Database Management Systems

ICT1212

Basic SQL

Department of ICT
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Lecture 8

What we Discuss Today…..

- SQL Data Definition and Data Types
- Specifying Basic Constraints in SQL
- Schema Change Statements in SQL
- Basic Queries in SQL
- More Complex SQL Queries
- Insert, Delete, and Update Statements in SQL Additional Features of SQL

Data Definition, Constraints, and Schema Changes

- Used to
  - CREATE,
  - DROP, and
  - ALTER

  the descriptions of the tables (relations) of a database

CREATE TABLE

- Specifies a new base relation by giving it a name, and specifying each of its attributes and their data types (INTEGER, FLOAT, DECIMAL(i,j), CHAR(n), VARCHAR(n) etc)
- A constraint NOT NULL may be specified on an attribute

```
CREATE TABLE   DEPARTMENT
    (        DNAME          VARCHAR(10) NOT NULL,
             DNUMBER        INTEGER     NOT NULL,
             MGRSSN         CHAR(9),
             MGRSTARTDATE        CHAR(9)  );
```

CREATE TABLE

- In SQL, can use the CREATE TABLE command for specifying the primary key attributes, secondary keys, and referential integrity constraints (foreign keys).
- Key attributes can be specified via the PRIMARY KEY and UNIQUE phrases

```
CREATE TABLE   DEPT
(   DNAME          VARCHAR(10)          NOT NULL,
     DNUMBER       INTEGER        NOT NULL,
     MGRSSN        CHAR(9),
     MGRSTARTDATE       CHAR(9),
     PRIMARY KEY (DNUMBER),
     UNIQUE (DNAME),
     FOREIGN KEY (MGRSSN) REFERENCES EMP
  );
```

DROP TABLE

- Used to remove a relation (base table) *and its definition*
- The relation can no longer be used in queries, updates, or any other commands since its description no longer exists
- Example:

```
DROP TABLE  DEPENDENT;
```

ALTER TABLE

- Used to add an attribute to one of the base relations
- The new attribute will have NULLs in all the tuples of the relation right after the command is executed; hence, the NOT NULL constraint is *not allowed* for such an attribute
- Example:

ALTER TABLE EMPLOYEE ADD JOB VARCHAR(12);

- The database users must still enter a value for the new attribute JOB for each EMPLOYEE tuple. This can be done using the UPDATE command.

REFERENTIAL INTEGRITY OPTIONS

- We can specify RESTRICT, CASCADE, SET NULL or SET DEFAULT on referential integrity constraints (foreign keys)

```
CREATE TABLE   DEPT
 (   DNAME        VARCHAR(10)      NOT
NULL,
     DNUMBER  INTEGER     NOT NULL,
     MGRSSN      CHAR(9),
     MGRSTARTDATE CHAR(9),
     PRIMARY KEY (DNUMBER),
     UNIQUE (DNAME),
     FOREIGN KEY (MGRSSN) REFERENCES
EMP
ON DELETE SET DEFAULT ON UPDATE
CASCADE  );
```

REFERENTIAL INTEGRITY OPTIONS (continued)

```
CREATE TABLE   EMP
    (        ENAME        VARCHAR(30)       NOT
  NULL,
             ESSN CHAR(9),
             BDATE        DATE,
             DNO  INTEGER  DEFAULT 1,
             SUPERSSN  CHAR(9),
             PRIMARY KEY (ESSN),
             FOREIGN KEY (DNO) REFERENCES
  DEPT
          ON DELETE SET DEFAULT ON UPDATE
  CASCADE,
             FOREIGN KEY (SUPERSSN)
  REFERENCES EMP
          ON DELETE SET NULL ON UPDATE
  CASCADE  );
```

Retrieval Queries in SQL (cont.)

- Basic form of the SQL SELECT statement is 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 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

Relational Database Schema

EMPLOYEE

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO

DEPARTMENT

DNAME	DNUMBER	MGRSSN	MGRSTARTDATE

DEPT_LOCATIONS

DNUMBER	DLOCATION

PROJECT

PNAME	PNUMBER	PLOCATION	DNUM

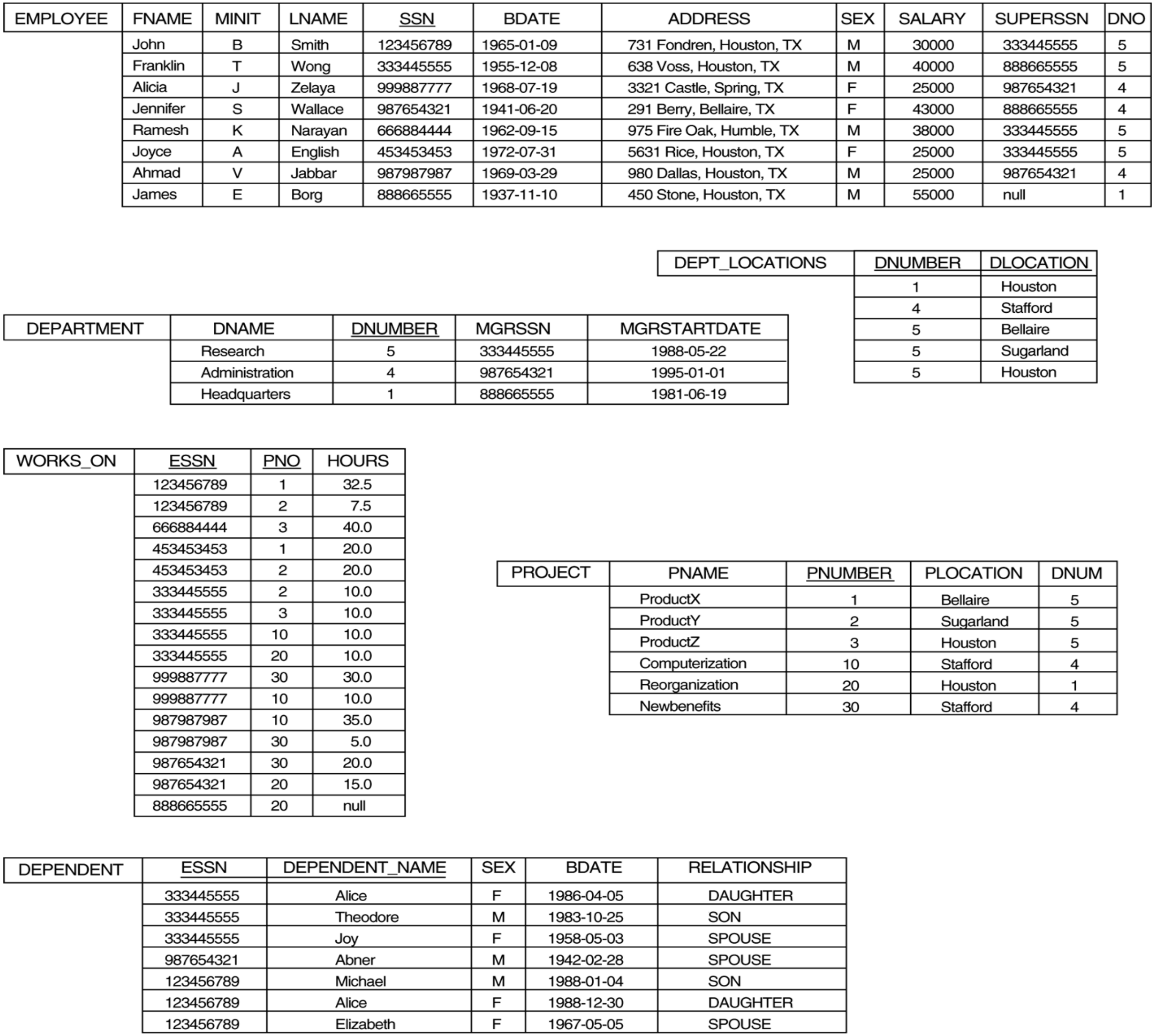
WORKS_ON

ESSN	PNO	HOURS

DEPENDENT

ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP

Populated Database



EMPLOYEE	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	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

DEPT_LOCATIONS	DNUMBER	DLOCATION
	1	Houston
	4	Stafford
	5	Bellaire
	5	Sugarland
	5	Houston

DEPARTMENT	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
	Research	5	333445555	1988-05-22
	Administration	4	987654321	1995-01-01
	Headquarters	1	888665555	1981-06-19

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

Simple SQL Queries

- Basic SQL queries correspond to using the SELECT, PROJECT, and JOIN operations of the relational algebra
- All subsequent examples use the COMPANY database
- Example of a simple query on *one* relation
- Query 0: Retrieve the birthdate and address of the employee whose name is 'John B. Smith'.

```
Q0:  SELECT          BDATE, ADDRESS
     FROM            EMPLOYEE
     WHEREFNAME='John' AND MINIT='B’
   AND               LNAME='Smith’
```

  - Similar to a SELECT-PROJECT pair of relational algebra operations; the SELECT-clause specifies the *projection attributes* and the WHERE-clause specifies the *selection condition*
  - However, the result of the query *may contain* duplicate tuples

Simple SQL Queries (cont.)

- 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
```

  - Similar to a SELECT-PROJECT-JOIN sequence of relational algebra operations
  - (DNAME='Research') is a *selection condition* (corresponds to a SELECT operation in relational algebra)
  - (DNUMBER=DNO) is a *join condition* (corresponds to a JOIN operation in relational algebra)

Simple SQL Queries (cont.)

- 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.

```
Q2:         SELECT        PNUMBER, DNUM, LNAME,
  BDATE, ADDRESS
    FROM                  PROJECT, DEPARTMENT,
  EMPLOYEE
    WHERE       DNUM=DNUMBER AND
  MGRSSN=SSN                        AND
    PLOCATION='Stafford'
```

  - In Q2, there are *two* join conditions
  - The join condition DNUM=DNUMBER relates a project to its controlling department
  - The join condition MGRSSN=SSN relates the controlling department to the employee who manages that department

Aliases, * and DISTINCT, Empty WHERE-clause

- In SQL, we can use the same name for two (or more) attributes as long as the attributes are in *different relations*
  A query that refers to two or more attributes with the same name must *qualify* the attribute name with the relation name by *prefixing* the relation name to the attribute name

<u>Example:</u>

- EMPLOYEE.DNAME, DEPARTMENT.DNAME

ALIASES

- Some queries need to refer to the same relation twice
- In this case, *aliases* are given to the relation name
- Query 8: For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.

```
Q8:  SELECT     E.FNAME, E.LNAME, S.FNAME,
                      S.LNAME
     FROM       EMPLOYEE E S
     WHERE      E.SUPERSSN=S.SSN
```

  - In Q8, the alternate relation names E and S are called *aliases* or *tuple variables* for the EMPLOYEE relation
  - We can think of E and S as two *different copies* of EMPLOYEE; E represents employees in role of *supervisees* and S represents employees in role of *supervisors*

ALIASES (cont.)

- Aliasing can also be used in any SQL query for convenience
  Can also use the AS keyword to specify aliases

```
Q8:     SELECT     E.FNAME, E.LNAME,
S.FNAME,                           S.LNAME
        FROM                EMPLOYEE AS E,
EMPLOYEE AS S
        WHERE      E.SUPERSSN=S.SSN
```

UNSPECIFIED WHERE-clause

- A *missing WHERE-clause* indicates no condition; hence, *all tuples* of the relations in the FROM-clause are selected
- This is equivalent to the condition WHERE TRUE
- Query 9: Retrieve the SSN values for all employees.

```
Q9: SELECT         SSN
           FROM  EMPLOYEE
```

- If more than one relation is specified in the FROM-clause *and* there is no join condition, then the *CARTESIAN PRODUCT* of tuples is selected

UNSPECIFIED WHERE-clause (cont.)

- Example:

```
Q10:    SELECT  SSN, DNAME
        FROM    EMPLOYEE,
DEPARTMENT
```

  - It is extremely important not to overlook specifying any selection and join conditions in the WHERE-clause; otherwise, incorrect and very large relations may result

USE OF *

- To retrieve all the attribute values of the selected tuples, a * is used, which stands for *all the attributes* Examples:

```
Q1C:     SELECT    *
         FROM      EMPLOYEE
         WHERE     DNO=5

Q1D:     SELECT    *
         FROM      EMPLOYEE,
DEPARTMENT
         WHERE     DNAME='Research' AND
                        DNO=DNUMBER
```

USE OF DISTINCT

- SQL does not treat a relation as a set; *duplicate tuples can appear*
- To eliminate duplicate tuples in a query result, the keyword **DISTINCT** is used
- For example, the result of Q11 may have duplicate SALARY values whereas Q11A does not have any duplicate values

```
Q11:    SELECT   SALARY
        FROM     EMPLOYEE
Q11A:   SELECT   DISTINCT SALARY
        FROM      EMPLOYEE
```

SET OPERATIONS

- SQL has directly incorporated some set operations
- There is a union operation (**UNION)**, and in *some versions* of SQL there are set difference (**MINUS)** and intersection (**INTERSECT)** operations
- The resulting relations of these set operations are sets of tuples; *duplicate tuples are eliminated from the result*
- The set operations apply only to *union compatible relations* ; the two relations must have the same attributes and the attributes must appear in the same order

SET OPERATIONS (cont.)

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

```
Q4:  (SELECT  PNAME
      FROM         PROJECT, DEPARTMENT, EMPLOYEE
      WHERE        DNUM=DNUMBER AND
MGRSSN=SSN         AND           LNAME='Smith')
      UNION                 (SELECT  PNAME
      FROM         PROJECT,WORKS_ON, EMPLOYEE
      WHERE        PNUMBER=PNO AND ESSN=SSN
AND                              LNAME='Smith')
```

NESTING OF QUERIES

- A complete SELECT query, called a *nested query* , can be specified within the WHERE-clause of another query, called the *outer query*
- Many of the previous queries can be specified in an alternative form using nesting
- Query 1: Retrieve the name and address of all employees who work for the 'Research' department.

```
Q1: SELECT      FNAME, LNAME, ADDRESS
    FROM        EMPLOYEE
    WHERE       DNO IN  (SELECT  DNUMBER
    FROM        DEPARTMENT
    WHERE       DNAME='Research' )
```

NESTING OF QUERIES (cont.)

- The nested query selects the number of the 'Research' department
- The outer query select an EMPLOYEE tuple if its DNO value is in the result of either nested query
- The comparison operator **IN** compares a value v with a set (or multi-set) of values V, and evaluates to **TRUE** if v is one of the elements in V
- In general, we can have several levels of nested queries
- A reference to an *unqualified attribute* refers to the relation declared in the *innermost nested query*
- In this example, the nested query is *not correlated* with the outer query

CORRELATED NESTED QUERIES

- If a condition in the WHERE-clause of a *nested query* references an attribute of a relation declared in the *outer query* , the two queries are said to be *correlated*
- Query 12: Retrieve the name of each employee who has a dependent with the same first name as the employee.

```
Q12: SELECT          E.FNAME, E.LNAME
     FROM            EMPLOYEE AS E
     WHERE           E.SSN IN (SELECT     ESSN
                     FROM  DEPENDENT
                     WHERE          ESSN=E.SSN AND

     E.FNAME=DEPENDENT_NAME)
```

CORRELATED NESTED QUERIES (cont.)

- A query written with nested SELECT... FROM... WHERE... blocks and using the = or IN comparison operators can ***always*** be expressed as a single block query. For example, Q12 may be written as in Q12A

```
Q12A:    SELECT      E.FNAME, E.LNAME
         FROM        EMPLOYEE E, DEPENDENT D
         WHERE       E.SSN=D.ESSN AND
                     E.FNAME=D.DEPENDENT_NAME
```

CORRELATED NESTED QUERIES (cont.)

- Most implementations of SQL *do not* have this operator
- The CONTAINS operator compares two *sets of values* , and returns TRUE if one set contains all values in the other set
  (reminiscent of the *division* operation of algebra).
  - Query 3: Retrieve the name of each employee who works on *all* the projects controlled by department number 5.

```
Q3:      SELECT  FNAME, LNAME
 FROM    EMPLOYEE
 WHERE   ( (SELECT          PNO
            FROM  WORKS_ON
            WHERE           SSN=ESSN)
            CONTAINS
           (SELECT          PNUMBER
            FROM  PROJECT
            WHERE           DNUM=5) )
```

NULLS IN SQL QUERIES

- SQL allows queries that check if a value is NULL (missing or undefined or not applicable)
- SQL uses **IS** or **IS NOT** to compare NULLs because it considers each NULL value distinct from other NULL values, so equality comparison is not appropriate .
- Query 14: Retrieve the names of all employees who do not have supervisors.

  ```
  Q14:    SELECT    FNAME, LNAME
          FROM      EMPLOYEE
          WHERE     SUPERSSN  IS  NULL
  ```

  Note: If a join condition is specified, tuples with NULL values for the join attributes are not included in the result

Joined Relations Feature in SQL2

- Examples:

```
Q8: SELECT      E.FNAME, E.LNAME, S.FNAME, S.LNAME
    FROM        EMPLOYEE E S
    WHERE       E.SUPERSSN=S.SSN
```

can be written as:

```
Q8: SELECT      E.FNAME, E.LNAME, S.FNAME, S.LNAME
    FROM  (EMPLOYEE E LEFT OUTER JOIN EMPLOYEES
           ON  E.SUPERSSN=S.SSN)

Q1: SELECT      FNAME, LNAME, ADDRESS
    FROM  EMPLOYEE, DEPARTMENT
    WHERE       DNAME='Research' AND DNUMBER=DNO
```

Joined Relations Feature in SQL2 (cont.)

- could be written as:

```
Q1: SELECT        FNAME, LNAME, ADDRESS
    FROM  (EMPLOYEE JOIN DEPARTMENT
           ON DNUMBER=DNO)
    WHERE         DNAME='Research’
```

or as:

```
Q1: SELECT        FNAME, LNAME, ADDRESS
    FROM  (EMPLOYEE NATURAL JOIN DEPARTMENT
           AS DEPT(DNAME, DNO, MSSN, MSDATE)
    WHERE         DNAME='Research’
```

Joined Relations Feature in SQL2 (cont.)

- Another Example;
  - Q2 could be written as follows; this illustrates multiple joins in the joined tables

```
Q2:      SELECT      PNUMBER, DNUM,
LNAME,                            BDATE,
ADDRESS
         FROM        (PROJECT JOIN
                     DEPARTMENT ON
                     DNUM=DNUMBER)
JOIN                       EMPLOYEE ON
                           MGRSSN=SSN) )
         WHERE        PLOCATION='Stafford’
```

AGGREGATE FUNCTIONS

- Include **COUNT**, **SUM**, **MAX**, **MIN**, and **AVG**
- Query 15: Find the maximum salary, the minimum salary, and the average salary among all employees.

```
Q15:    SELECT   MAX(SALARY),
                       MIN(SALARY),
AVG(SALARY)
        FROM     EMPLOYEE
```

  - Some SQL implementations *may not allow more than one function* in the SELECT-clause

AGGREGATE FUNCTIONS (cont.)

- Query 16: Find the maximum salary, the minimum salary, and the average salary among employees who work for the 'Research' department.

```
Q16: SELECT        MAX(SALARY),
MIN(SALARY),
    AVG(SALARY)
    FROM     EMPLOYEE,
DEPARTMENT
    WHERE   DNO=DNUMBER AND
                  DNAME='Research'
```

AGGREGATE FUNCTIONS (cont.)

- Queries 17 and 18: Retrieve the total number of employees in the company (Q17), and the number of employees in the 'Research' department (Q18).

```
Q17:    SELECT   COUNT (*)
        FROM     EMPLOYEE

Q18:    SELECT   COUNT (*)
        FROM     EMPLOYEE,
                 DEPARTMENT
        WHERE    DNO=DNUMBER AND

   DNAME='Research’
```

GROUPING

- In many cases, we want to apply the aggregate functions *to subgroups of tuples in a relation*
- Each subgroup of tuples consists of the set of tuples that have *the same value* for the *grouping attribute(s)*
- The function is applied to each subgroup independently
- SQL has a **GROUP BY**-clause for specifying the grouping attributes, which *must also appear in the SELECT-clause*

GROUPING (cont.)

- Query 20: For each department, retrieve the department number, the number of employees in the department, and their average salary.

```
Q20:SELECT          DNO, COUNT (*), AVG (SALARY)
    FROM   EMPLOYEE
    GROUP BY        DNO
```

  - In Q20, the EMPLOYEE tuples are divided into groups--each group having the same value for the grouping attribute DNO
  - The COUNT and AVG functions are applied to each such group of tuples separately
  - The SELECT-clause includes only the grouping attribute and the functions to be applied on each group of tuples
  - A join condition can be used in conjunction with grouping

GROUPING (cont.)

- Query 21: For each project, retrieve the project number, project name, and the number of employees who work on that project.

```
Q21:    SELECT    PNUMBER, PNAME,
COUNT (*)
        FROM      PROJECT, WORKS_ON
        WHERE     PNUMBER=PNO
        GROUP BY        PNUMBER,
PNAME
```

  - In this case, the grouping and functions are applied *after* the joining of the two relations

THE HAVING-CLAUSE

- Sometimes we want to retrieve the values of these functions for only those *groups that satisfy certain conditions*
- The HAVING-clause is used for specifying a selection condition on groups (rather than on individual tuples)

THE HAVING-CLAUSE (cont.)

- Query 22: For each project *on which more than two employees work* , retrieve the project number, project name, and the number of employees who work on that project.

```
Q22:     SELECT   PNUMBER, PNAME,
COUNT                        (*)
         FROM     PROJECT, WORKS_ON
         WHERE    PNUMBER=PNO
         GROUP BY      PNUMBER,
PNAME
         HAVING   COUNT (*) > 2
```

SUBSTRING COMPARISON

- The **LIKE** comparison operator is used to compare partial strings
- Two reserved characters are used: '%' (or '*' in some implementations) replaces an arbitrary number of characters, and '_' replaces a single arbitrary character

SUBSTRING COMPARISON (cont.)

- Query 25: Retrieve all employees whose address is in Houston, Texas. Here, the value of the ADDRESS attribute must contain the substring 'Houston,TX'.

```
Q25:    SELECT  FNAME, LNAME
        FROM            EMPLOYEE
        WHERE   ADDRESS LIKE

    '%Houston,TX%'
```

SUBSTRING COMPARISON (cont.)

- Query 26: Retrieve all employees who were born during the 1950s. Here, '5' must be the 8th character of the string (according to our format for date), so the BDATE value is '_______5_', with each underscore as a place holder for a single arbitrary character.

```
Q26:    SELECT   FNAME, LNAME
        FROM     EMPLOYEE
        WHERE    BDATE LIKE
   '_______5_’
```

- The LIKE operator allows us to get around the fact that each value is considered atomic and indivisible; hence, in SQL, character string attribute values are not atomic

ARITHMETIC OPERATIONS

- The standard arithmetic operators '+', '-'. '*', and '/' (for addition, subtraction, multiplication, and division, respectively) can be applied to numeric values in an SQL query result
- Query 27: Show the effect of giving all employees who work on the 'ProductX' project a 10% raise.

```
Q27:SELECT        FNAME, LNAME, 1.1*SALARY
                  FROM   EMPLOYEE, WORKS_ON, PROJECT
      WHERE       SSN=ESSN AND PNO=PNUMBER AND
                         PNAME='ProductX'
```

ORDER BY

- The **ORDER BY** clause is used to sort the tuples in a query result based on the values of some attribute(s)
- Query 28: Retrieve a list of employees and the projects each works in, ordered by the employee's department, and within each department ordered alphabetically by employee last name.

```
Q28:        SELECT       DNAME, LNAME, FNAME, PNAME
            FROM         DEPARTMENT, EMPLOYEE,
                         WORKS_ON, PROJECT
            WHERE        DNUMBER=DNO AND SSN=ESSN
            AND          PNO=PNUMBER
            ORDER BY     DNAME, LNAME
```

ORDER BY (cont.)

- The default order is in ascending order of values
- We can specify the keyword **DESC** if we want a descending order; the keyword **ASC** can be used to explicitly specify ascending order, even though it is the default

Summary of SQL Queries

- A query in SQL can consist of up to six clauses, but only the first two, SELECT and FROM, are mandatory. The clauses are specified in the following order:

  ```
  SELECT      <attribute list>
  FROM   <table list>
  [WHERE      <condition>]
  [GROUP BY <grouping attribute(s)>]
  [HAVING     <group condition>]
  [ORDER BY <attribute list>]
  ```

Summary of SQL Queries (cont.)

- The SELECT-clause lists the attributes or functions to be retrieved
- The FROM-clause specifies all relations (or aliases) needed in the query but not those needed in nested queries
- The WHERE-clause specifies the conditions for selection and join of tuples from the relations specified in the FROM-clause
- GROUP BY specifies grouping attributes
- HAVING specifies a condition for selection of groups
- ORDER BY specifies an order for displaying the result of a query
- A query is evaluated by first applying the WHERE-clause, then GROUP BY and HAVING, and finally the SELECT-clause

Specifying Updates in SQL

- There are three SQL commands to modify the database; INSERT, DELETE, and UPDATE

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

INSERT (cont.)

- Example:

```
U1:  INSERT INTO  EMPLOYEE
       VALUES ('Richard','K','Marini', '653298653', '30-DEC-
52',
       '98 Oak Forest,Katy,TX', 'M', 37000,'987654321', 4 )
```

- An alternate form of INSERT specifies explicitly the attribute names that correspond to the values in the new tuple
- Attributes with NULL values can be left out
- Example: Insert a tuple for a new EMPLOYEE for whom we only know the FNAME, LNAME, and SSN attributes.

```
U1A:   INSERT INTO EMPLOYEE (FNAME, LNAME, SSN)
         VALUES ('Richard', 'Marini', '653298653')
```

INSERT (cont.)

- Important Note: Only the constraints specified in the DDL commands are automatically enforced by the DBMS when updates are applied to the database
- Another variation of INSERT allows insertion of *multiple tuples* resulting from a query into a relation

INSERT (cont.)

1. **INSERT INTO**
   VALUES EMPLOYEE
   ('Richard', 'K', 'Marini', '653298653', '1962-12-30', '98
   Oak Forest,Katy,TX', 'M', 37000, '987654321', 4);
2. **INSERT INTO**
   VALUES
   EMPLOYEE (FNAME, LNAME, DNO, SSN)
   ('Richard', 'Marini', 4, '653298653');

INSERT (cont.)

- Example: Suppose we want to create a temporary table that has the name, number of employees, and total salaries for each department. A table DEPTS_INFO is created by U3A, and is loaded with the summary information retrieved from the database by the query in U3B.

```
U3A:     CREATE TABLE  DEPTS_INFO
                   (DEPT_NAME    VARCHAR(10),
                    NO_OF_EMPS   INTEGER,
                    TOTAL_SAL    INTEGER);

U3B:     INSERT INTO   DEPTS_INFO (DEPT_NAME,
                       NO_OF_EMPS, TOTAL_SAL)
         SELECT        DNAME, COUNT (*), SUM
(SALARY)
         FROM          DEPARTMENT, EMPLOYEE
         WHERE         DNUMBER=DNO
         GROUP BY      DNAME ;
```

INSERT (cont.)

- Note:
  - The DEPTS_INFO table may not be up-to-date if we change the tuples in either the DEPARTMENT or the EMPLOYEE relations *after* issuing U3B. We have to create a view (see later) to keep such a table up to date.

DELETE

- Removes tuples from a relation
- Includes a WHERE-clause to select the tuples to be deleted
- 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
- Referential integrity should be enforced

DELETE (cont.)

- Examples:

```
U4A:     DELETE FROM   EMPLOYEE
         WHERE         LNAME='Brown’

U4B:     DELETE FROM   EMPLOYEE
         WHERE
   SSN='123456789’

U4C:     DELETE FROM   EMPLOYEE
         WHERE         DNO  IN
               (SELECT DNUMBER
               FROM    DEPARTMENT
               WHERE
   DNAME='Research')

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 should be enforced

UPDATE (cont.)

- 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
```

UPDATE (cont.)

- 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

References

- *Chapter 4 : Fundamentals of Database Systems*

(6th Edition) By Remez Elmasri & Shamkant B. Navathe