COSC 3380
Design of Database Systems

Basic Structured Query Language (SQL)

March 4, 2024

Basic SQL Queries: SELECT-FROM-WHERE Structure

```
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.

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

Simple Queries

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

Basic Retrieval Queries

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';
```

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

Ambiguous Attribute Names

- Same name can be used for two (or more) attributes in different relations
  - As long as the attributes are in different relations
  - Must **qualify** the attribute name (column) with the relation name (table) to prevent ambiguity

```
Q1A:    SELECT    Fname, EMPLOYEE.Name, Address
        FROM      EMPLOYEE, DEPARTMENT
        WHERE     DEPARTMENT.Name='Research' AND
                  DEPARTMENT.Dnumber=EMPLOYEE.Dnumber;
```

Aliasing and Renaming

- **Aliases** or **tuple variables**
  - Declare alternative relation names E and S to refer to the EMPLOYEE relation twice in a query

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

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

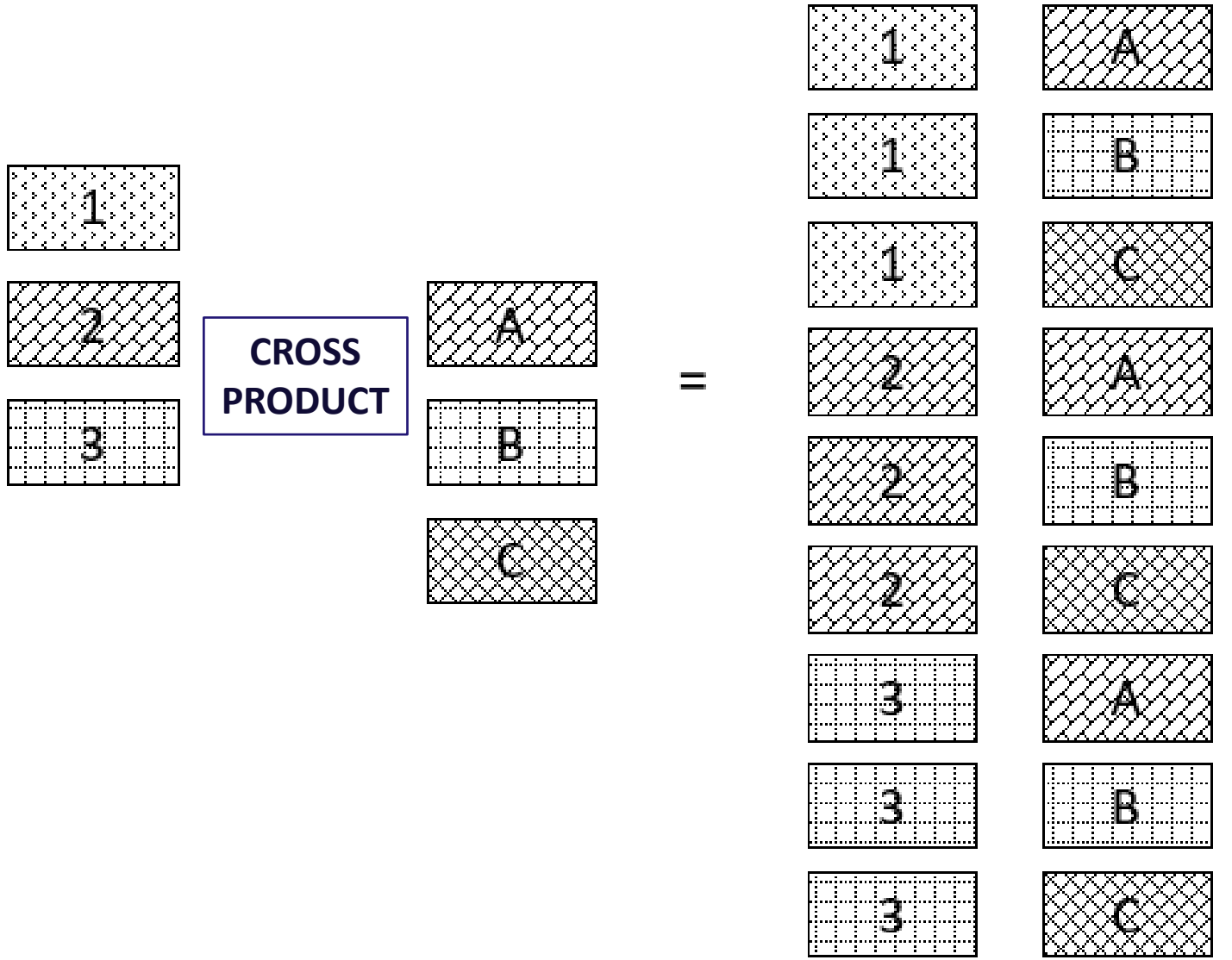
Unspecified WHERE Clause

- Missing `WHERE` clause
  - Indicates no condition on tuple selection
- Effect is a `CROSS PRODUCT`
  - Result is all possible tuple combinations (or the Algebra operation of Cartesian Product)

```
Q9:     SELECT    Ssn
        FROM      EMPLOYEE;

Q10:    SELECT    Ssn, Dname
        FROM      EMPLOYEE, DEPARTMENT;
```

Unspecified WHERE Clause – Cross Product



Unspecified WHERE Clause and Use of the Asterisk

- Specify an asterisk (*)
  - Retrieve all the attribute values of the selected tuples

```
Q1C:    SELECT    *
        FROM      EMPLOYEE
        WHERE     Dno=5;

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

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

Tables as Sets in SQL

```
Q11:    SELECT    ALL Salary
        FROM      EMPLOYEE;

Q11A:   SELECT    DISTINCT Salary
        FROM      EMPLOYEE;
```

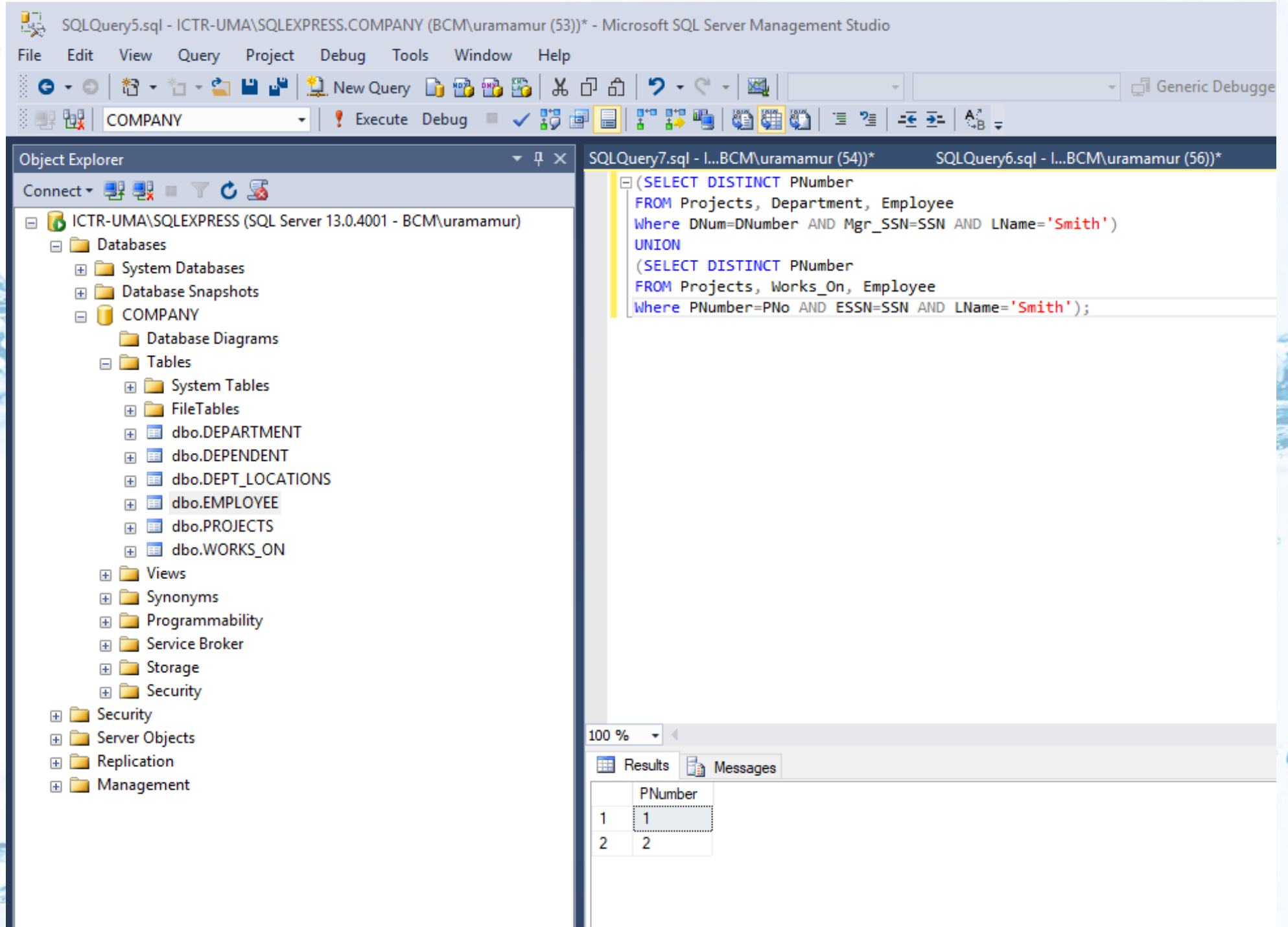
Tables as Sets in SQL

- 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

```
Q4A:  ( 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' );
```

Retrieve projects that involve 'Smith' as manager of Department which controls the project.

Retrieve projects that involve 'Smith' as a worker on the project.


SQLQuery5.sql - ICTR-UMA\SQLEXPRESS.COMPANY (BCM\uramamur (53))* - Microsoft SQL Server Management Studio
File Edit View Query Project Debug Tools Window Help
New Query
Generic Debugge
COMPANY
Execute Debug
Object Explorer
Connect
ICTR-UMA\SQLEXPRESS (SQL Server 13.0.4001 - BCM\uramamur)
Databases
System Databases
Database Snapshots
COMPANY
Database Diagrams
Tables
System Tables
FileTables
dbo.DEPARTMENT
dbo.DEPENDENT
dbo.DEPT_LOCATIONS
dbo.EMPLOYEE
dbo.PROJECTS
dbo.WORKS_ON
Views
Synonyms
Programmability
Service Broker
Storage
Security
Security
Server Objects
Replication
Management
SQLQuery7.sql - I...BCM\uramamur (54))*
SQLQuery6.sql - I...BCM\uramamur (56))*
(SELECT DISTINCT PNumber
FROM Projects, Department, Employee
Where DNum=DNumber AND Mgr_SSN=SSN AND LName='Smith')
UNION
(SELECT DISTINCT PNumber
FROM Projects, Works_On, Employee
Where PNumber=PNo AND ESSN=SSN AND LName='Smith');
100 %
Results
Messages
PNumber
1 1
2 2

Substring Pattern Matching & 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

```
WHERE (Salary BETWEEN 30000 AND 40000) AND Dno = 5;
```

```
mysql> SELECT name FROM colors WHERE name LIKE 'Gr%';
+-------+
| name  |
+-------+
| Green |
| green |
| GREEN |
+-------+
3 rows in set (0.00 sec)
```

```
mysql> SELECT name FROM colors WHERE name LIKE BINARY 'Gr%';
+-------+
| name  |
+-------+
| Green |
+-------+
1 row in set (0.00 sec)
```

Arithmetic Operations

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

```
Q13:    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';
```

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

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
```

Basic SQL Retrieval Query Block

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