SQL Advanced Command & Concept Reference (Interview + Architecture Level)

This document covers **ADVANCED SQL**, which differentiates a **senior data professional** from someone who only knows queries. These topics test your understanding of **performance, design, transactions, and internal database behavior**.

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1. WINDOW FUNCTIONS (MOST IMPORTANT 🔥🔥🔥)

Definition

Window functions perform calculations across a set of rows **related to the current row**, without collapsing rows like GROUP BY.

Syntax

```
function_name() OVER (
  PARTITION BY column
  ORDER BY column
)
```

Common Window Functions

ROW_NUMBER()

Assigns a unique number to each row.

```
SELECT name, salary,
ROW_NUMBER() OVER (ORDER BY salary DESC) AS rn
FROM employees;
```

RANK()

Assigns rank with gaps.

DENSE_RANK()

Assigns rank without gaps.

LAG() / LEAD()

Access previous or next row values.

```sql
SELECT name, salary,
LAG(salary) OVER (ORDER BY salary) AS prev_salary
FROM employees;
```

📌Interview Tip: Window functions do not reduce rows.

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2. INDEXING & PERFORMANCE

Index

A database object that improves data retrieval speed.

Types of Indexes

- Clustered Index (physically sorts data)
- Non-Clustered Index (separate structure)

Interview Difference

Clustered	Non-Clustered
One per table	Multiple allowed
Faster reads	Slightly slower
Slower inserts	Faster inserts

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3. TRANSACTIONS & ACID PROPERTIES

Transaction

A logical unit of work.

ACID Properties

- **Atomicity** – All or nothing
- **Consistency** – Valid state
- **Isolation** – Transactions independent
- **Durability** – Permanent changes

Commands

```
BEGIN;
COMMIT;
ROLLBACK;
```

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4. NORMALIZATION & DENORMALIZATION

Normalization

Process of reducing data redundancy.

- 1NF – Atomic values
- 2NF – No partial dependency
- 3NF – No transitive dependency

Denormalization

Intentional redundancy for performance.

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5. VIEWS

Definition

A virtual table based on a SQL query.

```
CREATE VIEW emp_view AS
SELECT name, salary FROM employees;
```

Use Cases

- Security
- Simplified queries

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6. STORED PROCEDURES & FUNCTIONS

Stored Procedure

Reusable SQL block.

Function

Returns a value.

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7. TRIGGERS

Definition

Automatically executed in response to table events.

```
CREATE TRIGGER before_insert
BEFORE INSERT ON employees
FOR EACH ROW
SET NEW.created_at = NOW();
```

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8. CORRELATED vs NON-CORRELATED SUBQUERY

Non-Correlated	Correlated
Runs once	Runs per row
Faster	Slower

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9. COLLATION & CHARACTER SET

Controls sorting and comparison rules.

- Case-sensitive vs insensitive

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10. DATA WAREHOUSE CONCEPTS

- Data Warehouse
- Data Mart
- OLTP vs OLAP
- Fact Table
- Dimension Table
- Star Schema
- Snowflake Schema

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11. SECURITY & CONTROL

• Users & Roles
• GRANT / REVOKE

ADVANCED INTERVIEW SUMMARY

• Window functions → Ranking & analytics
• Indexing → Performance tuning
• ACID → Reliability
• Normalization → Design quality
• DW concepts → Analytics readiness

🔔 Mastering this section puts you in **top 10–15% SQL candidates**.