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# SQL OPTIMIZATION

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## INTERVIEW QUESTION

**Deloitte.**Infosys

## Interview Question:

**Q:** When should you use JOINS and CTEs instead of subqueries in SQL?

**Asked by:** Deloitte, Infosys

### ☒ Answer:

- Use JOINS for better performance and maintainability, especially on large datasets.
- Correlated subqueries are executed once per row — making them inefficient as data size grows.
- JOINS and CTEs support parallel processing, are more readable, and scale well with indexed tables.



## **Why it matters:**

- In production databases (like Azure SQL, Snowflake, or PostgreSQL), correlated subqueries often cause significant performance bottlenecks.
- They trigger nested loop executions per row, increasing latency, memory usage, and query complexity — especially in analytical workloads.
- Using JOINS or CTEs helps databases optimize execution plans and utilize indexes or partitioning strategies.

## **Optimization Tips:**

- ◆ Replace correlated subqueries with LEFT JOINs and GROUP BY
- ◆ Use CTEs for clarity and modular query building
- ◆ Leverage execution plans to validate performance improvements
- ◆ Always check query cost before and after transformation

## Examples:

### **Slow Correlated Subquery:**

```
SELECT name,  
       (SELECT COUNT(*)  
        FROM orders o  
        WHERE o.customer_id = c.id)  
FROM customers c;
```


 Executes the subquery for **each row** in customers

### **JOIN-based Rewrite:**

```
SELECT c.name, COUNT(o.id)  
FROM customers c  
LEFT JOIN orders o ON c.id = o.customer_id  
GROUP BY c.name;
```

 Processes data in a **single pass**, supports index scans and is highly scalable.

## **Best Practice:**

- ☒ Default to JOINS when retrieving related data across tables
- ☒ Avoid correlated subqueries unless absolutely necessary
- ☒ Use CTEs for layering complex logic and improving readability
-  Watch out for duplicated rows — always validate aggregate logic when switching from subqueries to joins

## **Real-World Example:**

You're querying customers with their total order count from a table of 10 million rows:

### **✗ Inefficient Query (Correlated Subquery):**


```
SELECT name,  
       (SELECT COUNT(*)  
        FROM orders o  
        WHERE o.customer_id = c.id)  
FROM customers c;
```

 Takes 3–4 minutes due to nested execution

### **☑ Optimized JOIN:**

```
SELECT c.name, COUNT(o.id)  
FROM customers c  
LEFT JOIN orders o ON c.id = o.customer_id  
GROUP BY c.name;
```

 Runs in seconds — joins leverage indexes and process rows in parallel

 Massive improvement on systems like Azure Synapse, BigQuery, and Snowflake

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