Joins
Lecture 10

Multi-Table Queries

- To combine columns from several tables into a result table, we need to use a join operation.
- To perform a join, we include more than one table name in the FROM clause and WHERE clause to specify the join columns.

```
SELECT [DISTINCT|ALL] {* |column |[column_expression
                                   [AS new_name]] [,…]}
   FROM   table_name [alias] [, … ]
     [WHERE  condition];
```

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Joins in SQL

- By using joins, you can retrieve data from two or more tables based on logical relationships between the tables.
- A join condition defines the way two tables are related in a query by:

  Specifying the column from each table to be used for the join. A typical join condition specifies a foreign key from one table and its associated key (Primary Key) in the other table.

  Specifying a logical operator (for example, = or <>,) to be used in comparing values from the columns.

Computing a Join

A join is a subset of the Cartesian product.

The Cartesian product of two tables is another table consisting of all possible pairs of rows from the two table.

The columns of the product table are all the columns of the first table followed by all the columns of the second table.

Format of SELECT statement for the Cartesian product:

```
SELECT [DISTICNT | ALL]  {* | column_list }
  FROM  table_name1 CROSS JOIN  table_name2;
```

Join Example

BRANCH

BranchNo	bCity
B003	Glasgow
B004	Bristol
B002	London

PROPERTY

PropertyNo	pCity
PA14	Aberdeen
PL94	London
PG4	Glasgow

BranchNo	bCity	PropertyNo	pCity
B003	Glasgow	PG4	Glasgow
B002	London	PL94	London

```
SELECT   b.*, p.*
  FROM  branch  b, property p
    WHERE  b.bcity =  p.pcity;
```


Joins in SQL

Join Types:

INNER JOIN (Simple Join). An SQL INNER JOIN return all rows from multiple tables where the join condition is met. We can use it in FROM and WHERE Clause.

OUTER JOIN:
LEFT JOIN: Return all rows from the left table, and the matched rows from the right table

RIGHT JOIN: Return all rows from the right table, and the matched rows from the left table

FULL JOIN: Return all rows when there is a match in ONE of the tables

Inner Join / Simple Join

In the ISO standard, inner joins can be specified in either the FROM or WHERE clause. This is the only type of join that ISO supports in the WHERE clause. Inner joins specified in the WHERE clause are known as old-style inner joins.

STAFF (sno, fname, lname, position, gender, DOB, salary, bno)
BRANCH (bno, street, city, postcode)

Example:
List the names of all staff members along with their branch addresses.

```
SELECT s.sno, s.fname, s.salary, s.bno, b.bno, b.street
       FROM staff s
              INNER JOIN branch b
                     on s.bno = b.bno
```

Alternative:

```
FROM  staff WHERE s.bno = b.bno;
```


Inner Join / Simple Join

This inner join is known as an equi-join. It will returns all the columns in both tables, and returns only the rows for which there is an equal value in the join column.

Result:

	sno	fname	salary	bno	bno	street
1	s001	Naeem	80000.00	b001	b001	17 - C Johar Town
2	s002	Rehmat	50000.00	b001	b001	17 - C Johar Town
3	s003	Shakoor	30000.00	b001	b001	17 - C Johar Town
4	s004	Kamal	75000.00	b002	b002	45 - A Model Town
5	s005	Saima	45000.00	b002	b002	45 - A Model Town
6	s006	Yaseen	70000.00	b003	b003	122 - C Model Town
7	s007	Irfan	40000.00	b003	b003	122 - C Model Town
8	s008	Subhan	25000.00	b004	b004	21 - Gulberg III

Inner Join / Simple Join

Joining more than two tables:

PROPERTYFORRENT (pno, street, area, city, pcode, type, rooms, rent, sno)
STAFF (sno, fname, lname, position, gender, DOB, salary, bno)
BRANCH (bno, street, city, postcode)

Example:
List the names of all staff members along with their branch addresses working on some property.

```
SELECT b.bno, b.street, s.sno, s.fname, s.position,
        p.pno, p.street AS Location, p.sno AS P_Sno,
        p.area
                FROM staff s INNER JOIN
                        branch b ON b.bno = s.bno INNER JOIN
                                propertyforrent p ON s.sno = p.sno
```


Inner Join / Simple Join

Joining more than two tables:
Alternative:

```
SELECT b.bno, b.street, s.sno, s.fname, s.position,
                p.pno, p.street AS Location, p.sno AS P_Sno,
                p.area
                        from staff s ,branch b,  propertyforrent p
                                where s.bno = b.bno and s.sno = p.sno
```

Result:

	bno	street	sno	fname	position	pno	Location	P_Sno	area
1	b001	17 - C	s003	Shakoor	Supervisor	p001	23 - A	s003	Johar Town
2	b001	17 - C	s003	Shakoor	Supervisor	p002	45 - B	s003	Johar Town
3	b001	17 - C	s002	Rehmat	Assistant	p003	34 - B	s002	Johar Town
4	b002	45 - A	s004	Kamal	Manager	p004	87 - A	s004	Model Town
5	b002	45 - A	s004	Kamal	Manager	p005	272 - B	s004	Model Town
6	b003	122 - C	s007	Irfan	Assistant	p006	32 - C	s007	Model Town

Inner Join / Simple Join

You can also use other comparison / arithmetic operators within the where clause in joins to further specify the required data.

The following example uses a less-than (<) join to find sales prices of product 718 that are less than the list price recommended for that product.

Example:
List the names of all staff members along with their branch addresses working on some property where rent is less than 35000.

```
SELECT b.bno, b.street, s.sno, s.fname, s.position,
        p.pno, p.street AS Location, p.sno AS P_Sno,
        p.area, p.rent
            FROM staff s INNER JOIN
                branch b ON b.bno = s.bno INNER JOIN
                    propertyforrent p ON s.sno = p.sno
                        WHERE p.rent < 35000
```


	bno	street	sno	fname	position	pno	Location	P_Sno	area	rent
1	b001	17 - C	s003	Shakoor	Supervisor	p001	23 - A	s003	Johar Town	18000.00
2	b001	17 - C	s003	Shakoor	Supervisor	p002	45 - B	s003	Johar Town	25000.00
3	b001	17 - C	s002	Rehmat	Assistant	p003	34 - B	s002	Johar Town	30000.00
4	b002	45 - A	s004	Kamal	Manager	p005	272 - B	s004	Model Town	21000.00
5	b003	122 - C	s007	Irfan	Assistant	p006	32 - C	s007	Model Town	28000.00

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Sorting a Join

PROPERTYFORRENT (pno, street, area, city, pcode, type, rooms, rent, sno)
STAFF (sno, fname, lname, position, gender, DOB, salary, bno)
BRANCH (bno, street, city, postcode)

Example:
For each branch office, list the names of staff who manage properties, and the properties they manage, ordered by branch number, staff number and property number.

```
SELECT  s.bno, s.sno, fname,  lname,  pno
  FROM  staff s,  propertyforrent p
    WHERE  s.sno  =  p.sno
     ORDER BY  s.bno, s.sno, p.pno;
```


	bno	sno	fname	lname	pno
1	b001	s002	Rehmat	Elahi	p003
2	b001	s003	Shakoor	Ahmad	p001
3	b001	s003	Shakoor	Ahmad	p002
4	b002	s004	Kamal	NULL	p004
5	b002	s004	Kamal	NULL	p005
6	b003	s007	Irfan	Asghar	p006

Question

Assume the following relational schema:

EMPLOYEE (Fname, Lname, SSN, DOB, Address, gender, salary, DeptNo)
DEPARTMENT (Dname, DNo)
PROJECT (PName, PNo, PLocation, Dno)
WORKS_ON(SSN, PNo, Hours)

List all employees and identify the projects they are working on, ordered by department and, within each department, ordered alphabetically by last name, first name.

	bno	sno	count
1	b001	s002	1
2	b001	s003	2
3	b002	s004	2
4	b003	s007	1

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Outer Join

The **join** operation combines data from two tables by forming pairs of related rows where the matching columns in each table have the same value. If one row of a table is unmatched, the row is omitted from the result table.

Outer join include the unmatched rows in the result table.

Three types of outer join:

- Left Outer Join or Left Join
- Right Outer Join or Right Join
- Full Outer Join or Full Join

Outer Join

Inner joins return rows only when there is at least one row from both tables that matches the join condition.

Inner joins eliminate the rows that do not match with a row from the other table.

Outer joins, however, return all rows from at least one of the tables or views mentioned in the FROM clause, as long as those rows meet any WHERE or HAVING search conditions.

All rows are retrieved from the left table referenced with a left outer join, and all rows from the right table referenced in a right outer join.
All rows from both tables are returned in a full outer join.

SQL Server uses the following ISO keywords for outer joins specified in a FROM clause:

Left Outer Join

PROPERTYFORRENT (pno, street, area, city, pcode, type, rooms, rent, sno)
STAFF (sno, fname, lname, position, sex, DOB, salary, bno)
BRANCH (bno, street, city, postcode)

Example:
List the staff members and properties on which they are working with any unmatched staff members.

```
SELECT   s.sno, s.fname, s.bno, p.pno, p.area, p.city
         FROM  staff  s LEFT OUTER JOIN propertyforrent p
                                ON  s.sno =  p.sno;
```


STAFF

	sno	fname	lname	position	sex	DOB	salary	bno	address
1	s001	Naeem	Luqman	Manager	M	1970-06-12 ...	80000.00	b001	H# 21 - Employeer Society Model Town Link Road L...
2	s002	Rehmat	Elahi	Assistant	M	1982-08-19 ...	50000.00	b001	45 - Govt Society Johari Town Lahore
3	s003	Shakoor	Ahmad	Supervisor	M	1987-02-08 ...	30000.00	b001	33 - A Iqbal Avenue Lahore
4	s004	Kamal	NULL	Manager	M	1980-03-19 ...	75000.00	b002	45% - J Johar Town Lahore
5	s005	Saima	Asghar	Assistant	F	1983-09-28 ...	45000.00	b002	H# 561 - Y Block Defence Lahore
6	s006	Yaseen	Ahmad	Manager	M	1985-07-03 ...	70000.00	b003	61 - X Block Defence Lahore
7	s007	Irfan	Asghar	Assistant	M	1987-10-15 ...	40000.00	b003	233 - Izmir Society Canal Bank Lahore
8	s008	Subhan	NULL	Supervisor	M	1983-09-28 ...	25000.00	NULL	445 - B Johar Town Lahore
9	s009	Naeem	Ramazan	Manager	M	1987-02-08 ...	65000.00	NULL	21 - Zikriya Town Multan
10	s010	Irfan	Ali	Supervisor	M	NULL	25000.00	NULL	45 - Near 9 No Chowk Multan

Propertyforrent

	pno	street	area	city	pcode	type	rooms	rent	sno
1	p001	23 - A	Johar Town	Lahore	54000	Flat	3	18000.00	s003
2	p002	45 - B	Johar Town	Lahore	54000	House	5	25000.00	s003
3	p003	34 - B	Johar Town	Lahore	54000	House	5	30000.00	s002
4	p004	87 - A	Model Town	Lahore	54300	House	6	35000.00	s004
5	p005	272 - B	Model Town	Lahore	54300	Flat	4	21000.00	s004
6	p006	32 - C	Model Town	Lahore	54200	House	4	28000.00	s007
7	p007	99 - A	Gulgusht	Multan	60000	House	4	18000.00	NULL
8	p008	34 - B	Shah Shamas Colony	Multan	60000	House	5	20000.00	NULL

Result

	sno	fname	bno	pno	area	city
1	s001	Naeem	b001	NULL	NULL	NULL
2	s002	Rehmat	b001	p003	Johar Town	Lahore
3	s003	Shakoor	b001	p001	Johar Town	Lahore
4	s003	Shakoor	b001	p002	Johar Town	Lahore
5	s004	Kamal	b002	p004	Model Town	Lahore
6	s004	Kamal	b002	p005	Model Town	Lahore
7	s005	Saima	b002	NULL	NULL	NULL
8	s006	Yaseen	b003	NULL	NULL	NULL
9	s007	Irfan	b003	p006	Model Town	Lahore
10	s008	Subhan	NULL	NULL	NULL	NULL
11	s009	Naeem	NULL	NULL	NULL	NULL
12	s010	Irfan	NULL	NULL	NULL	NULL

Question

Assume the following relational schema:

PROPERTYFORRENT (pno, street, area, city, pcode, type, rooms, rent, sno)
STAFF (sno, fname, lname, position, sex, DOB, salary, bno)
BRANCH (bno, street, city, postcode)

List all staff members and branches in which they are working and the unmatched staff members.

Answer to Question

```
SELECT   s.sno, s.fname, s.bno, b.bno, b.area, b.city
         FROM  staff  s LEFT OUTER JOIN branch b
                              ON  s.bno =  b.bno;
```

	sno	fname	bno	bno	area	city
1	s001	Naeem	b001	b001	Johar Town	Lahore
2	s002	Rehmat	b001	b001	Johar Town	Lahore
3	s003	Shakoor	b001	b001	Johar Town	Lahore
4	s004	Kamal	b002	b002	Model Town	Lahore
5	s005	Saima	b002	b002	Model Town	Lahore
6	s006	Yaseen	b003	b003	Model Town	Lahore
7	s007	Irfan	b003	b003	Model Town	Lahore
8	s008	Subhan	NULL	NULL	NULL	NULL
9	s009	Naeem	NULL	NULL	NULL	NULL
10	s010	Irfan	NULL	NULL	NULL	NULL

Right Outer Join

Example:
List the staff members and properties on which they are working with any unmatched staff or properties.

```
SELECT    s.sno, s.fname, s.bno, p.pno, p.area, p.city
          FROM  staff  s RIGHT OUTER JOIN propertyforrent p
                              ON  s.sno =  p.sno;
```

	sno	fname	bno	pno	area	city
1	s003	Shakoor	b001	p001	Johar Town	Lahore
2	s003	Shakoor	b001	p002	Johar Town	Lahore
3	s002	Rehmat	b001	p003	Johar Town	Lahore
4	s004	Kamal	b002	p004	Model Town	Lahore
5	s004	Kamal	b002	p005	Model Town	Lahore
6	s007	Irfan	b003	p006	Model Town	Lahore
7	NULL	NULL	NULL	p007	Gulgusht	Multan
8	NULL	NULL	NULL	p008	Shah Shamas Colony	Multan

Full Outer Join

Example:
List the branch offices and properties that are in the same city and any unmatched branches or properties.

```
SELECT   s.sno, s.fname, s.bno, p.pno, p.area, p.city
        FROM  staff  s FULL OUTER JOIN propertyforrent p
                              ON  s.sno =  p.sno;
```

	sno	fname	bno	pno	area	city
1	s001	Naeem	b001	NULL	NULL	NULL
2	s002	Rehmat	b001	p003	Johar Town	Lahore
3	s003	Shakoor	b001	p001	Johar Town	Lahore
4	s003	Shakoor	b001	p002	Johar Town	Lahore
5	s004	Kamal	b002	p004	Model Town	Lahore
6	s004	Kamal	b002	p005	Model Town	Lahore
7	s005	Saima	b002	NULL	NULL	NULL
8	s006	Yaseen	b003	NULL	NULL	NULL
9	s007	Irfan	b003	p006	Model Town	Lahore
10	s008	Subhan	NULL	NULL	NULL	NULL
11	s009	Naeem	NULL	NULL	NULL	NULL
12	s010	Irfan	NULL	NULL	NULL	NULL
13	NULL	NULL	NULL	p007	Gulgusht	Multan
14	NULL	NULL	NULL	p008	Shah Sha...	Multan

Question

Assume the following relational schema:

EMPLOYEE (Fname, Lname, SSN, DOB, Address, Sex, salary, DeptNo)
DEPARTMENT (Dname, DNo)
PROJECT (PName, PNo, PLocation, Dno)
WORKS_ON(SSN, PNo, Hours)

Retrieve the names of employees who works on no project.

INSERT with subqueries

STAFF(sno, fname, lname, position, sex, DOB, salary, bno)
PROPERTYFORRENT(Pno, street, city, postcode, type, rooms, rent, ono, sno, bno)
StaffPropCount(sno, fname, lname, propcount)

Example:
Insert rows into the StaffPropCount table using the staff and property_for_rent tables.

```
INSERT INTO staffPropCount
(SELECT  s.sno, fname, lname, COUNT(*)
  FROM  staff s, PropertyForRent p
   WHERE  s.sno = p.sno
    GROUP BY s.sno, fname, lname)
```


For further reading

http://technet.microsoft.com/en-us/library/ms191517(v=sql.105).aspx