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**Course:** Bachelor of CSE (AI) – 2nd Year

**Subject:** Database Management Systems

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# Experiment 2: Advanced Data Aggregation and Filtering

## 1. Aim of the Session

The aim of this practical is to implement and analyze **Group Functions** and **Conditional Filtering** in SQL. The session focuses on using `GROUP BY`, `HAVING`, and `ORDER BY` clauses to extract meaningful insights from an employee dataset.

## 2. Objective of the Session

By completing this practical, I have achieved the following:

- Developed a schema for employee management using appropriate data types like `NUMERIC` and `DATE`.
- Mastered the use of **Aggregate Functions** (specifically `AVG`) to perform calculations on data groups.
- Learned to differentiate between the `WHERE` clause (row-level filtering) and the `HAVING` clause (group-level filtering).
- Gained proficiency in sorting aggregated results using the `ORDER BY` clause.

## 3. Practical / Experiment Steps

The following implementation tasks were completed:

1. **Schema Definition:** Created the `employee` table with constraints and precise numeric scaling for salaries.
2. **Data Population:** Inserted diverse records representing various departments (IT, HR, Sales, Finance) and salary ranges.
3. **Basic Aggregation:** Calculated the average salary per department using the `GROUP BY` clause.
4. **Advanced Filtering:** Applied the `HAVING` clause to filter out departments where the average salary did not meet a specific threshold.

5. **Complex Querying:** Combined `WHERE`, `GROUP BY`, `HAVING`, and `ORDER BY` into a single query to refine results based on individual salaries and group averages simultaneously.

# 4. Procedure of the Practical

The experiment was conducted following these sequential steps:

1. **System Initialization:** Logged into the PostgreSQL environment via pgAdmin 4 using `localhost` as the host server.
2. **Table Construction:** Executed the `CREATE TABLE` command to define the structure for the `employee` dataset.
3. **Data Insertion:** Ran multiple `INSERT` statements to populate the table with the provided employee data.
4. **Initial Verification:** Used `SELECT *` to confirm that all employee records were correctly stored and formatted.
5. **Group Analysis:** Executed a `GROUP BY` query to observe the distribution of average salaries across different departments.
6. **Applying Group Filters:** Integrated the `HAVING` clause to restrict the output to high-paying departments (Average > 30,000).
7. **Final Refinement:** Executed a comprehensive query that filtered individual employees (Salary > 20,000), grouped them by department, and sorted the results in descending order.
8. **Output Recording:** Captured screenshots of the query results and saved the final SQL script for documentation.

# 5. I/O Analysis (Input / Output Analysis)

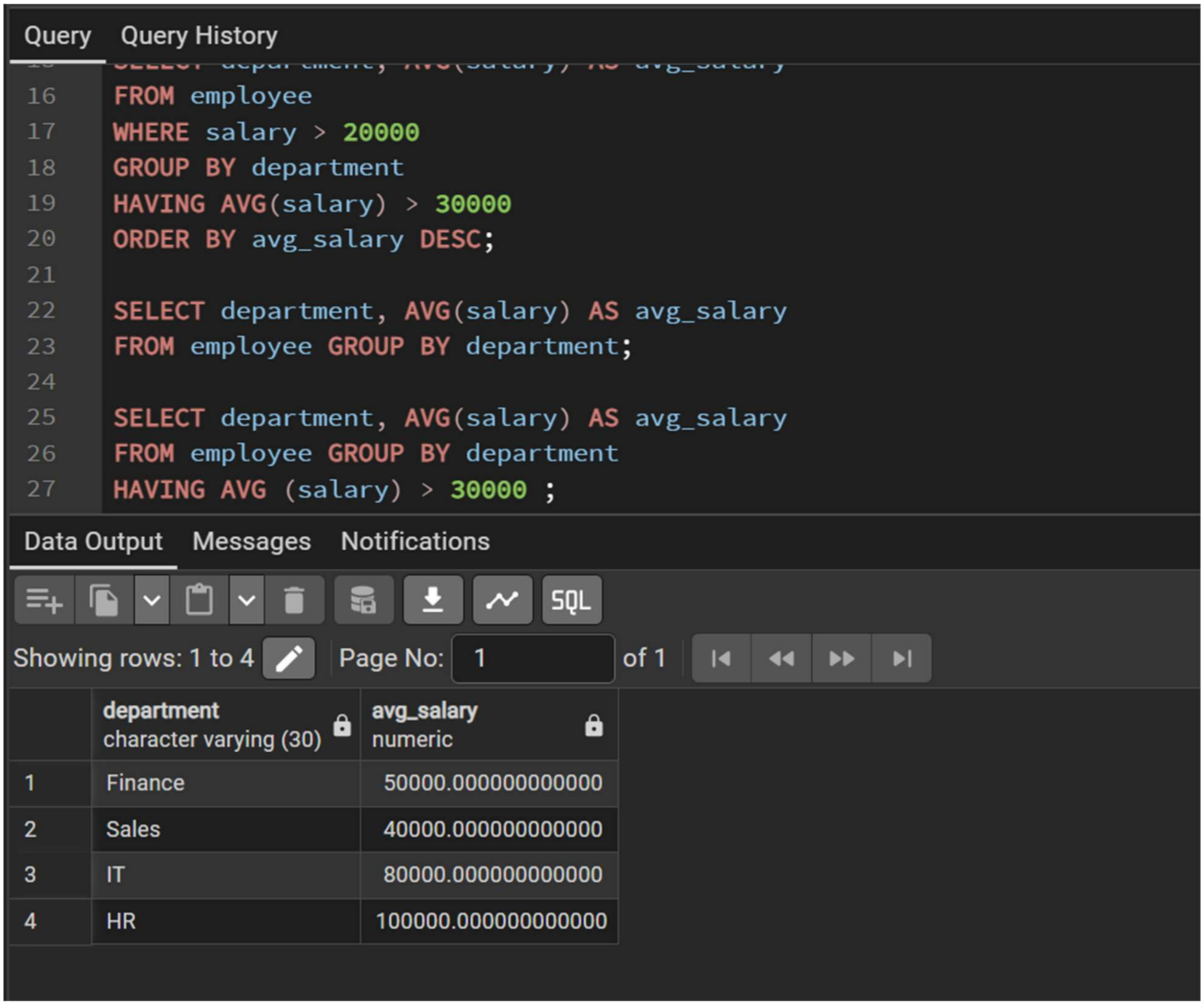
## Input Queries

SQL

```
CREATE TABLE Employee (
    Id VARCHAR(5),
    Name VARCHAR(50),
    Department VARCHAR(30),
    Salary INT,
    DOJ DATE
);

SELECT department, AVG(salary) AS avg_salary
FROM employee
WHERE salary > 20000
GROUP BY department
HAVING AVG(salary) > 30000
ORDER BY avg_salary DESC;
```

## Output Details

- **Aggregate Results:** The system successfully grouped employees by department.

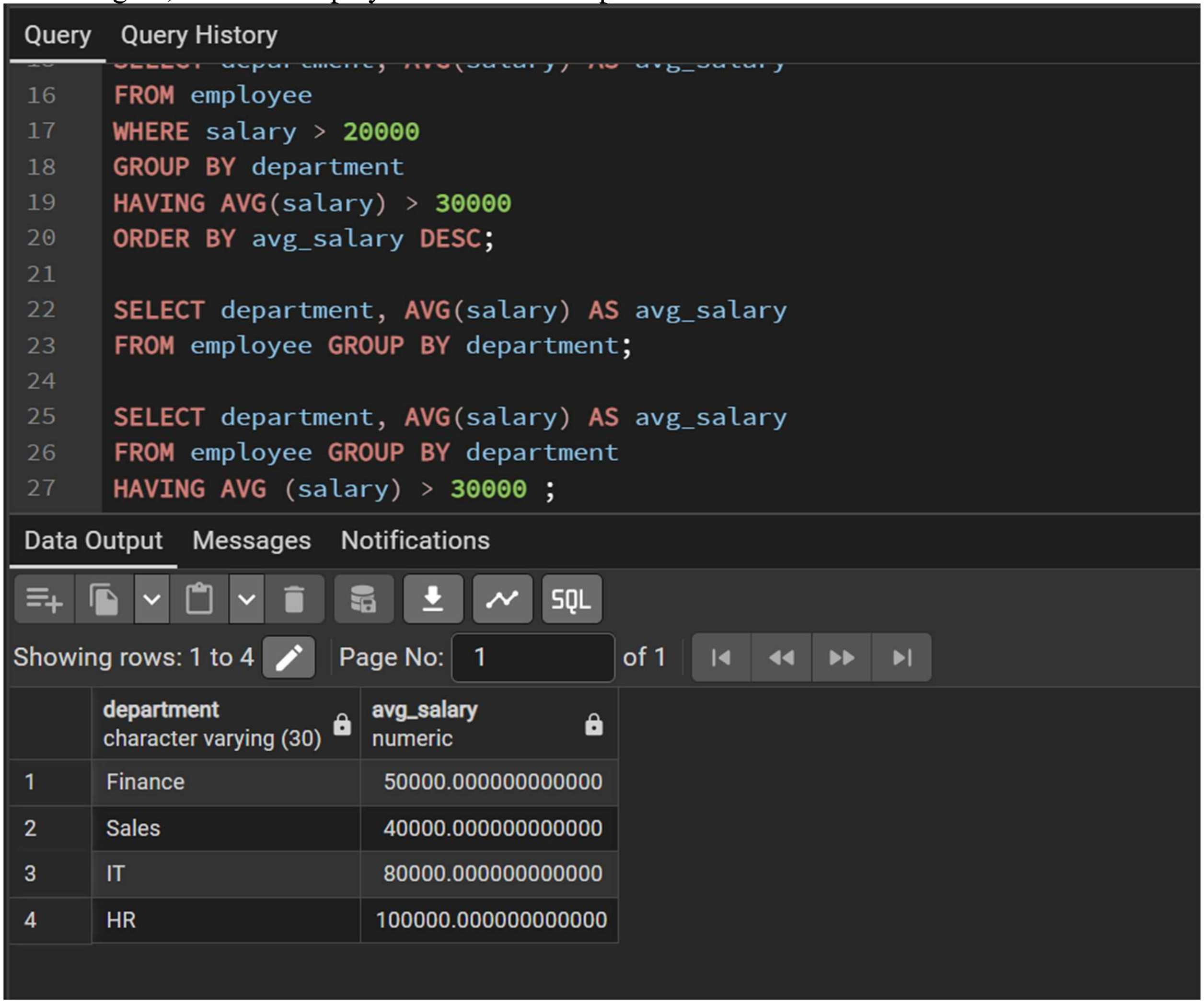


```sql
SELECT department, AVG(salary) AS avg_salary
FROM employee
WHERE salary > 20000
GROUP BY department
HAVING AVG(salary) > 30000
ORDER BY avg_salary DESC;

SELECT department, AVG(salary) AS avg_salary
FROM employee GROUP BY department;

SELECT department, AVG(salary) AS avg_salary
FROM employee GROUP BY department
HAVING AVG (salary) > 30000 ;
```

| | department<br>character varying (30) | avg_salary<br>numeric |
|---|---|---|
| 1 | Finance | 50000.000000000000 |
| 2 | Sales | 40000.000000000000 |
| 3 | IT | 80000.000000000000 |
| 4 | HR | 100000.000000000000 |

- **Filtering Logic:** The `WHERE` clause correctly excluded employees with salaries under 20,000 before calculating averages.

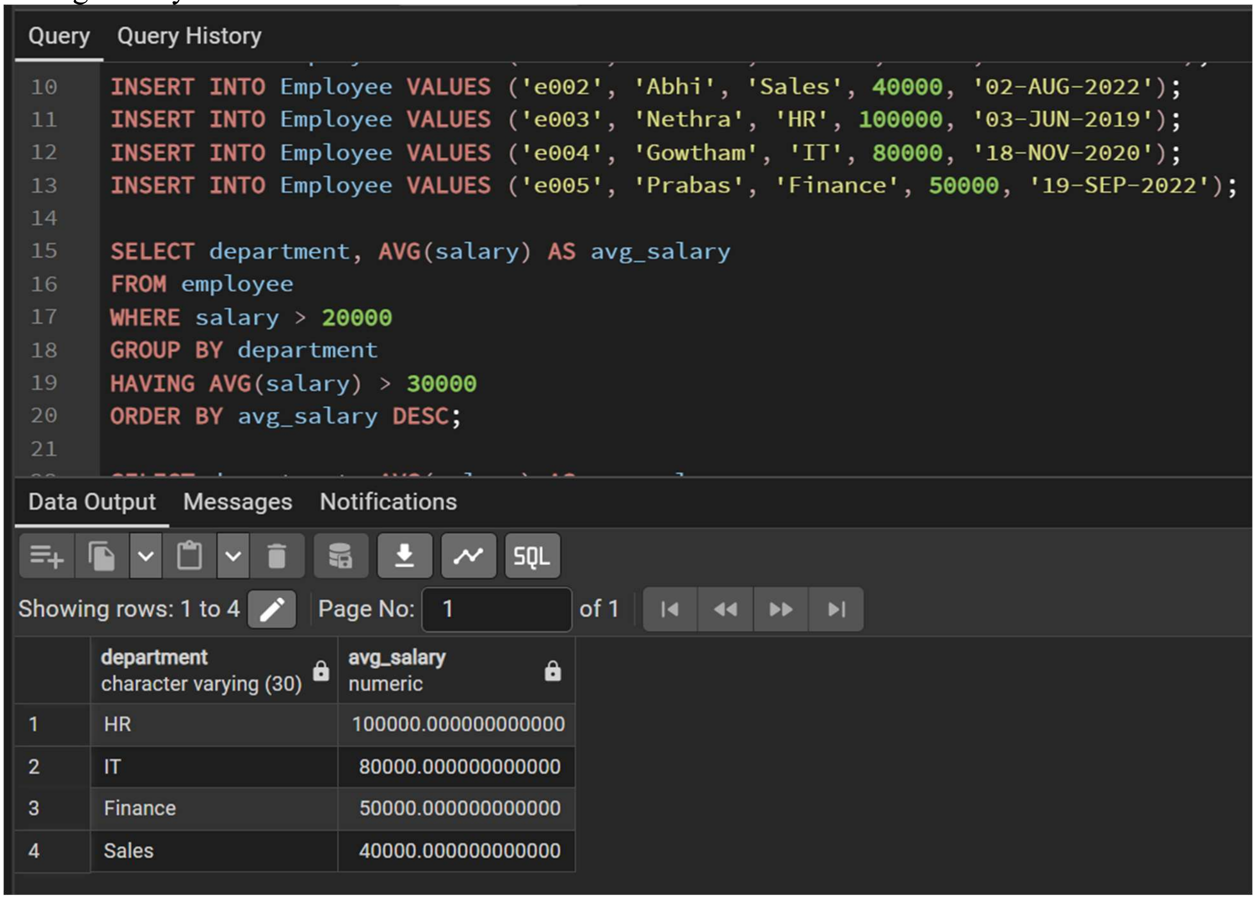
- **Group Filtering:** The `HAVING` clause ensured only departments with an average salary exceeding 30,000 were displayed in the final output.



```
SELECT department, AVG(salary) AS avg_salary
FROM employee
WHERE salary > 20000
GROUP BY department
HAVING AVG(salary) > 30000
ORDER BY avg_salary DESC;

SELECT department, AVG(salary) AS avg_salary
FROM employee GROUP BY department;

SELECT department, AVG(salary) AS avg_salary
FROM employee GROUP BY department
HAVING AVG (salary) > 30000 ;
```

| | department<br>character varying (30) | avg_salary<br>numeric |
|---|---|---|
| 1 | Finance | 50000.000000000000 |
| 2 | Sales | 40000.000000000000 |
| 3 | IT | 80000.000000000000 |
| 4 | HR | 100000.000000000000 |

- **Sorting:** The `ORDER BY` clause successfully sorted the final results from highest to lowest average salary.



```sql
INSERT INTO Employee VALUES ('e002', 'Abhi', 'Sales', 40000, '02-AUG-2022');
INSERT INTO Employee VALUES ('e003', 'Nethra', 'HR', 100000, '03-JUN-2019');
INSERT INTO Employee VALUES ('e004', 'Gowtham', 'IT', 80000, '18-NOV-2020');
INSERT INTO Employee VALUES ('e005', 'Prabas', 'Finance', 50000, '19-SEP-2022');

SELECT department, AVG(salary) AS avg_salary
FROM employee
WHERE salary > 20000
GROUP BY department
HAVING AVG(salary) > 30000
ORDER BY avg_salary DESC;
```

|  | department<br>character varying (30) | avg_salary<br>numeric |
|---|---|---|
| 1 | HR | 100000.000000000000 |
| 2 | IT | 80000.000000000000 |
| 3 | Finance | 50000.000000000000 |
| 4 | Sales | 40000.000000000000 |

# 6. Learning Outcome

Through this session, I have developed the following competencies:

- **Analytical Skills:** Gained the ability to transform raw row-level data into high-level summary reports using aggregation.
- **Query Logic:** Understood the logical execution order of SQL clauses: `FROM` → `WHERE` → `GROUP BY` → `HAVING` → `SELECT` → `ORDER BY`.
- **Practical Exposure:** Experienced handling real-world data scenarios, such as department-wise salary analysis and performance-based filtering in a professional database environment.