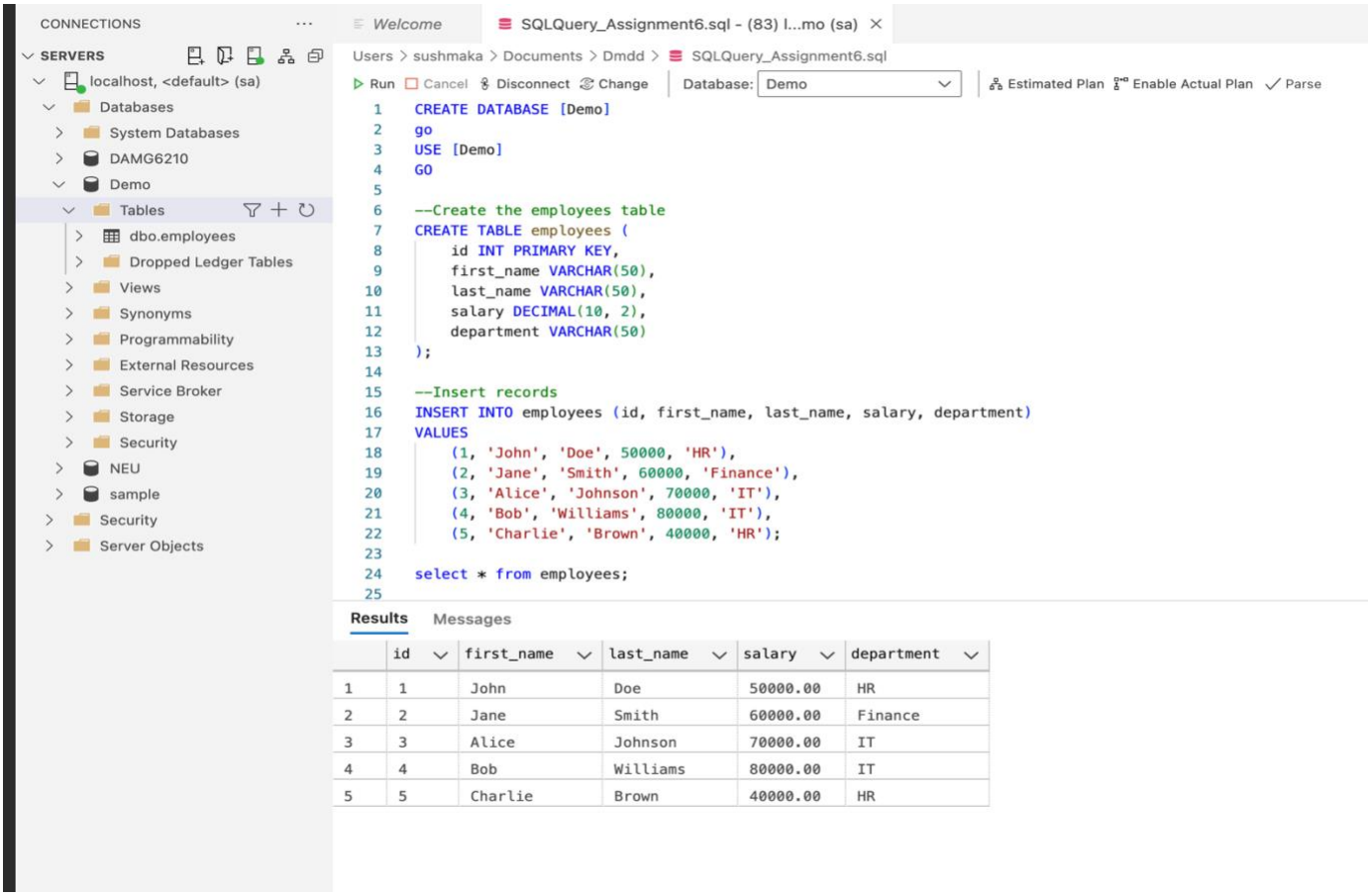
DAMG6210 - Data Management and Database Design

Homework 06



1.
INSERT INTO employees (id, first_name, last_name, salary, department)
SELECT id, first_name, last_name, salary, department
FROM contractors
WHERE department != 'HR';

CONNECTIONS

SERVERS

- localhost, <default> (sa)
  - Databases
    - System Databases
    - DAMG6210
    - Demo
      - Tables
        - dbo.contractors
        - dbo.employees
        - Dropped Ledger Tables
      - Views
      - Synonyms
      - Programmability
      - External Resources
      - Service Broker
      - Storage
      - Security
    - NEU
    - sample
  - Security
  - Server Objects

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Users > sushmaka > Documents > Dmdd > SQLQuery_Assignment6.sql

Run | Cancel | Disconnect | Change | Database: Demo | Estimated Plan | Enable Actual Plan | Parse

```sql
    department VARCHAR(50)
);

--Insert records
INSERT INTO contractors (id, first_name, last_name, salary, department)
VALUES
    (101, 'Sarah', 'Connor', 55000, 'IT'),
    (102, 'Mike', 'Johnson', 48000, 'HR'),
    (103, 'Emily', 'Davis', 62000, 'Finance'),
    (104, 'David', 'Brown', 58000, 'IT');

select * from employees;

select * from contractors;

INSERT INTO employees (id, first_name, last_name, salary, department)
SELECT id, first_name, last_name, salary, department
FROM contractors
WHERE department != 'HR';
```

Results | Messages

	id	first_name	last_name	salary	department
1	101	Sarah	Connor	55000.00	IT
2	102	Mike	Johnson	48000.00	HR
3	103	Emily	Davis	62000.00	Finance
4	104	David	Brown	58000.00	IT

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```sql
    department VARCHAR(50)
);

--Insert records
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VALUES
    (101, 'Sarah', 'Connor', 55000, 'IT'),
    (102, 'Mike', 'Johnson', 48000, 'HR'),
    (103, 'Emily', 'Davis', 62000, 'Finance'),
    (104, 'David', 'Brown', 58000, 'IT');

select * from employees;

select * from contractors;

INSERT INTO employees (id, first_name, last_name, salary, department)
SELECT id, first_name, last_name, salary, department
FROM contractors
WHERE department != 'HR';
```

Results Messages

	id	first_name	last_name	salary	department
1	1	John	Doe	50000.00	HR
2	2	Jane	Smith	60000.00	Finance
3	3	Alice	Johnson	70000.00	IT
4	4	Bob	Williams	80000.00	IT
5	5	Charlie	Brown	40000.00	HR
6	101	Sarah	Connor	55000.00	IT
7	103	Emily	Davis	62000.00	Finance
8	104	David	Brown	58000.00	IT

2.

```sql
DELETE FROM employees
WHERE salary <= 60000;
```

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```sql
    department VARCHAR(50)
);

--Insert records
INSERT INTO contractors (id, first_name, last_name, salary, department)
VALUES
    (101, 'Sarah', 'Connor', 55000, 'IT'),
    (102, 'Mike', 'Johnson', 48000, 'HR'),
    (103, 'Emily', 'Davis', 62000, 'Finance'),
    (104, 'David', 'Brown', 58000, 'IT');

select * from employees;

select * from contractors;

--Insert data from contractors table, excluding 'HR' department
INSERT INTO employees (id, first_name, last_name, salary, department)
SELECT id, first_name, last_name, salary, department
FROM contractors
WHERE department != 'HR';

--Delete employees with salary less than or equal to $60,000
DELETE FROM employees
WHERE salary <= 60000;
```

Results Messages

	id	first_name	last_name	salary	department
1	3	Alice	Johnson	70000.00	IT
2	4	Bob	Williams	80000.00	IT
3	103	Emily	Davis	62000.00	Finance

3.
UPDATE employees
SET salary = salary * 1.10
WHERE department = 'IT';

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Run Cancel Disconnect Change Database: Demo Estimated Plan

```sql
VALUES
    (101, 'Sarah', 'Connor', 55000, 'IT'),
    (102, 'Mike', 'Johnson', 48000, 'HR'),
    (103, 'Emily', 'Davis', 62000, 'Finance'),
    (104, 'David', 'Brown', 58000, 'IT');

select * from employees;

select * from contractors;

--Insert data from contractors table, excluding 'HR' department
INSERT INTO employees (id, first_name, last_name, salary, department)
SELECT id, first_name, last_name, salary, department
FROM contractors
WHERE department != 'HR';

--Delete employees with salary less than or equal to $60,000
DELETE FROM employees
WHERE salary <= 60000;

--Update salary of 'IT' department employees by 10%
UPDATE employees
SET salary = salary * 1.10
WHERE department = 'IT';
```

Results Messages

	id	first_name	last_name	salary	department
1	3	Alice	Johnson	77000.00	IT
2	4	Bob	Williams	88000.00	IT
3	103	Emily	Davis	62000.00	Finance

4. SELECT TOP 3 *
FROM employees
ORDER BY salary DESC;

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```sql
select * from contractors;

--Insert data from contractors table, excluding 'HR' department
INSERT INTO employees (id, first_name, last_name, salary, department)
SELECT id, first_name, last_name, salary, department
FROM contractors
WHERE department != 'HR';

--Delete employees with salary less than or equal to $60,000
DELETE FROM employees
WHERE salary <= 60000;

--Update salary of 'IT' department employees by 10%
UPDATE employees
SET salary = salary * 1.10
WHERE department = 'IT';

--Inserting more records
INSERT INTO employees (id, first_name, last_name, salary, department)
VALUES
  (6, 'David', 'Miller', 55000, 'Sales'),
  (7, 'Emily', 'Taylor', 65000, 'Marketing'),
  (8, 'Frank', 'Garcia', 75000, 'IT'),
  (9, 'Grace', 'Hall', 45000, 'HR');
```

Results Messages

	id	first_name	last_name	salary	department
1	3	Alice	Johnson	77000.00	IT
2	4	Bob	Williams	88000.00	IT
3	6	David	Miller	55000.00	Sales
4	7	Emily	Taylor	65000.00	Marketing
5	8	Frank	Garcia	75000.00	IT
6	9	Grace	Hall	45000.00	HR
7	103	Emily	Davis	62000.00	Finance

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```sql
--Inserting more records
INSERT INTO employees (id, first_name, last_name, salary, department)
VALUES
  (6, 'David', 'Miller', 55000, 'Sales'),
  (7, 'Emily', 'Taylor', 65000, 'Marketing'),
  (8, 'Frank', 'Garcia', 75000, 'IT'),
  (9, 'Grace', 'Hall', 45000, 'HR');

--Select top 3 highest salaries
SELECT TOP 3 *
FROM employees
ORDER BY salary DESC;
```

Results Messages

	id	first_name	last_name	salary	department
1	4	Bob	Williams	88000.00	IT
2	3	Alice	Johnson	77000.00	IT
3	8	Frank	Garcia	75000.00	IT

5.

```sql
SELECT *
FROM employees
WHERE first_name LIKE 'J%n';
```

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```sql
WHERE salary <= 60000;

--Update salary of 'IT' department employees by 10%
UPDATE employees
SET salary = salary * 1.10
WHERE department = 'IT';

--Inserting more records
INSERT INTO employees (id, first_name, last_name, salary, department)
VALUES
  (6, 'David', 'Miller', 55000, 'Sales'),
  (7, 'Emily', 'Taylor', 65000, 'Marketing'),
  (8, 'Frank', 'Garcia', 75000, 'IT'),
  (9, 'Grace', 'Hall', 45000, 'HR');

--Select top 3 highest salaries
SELECT TOP 3 salary
FROM employees
ORDER BY salary DESC;

--Select employees with first name starting with 'J' and ending with 'n'
SELECT *
FROM employees
WHERE first_name LIKE 'J%n';
```

Results Messages

id	first_name	last_name	salary	department

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```sql
(8, 'Frank', 'Garcia', 75000, 'IT'),
(9, 'Grace', 'Hall', 45000, 'HR');

--Select top 3 highest salaries
SELECT TOP 3 salary
FROM employees
ORDER BY salary DESC;

--Select employees with first name starting with 'J' and ending with 'n'
SELECT *
FROM employees
WHERE first_name LIKE 'J%n';

--Inserting a record
INSERT INTO employees (id, first_name, last_name, salary, department)
VALUES (10, 'John', 'Smith', 55000, 'Sales');

select * from employees;
```

Results Messages

	id	first_name	last_name	salary	department
1	3	Alice	Johnson	77000.00	IT
2	4	Bob	Williams	88000.00	IT
3	6	David	Miller	55000.00	Sales
4	7	Emily	Taylor	65000.00	Marketing
5	8	Frank	Garcia	75000.00	IT
6	9	Grace	Hall	45000.00	HR
7	10	John	Smith	55000.00	Sales
8	103	Emily	Davis	62000.00	Financ

Results grid

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```sql
(8, 'Frank', 'Garcia', 75000, 'IT'),
(9, 'Grace', 'Hall', 45000, 'HR');

--Select top 3 highest salaries
SELECT TOP 3 salary
FROM employees
ORDER BY salary DESC;

--Select employees with first name starting with 'J' and ending with 'n'
SELECT *
FROM employees
WHERE first_name LIKE 'J%n';

--Inserting a record
INSERT INTO employees (id, first_name, last_name, salary, department)
VALUES (10, 'John', 'Smith', 55000, 'Sales');

select * from employees;
```

Results Messages

	id	first_name	last_name	salary	department
1	10	John	Smith	55000.00	Sales

6.

```sql
SELECT *
FROM employees
WHERE (department = 'HR' AND salary <= 60000)
  OR (department != 'HR' AND salary > 60000);
```

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```sql
    (8, 'Frank', 'Garcia', 75000, 'IT'),
    (9, 'Grace', 'Hall', 45000, 'HR');

--Select top 3 highest salaries
SELECT TOP 3 salary
FROM employees
ORDER BY salary DESC;

--Select employees with first name starting with 'J' and ending with '
SELECT *
FROM employees
WHERE first_name LIKE 'J%n';

--Inserting a record
INSERT INTO employees (id, first_name, last_name, salary, department)
VALUES (10, 'John', 'Smith', 55000, 'Sales');

select * from employees;

--Select employees in 'HR' or salary > 60000, but not both
SELECT *
FROM employees
WHERE (department = 'HR' AND salary <= 60000)
   OR (department != 'HR' AND salary > 60000);
```

Results | Messages

	id	first_name	last_name	salary	department
1	3	Alice	Johnson	77000.00	IT
2	4	Bob	Williams	88000.00	IT
3	7	Emily	Taylor	65000.00	Marketing
4	8	Frank	Garcia	75000.00	IT
5	9	Grace	Hall	45000.00	HR
6	103	Emily	Davis	62000.00	Finance

7.

```sql
SELECT department, SUM(salary) as total_salary
FROM employees
GROUP BY department;
```

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```sql
FROM employees
ORDER BY salary DESC;

--Select employees with first name starting with 'J' and ending with 'n'
SELECT *
FROM employees
WHERE first_name LIKE 'J%n';

--Inserting a record
INSERT INTO employees (id, first_name, last_name, salary, department)
VALUES (10, 'John', 'Smith', 55000, 'Sales');

select * from employees;

--Select employees in 'HR' or salary > 60000, but not both
SELECT *
FROM employees
WHERE (department = 'HR' AND salary <= 60000)
   OR (department != 'HR' AND salary > 60000);

--Get total salary for each department
SELECT department, SUM(salary) as total_salary
FROM employees
GROUP BY department;
```

Results Messages

	department	total_salary
1	Finance	62000.00
2	HR	45000.00
3	IT	240000.00
4	Marketing	65000.00
5	Sales	110000.00

8.
SELECT *
FROM employees
ORDER BY department ASC, salary DESC;

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Run | Cancel | Disconnect | Change | Database: Demo | Estimated Plan

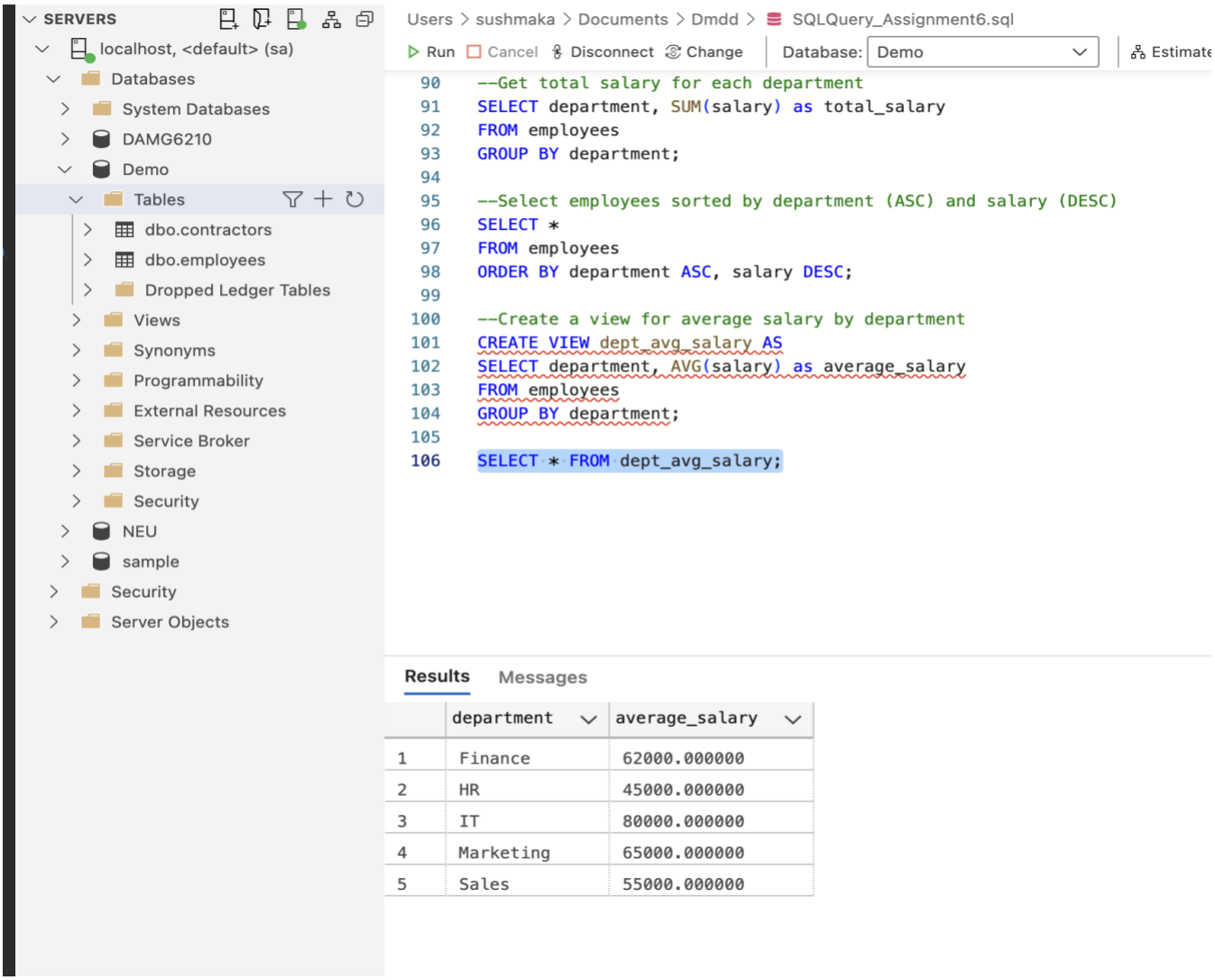
```sql
select * from employees;

--Select employees in 'HR' or salary > 60000, but not both
SELECT *
FROM employees
WHERE (department = 'HR' AND salary <= 60000)
   OR (department != 'HR' AND salary > 60000);

--Get total salary for each department
SELECT department, SUM(salary) as total_salary
FROM employees
GROUP BY department;

--Select employees sorted by department (ASC) and salary (DESC)
SELECT *
FROM employees
ORDER BY department ASC, salary DESC;
```

Results | Messages

	id	first_name	last_name	salary	department
1	103	Emily	Davis	62000.00	Finance
2	9	Grace	Hall	45000.00	HR
3	4	Bob	Williams	88000.00	IT
4	3	Alice	Johnson	77000.00	IT
5	8	Frank	Garcia	75000.00	IT
6	7	Emily	Taylor	65000.00	Marketing
7	6	David	Miller	55000.00	Sales
8	10	John	Smith	55000.00	Sales

9.

```sql
CREATE VIEW dept_avg_salary AS
SELECT department, AVG(salary) as average_salary
FROM employees
GROUP BY department;
```



10.

1. Index Optimization

Adding an index to the department column can greatly improve query speed. By making it easier to quickly access the rows linked to departments, indexes cut down on the amount of time needed to scan the entire table.

For instance, adding an index to the employee's table's department column speeds up searches that determine the average income for each department. For example, the database can effectively find all HR-related information using the index, which speeds up the process of collecting the average wage for the HR department.

```
-- Create an index on the department column
CREATE INDEX idx_department ON employees(department);
```

2. Covering Index
Performance can be further enhanced by implementing a covering index that considers both department and salary. With this kind of index, the database can obtain all required information straight from the index without having to consult the entire table.

The database can quickly determine the average wage for each department thanks to a covering index on department and salary. The database may retrieve department and salary data from the index alone when a query is run to determine the average wage in the IT department, which expedites the aggregation process.

```
-- Create a covering index on department and salary
CREATE INDEX idx_department_salary ON employees (department, salary);
```

3. Materialized Views
Repetitive computations can be avoided by developing a materialized view that calculates average pay by department beforehand. The aggregated results are stored in this view for easy retrieval.

For instance, the average salary for every department is kept in a materialized view called dept_avg_salary_mv. Faster response times are achieved by the database retrieving the precomputed value from the view rather than recalculating it when the average wage for the Marketing department is queried.

4. Query Caching
The database can save the outcomes of frequently run queries by utilizing query caching. The results of the same query can be retrieved straight from the cache by subsequent executions, negating the requirement for reprocessing.

For instance, the results may be cached if the query to determine the average salary per department is executed more than once. Performance is enhanced since the database provides the cached result immediately when the average wage for the Finance department is requested again.

5. Table Partitioning
To guarantee that queries only target pertinent partitions, the personnel table is partitioned according to the department column. This improves efficiency by lowering the amount of data the database must scan.

For instance, a query to get the average wage for the sales department only scans the sales partition as the workers data has been divided by department. Compared to scanning the full table, this targeted scanning reduces the amount of time needed to process the data.

6. Denormalization and Pre-Aggregation
Storing pre-aggregated data, such as average salaries per department, in a separate table eliminates the need for real-time calculations during queries. This approach provides instant access to aggregated values.

Because the average salary for each department is kept in a distinct table named department_salary_stats, queries can extract the average salary for the HR department straight from this table, saving time and effort compared to calculating it on the fly.

7. Regular Statistics Update

Maintaining current database statistics aids in the query optimizer's decision-making process, which results in more effective execution strategies. Faster data aggregation and retrieval are made possible by accurate statistics.

For instance, queries that determine average salaries by department are guaranteed to follow the most effective execution paths when statistics on the employees table are updated on a regular basis. When obtaining the average compensation for any department, including IT, this results in optimal performance.

References

Hoffer, J. A., Ramesh, V., & Topi, H. (2016). *Modern database management* (13th ed.). Pearson.