What are indexes in SQL? How do they improve query performance?

Indexes are special lookup tables that SQL databases use to speed up data retrieval. They work like an index in a book, allowing the database to find rows quickly without scanning the entire table.

Ex: CREATE INDEX idx_emp_sal ON EMP_LARGE(SAL);

Explain the difference between B-Tree and Bitmap indexes.

B-Tree Index: Best for high-cardinality columns (many unique values), such as Employee ID.

Bitmap Index: Best for low-cardinality columns (few unique values), such as Gender (Male/Female).

What is query optimization? How does the SQL optimizer work?

Query optimization is the process of improving query performance by analyzing different execution strategies and choosing the most efficient one. The SQL optimizer considers indexes, joins, partitions, and costs.

Use EXPLAIN PLAN to see how a query is executed.

EXPLAIN PLAN FOR

SELECT * FROM EMP_LARGE WHERE SAL > 50000;

SELECT * FROM TABLE(DBMS_XPLAN.DISPLAY);

What are query hints, and when should they be used?

Query hints are instructions given to the SQL optimizer to force a specific execution plan. They should be used only when the optimizer does not choose the best plan.

SELECT /*+ INDEX(EMP_LARGE idx_emp_sal) */ * FROM EMP_LARGE WHERE SAL > 50000;

What is the difference between a full table scan and an index scan?

Full Table Scan: Reads the entire table, slow for large datasets.

Index Scan: Uses an index to retrieve only relevant rows, improving performance.

What are ACID properties in SQL transactions?

- **Atomicity**: Transactions are all-or-nothing.
- **Consistency**: Database remains in a valid state.
- **Isolation**: Transactions are independent.
- **Durability**: Data is permanent after commit.

What is a stored procedure? How is it different from a function?

Procedure: Can return multiple values, does not return a value directly.

Function: Must return a single value.

What are IN, OUT, and INOUT parameters in stored procedures?

- **IN**: Input-only parameter.
- **OUT**: Output-only parameter.
- **INOUT**: Both input and output.

What are the different types of window functions in SQL?

Window functions are categorized as:

Ranking Functions: RANK(), DENSE_RANK(), ROW_NUMBER(), NTILE()

Aggregate Window Functions: SUM(), AVG(), MAX(), MIN(), COUNT()

Value Functions: LEAD(), LAG(), FIRST_VALUE(), LAST_VALUE()

Explain the difference between RANK(), DENSE_RANK(), and ROW_NUMBER()?

RANK() – Skips ranking numbers if there are ties.

DENSE_RANK() – No gaps in ranking, even if there are ties.

ROW_NUMBER() – Assigns a unique number to each row, even if values are the same.

How does LEAD() and LAG() work in SQL?

LEAD() fetches the value from the next row.

LAG() fetches the value from the previous row.