National University of Computer & Emerging Sciences, Peshawar
Computer Science Department
Spring 2025, Lab Manual - 04

Course Code: CL-2005	**Course : Database Systems Lab**
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Contents:

- Groups of Data (Group by, Having)
- Sub Queries (Single Row, Multiple and correlated)
- Sub Queries and DML
- Tasks

Group by Statement:

The GROUP BY statement group's rows that have the same values into summary rows, like "find the number of customers in each country".
The GROUP BY statement is often used with aggregate functions (COUNT, MAX, MIN, SUM, AVG) to group the result-set by one or more columns.

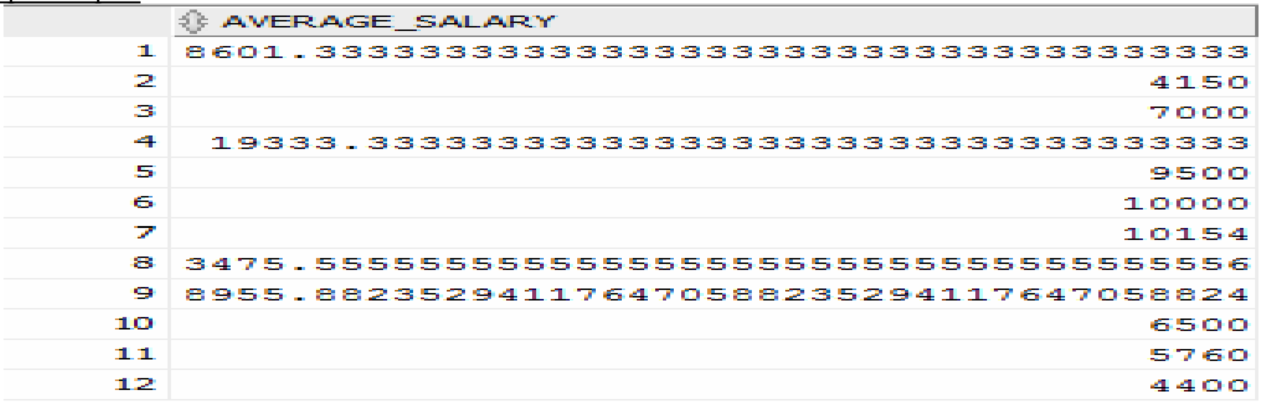
Group by Syntax

```
SELECT column_name(s)
FROM table_name
GROUP BY column_name(s)
```

Group by:

```
SELECT
   AVG(salary) as "average_salary"
FROM
   employees
GROUP BY Department_id
```

Sample Output:



```
     AVERAGE_SALARY
 1   8601.333333333333333333333333333333333333
 2                                        4150
 3                                        7000
 4    19333.3333333333333333333333333333333333
 5                                        9500
 6                                       10000
 7                                       10154
 8   3475.555555555555555555555555555555555556
 9   8955.882352941176470588235294117647058824
10                                        6500
11                                        5760
12                                        4400
```

Group by (Having)

HAVING Clause is used with GROUP BY Clause to restrict the groups of returned rows where condition is TRUE.

Syntax:

```
SELECT expression1, expression2, ... expression_n,
 aggregate_function (aggregate_expression)
FROM tables
WHERE conditions
GROUP BY expression1, expression2, ... expression_n
HAVING having_condition;
```

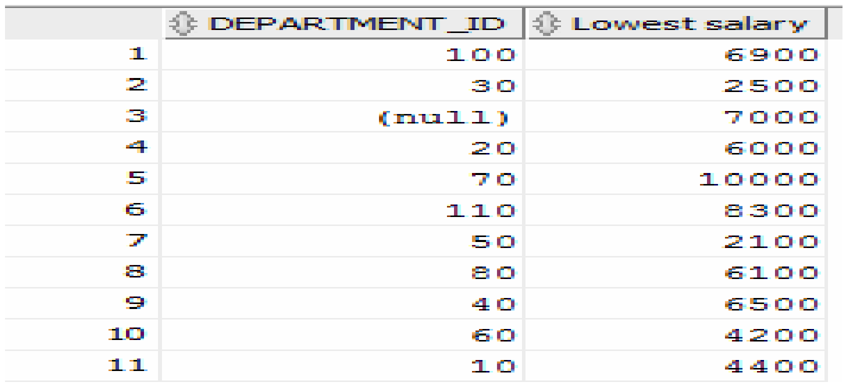
HAVING Example: (with GROUP BY SUM function)

```
SELECT department_id, SUM(salary) AS "Total Salary"
FROM employees
GROUP BY department_id
HAVING SUM(salary) < 100000;
```

HAVING Example: (with GROUP BY MIN function)

```
SELECT Department_ID,
MIN(salary) AS "Lowest salary"
FROM employees
GROUP BY Department_ID
HAVING MIN(salary) < 15000;
```

Sample Output:

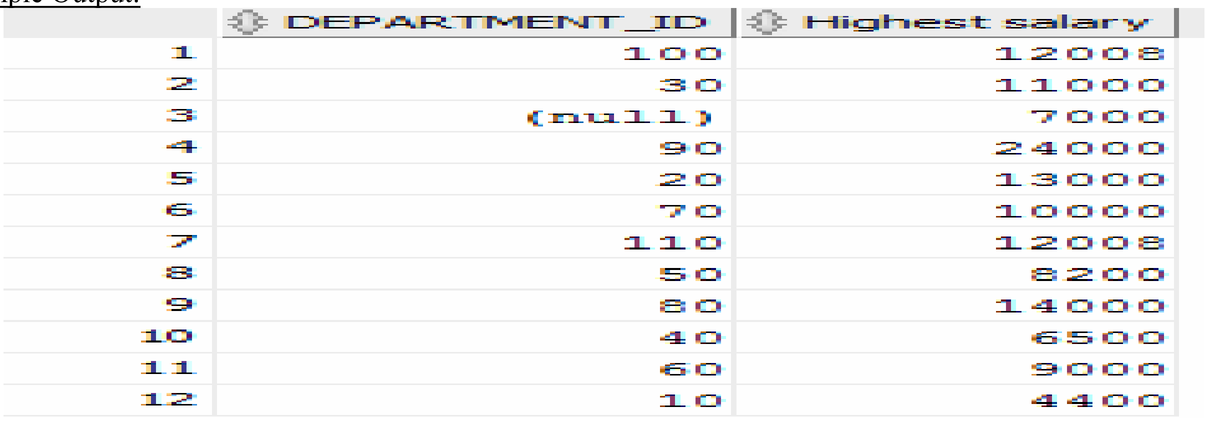


	DEPARTMENT_ID	Lowest salary
1	100	6900
2	30	2500
3	(null)	7000
4	20	6000
5	70	10000
6	110	8300
7	50	2100
8	80	6100
9	40	6500
10	60	4200
11	10	4400

HAVING Example: (with GROUP BY MAX function)

```
SELECT Department_ID,
MAX(salary) AS "Highest salary"
FROM employees
GROUP BY Department_ID
HAVING MAX(salary) > 3000;
```

Sample Output:



	DEPARTMENT_ID	Highest salary
1	100	12008
2	30	11000
3	(null)	7000
4	90	24000
5	20	13000
6	70	10000
7	110	12008
8	50	8200
9	80	14000
10	40	6500
11	60	9000
12	10	4400

Sub Queries:

A Subquery is a query within another SQL query and embedded within the WHERE clause.
Important Rule:

- A subquery can be placed in a number of SQL clauses like WHERE clause, FROM clause, HAVING clause.
- You can use Subquery with SELECT, UPDATE, INSERT, DELETE statements along with the operators like =, <, >, >=, <=, IN, BETWEEN, etc.
- A subquery is a query within another query. The outer query is known as the main query, and the inner query is known as a subquery.
- Subqueries are on the right side of the comparison operator.
- A subquery is enclosed in parentheses.
- In the Subquery, ORDER BY command cannot be used. But GROUP BY command can be used to perform the same function as ORDER BY command.

NOTE:
Subqueries are useful when a query is based on unknown values.

Sub Queries with SELECT Statement:
Syntax:

```
SELECT column_name
FROM table_name
WHERE column_name expression operator
( SELECT column_name  from table_name WHERE ... );
```

Types of Subqueries:

1. **Single Row Sub Query**: Sub query which returns single row output. They mark the usage of single row comparison operators, when used in WHERE conditions.
2. **Multiple row sub query**: Sub query returning multiple row output. They make use of multiple row comparison operators like IN, ANY, ALL. There can be sub queries returning multiple columns also.
3. **Correlated Sub Query**: Correlated subqueries depend on data provided by the outer query. This type of subquery also includes subqueries that use the EXISTS operator to test the existence of data rows satisfying specified criteria.

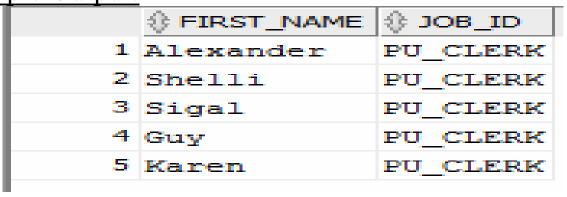
Single Row Sub Queries:

- Return only one row
- Use single-row comparison operators

Operator	Meaning
=	Equal to
>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to
<> , =!	Not equal to

```
SELECT First_Name, Job_ID FROM Employees WHERE job = ( SELECT job_ID FROM Employees WHERE empno=7369 )
```

Sample Output:



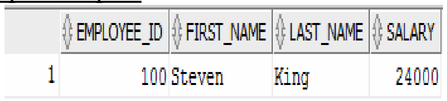
```
    FIRST_NAME   JOB_ID
1   Alexander    PU_CLERK
2   Shelli       PU_CLERK
3   Sigal        PU_CLERK
4   Guy          PU_CLERK
5   Karen        PU_CLERK
```

Single Row Functions:

Finds the employees who have the highest salary:

```
SELECT
   employee_id, first_name, last_name, salary
FROM
   employees
WHERE
   salary = (SELECT
         MAX(salary)
      FROM
         employees)
```

Sample Output:

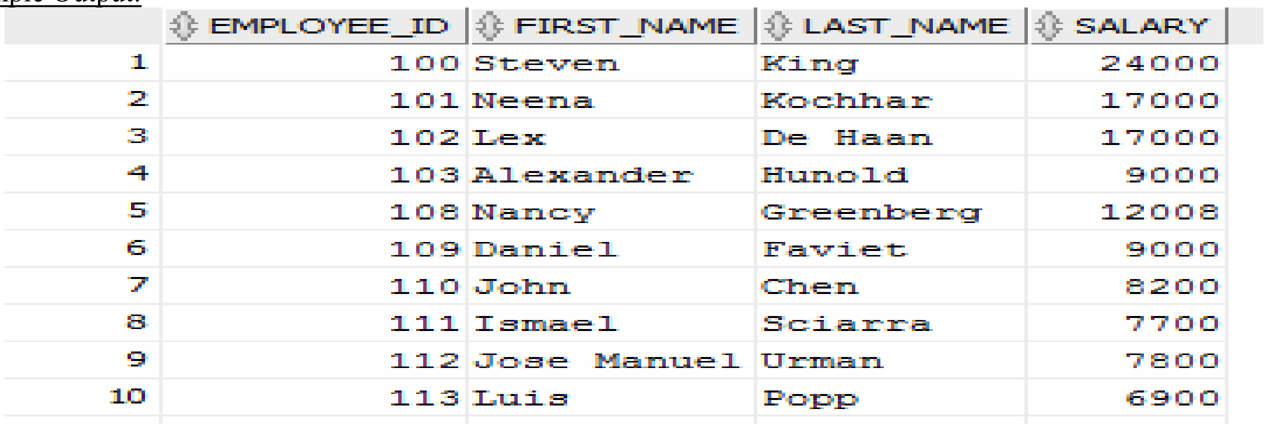


	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY
1	100	Steven	King	24000

Finds all employees who salaries are greater than the average salary of all employees:

```
SELECT
   employee_id, first_name, last_name, salary
FROM
   employees
WHERE
   salary > (SELECT
         AVG(salary)
      FROM
         employees)
```

Sample Output:



	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY
1	100	Steven	King	24000
2	101	Neena	Kochhar	17000
3	102	Lex	De Haan	17000
4	103	Alexander	Hunold	9000
5	108	Nancy	Greenberg	12008
6	109	Daniel	Faviet	9000
7	110	John	Chen	8200
8	111	Ismael	Sciarra	7700
9	112	Jose Manuel	Urman	7800
10	113	Luis	Popp	6900

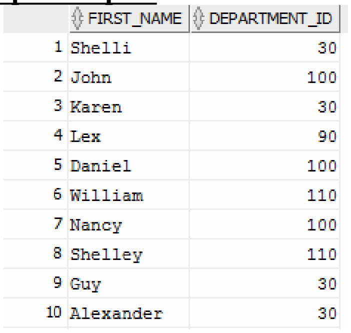
Multiple row sub query:

- Return more than one row
- Use multiple-row comparison operators
  - [> ALL] More than the highest value returned by the subquery
  - [< ALL] Less than the lowest value returned by the subquery
  - [< ANY] Less than the highest value returned by the subquery
  - [> ANY] More than the lowest value returned by the subquery
  - [= A NY] Equal to any value returned by the subquery (same as IN)

IN:

```
SELECT first_name, department_id
FROM employees
WHERE department_id IN (SELECT Department_id
                        FROM departments
                        WHERE LOCATION_ID = 100)
```

Sample Output:

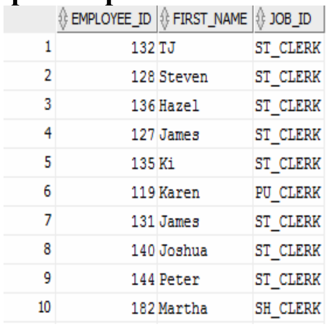


	FIRST_NAME	DEPARTMENT_ID
1	Shelli	30
2	John	100
3	Karen	30
4	Lex	90
5	Daniel	100
6	William	110
7	Nancy	100
8	Shelley	110
9	Guy	30
10	Alexander	30

ANY:

```
SELECT employee_ID, First_Name, job_ID FROM EMPLOYEES WHERE SALARY < ANY
 ( SELECT salary FROM  EMPLOYEES WHERE JOB_ID = 'PU_CLERK' );
```

Sample Output:

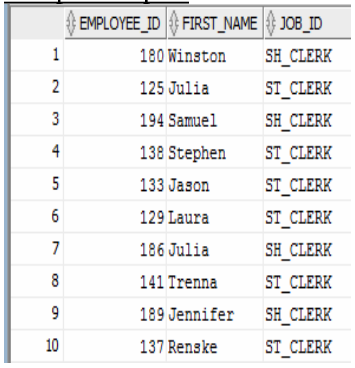


	EMPLOYEE_ID	FIRST_NAME	JOB_ID
1	132	TJ	ST_CLERK
2	128	Steven	ST_CLERK
3	136	Hazel	ST_CLERK
4	127	James	ST_CLERK
5	135	Ki	ST_CLERK
6	119	Karen	PU_CLERK
7	131	James	ST_CLERK
8	140	Joshua	ST_CLERK
9	144	Peter	ST_CLERK
10	182	Martha	SH_CLERK

ALL:

```
SELECT employee_ID, First_Name, job_ID FROM EMPLOYEES WHERE SALARY >All
 ( SELECT salary FROM HR.EMPLOYEES WHERE JOB_ID = 'PU_CLERK' ) AND job_ID <>
'PU_CLERK' ;
```

Sample Output:

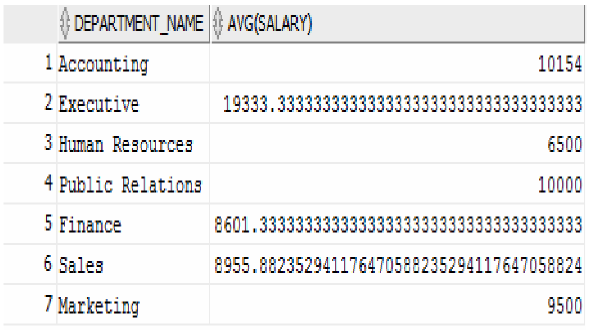


	EMPLOYEE_ID	FIRST_NAME	JOB_ID
1	180	Winston	SH_CLERK
2	125	Julia	ST_CLERK
3	194	Samuel	SH_CLERK
4	138	Stephen	ST_CLERK
5	133	Jason	ST_CLERK
6	129	Laura	ST_CLERK
7	186	Julia	SH_CLERK
8	141	Trenna	ST_CLERK
9	189	Jennifer	SH_CLERK
10	137	Renske	ST_CLERK

Group By and HAVING IN SUB QUERIES:

```
SELECT department_name, avg(salary)
FROM EMP_DETAILS_VIEW
GROUP BY department_name
HAVING avg(salary) > (
          SELECT avg(salary)
          FROM EMPLOYEES
);
```

Sample Output:



	DEPARTMENT_NAME	AVG(SALARY)
1	Accounting	10154
2	Executive	19333.3333333333333333333333333333333333
3	Human Resources	6500
4	Public Relations	10000
5	Finance	8601.333333333333333333333333333333333333
6	Sales	8955.882352941176470588235294117647058824
7	Marketing	9500

SUBQUERIES AND DML:

Subqueries with the INSERT Statement

- SQL subquery can also be used with the Insert statement. In the insert statement, data returned from the subquery is used to insert into another table.
- In the subquery, the selected data can be modified with any of the character, date functions.

Syntax:

```
INSERT INTO table_name (column1, column2, column3....)
SELECT *
FROM table_name
WHERE VALUE OPERATOR
```

You may login from a new user for DML sub Queries.

Example: Let's assume we have an EMPLOYEE_BKP table available which is backup of EMPLOYEE table having all the attributes of Employees table

```
INSERT INTO EMPLOYEE_BKP
SELECT * FROM EMPLOYEES
WHERE job_ID IN (SELECT job_id
FROM jobs WHERE job_title='Accountant');
```

Subqueries with the UPDATE Statement

The subquery of SQL can be used in conjunction with the Update statement. When a subquery is used with the Update statement, then either single or multiple columns in a table can be updated.

Syntax

```
UPDATE table
SET column_name = new_value
WHERE VALUE OPERATOR
  (SELECT COLUMN_NAME
  FROM TABLE_NAME
  WHERE condition);
```

Example:

The given example updates the SALARY by 10 times in the EMPLOYEE table for all employee whose minimum salary is 3000.

```
Update employees
set salary= salary+(0.1*salary)
WHERE job_ID IN (SELECT job_ID
FROM jobs WHERE min_salary=3000);
```

Subqueries with the DELETE Statement

The subquery of SQL can be used in conjunction with the Delete statement just like any other statements mentioned above.

Syntax

```
DELETE FROM TABLE_NAME
WHERE VALUE OPERATOR
   (SELECT COLUMN_NAME
   FROM TABLE_NAME
   WHERE condition);
```

Example:

Let's assume we have an EMPLOYEE_BKP table available which is backup of EMPLOYEE table. The given example deletes the records from the EMPLOYEE_BKP table for all EMPLOYEE whose end date is '31-DEC-06'.

```
Delete from employee_BKP
WHERE job_ID IN (SELECT job_ID
FROM job_History WHERE end_Date='31-Dec-06');
```

```
SELECT
    e.employee_id,
    e.first_name,
    e.last_name,
    (SELECT job_title FROM jobs WHERE job_id = e.job_id) AS job_title,
        (SELECT department_name FROM departments WHERE department_id = e.department_id) AS
department_name,
    (SELECT city FROM locations WHERE location_id = d.location_id) AS department_location,
    (SELECT region_name FROM regions WHERE region_id = r.region_id) AS region_name
FROM
    employees e,
    departments d,
    locations l,
    regions r
WHERE
    e.department_id = d.department_id
    AND d.location_id = l.location_id;
```