1. Basic Terminology

- **Schema**: Logical structure of the database (tables, views, indexes, etc.)
- **Instance**: Actual content of the database at a point in time
- **DDL (Data Definition Language)**: SQL commands to define schema

2. Common DDL Commands

Command	Description
CREATE	Create database objects (tables, views, indexes, etc.)
ALTER	Modify existing database objects.
DROP	Delete database objects
TRUNCATE	Remove all records from a table

3. **Creating a Table**

Syntax:
CREATE TABLE table_name (column1 datatype [constraints], column2 datatype [constraints],
... PRIMARY KEY (column), FOREIGN KEY (column) REFERENCES other_table(column));

4. **Common Data Types**

Type	Description
INT	Integer
VARCHAR(n)	Variable-length string
DATE	Date
FLOAT	Floating-point number
BOOLEAN	True/False

5. **Common Constraints**

Constraint	Use
PRIMARY KEY	Uniquely identifies each row
FOREIGN KEY	Enforces referential integrity
NOT NULL	Prevents null values

Constraint	Use
UNIQUE	Ensures all values in a column are unique
CHECK	Ensures values meet a condition
DEFAULT	Provides a default value

6. **Altering a Schema**

Ver1: ALTER TABLE table_name ADD column_name datatype;

Ver2: ALTER TABLE table_name MODIFY column_name new_datatype;

Ver3:ALTER TABLE table_name DROP COLUMN column_name;

7. Dropping a Schema

DROP TABLE table_name;

8. Creating Relationships

CREATE TABLE Orders (OrderID INT PRIMARY KEY, CustomerID INT, FOREIGN KEY (CustomerID) REFERENCES Customers(CustomerID));

On running this query table named order was created in the database.

To show the structure of the table, describe the command

Desc orders;

```
Name        Null?    Type
----------- -------- ----------
ORDERID     NOT NULL NUMBER(38)
CUSTOMERID           NUMBER(38)
```

Here are concise notes on the **INSERT**, **SELECT**, **DELETE**, and **UPDATE** commands in SQL, which are used to manage data in relational databases:

9. INSERT Command

Purpose: Adds new records (rows) into a table.

Syntax: INSERT INTO table_name (column1, column2, ...)
VALUES (value1, value2, ...);
Or
INSERT INTO table_name
VALUES (value1, value2, value3, ...);

Example:
INSERT INTO students (id, name, age)
VALUES (1, 'Alice', 20);

Pin Points to remember:

- Column list is optional if values are provided for all columns.
- You can insert multiple rows in one command using:
- INSERT INTO table_name (col1, col2)

- VALUES (val1, val2), (val3, val4), ...;

2. SELECT Command
Purpose: Retrieves data from one or more tables.
Syntax:
SELECT column1, column2, ...
FROM table_name
WHERE condition;
Example:
SELECT name, age
FROM students
WHERE age > 18;
Pin Points to remember:

- SELECT * returns all columns.
- Can use ORDER BY, GROUP BY, JOIN, LIMIT, etc., for advanced queries.

3. DELETE Command
Purpose: Removes existing records from a table.
Syntax:
DELETE FROM table_name
WHERE condition;
Example:
DELETE FROM students
WHERE id = 1;
Pin Points to remember:

- **Always include a WHERE clause** to avoid deleting all rows.
- To remove all rows without deleting the table:
- DELETE FROM table_name;

4. UPDATE Command
Purpose: Modifies existing data in a table.
Syntax:
UPDATE table_name
SET column1 = value1, column2 = value2, ...
WHERE condition;
Example:
UPDATE students
SET age = 21
WHERE name = 'Alice

5. Joins

5.1 Join Operations

- JOINs can be used to **combine tables**
- Join is a **derivative of the Cartesian** product.
- Equivalent to performing a Selection, using a join predicate as selection formula, over the Cartesian product of the two operand relations.
- One of the **most difficult operations** to implement efficiently in an RDBMS, and **one reason why RDBMSs have an intrinsic performance problem**

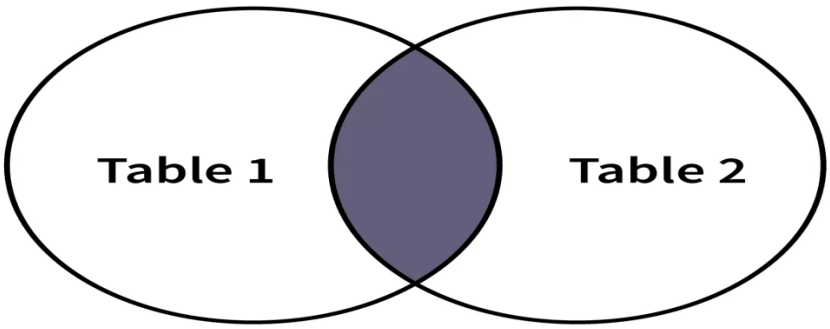
5.2 Various forms of join operation

- JOIN (Inner Join): Return rows when there is at least one match in both tables
- LEFT JOIN(Left Outer Join): Return all rows from the left table, even if there are no matches in the right table
- RIGHT JOIN(Right Outer Join): Return all rows from the right table, even if there are no matches in the left table
- FULL JOIN: Return rows when there is a match in

One of the tables

5.3 SQL INNER JOIN

- Returns only the rows that have matching values in both tables.
- Matching rows only.



INNER JOIN

Syntax

SELECT column_name(s) FROM table_name1
INNER JOIN table_name2 ON
table_name1.column_name=table_name2.column_
name

INNER JOIN is the same as JOIN. The word "INNER" is optional

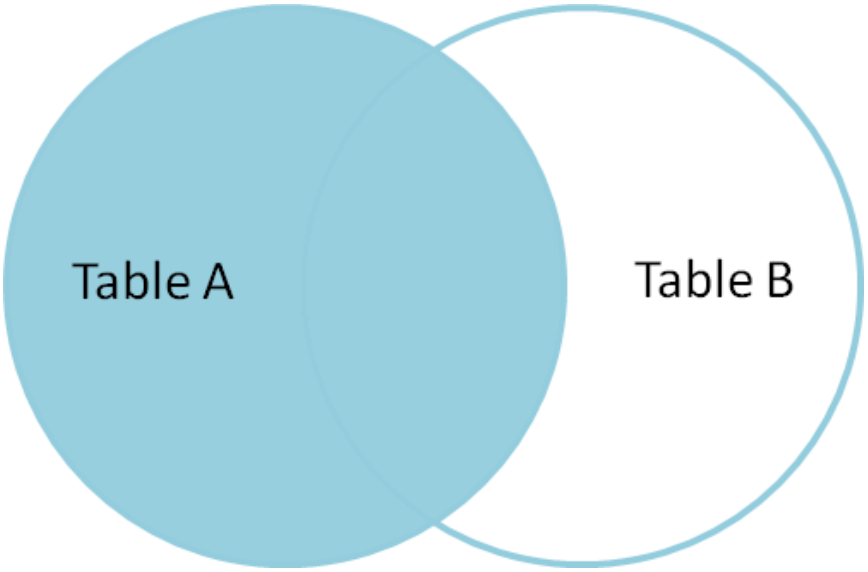
Special Case of INNER JOIN: NATURAL JOIN

SQL Natural Join is a type of Inner join based on the condition that columns having the same name and datatype are present in both the tables to be joined.

```
SELECT * FROM
table-1 NATURAL JOIN table-2;
```

5.4 Left Join

- Returns all records from the left table and matched records from the right table. If no match, NULLs on the right.
- All from A matched B.



SQL LEFT JOIN Keyword

The LEFT JOIN keyword returns all rows from the left table (table_name1), even if there are no matches in the right table (table_name2).

SQL LEFT JOIN Syntax

```
SELECT column_name(s)
FROM table_name1
LEFT JOIN table_name2
ON table_name1.column_name=table_name2.column_name
```

PS: In some databases LEFT JOIN is called LEFT OUTER JOIN.

Example - Left Join

The "Persons" table:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger

The "Orders" table:

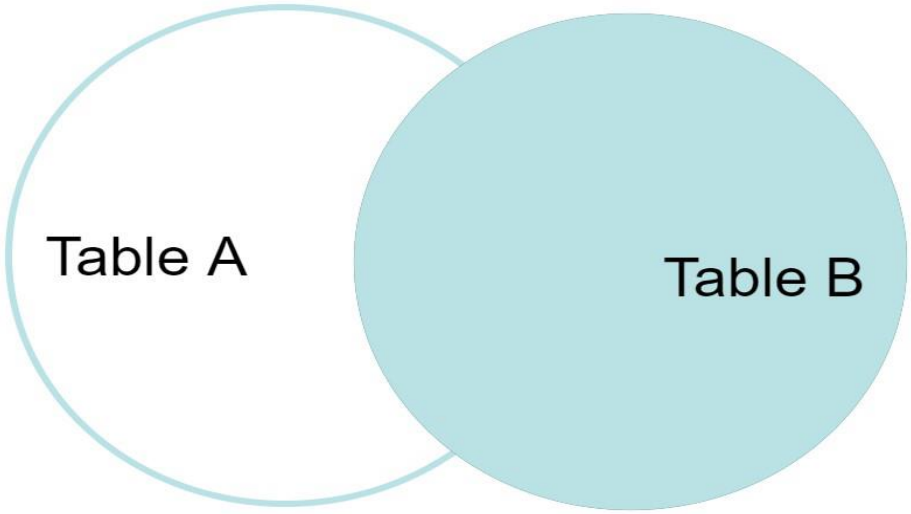
O_Id	OrderNo	P_Id
1	77895	3
2	44678	3
3	22456	1
4	24562	1
5	34764	15

We use the following SELECT statement:

```
SELECT Persons.LastName, Persons.FirstName, Orders.OrderNo
FROM Persons
LEFT JOIN Orders
ON Persons.P_Id=Orders.P_Id
ORDER BY Persons.LastName
```

5.5 Right Join

- Returns all records from the right table and matched records from the left table. If no match, NULLs on the left.
- All from B matched A.



SQL RIGHT JOIN Keyword

The RIGHT JOIN keyword Return all rows from the right table (table_name2), even if there are no matches in the left table (table_name1).

SQL RIGHT JOIN Syntax

```
SELECT column_name(s)
FROM table_name1
RIGHT JOIN table_name2
ON table_name1.column_name=table_name2.column_name
```

PS: In some databases RIGHT JOIN is called RIGHT OUTER JOIN.

Example – Right Join

SQL RIGHT JOIN Example

The "Persons" table:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger

The "Orders" table:

O_Id	OrderNo	P_Id
1	77895	3
2	44678	3
3	22456	1
4	24562	1
5	34764	15

We use the following SELECT statement:

```
SELECT Persons.LastName, Persons.FirstName, Orders.OrderNo
FROM Persons
RIGHT JOIN Orders
ON Persons.P_Id=Orders.P_Id
ORDER BY Persons.LastName
```

The result-set will look like this:

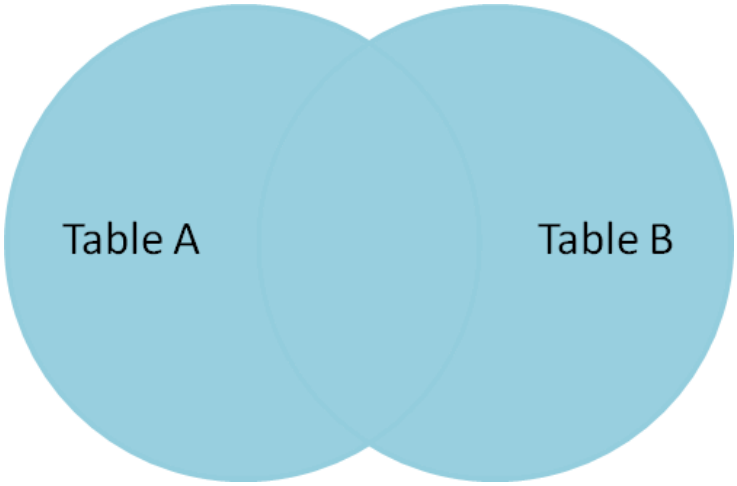
LastName	FirstName	OrderNo
Hansen	Ola	22456
Hansen	Ola	24562
Pettersen	Kari	77895
Pettersen	Kari	44678
		34764

The RIGHT JOIN keyword returns all the rows from the right table (Orders), even if there are no matches in the left table (Persons).

Now we want to list all the orders with containing persons - if any, from the tables above.

5.5 FULL JOIN (FULL OUTER JOIN):

- Returns all records when there is a match in either the left or right table. Fills NULLs where there's no match.
- All from A and B.



SQL FULL JOIN Example

The "Persons" table:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger

The "Orders" table:

O_Id	OrderNo	P_Id
1	77895	3
2	44678	3
3	22456	1
4	24562	1
5	34764	15

We use the following SELECT statement:

```
SELECT Persons.LastName, Persons.FirstName, Orders.OrderNo
FROM Persons
FULL JOIN Orders
ON Persons.P_Id=Orders.P_Id
ORDER BY Persons.LastName
```

The result-set will look like this:

LastName	FirstName	OrderNo
Hansen	Ola	22456
Hansen	Ola	24562
Pettersen	Kari	77895
Pettersen	Kari	44678
Svendson	Tove	
		34764

The FULL JOIN keyword returns all the rows from the left table (Persons), and all the rows from the right table (Orders). If there are rows in "Persons" that do not have matches in "Orders", or if there are rows in "Orders" that do not have matches in "Persons", those rows will be listed as well.

Now we want to list all the persons and their orders, and all the orders with their persons.

FROM departments WHERE location = 'NY');

6.1.3 Correlated Subquery

References columns from the outer query.
Executed once per row of the outer query.
Example:

SELECT e.name FROM employees WHERE salary > (SELECT AVG(salary) FROM employees WHERE department_id = e.department_id);

6.2 Clauses Supporting Subqueries

SELECT

- Used to filter or compute values in the output.
  Example:
  SELECT name, (SELECT department_name FROM departments d WHERE d.id = e.department_id) FROM employees ;

FROM

- Subquery acts as a table (a derived table).
  Example:
  SELECT dept_name, total_salary FROM (SELECT department_id, SUM(salary) AS total_salary FROM employees GROUP BY department_id) AS dept_salary
  JOIN departments ON dept_salary.department_id = departments.id;

WHERE

- Filters rows using a subquery.
  Example:
- SELECT name FROM employees
- WHERE department_id = (SELECT id FROM departments WHERE name = 'HR');

HAVING

- Filters groups after aggregation.
  Example:
  SELECT department_id, COUNT(*) FROM employees GROUP BY department_id HAVING COUNT(*) > (SELECT AVG(emp_count FROM (SELECT department_id, COUNT(*) AS emp_count FROM employees GROUP BY department_id) AS dept_counts);

EXISTS

- Tests for the existence of rows.
  Example:
  SELECT name FROM departments WHERE EXISTS (SELECT 1 FROM employees e WHERE e.department_id = d.id);

IN, ANY, ALL

- Compare against multiple results.
  Examples:
- -- IN
  SELECT name FROM employees WHERE department_id IN (SELECT id FROM departments WHERE location = 'NY');

- -- ANY
  SELECT name FROM employees WHERE salary > ANY (SELECT salary FROM employees WHERE department_id = 10);

- -- ALL
  SELECT name FROM employees WHERE salary > ALL (SELECT salary FROM employees WHERE department_id = 10);

6.3. Subquery Rules

- Must be enclosed in parentheses.

- Must return a single column if used with =, <, etc.
- Correlated subqueries cannot be used in FROM in some databases (like MySQL).
- Alias subqueries in the FROM clause.

7. Views

Definition: A virtual table based on the result set of an SQL statement.

7.1 Create a View

CREATE VIEW view_name AS SELECT column1, column2 FROM table_name WHERE condition;

7.2 Update a View

In SQL, a **view** is a virtual table created by a query. If you want to **update** or **modify a view**, there are a few different meanings to "updation" depending on context:

If you want to change how a view is defined (e.g., modify the SELECT statement), you use:

CREATE OR REPLACE VIEW view_name AS SELECT column1, column2
FROM table_name WHERE condition;

This is the standard way in **SQL**, **Oracle**, and some other databases.

For **SQL Server**, use:

ALTER VIEW view_name AS SELECT column1, column2
FROM table_name WHERE condition;

7.3 Update Data Through a View

You can **update records** through a view **only if**:

- The view is **updatable** (i.e., based on a single table, no aggregates or GROUP BY, etc.).
- You have the proper permissions.

UPDATE view_name SET column1 = value WHERE condition;

7.3.1 If the View Is Not Updatable

Some views (like those involving joins, aggregations, or DISTINCT) **cannot be directly updated**. You would need to update the base tables instead.

Example

Original View:

CREATE VIEW employee_view AS SELECT id, name, department FROM employees WHERE status = 'active';

Update View Definition:

CREATE OR REPLACE VIEW employee_view AS SELECT id, name, department, salary FROM employees WHERE status = 'active';

Update Data via View:

UPDATE employee_view SET department = 'HR' WHERE id = 101;

This updates the department in the employees table, assuming the view is updatable.

8. Indexes

Definition: A Performance tuning method to speed up data retrieval.

8.1 Create Index

CREATE INDEX index_name ON table_name (column1, column2);

8.2 Drop Index

DROP INDEX index_name;

9. Stored Procedures

Definition: A group of SQL statements saved to be reused.

9.1 Create a Stored Procedure

```
CREATE PROCEDURE procedure_name (param1 datatype, param2 datatype)
 BEGIN
   -- SQL statements
END;
```

9.2 Execute Stored Procedure

```
CALL procedure_name(param1, param2);
```

9.3 Drop Stored Procedure

```
DROP PROCEDURE procedure_name;
```

10. Functions

Definition: Similar to procedures, but must return a value.

10.1 Create Function

```
CREATE FUNCTION function_name (param1 datatype)
RETURNS datatype
BEGIN
 DECLARE result datatype;
 -- SQL logic
 RETURN result;
END;
```

10.2 Call Function

```
SELECT function_name(param1);
```

10.3 Drop Function

```
DROP FUNCTION function_name;
```

Company-based SQL questions:

Schema Creation, INSERT/DELETE/UPDATE/SELECT

1. **Create a table** for employees with fields: emp_id, name, department, salary, and joining_date.
2. **Insert** 3 records into the employees table.
3. **Update** the salary of an employee with emp_id = 101.
4. **Delete** employees from the Sales department.
5. **Select** all employees who joined after '2023-01-01'.

Joins: INNER, LEFT, RIGHT, FULL

Given two tables: `Employees(emp_id, name, dept_id)` and `Departments(dept_id, dept_name)`:

6. Write a query to **INNER JOIN** these tables and show employee names with department names.
7. Use a **LEFT JOIN** to list all employees and their departments, including employees with no department.
8. Use a **RIGHT JOIN** to find all departments and the employees in them, even if no employees exist.
9. Use a **FULL OUTER JOIN** to get all employees and departments, matching if possible.

Subqueries & WITH Clauses

10. Write a query to find employees who earn more than the **average salary** (using a subquery).
11. Using a **correlated subquery**, find employees who earn more than the average salary of their department.

12. Use a **WITH** clause (Common Table Expression) to get the top 3 highest-paid employees.
13. Find the second-highest salary using a subquery.
14. Write a query using **EXISTS** to check if any employee exists in the 'HR' department.

Views, Indexes, Stored Procedures, Functions

15. Create a **view** called `HighEarners` showing employees with a salary > 100000.
16. Create an **index** on the `salary` column of the `employees` table. Explain why you would do that.
17. Write a **stored procedure** to give a bonus (10%) to employees in a given department.
18. Create a **function** that takes a department ID and returns the count of employees in that department.
19. What are the **advantages/disadvantages** of views and indexes?