Default is 1
VARBINARY(size)	Equal to VARCHAR(), but stores binary byte strings. The *size* parameter specifies the maximum column length in bytes.
TINYBLOB	For BLOBs (Binary Large Objects). Max length: 255 bytes
TINYTEXT	Holds a string with a maximum length of 255 characters
TEXT(size)	Holds a string with a maximum length of 65,535 bytes
BLOB(size)	For BLOBs (Binary Large Objects). Holds up to 65,535 bytes of data
MEDIUMTEXT	Holds a string with a maximum length of 16,777,215 characters
MEDIUMBLOB	For BLOBs (Binary Large Objects). Holds up to 16,777,215 bytes of data

https://www.w3schools.com/sql/sql_datatypes.asp

Numeric Data Types

Data type	Description
BIT(*size*)	A bit-value type. The number of bits per value is specified in *size*. The *size* parameter can hold a value from 1 to 64. The default value for *size* is 1.
TINYINT(*size*)	A very small integer. Signed range is from -128 to 127. Unsigned range is from 0 to 255. The *size* parameter specifies the maximum display width (which is 255)
BOOL	Zero is considered as false, nonzero values are considered as true.
BOOLEAN	Equal to BOOL
SMALLINT(*size*)	A small integer. Signed range is from -32768 to 32767. Unsigned range is from 0 to 65535. The *size* parameter specifies the maximum display width (which is 255)
MEDIUMINT(*size*)	A medium integer. Signed range is from -8388608 to 8388607. Unsigned range is from 0 to 16777215. The *size* parameter specifies the maximum display width (which is 255)
INT(*size*)	A medium integer. Signed range is from -2147483648 to 2147483647. Unsigned range is from 0 to 4294967295. The *size* parameter specifies the maximum display width (which is 255)
INTEGER(*size*)	Equal to INT(size)
BIGINT(*size*)	A large integer. Signed range is from -9223372036854775808 to 9223372036854775807. Unsigned range is from 0 to 18446744073709551615. The *size* parameter specifies the maximum display width (which is 255)

https://www.w3schools.com/sql/sql_datatypes.asp

Date & Time Data Types

Data type	Description
DATE	A date. Format: YYYY-MM-DD. The supported range is from '1000-01-01' to '9999-12-31'
DATETIME(*fsp*)	A date and time combination. Format: YYYY-MM-DD hh:mm:ss. The supported range is from '1000-01-01 00:00:00' to '9999-12-31 23:59:59'. Adding DEFAULT and ON UPDATE in the column definition to get automatic initialization and updating to the current date and time
TIMESTAMP(*fsp*)	A timestamp. TIMESTAMP values are stored as the number of seconds since the Unix epoch ('1970-01-01 00:00:00' UTC). Format: YYYY-MM-DD hh:mm:ss. The supported range is from '1970-01-01 00:00:01' UTC to '2038-01-09 03:14:07' UTC. Automatic initialization and updating to the current date and time can be specified using DEFAULT CURRENT_TIMESTAMP and ON UPDATE CURRENT_TIMESTAMP in the column definition
TIME(*fsp*)	A time. Format: hh:mm:ss. The supported range is from '-838:59:59' to '838:59:59'
YEAR	A year in four-digit format. Values allowed in four-digit format: 1901 to 2155, and 0000. MySQL 8.0 does not support year in two-digit format.

https://www.w3schools.com/sql/sql_datatypes.asp

Attribute Data Types and Domains in SQL (cont'd.)

Domain

- Name used with the attribute specification
- Makes it easier to change the data type for a domain that is used by numerous attributes
- Improves schema readability
- Example:

```
CREATE DOMAIN SSN_TYPE AS CHAR(9);

CREATE DOMAIN CPI_DATA AS REAL CHECK
(value >= 0 AND value <= 10);
```

TYPE

- User Defined Types (UDTs) are supported for object-oriented applications. (See Ch.12) Uses the command: `CREATE TYPE`

```
CREATE TYPE AUDIO  AS BLOB (1M) [Binary Large OBject]
```

Specifying Key and Referential Integrity Constraints

`PRIMARY KEY` clause

Specifies one or more attributes that make up the primary key of a relation

```
Dnumber INT PRIMARY KEY;
```

`UNIQUE` clause

Specifies alternate (secondary) keys (called CANDIDATE keys in the relational model).

```
Dname VARCHAR(15) UNIQUE;
```

Both the UNIQUE and PRIMARY KEY constraints provide a guarantee for uniqueness for a column or set of columns.

A PRIMARY KEY constraint automatically has a UNIQUE constraint.

However, you can have many UNIQUE constraints per table, but only one PRIMARY KEY constraint per table.

https://www.w3schools.com/sql/sql_unique.asp

Specifying Key and Referential Integrity Constraints (cont'd.)

`FOREIGN KEY` clause

- Default operation: reject update on violation
- Attach **referential triggered action** clause
  - Options include `SET NULL`, `CASCADE`, and `SET DEFAULT`
  - Action taken by the DBMS for `SET NULL` or `SET DEFAULT` is the same for both `ON DELETE` and `ON UPDATE`
  - `CASCADE` option suitable for some propagation needs to be done [Manager leaving organization, or somebody stepping down as manager]

```
CREATE TABLE EMPLOYEE
    ( … ,
      Dno          INT            NOT NULL       DEFAULT 1,
    CONSTRAINT EMPPK
      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);
CREATE TABLE DEPARTMENT
    ( … ,
      Mgr_ssn CHAR(9)          NOT NULL       DEFAULT '888665555',
      … ,
    CONSTRAINT DEPTPK
      PRIMARY KEY(Dnumber),
    CONSTRAINT DEPTSK
      UNIQUE (Dname),
    CONSTRAINT DEPTMGRFK
      FOREIGN KEY (Mgr_ssn) REFERENCES EMPLOYEE(Ssn)
                    ON DELETE SET DEFAULT       ON UPDATE CASCADE);
CREATE TABLE DEPT_LOCATIONS
    ( … ,
    PRIMARY KEY (Dnumber, Dlocation),
    FOREIGN KEY (Dnumber) REFERENCES DEPARTMENT(Dnumber)
                    ON DELETE CASCADE           ON UPDATE CASCADE);
```

Default attribute values and referential integrity triggered action specification (Fig. 6.2)

Activity

Modify CREATE Table for PROJECT, WORKS_ON & DEPENDENT

```
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) );
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) );
```

Basic Retrieval Queries in SQL

`SELECT` statement

- One basic statement for retrieving information from a database

SQL allows a table to have two or more tuples that are identical in all their attribute values [Results from the query]

- Unlike relational model (relational model is strictly set-theory based)
- Tuple-id may be used as a key

The SELECT-FROM-WHERE Structure of Basic SQL Queries

Basic form of the `SELECT` statement:

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

where

- <attribute list> is a list of attribute names whose values are 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.

The SELECT-FROM-WHERE Structure of Basic SQL Queries (cont'd.)

Logical comparison operators

=, <, <=, >, >=, and <>

Projection attributes

Attributes whose values are to be retrieved

Selection condition

Boolean condition that must be true for any retrieved tuple. Selection conditions include join conditions (see Ch.8) when multiple relations are involved.

Basic Retrieval Queries

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

DEPT_LOCATIONS

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

Query 1. Retrieve the name and address of all employees who work for the 'Research' department.

```
Q1:   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

This Lecture

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

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
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

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

Where condition

```
mysql> select fname, lname, address from employee, department where dname='research' AND dno = dnumber;
+----------+---------+--------------------------+
```

Where condition

```
mysql> select fname, lname, address from employee, department where dname='research' AND dno = dnumber;
+----------+---------+-------------------------+
| fname    | lname   | address                 |
+----------+---------+-------------------------+
| John     | Smith   | 731 Fondren, Houston TX |
| Franklin | Wong    | 638 Voss, Houston TX    |
| Joyce    | English | 5631 Rice, Houston TX   |
| Ramesh   | Narayan | 975 Fire Oak, Humble TX |
+----------+---------+-------------------------+
4 rows in set (0.00 sec)
```

Where condition

```
mysql> select fname, lname, address from employee, department where dname='research' AND dno = dnumber;
+----------+---------+-------------------------+
| fname    | lname   | address                 |
+----------+---------+-------------------------+
| John     | Smith   | 731 Fondren, Houston TX |
| Franklin | Wong    | 638 Voss, Houston TX    |
| Joyce    | English | 5631 Rice, Houston TX   |
| Ramesh   | Narayan | 975 Fire Oak, Humble TX |
+----------+---------+-------------------------+
4 rows in set (0.00 sec)

mysql> select fname, lname, address from employee, department where dno = dnumber AND dname='research';
```

Where condition

```
mysql> select fname, lname, address from employee, department where dname='research' AND dno = dnumber;
+----------+---------+-------------------------+
| fname    | lname   | address                 |
+----------+---------+-------------------------+
| John     | Smith   | 731 Fondren, Houston TX |
| Franklin | Wong    | 638 Voss, Houston TX    |
| Joyce    | English | 5631 Rice, Houston TX   |
| Ramesh   | Narayan | 975 Fire Oak, Humble TX |
+----------+---------+-------------------------+
4 rows in set (0.00 sec)

mysql> select fname, lname, address from employee, department where dno = dnumber AND dname='research';
+----------+---------+-------------------------+
| fname    | lname   | address                 |
+----------+---------+-------------------------+
| John     | Smith   | 731 Fondren, Houston TX |
| Franklin | Wong    | 638 Voss, Houston TX    |
| Joyce    | English | 5631 Rice, Houston TX   |
| Ramesh   | Narayan | 975 Fire Oak, Humble TX |
+----------+---------+-------------------------+
4 rows in set (0.01 sec)
```

Case In-sensitive

```
mysql> 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    |
| Joyce    | English | 5631 Rice, Houston TX   |
| Ramesh   | Narayan | 975 Fire Oak, Humble TX |
+----------+---------+-------------------------+
4 rows in set (0.00 sec)
```

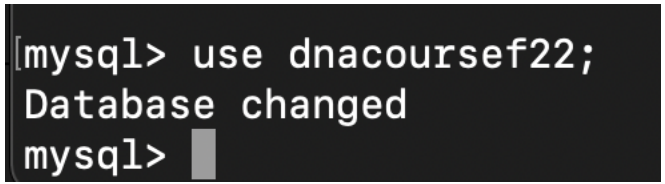
Hands-on for some basics

mysql> show tables;

```
mysql> show tables;
+------------------------+
| Tables_in_dnacoursef22 |
+------------------------+
| DEPARTMENT             |
| DEPENDENT              |
| DEPT_LOCATIONS         |
| EMPLOYEE               |
| PROJECT                |
| WORKS_ON               |
+------------------------+
6 rows in set (0.01 sec)
```

Hands-on for some basics

mysql> use dnacoursef22;



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.

```
Q2:   SELECT   Pnumber, Dnum, Lname, Address, Bdate
      FROM     PROJECT, DEPARTMENT, EMPLOYEE
      WHERE    Dnum=Dnumber AND Mgr_ssn=Ssn AND
               Plocation='Stafford';
```

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

```
mysql> SELECT Pnumber, Dnum, Lname, Address, Bdate
    -> FROM EMPLOYEE, DEPARTMENT, PROJECT
    -> 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 |
+---------+------+---------+-----------------------+------------+
2 rows in set (0.00 sec)
```

Unspecified WHERE Clause and Use of the Asterisk

```
Select Ssn
FROM EMPLOYEE;

SELECT SSN, DNAME
FROM EMPLOYEE, DEPARTMENT;
```

Unspecified WHERE Clause and Use of the Asterisk

Select Ssn
FROM EMPLOYEE;

SELECT SSN, DNAME
FROM EMPLOYEE, DEPARTMENT;

```
mysql> Select Ssn
    -> FROM EMPLOYEE;
+-----------+
| Ssn       |
+-----------+
| 123456789 |
| 333445555 |
| 453453453 |
| 666884444 |
| 888665555 |
| 987654321 |
| 987987987 |
| 999887777 |
+-----------+
8 rows in set (0.00 sec)
```

Unspecified WHERE Clause and Use of the Asterisk

```
Select Ssn
FROM EMPLOYEE;

SELECT SSN, DNAME
FROM EMPLOYEE, DEPARTMENT;
```

Unspecified WHERE Clause and Use of the Asterisk

Select Ssn
FROM EMPLOYEE;

SELECT SSN, DNAME
FROM EMPLOYEE, DEPARTMENT;

```
mysql> SELECT SSN, DNAME
    -> FROM EMPLOYEE, DEPARTMENT;
+-----------+----------------+
| SSN       | DNAME          |
+-----------+----------------+
| 123456789 | Research       |
| 123456789 | Headquarters   |
| 123456789 | Administration |
| 333445555 | Research       |
| 333445555 | Headquarters   |
| 333445555 | Administration |
| 453453453 | Research       |
| 453453453 | Headquarters   |
| 453453453 | Administration |
| 666884444 | Research       |
| 666884444 | Headquarters   |
| 666884444 | Administration |
| 888665555 | Research       |
| 888665555 | Headquarters   |
| 888665555 | Administration |
| 987654321 | Research       |
| 987654321 | Headquarters   |
| 987654321 | Administration |
| 987987987 | Research       |
| 987987987 | Headquarters   |
| 987987987 | Administration |
| 999887777 | Research       |
| 999887777 | Headquarters   |
| 999887777 | Administration |
+-----------+----------------+
24 rows in set (0.00 sec)
```

Unspecified WHERE Clause and Use of the Asterisk (cont'd.)

Specify an asterisk (*)

Retrieve all the attribute values of the selected tuples

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

Unspecified WHERE Clause and Use of the Asterisk (cont'd.)

Specify an asterisk (*)

Retrieve all the attribute values of the selected tuples

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

```
mysql> SELECT *
    -> FROM EMPLOYEE
    -> WHERE Dno = 5;
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+
| 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 | 1965-12-08 | 638 Voss, Houston TX    | M    |  40000 | 888665555 |   5 |
| Joyce    | A     | English | 453453453 | 1972-07-31 | 5631 Rice, Houston TX   | F    |  25000 | 333445555 |   5 |
| Ramesh   | K     | Narayan | 666884444 | 1962-09-15 | 975 Fire Oak, Humble TX | M    |  38000 | 333445555 |   5 |
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+
4 rows in set (0.00 sec)
```

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

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

Attributes from both tables

```
mysql> SELECT *
    -> FROM EMPLOYEE, DEPARTMENT
    -> WHERE Dname='Research' AND Dno=Dnumber;
+----------+-------+----------+-----------+------------+-------------------------+-----+--------+-----------+-----+----------+---------+-----------+----------------+
| Fname    | Minit | Lname    | Ssn       | Bdate      | Address                 | Sex | Salary | Super_ssn | Dno | Dname    | Dnumber | Mgr_ssn   | Mgr_start_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 | 1965-12-08 | 638 Voss, Houston TX    | M   |  40000 | 888665555 |   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     |
| Ramesh   | K     | Narayan  | 666884444 | 1962-09-15 | 975 Fire Oak, Humble TX | M   |  38000 | 333445555 |   5 | Research |       5 | 333445555 | 1988-05-22     |
+----------+-------+----------+-----------+------------+-------------------------+-----+--------+-----------+-----+----------+---------+-----------+----------------+
4 rows in set (0.00 sec)
```

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

SELECT *
FROM EMPLOYEE, DEPARTMENT;

Attributes from both tables

```
mysql> SELECT *
    -> FROM EMPLOYEE, DEPARTMENT;
```

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

```
24 rows in set (0.00 sec)
```

Tables as Sets in SQL

SQL does not automatically eliminate duplicate tuples in query results

For aggregate operations (See sec 7.1.7) duplicates must be accounted for

Use the keyword **`DISTINCT`** in the `SELECT` clause

Only distinct tuples should remain in the result

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

```
Q11:   SELECT    ALL Salary
       FROM      EMPLOYEE;

Q11A:  SELECT    DISTINCT Salary
       FROM      EMPLOYEE;
```

```
SELECT ALL Salary
FROM EMPLOYEE;
```

SELECT ALL Salary
FROM EMPLOYEE;

```
mysql> SELECT ALL Salary
    -> FROM EMPLOYEE;
+--------+
| Salary |
+--------+
|  30000 |
|  40000 |
|  25000 |
|  38000 |
|  55000 |
|  43000 |
|  25000 |
|  25000 |
+--------+
8 rows in set (0.01 sec)
```

SELECT Salary FROM EMPLOYEE;

```
mysql> SELECT Salary FROM EMPLOYEE;
+--------+
| Salary |
+--------+
|  30000 |
|  40000 |
|  25000 |
|  38000 |
|  55000 |
|  43000 |
|  25000 |
|  25000 |
+--------+
8 rows in set (0.00 sec)
```

```
SELECT DISTINCT Salary
FROM EMPLOYEE;
```

SELECT DISTINCT Salary
FROM EMPLOYEE;

```
mysql> SELECT DISTINCT Salary
    -> FROM EMPLOYEE;
+--------+
| Salary |
+--------+
|  30000 |
|  40000 |
|  25000 |
|  38000 |
|  55000 |
|  43000 |
+--------+
6 rows in set (0.01 sec)
```

Tables as Sets in SQL (cont'd.)

Set operations

- **`UNION`**, **`EXCEPT`** (difference), **`INTERSECT`**
- Corresponding multiset operations: `UNION ALL`, `EXCEPT ALL`, `INTERSECT ALL`
- Type compatibility is needed for these operations to be valid

> **Query 4.** Make a list of all project numbers for projects that involve an employee whose last name is 'Smith', either as a worker or as a manager of the department that controls the project.

Try it yourself first!

Tables as Sets in SQL (cont'd.)

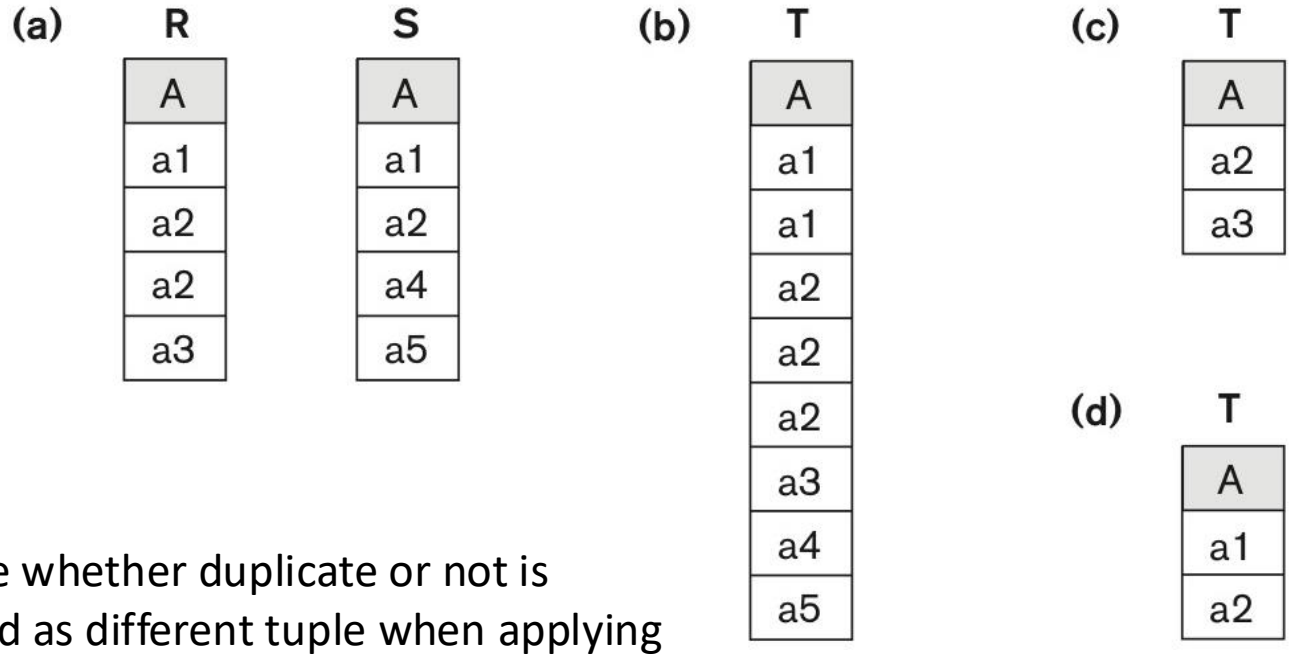
```
(SELECT DISTINCT Pnumber
FROM PROJECT, DEPARTMENT, EMPLOYEE
WHERE Dnum=Dnumber AND Mgr_ssn=Ssn
      AND Lname='Smith')
UNION
(SELECT DISTINCT Pnumber
FROM PROJECT, WORKS_ON, EMPLOYEE
WHERE Pnumber=Pno AND Essn=Ssn
      AND Lname='Smith');
```

Tables as Sets in SQL (cont'd.)

```
(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');
```

```
mysql> (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');
+---------+
| Pnumber |
+---------+
|       1 |
|       2 |
+---------+
2 rows in set (0.00 sec)
```

Figure 6.5 The results of SQL multiset operations. (a) Two tables, R(A) and S(A). (b) R(A)UNION ALL S(A). (c) R(A) EXCEPT ALL S(A). (d) R(A) INTERSECT ALL S(A).



Each tuple whether duplicate or not is considered as different tuple when applying these operations

Substring Pattern Matching and Arithmetic Operators

LIKE comparison operator

Used for string **pattern matching**

% replaces an arbitrary number of zero or more characters

underscore (_) replaces a single character

Examples: **WHERE** Address **LIKE** '%Houston,TX%';

WHERE Ssn **LIKE** '_ _ 1_ _ 8901';

BETWEEN comparison operator [ka_ _ _ ka%]

E.g., in Q14 :

WHERE(Salary **BETWEEN** 30000 **AND** 40000)

AND Dno = 5;

Arithmetic Operations

Standard arithmetic operators:

Addition (+), subtraction (–), multiplication (*), and division (/) may be included as a part of **SELECT**

Query 13. Show the resulting salaries if every employee working on the ‘ProductX’ project is given a 10 percent raise.

Arithmetic Operations

Standard arithmetic operators:

Addition (+), subtraction (–), multiplication (*), and division (/) may be included as a part of **SELECT**

Query 13. Show the resulting salaries if every employee working on the 'ProductX' project is given a 10 percent raise.

```
SELECT  E.Fname, E.Lname, 1.1 * E.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';
```

Ordering of Query Results

Use **`ORDER BY`** clause

- Keyword **`DESC`** to see result in a descending order of values
- Keyword **`ASC`** to specify ascending order explicitly
- Typically placed at the end of the query

```
ORDER BY D.Dname DESC, E.Lname ASC, E.Fname ASC
```

Order by

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, then first name.

Order by

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, then first name.

```
Q15:    SELECT      D.Dname, E.Lname, E.Fname, P.Pname
        FROM        DEPARTMENT AS D, EMPLOYEE AS E, WORKS_ON AS W,
                    PROJECT AS P
        WHERE       D.Dnumber = E.Dno AND E.Ssn = W.Essn AND W.Pno =
                    P.Pnumber
        ORDER BY    D.Dname, E.Lname, E.Fname;
```

Basic SQL Retrieval Query Block

```
SELECT      <attribute list>
FROM        <table list>
[ WHERE     <condition> ]
[ ORDER BY <attribute list> ];
```

INSERT, DELETE, and UPDATE Statements in SQL

Three commands used to modify the database:

INSERT, DELETE, and UPDATE

INSERT typically inserts a tuple (row) in a relation (table)

UPDATE may update a number of tuples (rows) in a relation (table) that satisfy the condition

DELETE may also update a number of tuples (rows) in a relation (table) that satisfy the condition

INSERT

In its simplest form, it is used to add one or more tuples to a relation

Attribute values should be listed in the same order as the attributes were specified in the **CREATE TABLE** command

Constraints on data types are observed automatically

Any integrity constraints as a part of the DDL specification are enforced

The INSERT Command

Specify the relation name and a list of values for the tuple. All values including nulls are supplied.

```
U1:   INSERT INTO   EMPLOYEE
      VALUES        ( 'Richard', 'K', 'Marini', '653298653', '1962-12-30', '98
                      Oak Forest, Katy, TX', 'M', 37000, '653298653', 4 );
```

The variation below inserts multiple tuples where a new table is loaded values from the result of a query.

```
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;
```

BULK LOADING OF TABLES

Another variation of **INSERT** is used for bulk-loading of several tuples into tables

A new table TNEW can be created with the same attributes as T and using LIKE and DATA in the syntax, it can be loaded with entire data.

EXAMPLE:

```
CREATE TABLE D5EMPS  LIKE  EMPLOYEE
                    (SELECT   E.*
                     FROM       EMPLOYEE AS E
                    WHERE     E.Dno=5)
 WITH DATA;
```

WITH DATA specifies that the table will be created & loaded with the data specified in the query

DELETE

Removes tuples from a relation

- Includes a WHERE-clause to select the tuples to be deleted
- Referential integrity should be enforced
- Tuples are deleted from only *one table* at a time (unless CASCADE is specified on a referential integrity constraint)
- A missing WHERE-clause specifies that *all tuples* in the relation are to be deleted; the table then becomes an empty table
- The number of tuples deleted depends on the number of tuples in the relation that satisfy the WHERE-clause

The DELETE Command

Removes tuples from a relation

Includes a `WHERE` clause to select the tuples to be deleted. The number of tuples deleted will vary.

```
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;
```

UPDATE

Used to modify attribute values of one or more selected tuples

A WHERE-clause selects the tuples to be modified

An additional SET-clause specifies the attributes to be modified and their new values

Each command modifies tuples *in the same relation*

Referential integrity specified as part of DDL specification is enforced

UPDATE (contd.)

Example: Change the location and controlling department number of project number 10 to 'Bellaire' and 5, respectively

```
U5: UPDATE      PROJECT
    SET         PLOCATION = 'Bellaire', DNUM = 5
    WHERE       PNUMBER=10
```

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

UPDATE (contd.)

Example: Give all employees in the 'Research' department a 10% raise in salary.

Try it yourself first!

UPDATE (contd.)

Example: Give all employees in the 'Research' department a 10% raise in salary.

```
U6: UPDATE          EMPLOYEE
    SET             SALARY = SALARY *1.1
    WHERE DNO  IN (SELECT        DNUMBER
                   FROM          DEPARTMENT
                   WHERE         DNAME='Research')
```

In this request, the modified SALARY value depends on the original SALARY value in each tuple

- The reference to the SALARY attribute on the right of = refers to the old SALARY value before modification
- The reference to the SALARY attribute on the left of = refers to the new SALARY value after modification

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.

Bibliography / Acknowledgements

Instructor materials from Elmasri & Navathe 7e


pk.profgiri


Ponnurangam.kumaraguru


/in/ponguru


ponguru

Thank you for attending the class!!!


pk.guru@iiit.ac.in