Unit 2 –Part 2: SQL –Basic Query

Database System Concepts

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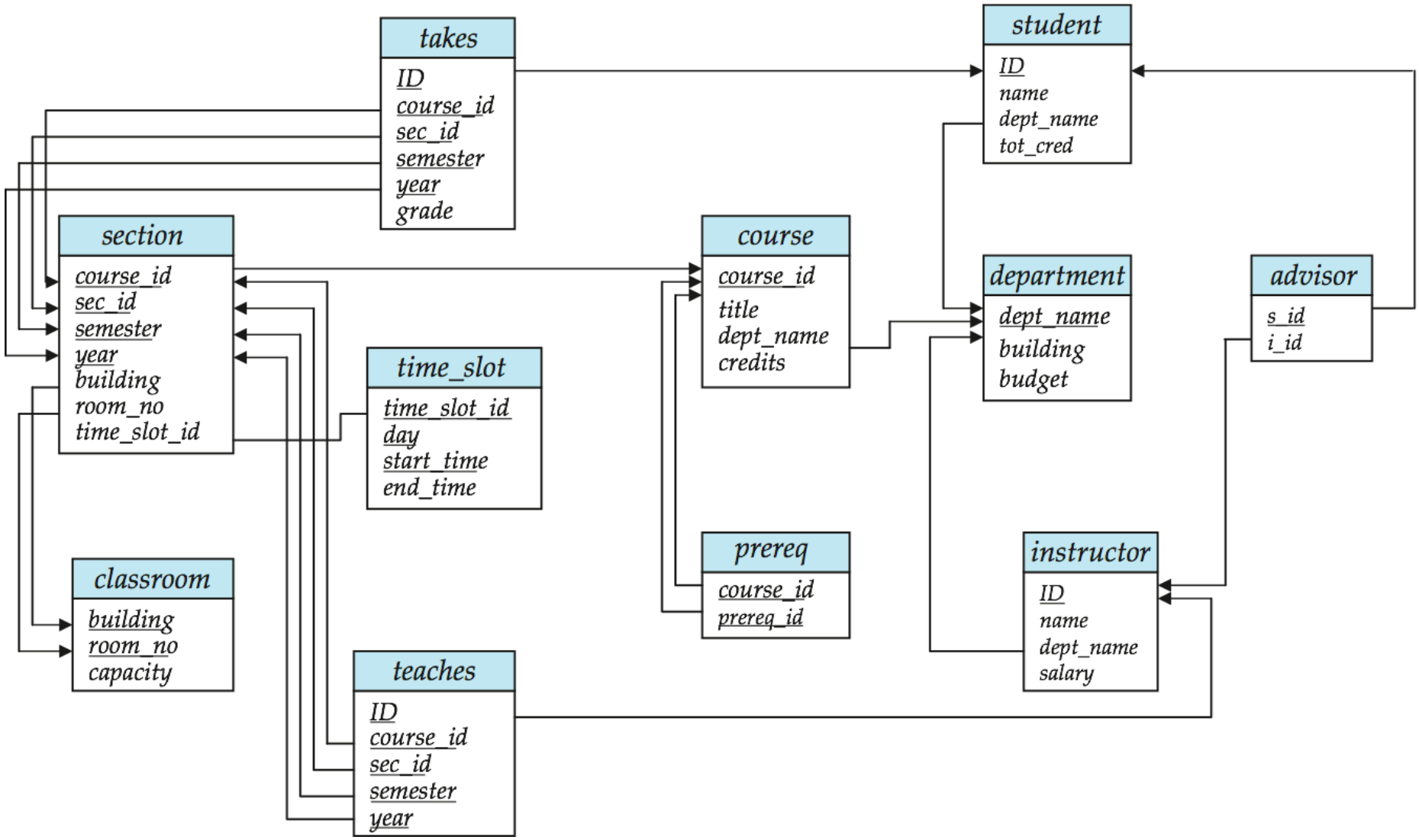
Oracle database SQL Reference

Basic SQL Query

- Basic Query Structure
- Additional Basic Operations
- Set Operations
- Null Values
- Aggregate Functions
- Nested Subqueries
- Modification of the Database

Schema



Schema referred in query examples.

Basic Query Structure

- The SQL **data-manipulation language (DML)** provides the ability to query information, and insert, delete and update tuples
- A typical SQL query has the form:

select A_1, A_2, ..., A_n
from r_1, r_2, ..., r_m
where P

  - A_i represents an attribute
  - R_i represents a relation
  - P is a predicate -condition.
- The result of an SQL query is a relation.

The select Clause

- The **select** clause list the attributes desired in the result of a query
  - corresponds to the projection operation of the relational algebra
- **Example:** find the names of all instructors:

select *name*

from *instructor*

- NOTE: SQL names are case insensitive (i.e., you may use upper- or lower-case letters.)

The select Clause (Cont.)

- SQL allows duplicates in relations as well as in query results.
- To force the elimination of duplicates, insert the keyword **distinct** after select.
- Find the names of all departments with instructor, and remove duplicates

```
select distinct dept_name
from instructor;
```

- The keyword **all** specifies that duplicates not be removed.

```
select all dept_name
from instructor;
```

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

The select Clause (Cont.)

- An **asterisk** in the select clause denotes "all attributes"

  select *
  from *instructor;*

- The **select** clause can contain **arithmetic expressions** involving the operation, **+, –, ∗,** and */**, and operating on constants or attributes of tuples.
- The query:

  select *ID, name, salary/12*
  from *instructor*

  would return a relation that is the same as the *instructor* relation, except that the value of the attribute *salary* is divided by 12.

The where Clause

- The **where** clause specifies conditions that the result must satisfy
- Find the instructors who works in physics department

```
select name
from instructor
where dept_name='Physics';
```

Simple Queries
Row selection (WHERE clause)

WHERE clause consists of five basic search conditions:

- **Comparison:** Compare the value of one expression to the value of another expression (= , <, >, <=, >=, <>).
- **Range:** Test whether the value of an expression falls within a specified range of values (BETWEEN/ NOT BETWEEN).
- **Set membership:** Test whether the value of an expression equals one of a set of values (IN/ NOT IN).
- **Pattern match:** Test whether a string matches a specified pattern (LIKE/ NOT LIKE).
- **NULL:** Test whether a column has null value (IS NULL/ IS NOT NULL).

Choosing Rows with the WHERE Clause

- The **where** clause specifies conditions that the result must satisfy
  - Corresponds to the selection predicate of the relational algebra.
- Used to return rows that match a condition, such as having a column value that exactly matches a string, a number greater or less than a value, or a string that is a prefix of another.
- The simplest WHERE clause is one that exactly matches a value.
- Consider the following relational schema:

Dept(Dno,Dname,location)

Emp(Empno, ename,job,mgrid ,date_birth ,sal ,comm ,deptno ,date_join , prj_id)

Choosing Rows with the WHERE Clause

- Display the details of empno=102.
- select * from emp where empno=102;

```
+-------+---------+------+-------+-----------+---------+---------+--------+---
---------+--------+
| empno | ename    | job  | mgrid | date_birth | sal  | comm  | deptno | date_join  |
prj_id |
+-------+---------+------+-------+-----------+---------+---------+--------+---
---------+--------+
|02| Raviraj |CLRK |05|1985-05-20 | 30000.00 | 2000.00 | d1| 2009-10-30|p1 |
+-------+---------+------+-------+-----------+---------+---------+--------+---
```

Example: Display the location of Research department.

```
select location from dept where dname='Research';
+----------+
| location |
+----------+
| MNG      |
```

Choosing Rows with the WHERE Clause

- To find number and name of all employees with salary > 80000
- select empno, ename,sal from emp where sal>80000;

```
+-------+-------+----------+
| empno | ename | sal      |
+-------+-------+----------+
|   109 | Shan  | 99999.99 |
|   110 | Sona  | 99999.99 |
+-------+-------+----------+
```

- For numbers, the frequently used operators are equals (=), greater than (>), less than (<), less than or equal (<=), greater than or equal (>=), and not equal (<> or !=).

Choosing Rows with the WHERE Clause

- Comparison results can be combined using the logical connectives **and, or,** and **not.**
- Comparisons can be applied to results of arithmetic expressions
- Example: Select the employee with salary greater than 80000 and working in the department D1
- **select** e*name*
  from *emp*
  where *deptno = 'D1'* **and** *salary* > 80000
- Find the instructors whose salary exceed 100000 after 10% increment

```
select name
from instructor
where Salary*1.1 >100000;
```

Choosing Rows with the WHERE Clause

- We can use the same operators for strings.
- For example, if we want to list all departments whose name appears earlier alphabetically than (is less than) 'M',

```
select dname from dept where dname < 'M‘
+-----------+
| dname     |
+-----------+
| Accounts  |
| Corporate |
| HR        |
| IT        |
+-----------+
```

Simple Queries –between/not between

- BETWEEN checks if a value is within a range.
- NOT BETWEEN checks if a value is outside a range.
- Example- List all employee with a salary between 30000 and 40000

  select empno,ename,sal from emp where sal between 30000 and 40000;

- This would be expressed as-

  select empno,ename,sal from emp where sal>=30000 and

  sal<=40000;

Simple Queries-in/Not in

- IN tests whether a data value matches one of a list values.
- NOT IN checks for data values that do not lie in a specific list of values.
- ***List all Managers or Assistants***.

```
select empno,ename,job from emp where job in('MGR','A.MGR');
```

- It can also be expressed as:

```
select empno,ename,job from emp where job ='MGR' OR job='A.MGR';
```

Simple Queries-Like/Not Like

- **SQL has special pattern matching symbol:**
- % represents any sequence of zero or more character(wildcard)
- _represents any single character
- **Example:**
- Address LIKE ‘H%’means that the first character must be *H*,but the rest can be anything.
- Address LIKE ‘H___’ means that there must be exactly four characters in the string,the first of which must be *H.*
- Address LIKE ‘%e’ means any sequence of characters,of length at least 1,with the last character an *e.*
- Address LIKE ‘%Glasgow%’ means a sequence of characters of any length containing *Glasgow.*
- Address NOT LIKE ‘H%’ means the first character cannot be *H.*

Simple Queries-Like/Not Like

- Example – Display the employee with the name ending with ‘raj’

```
select ename from emp where ename like '%raj';
```

- Example – Display the employee with the name four-letter word beginning with ‘S‘

```
select ename from emp where ename like ‘S___';
```

Simple Queries-is NULL/is not NULL

- NULL represents missing or unknown value
- NULL does not represent a zero or a string of blank spaces
- A NULL value cannot be tested with = or <> to another string
- We have to test for NULL explicitly
- Example: To display the employee who does not have a manager

```
select empno,ename from emp where mgrid is NULL;
```

Simple Queries-Order By clause

- Allows the retrieved records to be ordered in ascending(ASC) or descending order(DESC) on any column or combination of columns

```
SELECT {* | [column_expression] [,…]}
   FROM   table_name
     [ORDER BY  column_list [ASC|DESC] ]
```

Display the details of employee in the descending order of their salary

select empno,ename,sal from emp order by sal desc;

Simple Queries-Order By clause

- List all employees, ordered by department and within each department, ordered alphabetically by name

  select ename from emp order by deptno,ename;

Deptno	Ename
D1	Anu
D1	Suraj
D1	Tanay
D2	Suma
D2	Vandhana

The from Clause

Cartesian Product

- The **from** clause lists the relations involved in the query
  - Corresponds to the **Cartesian product** operation.
- Find the Cartesian product *instructor X teaches*

select ∗
from *instructor, teaches*

  - generates **every possible instructor – teaches pair,** with all attributes from both relations
- Cartesian product **not very useful directly**, but **useful combined with where-clause** condition.

Student

Roll No	Name	Place	Gender	Dept No
101	Ananya	Cochin	F	D1
102	Gauri	Hubli	F	D2
103	Harsha	Manipal	M	D3
104	John	Mysore	M	D1
105	Peter	Allahabad	M	D1
106	Faizal	Poona	M	D2
107	Lisa	Kanpur	F	D2

Department

Dept No	Dname
D1	Computer Applications
D2	Electronics
D3	Mathematics

Resultant Table after join

Roll No	Name	Place	Gender	Dept No	Dname
101	Ananya	Cochin	F	D1	Computer Applications
102	Gauri	Hubli	F	D2	Electronics
103	Harsha	Manipal	M	D3	Mathematics
104	John	Mysore	M	D1	Computer Applications
105	Peter	Allahabad	M	D1	Computer Applications
106	Faizal	Poona	M	D2	Electronics
107	Lisa	Kanpur	F	D2	Electronics

Cartesian Product: *instructor X teaches*

instructor

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000

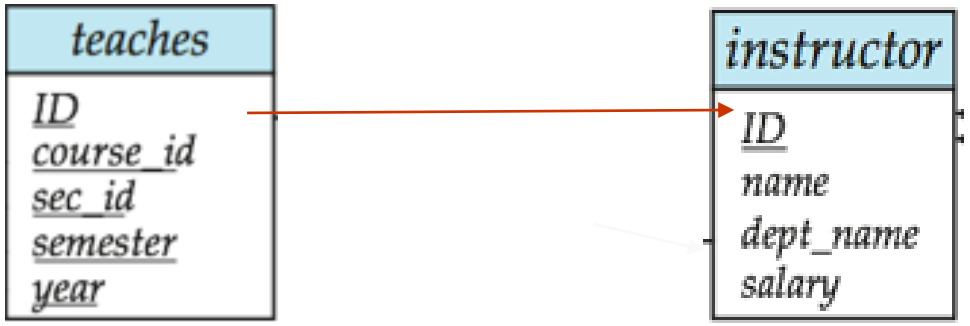
teaches

ID	*course_id*	*sec_id*	*semester*	*year*
10101	CS-101	1	Fall	2009
10101	CS-315	1	Spring	2010
10101	CS-347	1	Fall	2009
12121	FIN-201	1	Spring	2010
15151	MU-199	1	Spring	2010
22222	PHY-101	1	Fall	2009

inst.ID	*name*	*dept_name*	*salary*	*teaches.ID*	*course_id*	*sec_id*	*semester*	*year*
10101	Srinivasan	Comp. Sci.	65000	10101	CS-101	1	Fall	2009
10101	Srinivasan	Comp. Sci.	65000	10101	CS-315	1	Spring	2010
10101	Srinivasan	Comp. Sci.	65000	10101	CS-347	1	Fall	2009
10101	Srinivasan	Comp. Sci.	65000	12121	FIN-201	1	Spring	2010
10101	Srinivasan	Comp. Sci.	65000	15151	MU-199	1	Spring	2010
10101	Srinivasan	Comp. Sci.	65000	22222	PHY-101	1	Fall	2009
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
12121	Wu	Finance	90000	10101	CS-101	1	Fall	2009
12121	Wu	Finance	90000	10101	CS-315	1	Spring	2010
12121	Wu	Finance	90000	10101	CS-347	1	Fall	2009
12121	Wu	Finance	90000	12121	FIN-201	1	Spring	2010
12121	Wu	Finance	90000	15151	MU-199	1	Spring	2010
12121	Wu	Finance	90000	22222	PHY-101	1	Fall	2009
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...

Joins

For all instructors who have taught some course, find their names and the course ID of the courses they taught.



select *name, course_id*

from *instructor, teaches*

where *instructor.ID = teaches.ID*

Joins

Find the course ID, semester, year and title of each course offered by the Comp. Sci. department.

select *section.course_id, semester, year, title*

from *section, course*

where *section.course_id = course.course_id* **and** *dept_name* = 'Comp. Sci.'

Natural Join

- Natural join matches tuples with the same values for all **common attributes**, and retains **only one copy** of each common column
- **select** *
  from *instructor* **natural join** *teaches*;

ID	*name*	*dept_name*	*salary*	*course_id*	*sec_id*	*semester*	*year*
10101	Srinivasan	Comp. Sci.	65000	CS-101	1	Fall	2009
10101	Srinivasan	Comp. Sci.	65000	CS-315	1	Spring	2010
10101	Srinivasan	Comp. Sci.	65000	CS-347	1	Fall	2009
12121	Wu	Finance	90000	FIN-201	1	Spring	2010
15151	Mozart	Music	40000	MU-199	1	Spring	2010
22222	Einstein	Physics	95000	PHY-101	1	Fall	2009
32343	El Said	History	60000	HIS-351	1	Spring	2010
45565	Katz	Comp. Sci.	75000	CS-101	1	Spring	2010
45565	Katz	Comp. Sci.	75000	CS-319	1	Spring	2010
76766	Crick	Biology	72000	BIO-101	1	Summer	2009
76766	Crick	Biology	72000	BIO-301	1	Summer	2010

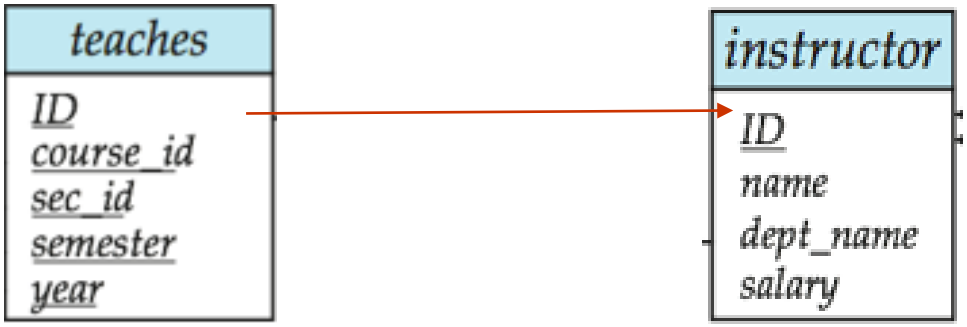
Natural Join Example

- List the names of instructors along with the course ID of the courses that they taught.

  - **select** *name*, *course_id*
    from *instructor, teaches*
    where *instructor.ID = teaches.ID*;

  OR

  - **select** *name*, *course_id*
    from *instructor* **natural join** *teaches*;



Student

Roll No	Name	Place	Gender	DeptNo
101	Ananya	Cochin	F	D1
102	Gauri	Hubli	F	D2
103	Harsha	Manipal	M	D3
104	John	Mysore	M	D1
105	Peter	Allahabad	M	D1
106	Faizal	Poona	M	D2
107	Lisa	Kanpur	F	D2

Department

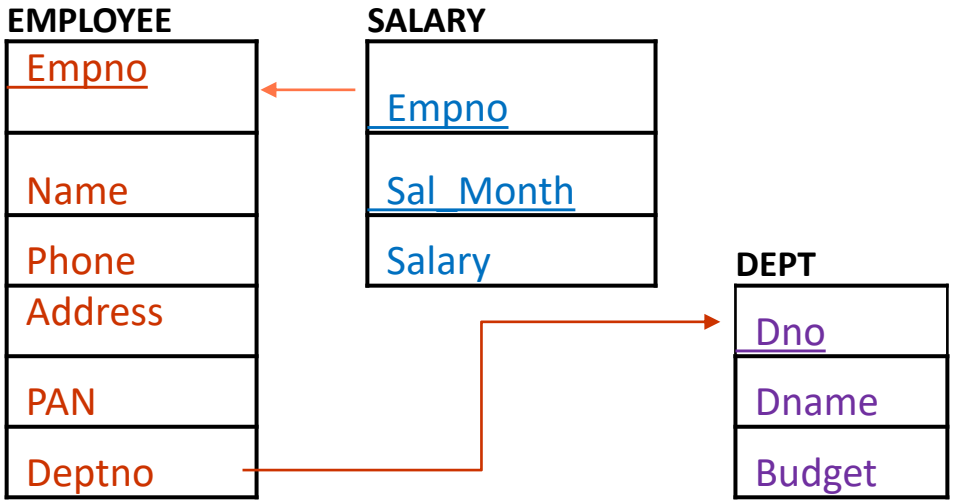
DNo	Dname
D1	Computer Applications
D2	Electronics
D3	Mathematics

Display the name of the students studying in Electronics Department

```
SELECT Name
FROM student join Department on Deptno=Dno
Where Dname='Electronics';
```

Try Writing Some Queries in SQL

- Suggest queries to be written…..



1.Display the employee Names whose PAN number is **APQTY4679Z**

2.Display name of employee along with dept name who is working in department number **10** and having PAN number **APHFR6945G**

3.Display the name of employees who got salary more than **70000** during month **August.**

4.Display the name of employees and their respective department names.

5.Display the name of employees who are working in the '**Research'** department

6.Display the name of employee, Salary and name of department in which he is working.

DEPT

DNO	DNAME	BUDGET
10	Research	569080
11	Production	6798980
12	Finance	989808

EMPLOYEE

EMPNO	ENAME	PHONE	ADDRESS	PAN	DEPTNO
101	Ashu	8980909091	Manipal	APQTY4679Z	10
102	Vemu	9800909091	Mumbai	APHFR6945G	10
103	Saru	8030909091	Mumbai	BPHFR9945G	11
104	Paru	7803909091	Pune	DPHFR9745G	11
105	Vishu	7865390909	Pune	ANHFR9748G	12

SALARY

EMPNO	SALARY_MON	SALARY
101	August	65000
101	September	75000
102	August	174000
102	September	175000
103	August	94000
104	August	64000
105	August	65000
105	September	65500

1) Display the employee Names whose PAN number is **APQTY4679Z**

```
SELECT ename
FROM employee
WHERE pan='APQTY4679Z';
```

```
ENAME
--------------------
Ashu
```

2.Display name of employee along with dept name who is working in department number **10** and having PAN number **APHFR6945G**

```
SELECT ename,dname
FROM employee join dept on employee.deptno=dept.dno
WHERE deptno=10 and pan='APHFR6945G';
```

```
ENAME                DNAME
-------------------- --------------------
Vemu                 Research
```

3.Display the name of employees who got salary more than **70000** during month **August.**

```
SELECT ename
FROM employee natural join salary
WHERE salary>70000 and salary_month='August';
```

```
ENAME
--------------------
Vemu
Saru
```

4.Display the name of employees and their respective department names

```
SELECT ename,dname
FROM employee join dept on employee.deptno=dept.dno;
```

```
ENAME                DNAME
-------------------- ------------------------------
Ashu                  Research
Vemu                  Research
Saru                 Production
Paru                 Production
Vishu                 Finance
```

5. Display the name, phone no, location of employees who are working in the '**Research'** department

```
SELECT ename,phone,address
 FROM employee join dept on employee.deptno=dept.dno
 WHERE dname='Research';
```

ENAME	PHONE	ADDRESS
Ashu	8980909091	Manipal
Vemu	9800909091	Mumbai

6. Display the name of employee, salary and name of department in which he is working

```
SELECT ename,salary,dname
 FROM employee e JOIN dept d ON e.deptno=d.dno
 JOIN salary s ON e.empno=s.empno;
```

ENAME	SALARY_MON	SALARY	DNAME
Ashu	August	65000	Research
Ashu	September	75000	Research
Vemu	August	174000	Research
Vemu	September	175000	Research
Saru	August	94000	Production
Paru	August	64000	Production
Vishu	August	65000	Finance
Vishu	September	65500	Finance

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**
- **Right**
- **Full**

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;

In the example Branch b , property p, **b** and **p** are said to be Alias names to the tables branch & property respectively.

Left Outer Join

Example:

List the branch offices and properties that are in the same city along with any unmatched branches.

```
SELECT  b.*, p.*
        FROM  branch  b
                LEFT  JOIN  property  p ON
                        b.bcity  =  p.pcity;
```

Result of Left Outer Join

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
B004	Bristol	NULL	NULL
B002	London	PL94	London

```
SELECT  b.*, p.*
 FROM  branch  b
  LEFT  JOIN  property  p ON
            b.bcity  =  p.pcity;
```

Right Outer Join

Example:

List the branch offices and properties in the same city and any unmatched property.

```
SELECT  b.*, p.*
        FROM  branch  b
              RIGHT JOIN  property  p ON
                    b.bcity  =  p.pcity;
```

Result of Right Outer Join

BRANCH

BranchNo	bCity
B003	Glasgow
B004	Bristol
B002	London

PROPERTY

PropertyNo	pCity
PA14	Aberdeen
PL94	London
PG4	Glasgow

BranchNo	bCity	PropertyNo	pCity
NULL	NULL	PA14	Aberdeen
B003	Glasgow	PL94	London
B002	London	PG4	Glasgow

```
SELECT  b.*, p.*
  FROM  branch  b
     RIGHT  JOIN  property  p ON
              b.bcity  =  p.pcity;
```

Full Outer Join

Example:

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

```
SELECT  b.*, p.*
        FROM  branch  b
                FULL JOIN  property  p ON
                        b.bcity  =  p.pcity;
```

Result of FULL Outer Join

BRANCH

BranchNo	bCity
B003	Glasgow
B004	Bristol
B002	London

PROPERTY

PropertyNo	pCity
PA14	Aberdeen
PL94	London
PG4	Glasgow

BranchNo	bCity	PropertyNo	pCity
NULL	NULL	PA14	Aberdeen
B003	Glasgow	PG4	Glasgow
B004	Bristol	NULL	NULL
B002	London	PL94	London

```
SELECT  b.*, p.*
  FROM  branch  b
     FULL  JOIN  property  p ON
           b.bcity  =  p.pcity;
```

The Rename Operation

- The SQL allows renaming relations and attributes using the **as** clause:

  old-name **as** *new-name*

- E.g.
  - **select** *ID*, *name*, *salary/12* **as** *monthly_salary*
    from *instructor*

- Keyword **as** is optional and may be omitted

  instructor **as** *T* ≡ *instructor T*
  - Keyword **as** must be omitted in Oracle

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

Compare Tuples in the Same Relation-Self Join

- Another reason to rename a relation is a case where we wish to compare tuples in the same relation. We then need to take the Cartesian product of a relation with itself.
- Since we need to join a tuple of relation with another tuple in the same relation, It becomes impossible to distinguish one tuple from another without renaming.
- **Example: Find the names of all instructors who have a higher salary than some instructor in 'Comp. Sci'.**
  - **select distinct** *T. name*

    from *instructor T, instructor S*

    where *T.salary > S.salary* **and** *S.dept_name = 'Comp. Sci.'*

An identifier, such as ***T*** and ***S***, that is used to rename a relation is referred to as a **correlation name** and is also commonly referred to as a **table alias**, or a **correlation variable**, or a **tuple variable**.

Set Operations-UNION

- **Display Employee names who are working in deptno 10 , 20.**
- **Assume the schema EMP(empno,ename,sal,deptno)**

```
SELECT Ename
FROM Emp WHERE deptno=10
UNION
SELECT Ename
FROM Emp WHERE deptno=20;
```

The query is equivalent to-

```
SELECT Ename
FROM Emp
WHERE deptno=10 OR deptno=20;
```

Set Operations-INTERESECT

- **Find the name of employees working in department –'RESEARCH' and drawing salary more than 25000.**
- **Assume Emp(**empno,ename,sal,deptno**) & Dept(**Deptno,Dname,City**)**
  - **Emp.deptno is F.key referencing Dept.Deptno(p.key)**

Select ename from emp,dept where **emp.deptno=dept.deptno and dname='RESEARCH'**

INTERSECT

Select ename from emp,dept where **emp.deptno=dept.deptno** and **sal>25000;**

Set Operations-MINUS

- **Find ename and deptno from emp who are not working in deptno 20.**

Select empno,ename,deptno from emp

MINUS

Select empno,ename,deptno from emp where deptno=20;

Section

course_id	*sec_id*	*semester*	*year*	*building*	*room_number*	*time_slot_id*
BIO-101	1	Summer	2009	Painter	514	B
BIO-301	1	Summer	2010	Painter	514	A
CS-101	1	Fall	2009	Packard	101	H
CS-101	1	Spring	2010	Packard	101	F
CS-190	1	Spring	2009	Taylor	3128	E
CS-190	2	Spring	2009	Taylor	3128	A
CS-315	1	Spring	2010	Watson	120	D
CS-319	1	Spring	2010	Watson	100	B
CS-319	2	Spring	2010	Taylor	3128	C
CS-347	1	Fall	2009	Taylor	3128	A
EE-181	1	Spring	2009	Taylor	3128	C
FIN-201	1	Spring	2010	Packard	101	B
HIS-351	1	Spring	2010	Painter	514	C
MU-199	1	Spring	2010	Packard	101	D
PHY-101	1	Fall	2009	Watson	100	A

Set Operations

- Find courses that ran in Fall 2009 or in Spring 2010

(**select** *course_id* **from** *section* **where** *sem* = 'Fall' **and** *year* = 2009)
union
(**select** *course_id* **from** *section* **where** *sem* = 'Spring' **and** *year* = 2010)

- Find courses that ran in Fall 2009 and in Spring 2010

(**select** *course_id* **from** *section* **where** *sem* = 'Fall' **and** *year* = 2009)
intersect
(**select** *course_id* **from** *section* **where** *sem* = 'Spring' **and** *year* = 2010)

- Find courses that ran in Fall 2009 but not in Spring 2010

(**select** *course_id* **from** *section* **where** *sem* = 'Fall' **and** *year* = 2009)
except
(**select** *course_id* **from** *section* **where** *sem* = 'Spring' **and** *year* = 2010)

Set Operations

- Set operations **union**, **intersect**, and **Minus**
  - Each of the above operations automatically eliminates duplicates
- To retain all duplicates use the corresponding multiset versions **union all.**

Operator	Returns
UNION	All distinct rows selected by either query
UNION ALL	All rows selected by either query, including all duplicates
INTERSECT	All distinct rows selected by both queries
MINUS	All distinct rows selected by the first query but not the second

- Suppose a tuple occurs *m* times in *r* and *n* times in *s,* then, it occurs:
  - *m* + *n* times in *r* **union all** *s*

Null Values

- It is possible for tuples to have a null value, denoted by *null*, for some of their attributes
- *null* signifies an unknown value or that a value does not exist.
- The result of any arithmetic expression involving *null* is *null*
  - **Example**: **5 + *null*** returns null
- The predicate **is null** can be used to check for null values.
  - **Example**: Find all instructors whose salary is null.

select *name*
from *instructor*
where *salary* **is null**

IS NULL/ IS NOT NULL

.

Example:

List the details of all staff who have only first name but not last name.

```
SELECT sno, fname, lname, salary
  FROM staff
    WHERE  lname IS NULL.
```

Null Values and Three Valued Logic

- Any **comparison with *null* returns *unknown***
  - Example*: 5 < null or null <> null or null = null*
- Three-valued logic using the truth value *unknown*:
  - OR: (*unknown* **or** *true*) = *true*,
    (*unknown* **or** *false*) = *unknown*
    (*unknown* **or** *unknown)* = *unknown*
  - AND: *(true* **and** *unknown)* = *unknown,*
    (false **and** *unknown)* = *false,*
    (unknown **and** *unknown)* = *unknown*
  - NOT*: (***not** *unknown)* = *unknown*
- Result of **where** clause predicate is treated as *false* if it evaluates to *unknown*

Aggregate Functions

- These functions operate on the multiset of values of a column of a relation, and return a value

avg: average value

min: minimum value

max: maximum value

sum: sum of values

count: number of values

Consider the following relation to write SQL queries

Student(RollNo,Name,Mark1)

Roll No	Name	Mark1
101	Anu	45
102	Shan	44
103	Diya	30
104	Arun	25
105	Farah	30

- **AVG()**

  SELECT AVG(*column_name*) FROM *table_name* WHERE *condition*;

  SELECT AVG(Mark1) FROM Student;

  AVG(Mark1)

  34.8

- **SUM()**

  SELECT SUM(*column_name*) FROM *table_name* WHERE *condition*;

  SELECT SUM(Mark1) FROM Student;

  SUM(Mark1)

  174

- **COUNT()**

  SELECT COUNT(*column_name*) FROM *table_name* WHERE *condition*;

  SELECT COUNT(Mark1) FROM Student;

- **MAX()**

  SELECT MAX(*column_name*) FROM *table_name* WHERE *condition*;

  SELECT MAX(Mark1) FROM Student;

- **MIN()**

  SELECT MIN(*column_name*) FROM *table_name* WHERE *condition*;

  SELECT MIN(Mark1) FROM Student;

Aggregate Functions (Cont.)

- **Find the average salary of instructors in the Computer Science department**
  - **select avg** (*salary*)
    from *instructor*
    where *dept_name*= 'Comp. Sci.';

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

- **Find the total number of instructors who teach a course in the Spring 2010 semester**
  - **select count** (**distinct** *ID*)
    from *teaches*
    where *semester* = 'Spring' **and** *year* = 2010

ID	*course_id*	*sec_id*	*semester*	*year*
10101	CS-101	1	Fall	2009
10101	CS-315	1	Spring	2010
10101	CS-347	1	Fall	2009
12121	FIN-201	1	Spring	2010
15151	MU-199	1	Spring	2010
22222	PHY-101	1	Fall	2009
32343	HIS-351	1	Spring	2010
45565	CS-101	1	Spring	2010
45565	CS-319	1	Spring	2010
76766	BIO-101	1	Summer	2009
76766	BIO-301	1	Summer	2010
83821	CS-190	1	Spring	2009
83821	CS-190	2	Spring	2009
83821	CS-319	2	Spring	2010
98345	EE-181	1	Spring	2009

- **Find the number of tuples in the *course* relation**
  - **select count** (*) **from** *course*;

Aggregate Functions – Group By

- **Find the average salary of instructors in each department**
  - **select** *dept_name*, **avg** (*salary*)
    from *instructor*
    group by *dept_name*;
  - **Note:** departments with no instructor will not appear in result

ID	*name*	*dept_name*	*salary*
76766	Crick	Biology	72000
45565	Katz	Comp. Sci.	75000
10101	Srinivasan	Comp. Sci.	65000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000
12121	Wu	Finance	90000
76543	Singh	Finance	80000
32343	El Said	History	60000
58583	Califieri	History	62000
15151	Mozart	Music	40000
33456	Gold	Physics	87000
22222	Einstein	Physics	95000

dept_name	*avg_salary*
Biology	72000
Comp. Sci.	77333
Elec. Eng.	80000
Finance	85000
History	61000
Music	40000
Physics	91000

Aggregation (Cont.)

- Attributes in **select** clause outside of aggregate functions must appear in **group by** list
  - /* erroneous query */

    select *dept_name*, *ID*, **avg** (*salary*)

    from *instructor*

    group by *dept_name*;

Aggregate Functions – Having Clause

- Find the names and average salaries of all departments whose average salary is greater than 42000

```
select dept_name, avg (salary)
from instructor
group by dept_name
having avg (salary) > 42000;
```

Note: predicates in the **having** clause **are applied after the formation of groups** whereas predicates in the **where** clause are applied **before forming groups**

Null Values and Aggregates

- Total all salaries

  select sum (*salary*)
  from *instructor*

  - Above statement **ignores** null amounts
  - Result is *null* if there is no non-null amount
- All aggregate operations except **count(*)** ignore tuples with null values on the aggregated attributes
- What if collection has only null values?
  - count returns **0**
  - all other aggregates return **null**

Nested Subqueries

- SQL provides a mechanism for the nesting of subqueries
- A **subquery** is a **select-from-where** expression that is nested within another query
- The subquery can be nested inside a SELECT, INSERT, UPDATE, or DELETE statement or inside another subquery
- A subquery is also called an inner query or inner select, while the statement containing a subquery is also called an outer query or outer select
- The inner query executes first before its parent query so that the results of an inner query can be passed to the outer query

Nested Subqueries

- A common use of subqueries is to perform tests for set membership, set comparisons, and set cardinality
- Syntax:

```
SELECT    select_list
FROM      table
WHERE     expr operator
                    (SELECT    select_list
                     FROM      table);
```

Nested Subqueries

Student

StudentID	Name
V001	Abe
V002	Abhay
V003	Acelin
V004	Adelphos

Marks

StudentID	Total_marks
V001	95
V002	80
V003	74
V004	81

Write a query to identify all students who get better marks than that of the student who's StudentID is 'V002'

Query

SELECT a.studentid, a.name, b.total_marks

FROM student a, marks b

WHERE a.studentid = b.studentid AND b.total_marks >80;

```
SELECT a.studentid, a.name, b.total_marks
FROM student a, marks b
WHERE a.studentid = b.studentid
AND b.total_marks >
(SELECT total_marks FROM marks WHERE studentid =
'V002');
```

Subqueries

There are some guidelines to consider when using subqueries :

- A subquery must be enclosed in parentheses.
- A subquery must be placed on the right side of the comparison operator.
- Subqueries cannot manipulate their results internally, therefore ORDER BY clause cannot be added into a subquery. You can use an ORDER BY clause in the main SELECT statement (outer query) which will be the last clause.
- Use single-row operators with single-row subqueries.
- If a subquery (inner query) returns a null value to the outer query, the outer query will not return any rows when using certain comparison operators in a WHERE clause.

Types of Subquery

- Single row subquery : Returns zero or one row.
- Multiple row subquery : Returns one or more rows.
- Multiple column subqueries : Returns one or more columns.
- Correlated subqueries : Reference one or more columns in the outer SQL statement. The subquery is known as a correlated subquery because the subquery is related to the outer SQL statement.
- Nested subqueries : Subqueries are placed within another subquery.

Set Membership

- SQL allows testing tuples for membership in a relation.
- The **in** connective tests for set membership, where the set is a collection of values produced by a **select** clause.
- The **not in** connective tests for the absence of set membership.

Example Query

- Find courses offered in Fall 2009 and in Spring 2010

```
select distinct course_id
from section
where semester = 'Fall' and year= 2009 and
        course_id in (select course_id
                      from section
                      where semester = 'Spring' and year= 2010);
```

- Find courses offered in Fall 2009 but not in Spring 2010

```
select distinct course_id
from section
where semester = 'Fall' and year= 2009 and
        course_id  not in (select course_id
                      from section
                      where semester = 'Spring' and year= 2010);
```

ID	course_id	sec_id	semester	year	grade
00128	CS-101	1	Fall	2009	A
00128	CS-347	1	Fall	2009	A-
12345	CS-101	1	Fall	2009	C
12345	CS-190	2	Spring	2009	A
12345	CS-315	1	Spring	2010	A
12345	CS-347	1	Fall	2009	A
19991	HIS-351	1	Spring	2010	B
23121	FIN-201	1	Spring	2010	C+
44553	PHY-101	1	Fall	2009	B-
45678	CS-101	1	Fall	2009	F
45678	CS-101	1	Spring	2010	B+
45678	CS-319	1	Spring	2010	B
54321	CS-101	1	Fall	2009	A-
54321	CS-190	2	Spring	2009	B+
55739	MU-199	1	Spring	2010	A-
76543	CS-101	1	Fall	2009	A
76543	CS-319	2	Spring	2010	A
76653	EE-181	1	Spring	2009	C
98765	CS-101	1	Fall	2009	C-
98765	CS-315	1	Spring	2010	B
98988	BIO-101	1	Summer	2009	A
98988	BIO-301	1	Summer	2010	*null*

Takes

ID	course_id	sec_id	semester	year
10101	CS-101	1	Fall	2009
10101	CS-315	1	Spring	2010
10101	CS-347	1	Fall	2009
12121	FIN-201	1	Spring	2010
15151	MU-199	1	Spring	2010
22222	PHY-101	1	Fall	2009
32343	HIS-351	1	Spring	2010
45565	CS-101	1	Spring	2010
45565	CS-319	1	Spring	2010
76766	BIO-101	1	Summer	2009
76766	BIO-301	1	Summer	2010
83821	CS-190	1	Spring	2009
83821	CS-190	2	Spring	2009
83821	CS-319	2	Spring	2010
98345	EE-181	1	Spring	2009

Teaches

Example Query

- Find the total number of (distinct) students who have taken course sections taught by the instructor with *ID* 10101

SELECT COUNT(distinct S.ID)
FROM takes S **join** teaches T **on** S.course_id=T.course_id and S.sec_id=T.sec_id and S.semester=T.semester and S.year=T.year
WHERE T.ID=10101.

OR

select count (**distinct** *ID*)
from *takes*
where (*course_id*, *sec_id*, *semester*, *year*) **in**
(**select** *course_id*, *sec_id*, *semester*, *year*
from *teaches*
where *teaches*.*ID*= 10101);

Set Comparison

- Find names of instructors with salary greater than that of some (at least one) instructor in the Comp.Sci.department.

select distinct *T.name*
from *instructor* **as** *T*, *instructor* **as** *S*
where *T.salary* > *S.salary* **and** *S.dept_name* = ’ Comp.Sci.’;

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

Instructor

- Same query using > **some** clause

select *name*
from *instructor*
where *salary* > **some** (**select** *salary*
from *instructor*
where *dept_name* = ’ Comp.Sci.’);

Definition of Some Clause

- F <comp> **some** $r \Leftrightarrow \exists\, t \in r$ such that (F <comp> t)
  Where <comp> can be: $<,\ \leq,\ >,\ =,\ \neq$

(5 < **some** | 0 / 5 / 6 |) = true (read: 5 < some tuple in the relation)

(5 < **some** | 0 / 5 |) = false

(5 = **some** | 0 / 5 |) = true

(5 ≠ **some** | 0 / 5 |) = true (since 0 ≠ 5)

(= **some**) ≡ **in**
However, (≠ **some**) ≢ **not in**

SQL> **select empno, ename,sal,deptno from emp order by deptno;**

EMPNO	ENAME	SAL	DEPTNO
7934	MILLER	10000	10
7782	CLARK	2450	10
7839	KING	5000	10
1000	DDD	3333	10
7566	JONES	2975	20
7369	SMITH	800	20
1001	EEEE	2005	20
7902	FORD	3000	20
7876	ADAMS	1100	20
7788	SCOTT	3000	20
7900	JAMES	950	30
7499	ALLEN	1600	30
7844	TURNER	1500	30
50	BBB	777	30
7521	WARD	1250	30
7698	BLAKE	2850	30
7654	MARTIN	1250	30

Find the Employee No, Sal and Deptno of employees who earn salary more than any employee in Dept 20

SQL> **select sal, deptno from emp where deptno=20;**

SAL	DEPTNO
2005	20
800	20
2975	20
3000	20
1100	20
3000	20

SQL> **select empno,sal,deptno from emp where**

sal > some(select sal from emp where deptno=20);

EMPNO	SAL	DEPTNO
7934	10000	10
7839	5000	10
1000	3333	10
7788	3000	20
7902	3000	20
7566	2975	20
7698	2850	30
7782	2450	10
1001	2005	20
7499	1600	30
7844	1500	30
7654	1250	30
7521	1250	30
7876	1100	20
7900	950	30

50 777 30 will not appear as result here, because salary 777 **is lesser than salary of all the employees** in the department 20

Example: Find employee name and their manager names.

EMP(Empno,Ename,Mgrno,Deptno)

SQL> select s.empno ,t.empno mgr_no,s.ename,t.ename mgr_name from emp s, emp t where **s.mgr_no=t.empno;**

EMPNO	MGR_NO	ENAME	MGR_NAME
7902	7566	FORD	JONES
7788	7566	SCOTT	JONES
7900	7698	JAMES	BLAKE
7844	7698	TURNER	BLAKE
7654	7698	MARTIN	BLAKE
7521	7698	WARD	BLAKE
7499	7698	ALLEN	BLAKE
7934	7782	MILLER	CLARK
7876	7788	ADAMS	SCOTT
7782	7839	CLARK	KING
7698	7839	BLAKE	KING
7566	7839	JONES	KING
7369	7902	SMITH	FORD

Example Query

- Find the names of all instructors whose salary is greater than the salary of all instructors in the Biology department.

```
select name
from instructor
where salary > all (select salary
                    from instructor
                    where dept_name = 'Comp.Sci.');
```

Instructor

ID	name	dept_name	salary
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

Definition of all Clause

- F <comp> **all** $r \Leftrightarrow \forall\ t \in r$ (F <comp> *t)*

(5 < **all** | 0, 5, 6 |) = false

(5 < **all** | 6, 10 |) = true

(5 = **all** | 4, 5 |) = false

(5 ≠ **all** | 4, 6 |) = true (since 5 ≠ 4 and 5 ≠ 6)

(≠ **all**) ≡ **not in**

However, (= **all**) ≢ **in**

SQL> **select empno, ename,sal,deptno from emp order by deptno;**

EMPNO	ENAME	SAL	DEPTNO
7934	MILLER	10000	10
7782	CLARK	2450	10
7839	KING	5000	10
1000	DDD	3333	10
7566	JONES	2975	20
7369	SMITH	800	20
1001	EEEE	2005	20
7902	FORD	3000	20
7876	ADAMS	1100	20
7788	SCOTT	3000	20
7900	JAMES	950	30
7499	ALLEN	1600	30
7844	TURNER	1500	30
50	BBB	777	30
7521	WARD	1250	30
7698	BLAKE	2850	30
7654	MARTIN	1250	30

Find the Employee No, Sal and Deptno of employees who earn salary more than every employee in Dept 20

SQL> **select sal,deptno from emp where deptno=20;**

SAL	DEPTNO
2005	20
800	20
2975	20
3000	20
1100	20
3000	20

SQL> select empno,sal,deptno from emp where sal > all (select sal from emp where deptno=20);

EMPNO	SAL	DEPTNO
1000	3333	10
7839	5000	10
7934	10000	10

- Write the previous query by comparing salary of employees with maximum salary of employees in the department 20;

Select empno,sal,deptno from emp where sal >

(Select max(sal) From Emp where deptno=20);

Example query

- Find the departments that have the highest average salary

select *dept name*

from *instructor*

group by *dept name*

having avg (*salary*) >= **all** (**select avg** (*salary*)

from *instructor*

group by *dept name*);

Instructor

ID	*name*	*dept_name*	*salary*
76766	Crick	Biology	72000
45565	Katz	Comp. Sci.	75000
10101	Srinivasan	Comp. Sci.	65000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000
12121	Wu	Finance	90000
76543	Singh	Finance	80000
32343	El Said	History	60000
58583	Califieri	History	62000
15151	Mozart	Music	40000
33456	Gold	Physics	87000
22222	Einstein	Physics	95000

dept_name	*avg_salary*
Biology	72000
Comp. Sci.	77333
Elec. Eng.	80000
Finance	85000
History	61000
Music	40000
Physics	91000

Correlated Subquery

- Correlated subqueries are used for row-by-row processing
- Each subquery is executed once for every row of the outer query.
- A correlated subquery is evaluated once for each row processed by the parent statement
- The parent statement can be a **SELECT**, **UPDATE**, or **DELETE** statement.

```
SELECT column1, column2, ....
FROM table1 outer
WHERE column1 operator
                (SELECT column1, column2
                 FROM table2
                 WHERE expr1 = outer.expr2 );
```

Correlated Subquery

- Find all the instructors who earn more than their department average salary.

```
SELECT name, salary, dept_name
FROM instructor outer
WHERE salary >
(SELECT AVG(salary)
 FROM instructor
 WHERE dept_name= outer.dept_name;
```

ID	*name*	*dept_name*	*salary*
76766	Crick	Biology	72000
45565	Katz	Comp. Sci.	75000
10101	Srinivasan	Comp. Sci.	65000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000
12121	Wu	Finance	90000
76543	Singh	Finance	80000
32343	El Said	History	60000
58583	Califieri	History	62000
15151	Mozart	Music	40000
33456	Gold	Physics	87000
22222	Einstein	Physics	95000

dept_name	*avg_salary*
Biology	72000
Comp. Sci.	77333
Elec. Eng.	80000
Finance	85000
History	61000
Music	40000
Physics	91000

Correlated Subquery

- Use of Exists and Not Exists
- The EXISTS operator tests for existence of rows in the results set of the subquery
- If a subquery row value is found the condition is flagged **TRUE** and the search does not continue in the inner query, and if it is not found then the condition is flagged **FALSE** and the search continues in the inner query

Correlated Subquery

- "Find all courses taught in both the Fall 2009 semester and in the Spring 2010 semester"

```
select course_id
from section S
where semester = 'Fall' and year= 2009 and
  exists (select *
            from section T
            where semester = 'Spring'
and year= 2010
and S.course_id= T.course_id);
```

course_id	sec_id	semester	year	building	room_number	time_slot_id
BIO-101	1	Summer	2009	Painter	514	B
BIO-301	1	Summer	2010	Painter	514	A
CS-101	1	Fall	2009	Packard	101	H
CS-101	1	Spring	2010	Packard	101	F
CS-190	1	Spring	2009	Taylor	3128	E
CS-190	2	Spring	2009	Taylor	3128	A
CS-315	1	Spring	2010	Watson	120	D
CS-319	1	Spring	2010	Watson	100	B
CS-319	2	Spring	2010	Taylor	3128	C
CS-347	1	Fall	2009	Taylor	3128	A
EE-181	1	Spring	2009	Taylor	3128	C
FIN-201	1	Spring	2010	Packard	101	B
HIS-351	1	Spring	2010	Painter	514	C
MU-199	1	Spring	2010	Packard	101	D
PHY-101	1	Fall	2009	Watson	100	A

- **select** *course_id*
  from *section S*
  where *semester* = ’Fall’ **and** *year*= 2009
- Result is –
- course_id**={CS-101,CS-347,PHY-101}**

- **select** *
  from *section T*
  where *semester* = ’Spring’ **and** *year*= 2010
- Result is-

{<CS-101,..>,< CS-315,…>,<CS-319,…>,<FIN-201,…>,<HIS-351,…>,<MU-199,…>}

and *S.course_id= T.course_id*);

CS-101=CS-101 YES, inner query return row(row exists satisfying)

CS-347=CS-101/CS-325/….MU-199 NO, No row exists.

PHY-101= CS-101/CS-325/….MU-199 NO, No row exists

Find the customers who have placed order on the date 2016/04/18

Customer

customer_id	last_name	first_name
4000	Jackson	Joe
5000	Smith	Jane
6000	Ferguson	Samantha
7000	Reynolds	Allen
8000	Anderson	Paige
9000	Johnson	Derek

Order

order_id	customer_id	order_date
1	7000	2016/04/18
2	5000	2016/04/18
3	8000	2016/04/19
4	4000	2016/04/20
5	NULL	2016/05/01

Select First_Name FROM Customer natural join Order where order_date=to_date('2016/04/18','yyyy/mm/dd'));

Equivalently using IN

Select First_Name FROM Customer Where Customer_id IN (select Customer_id From Order where order_date=to_date('2016/04/18','yyyy/mm/dd'));

Equivalently using EXISTS

SELECT First_Name FROM customers T WHERE EXISTS (SELECT * FROM order_details WHERE T.customer_id = order_details.customer_id and order_date=to_date('2016/04/18','yyyy/mm/dd'));

Subqueries in the From Clause

- SQL allows a subquery expression to be used in the **from** clause.
- **Find the average salaries of those departments where the average salary is greater than $42,000.**

```
select dept_name, avg_salary
from (select dept_name, avg (salary)  avg_salary
        from instructor
        group by dept_name) where avg_salary > 42000;
```

dept_name	avg_salary
Biology	72000
Comp. Sci.	77333
Elec. Eng.	80000
Finance	85000
History	61000
Music	40000
Physics	91000

- Note that we do not need to use the **having** clause
- **Another way to write above query**

```
select dept_name, avg_salary
from (select dept_name, avg (salary)
        from instructor
        group by dept_name)
      dept_avg (dept_name,  avg_salary)
 where avg_salary > 42000;
```

With Clause

- The **with** clause provides a way of **defining a temporary view** whose definition is available **only to the query** in which the **with** clause occurs.

Syntax: WITH query_name As (SQL query) SELECT * FROM query_name;

- Find all departments with the maximum budget

```
with max_budget (value) as
    (select max(budget)
      from department)
select budget
from department, max_budget
where department.budget = max_budget.value;
```

```
with max_sal(value) as (select
max(sal) From emp)
select sal from emp, max_sal
where emp.sal=max_sal.value;
```

With Clause

Examples:

```
WITH temporaryTable(averageValue) as
    (SELECT avg(Salary)
    from Employee)
        SELECT EmployeeID,Name, Salary
        FROM Employee, temporaryTable
        WHERE Employee.Salary > temporaryTable.averageValue;
```

```
with max_sal(value) as
 (select max(sal) From emp)
select sal from emp, max_sal where
emp.sal=max_sal.value;
```

CREATE .. AS.. SELECT…

Create a table with the same schema as an existing table

Syntax:

CREATE TABLE <new_table_Name> AS SELECT

<column1>,<column2>,… FROM <existing_table_name>

WHERE <condition>;

Example:

- Create a table Emp_Copy1 with the same schema as an existing Emp table:

CREATE TABLE Emp_Copy1 AS SELECT * FROM EMP;

Example:

- Create a table Emp_Copy2 with columns Empno,Ename,Sal from an existing Emp table:

CREATE TABLE Emp_Copy2 AS SELECT Empno,Ename,Sal FROM EMP;

CREATE .. AS.. SELECT…

Create a table with the same schema as an existing table

Example:

- Create a table Emp_Copy3 with columns Eno,Name,Salary by taking the column structure information from an existing Emp table:

CREATE TABLE Emp_Copy3(Eno,Name,Salary) AS SELECT Empno,Ename,Sal FROM EMP;

Create.. AS.. Select .. Command not only copies the structure of select copies but **also copies data from** those columns.

Example:

CREATE TABLE Emp_Copy3(Eno,Name,Salary) AS SELECT Empno,Ename,Sal FROM EMP WHERE Deptno=10;

Views

- In some cases, it is not desirable for all users to see the entire logical model (that is, all the actual relations stored in the database.)
- Consider a person who needs to know an instructors name and department, but not the salary. This person should see a relation described, in SQL, by

  select *ID*, *name*, *dept_name* **from** *instructor;*

- A **view** provides a mechanism to hide certain data from the view of certain users.
- Any relation that is not of the conceptual model but is made visible to a user as a "**virtual relation**" is called a **view**.

View Definition

- A view is defined using the **create view** statement which has the form

  create view *v* **as** < query expression >

  where <query expression> is any legal SQL expression. The view name is represented by *v.*

- Once a view is defined, the view name can be used to refer to the virtual relation that the view generates.
- View definition is not the same as creating a new relation by evaluating the query expression
  - Rather, a view definition causes the saving of an expression; the expression is substituted into queries using the view.

Example:

- create view V1 as select * from emp;

```
SQL> desc v1;
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------
 EMPNO                                     NOT NULL NUMBER(4)
 ENAME                                              VARCHAR2(10)
 JOB                                                VARCHAR2(9)
 MGR                                                NUMBER(4)
 HIREDATE                                           DATE
 SAL                                                NUMBER(7,2)
 COMM                                               NUMBER(7,2)
 DEPTNO                                             NUMBER(2)
```

Example:
Renaming column names in the View

create view V2(employee_number, Name, Date_of_Join) as select empno,ename,hiredate from emp;

```
SQL> desc v2
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------
 EMPLOYEE_NUMBER                           NOT NULL NUMBER(4)
 NAME                                               VARCHAR2(10)
 DATE_OF_JOIN                                       DATE
```

Example:

create view v3 as select job, avg(sal) Avg_sal from emp group by job;

```
SQL> desc v3;
 Name                                      Null?    Type
 ----------------------------------------- -------- ------------
 JOB                                                VARCHAR2(9)
 AVG_SAL                                            NUMBER
```

Views Defined Using Other Views

- One view may be used in the expression defining another view
- A view relation v_1 is said to *depend directly* on a view relation v_2 if v_2 is used in the expression defining v_1

Example:
Creating a View from another view

- create view v5 as select employee_number,name from v2 where date_of_join>'17-DEC-1980';

```
SQL> desc v5;
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------
 EMPLOYEE_NUMBER                           NOT NULL NUMBER(4)
 NAME                                               VARCHAR2(10)
```

Example Views

- A view of instructors without their salary

  create view *faculty* **as**
  select *ID*, *name*, *dept_name*
  from *instructor*

- Find all instructors in the Biology department

  select *name*
  from *faculty*
  where *dept_name* = 'Biology'

- Create a view of department salary totals

  create view *departments_total_salary*(*dept_name*, *total_salary*) **as**
  select *dept_name*, **sum** (*salary*)
  from *instructor*
  group by *dept_name*;

Views Defined Using Other Views

- **create view** *physics_fall_2009* **as**
  select *course*.*course_id*, *sec_id*, *building*, *room_number*
  from *course*, *section*
  where *course*.*course_id* = *section*.*course_id*
  and *course*.*dept_name* = 'Physics'
  and *section*.*semester* = 'Fall'
  and *section*.*year* = '2009';
- **create view** *physics_fall_2009_watson* **as**
  select *course_id*, *room_number*
  from *physics_fall_2009*
  where *building*= 'Watson';

Querying a View

SQL> select * from v5;

```
EMPLOYEE_NUMBER NAME
--------------- ----------
           7499 ALLEN
           7521 WARD
           7566 JONES
           7654 MARTIN
           7698 BLAKE
           7782 CLARK
           7788 SCOTT
           7839 KING
           7844 TURNER
           7876 ADAMS
           7900 JAMES
```

View Expansion

- A way to define the meaning of views defined in terms of other views.
- Replace the view relation v_i by the expression defining v_i

Assume V2 is created and v5 created using V2.

- **create view V2(employee_number, Name, Date_of_Join) as select empno,ename,hiredate from emp;**
- **create view v5 as select employee_number,name from v2 where date_of_join>'17-DEC-1980';**

Update of a View

- Add a new tuple to *faculty* view which we defined earlier

  insert into *faculty* **values** (’30765’, ’Green’, ’Music’);

  This insertion must be represented by the insertion of the tuple

  (’30765’, ’Green’, ’Music’, null) into the *instructor* relation

insert into v2 values(7868,'Ravi','10-Oct-2012');

```
SQL> desc v2;
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------
 EMPLOYEE_NUMBER                           NOT NULL NUMBER(4)
 NAME                                               VARCHAR2(10)
 DATE_OF_JOIN                                       DATE
```

select empno,ename,hiredate from scott.em

```
SQL> select empno,ename,hiredate from emp;

     EMPNO ENAME      HIREDATE
---------- ---------- ---------
        50 BBB
      1212 XXX
      1213
      7868 Ravi       10-OCT-12
      1000 DDD
      1001 EEEE
      7369 SMITH      17-DEC-80
```

Some Updates cannot be Translated Uniquely

- Assume the following view is created-
- **create view** *instructor_info* **as**
  select *ID*, *name*, *building* **from** *instructor*, *department*
  where *instructor*.*dept_name*= *department*.*dept_name*;
- **insert into** *instructor_info* **values** (’69987’, ’White’, ’Taylor’);
  - which department, if multiple departments in Taylor?
  - what if no department is in Taylor?
- Most SQL implementations **allow updates only on simple views**
  - The **from** clause has only one database relation.
  - The **select** clause contains only attribute names of the relation, and does not have any expressions, aggregates, or **distinct** specification.
  - Any attribute not listed in the **select** clause can be set to null
  - The query does not have a **group** by or **having** clause.