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# SQL 5 Data Analyst Fellowship

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# Common Table Expression (CTE)

- A common table expression, or CTE, is a temporary named result set created from a simple SELECT statement that can be used in a subsequent SELECT statement

We define CTEs by adding a WITH clause directly before SELECT, UPDATE or DELETE statement.

The WITH Clause can include one or more CTEs with the help of comma (,)

# Common Table Expression (CTE)

- **Syntax**

```
WITH my_cte AS (
        SELECT a,b,c
        FROM Table1 )
SELECT a,c
FROM my_cte
```

CTE query

Main query

# Example Table for CTEs -

| | employee_id [PK] integer | name character varying (100) | department character varying (100) | salary integer |
|---|---|---|---|---|
| 1 | 1 | John Doe | HR | 50000 |
| 2 | 2 | Jane Smith | IT | 60000 |
| 3 | 3 | Alice Johnson | Finance | 55000 |
| 4 | 4 | Bob Brown | IT | 70000 |
| 5 | 5 | Charlie White | HR | 48000 |

# Basic CTE Example

```
18  WITH it_employees AS (
19      SELECT employee_id, name, salary, department
20      FROM employees
21      WHERE department LIKE 'IT'
22  )
23  SELECT * FROM it_employees;
24
```

Data Output | Messages | Notifications

| | employee_id [PK] integer | name character varying (100) | salary integer | department character varying (100) |
|---|---|---|---|---|
| 1 | 2 | Jane Smith | 60000 | IT |
| 2 | 4 | Bob Brown | 70000 | IT |

# Multiple CTE

Query | Query History

```sql
WITH hr_employees AS (
    SELECT employee_id, name, salary
    FROM employees
    WHERE department LIKE 'HR'
),
it_employees AS (
    SELECT employee_id, name, salary
    FROM employees
    WHERE department LIKE 'IT'
)
SELECT * FROM hr_employees
UNION ALL
SELECT * FROM it_employees;
```

Data Output | Messages | Notifications

| | employee_id integer | name character varying (100) | salary integer |
|---|---|---|---|
| 1 | 1 | John Doe | 50000 |
| 2 | 5 | Charlie White | 48000 |
| 3 | 2 | Jane Smith | 60000 |
| 4 | 4 | Bob Brown | 70000 |

# Recursive CTE

Table -

```
CREATE TABLE employee_hierarchy (
    employee_id SERIAL PRIMARY KEY,
    name VARCHAR(100),
    manager_id INT
);

INSERT INTO employee_hierarchy (name, manager_id)
VALUES
('CEO', NULL),
('CTO', 1),
('HR Head', 1),
('IT Manager', 2),
('HR Specialist', 3),
('Developer', 4);
```

```
56  SELECT * FROM employee_hierarchy
57
```

Data Output | Messages | Notifications

| | employee_id [PK] integer | name character varying (100) | manager_id integer |
|---|---|---|---|
| 1 | 1 | CEO | [null] |
| 2 | 2 | CTO | 1 |
| 3 | 3 | HR Head | 1 |
| 4 | 4 | IT Manager | 2 |
| 5 | 5 | HR Specialist | 3 |
| 6 | 6 | Developer | 4 |

```
WITH RECURSIVE employee_tree AS (
    -- Base case: start with the CEO (the top level)
    SELECT employee_id, name, manager_id, 1 AS level
    FROM employee_hierarchy
    WHERE manager_id IS NULL

    UNION ALL

    -- Recursive case: find employees who report to the employees in the previous result
    SELECT e.employee_id, e.name, e.manager_id, et.level + 1
    FROM employee_hierarchy e
    INNER JOIN employee_tree et ON e.manager_id = et.employee_id
)
SELECT employee_id, name, level
FROM employee_tree
ORDER BY level;
```

**Base Case:**

- Starts with the `CEO` (i.e., `manager_id IS NULL`), returning the CEO's `employee_id`, `name`, and level `1`.

sql Copy code

```
employee_id | name        | manager_id | level
------------|-------------|------------|-------
1           | CEO         | NULL       | 1
```

**First Recursive Call:**

- The first recursive step joins the `CEO`'s `employee_id` with the `manager_id` in the `employee_hierarchy` table to find direct reports of the `CEO`.
- The query returns employees reporting directly to the CEO (like `CTO` and `HR Head`), with their level now being `2`.

diff

Copy code

```
employee_id | name        | manager_id | level
------------|-------------|------------|-------
2           | CTO         | 1          | 2
3           | HR Head     | 1          | 2
```

**Second Recursive Call:**

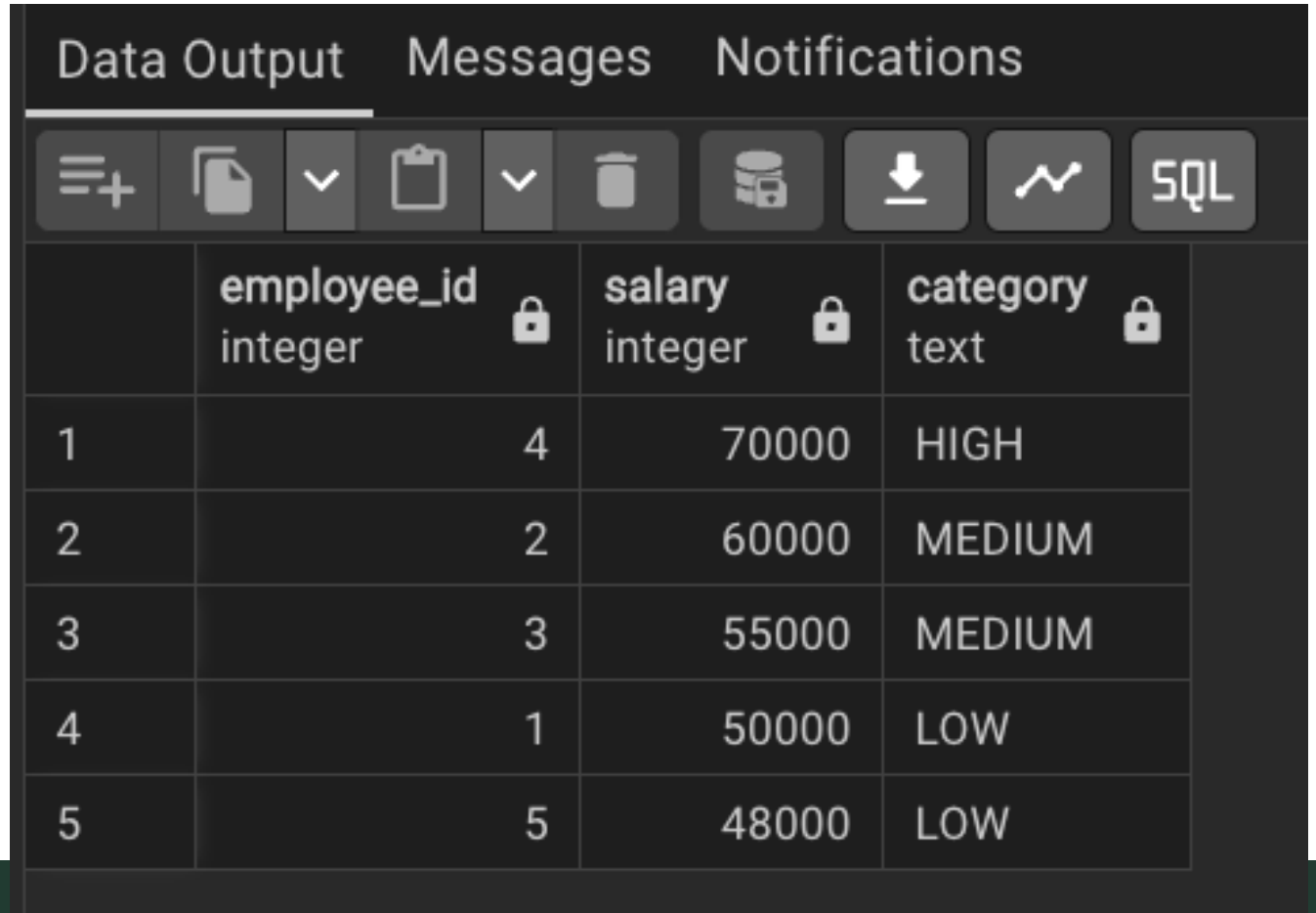
- Now the recursive part looks for employees reporting to `CTO` (employee_id `2`) and `HR Head` (employee_id `3`).
- It finds `IT Manager` reporting to the `CTO` and `HR Specialist` reporting to `HR Head`, and adds them to the result set with `level = 3`.

diff Copy code

```
employee_id | name           | manager_id | level
------------|----------------|------------|-------
4           | IT Manager     | 2          | 3
5           | HR Specialist  | 3          | 3
```

Assign Category to all employees based on salary

- salary >= 70000 then display category as HIGH
- salary >= 55000 and salary < 70000 then display category as MEDIUM
- salary < 55000 then display category as LOW



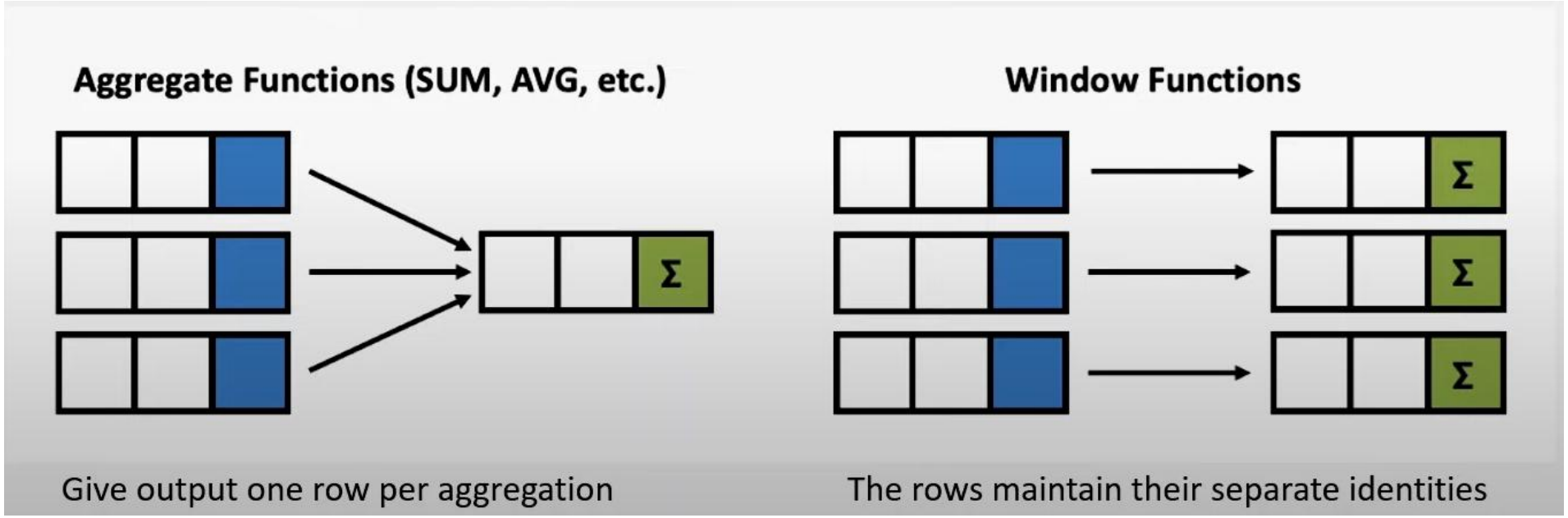

| | employee_id integer | salary integer | category text |
|---|---|---|---|
| 1 | 4 | 70000 | HIGH |
| 2 | 2 | 60000 | MEDIUM |
| 3 | 3 | 55000 | MEDIUM |
| 4 | 1 | 50000 | LOW |
| 5 | 5 | 48000 | LOW |

## When to Use CTEs:

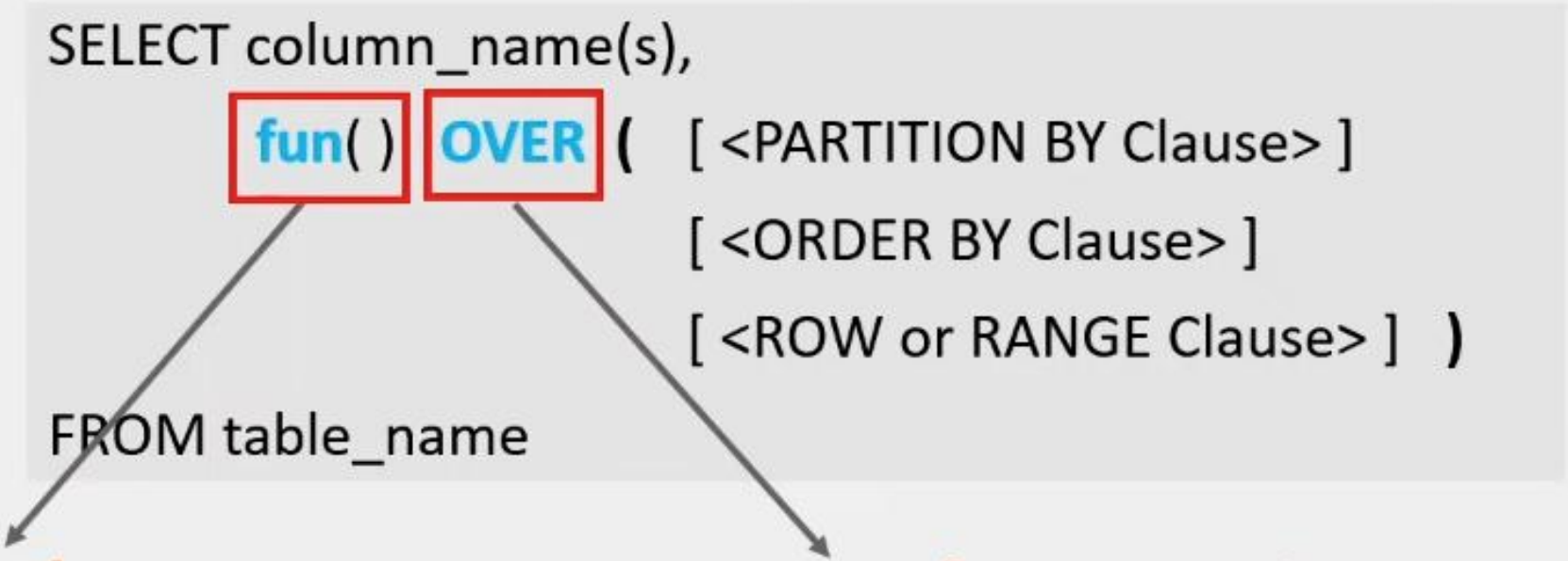
- When breaking down **complex** queries.
- When needing **intermediate results** that are reused.
- When dealing with **recursive or hierarchical data**.
- When improving the **readability** of long queries.
- When using **window functions** or **ranking**.

# WINDOW FUNCTION

- **Window functions** applies aggregate, ranking and analytic functions over a particular window (set of rows).
- And **OVER** clause is used with window functions to define that window.



# WINDOW FUNCTION SYNTAX




## Select a function

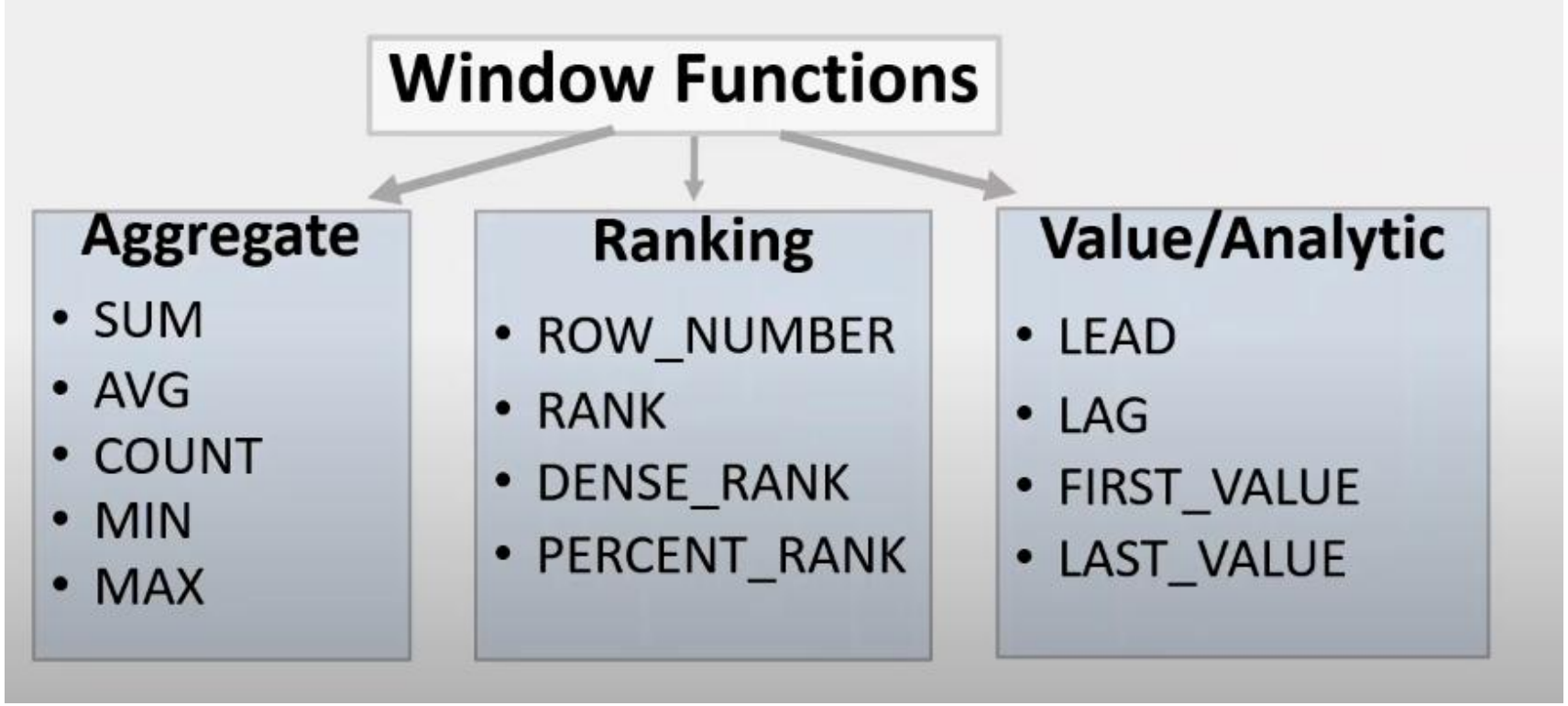
- Aggregate functions
- Ranking functions
- Analytic functions

## Define a Window

- PARTITION BY
- ORDER BY
- ROWS

# WINDOW FUNCTION TYPES

There is no official division of the SQL window functions into categories but high level we can divide into three types



# Example Table for Window Functions -

Data Output | Messages | Notifications

| | employee_id [PK] integer | name character varying (100) | department character varying (100) | salary integer |
|---|---|---|---|---|
| 1 | 1 | John Doe | IT | 60000 |
| 2 | 2 | Jane Smith | HR | 50000 |
| 3 | 3 | Alice Johnson | Finance | 55000 |
| 4 | 4 | Bob Brown | IT | 70000 |
| 5 | 5 | Charlie White | HR | 48000 |
| 6 | 6 | Diana Green | Finance | 62000 |
| 7 | 7 | Eve Black | IT | 62000 |

```sql
SELECT employee_id, department, salary,
SUM(salary) OVER(PARTITION BY department ORDER BY salary) as "CUMULATIVE_SUM",
AVG(salary) OVER(PARTITION BY department ORDER BY salary) as "WINDOW_AVG",
COUNT(employee_id) OVER(PARTITION BY department ORDER BY salary) as "ORDER_GROUPWISE",
MAX(salary) OVER(PARTITION BY department ORDER BY salary) as "PREFIX_MAX",
MIN(salary) OVER(PARTITION BY department ORDER BY salary) as "PREFIX_MIN"
FROM employees
```

Data Output | Messages | Notifications

| | employee_id [PK] integer | department character varying (100) | salary integer | CUMULATIVE_SUM bigint | WINDOW_AVG numeric | ORDER_GROUPWISE bigint | PREFIX_MAX integer | PREFIX_MIN integer |
|---|---|---|---|---|---|---|---|---|
| 1 | 3 | Finance | 55000 | 55000 | 55000.000000000000 | 1 | 55000 | 55000 |
| 2 | 6 | Finance | 62000 | 117000 | 58500.000000000000 | 2 | 62000 | 55000 |
| 3 | 5 | HR | 48000 | 48000 | 48000.000000000000 | 1 | 48000 | 48000 |
| 4 | 2 | HR | 50000 | 98000 | 49000.000000000000 | 2 | 50000 | 48000 |
| 5 | 1 | IT | 60000 | 60000 | 60000.000000000000 | 1 | 60000 | 60000 |
| 6 | 7 | IT | 62000 | 122000 | 61000.000000000000 | 2 | 62000 | 60000 |
| 7 | 4 | IT | 70000 | 192000 | 64000.000000000000 | 3 | 70000 | 60000 |

# RANK functions -

```
17  SELECT *,
18  ROW_NUMBER() OVER(ORDER BY employee_id) as "ROW_NUMBER",
19  RANK() OVER(ORDER BY employee_id) as "RANK",
20  DENSE_RANK() OVER(ORDER BY employee_id) as "DENSE_RANK",
21  PERCENT_RANK() OVER(ORDER BY employee_id) as "PERCENT_RANK"
22  FROM employees
23
```

Data Output | Messages | Notifications

SQL

| | employee_id [PK] integer | name character varying (100) | department character varying (100) | salary integer | ROW_NUMBER bigint | RANK bigint | DENSE_RANK bigint | PERCENT_RANK double precision |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | John Doe | IT | 60000 | 1 | 1 | 1 | 0 |
| 2 | 2 | Jane Smith | HR | 50000 | 2 | 2 | 2 | 0.16666666666666666 |
| 3 | 3 | Alice Johnson | Finance | 55000 | 3 | 3 | 3 | 0.3333333333333333 |
| 4 | 4 | Bob Brown | IT | 70000 | 4 | 4 | 4 | 0.5 |
| 5 | 5 | Charlie White | HR | 48000 | 5 | 5 | 5 | 0.6666666666666666 |
| 6 | 6 | Diana Green | Finance | 62000 | 6 | 6 | 6 | 0.8333333333333334 |
| 7 | 7 | Eve Black | IT | 62000 | 7 | 7 | 7 | 1 |

# RANK functions -

```
SELECT new_id,
ROW_NUMBER() OVER( ORDER BY new_id) AS "ROW_NUMBER",
RANK() OVER( ORDER BY new_id) AS "RANK",
DENSE_RANK() OVER( ORDER BY new_id) AS "DENSE_RANK“,
PERCENT_RANK() OVER( ORDER BY new_id) AS "PERCENT_RANK"
FROM test_data
```

| new_id | ROW_NUMBER | RANK | DENSE_RANK | PERCENT_RANK |
|---|---|---|---|---|
| 100 | 1 | 1 | 1 | 0 |
| 200 | 2 | 2 | 2 | 0.166 |
| 200 | 3 | 2 | 2 | 0.166 |
| 300 | 4 | 4 | 3 | 0.5 |
| 500 | 5 | 5 | 4 | 0.666 |
| 500 | 6 | 5 | 4 | 0.666 |
| 700 | 7 | 7 | 5 | 1 |

```sql
SELECT employee_id, department, salary,
FIRST_VALUE(employee_id) OVER(ORDER BY employee_id) as "FIRST_VALUE",
LAST_VALUE(employee_id) OVER(ORDER BY employee_id) as "LAST_VALUE",
LEAD(employee_id) OVER(ORDER BY employee_id) as "LEAD",
LAG(employee_id) OVER(ORDER BY employee_id) as "LAG"
FROM employees
```

Data Output | Messages | Notifications

| | employee_id [PK] integer | department character varying (100) | salary integer | FIRST_VALUE integer | LAST_VALUE integer | LEAD integer | LAG integer |
|---|---|---|---|---|---|---|---|
| 1 | 1 | IT | 60000 | 1 | 1 | 2 | [null] |
| 2 | 2 | HR | 50000 | 1 | 2 | 3 | 1 |
| 3 | 3 | Finance | 55000 | 1 | 3 | 4 | 2 |
| 4 | 4 | IT | 70000 | 1 | 4 | 5 | 3 |
| 5 | 5 | HR | 48000 | 1 | 5 | 6 | 4 |
| 6 | 6 | Finance | 62000 | 1 | 6 | 7 | 5 |
| 7 | 7 | IT | 62000 | 1 | 7 | [null] | 6 |

Questions to practice -

https://leetcode.com/problems/department-highest-salary/description/

https://leetcode.com/problems/rank-scores/description/

https://nextleap.app/interview-preparation/sql/questions

# Q&A

What’s on your mind?


SKELLYSCOO
I have several questions.

# Feed us back!