PostgreSQL

Advanced Postgres

Surendra Panpaliya

Agenda

Basic Concepts and SQL Commands

Database, schema, tables, rows, and columns

Data types and constraints

Primary keys and foreign keys

Agenda

Basic SQL Commands

CREATE, INSERT, SELECT, UPDATE, DELETE

Filtering and sorting data

Aggregate function

Database

A PostgreSQL database is

Collection of schemas

Store data

Database

A company database

store data related to employees,

departments, products

CREATE DATABASE company_db;

Schema

LOGICAL CONTAINER INSIDE A DATABASE.

HOLDS TABLES, VIEWS,

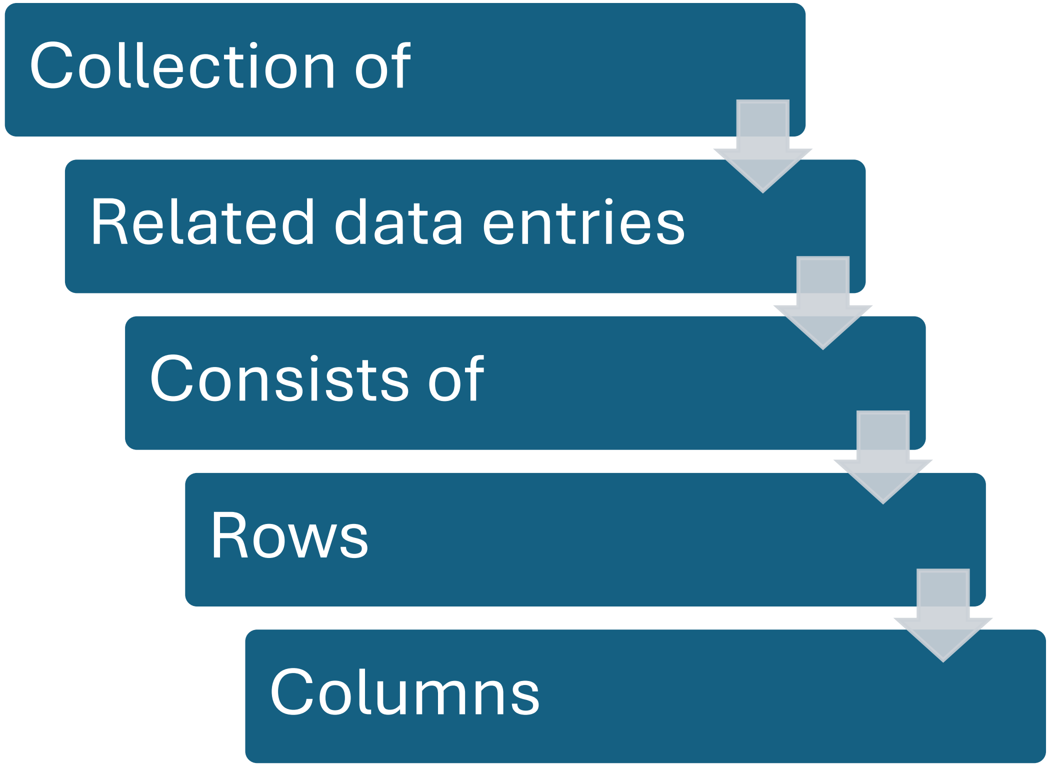
INDEXES, SEQUENCES,

FUNCTIONS

Example

- public (default)
- hr (human resources)
- sales
- CREATE SCHEMA hr;

Table



Collection of

Related data entries

Consists of

Rows

Columns

Table Example

An employees table

store details like

employee ID, name,

position, salary

Creating a Table

```
CREATE TABLE hr.employees (
    employee_id SERIAL PRIMARY KEY,
    first_name VARCHAR(50),
    last_name VARCHAR(50),
    email VARCHAR(100) UNIQUE,
    hire_date DATE,
    salary NUMERIC(8, 2)
);
```

Creating a Table

employee_id:
An integer column that
automatically increments with each new row,
serving as the primary key.

Creating a Table

first_name & last_name:
A string column with
a maximum length of
50 characters.

Creating a Table

email:
A string column with a
maximum length of 100 characters,
unique for each row.

Creating a Table

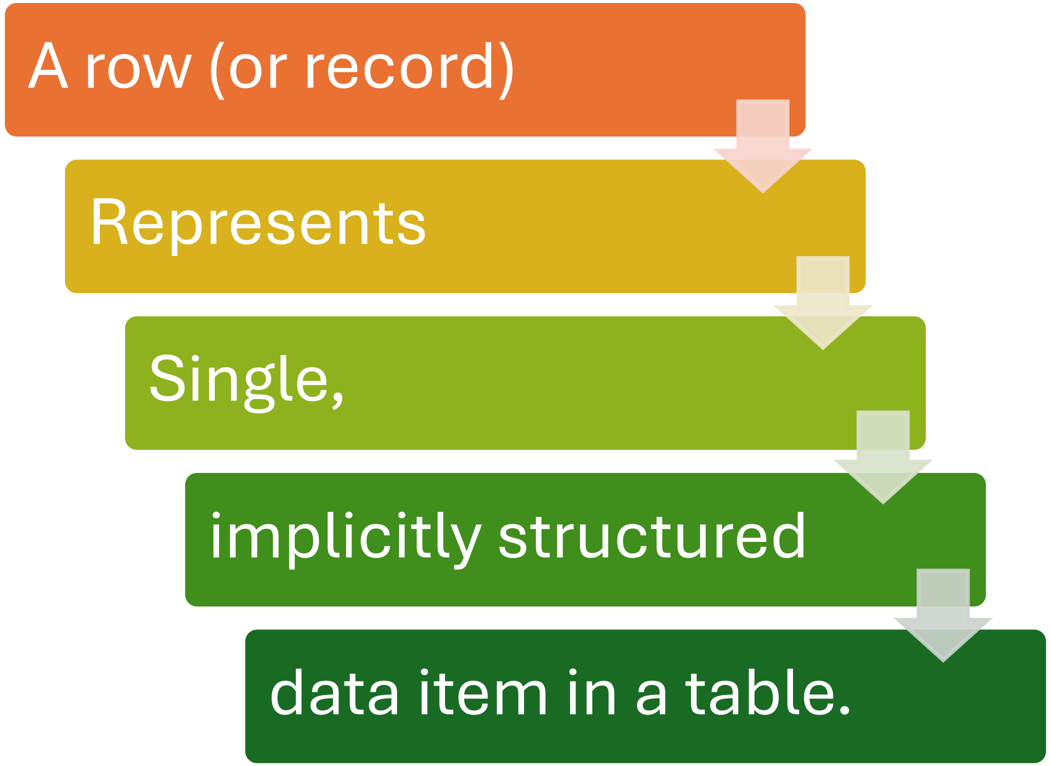
hire_date:

A date column.

Creating a Table

salary:
A numeric column
allows up to 8 digits,
including 2 decimal places

Row



A row (or record)

Represents

Single,

implicitly structured

data item in a table.

Row Examples

A row in

Employees table

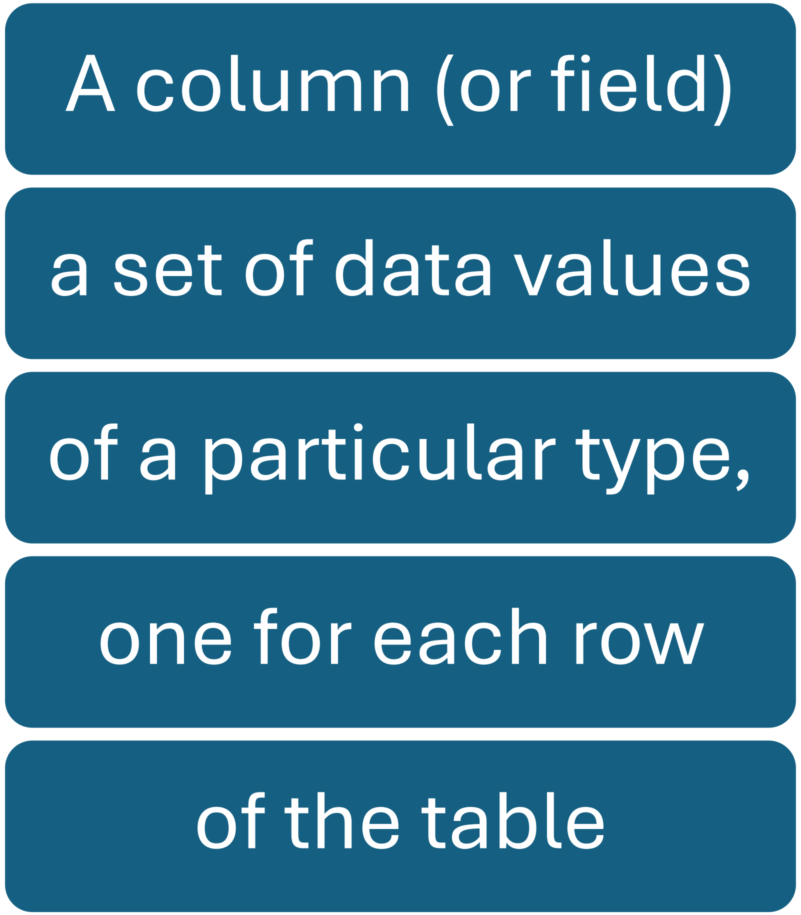
Contain data

about a Single employee.

Inserting Row into a Table

```
INSERT INTO hr.employees (first_name, last_name, email, hire_date, salary)
VALUES (‘Dev’, ‘Rathi', ‘dev.rathi@example.com', ‘2024-07-18', 50000.00);
```

Column



A column (or field)

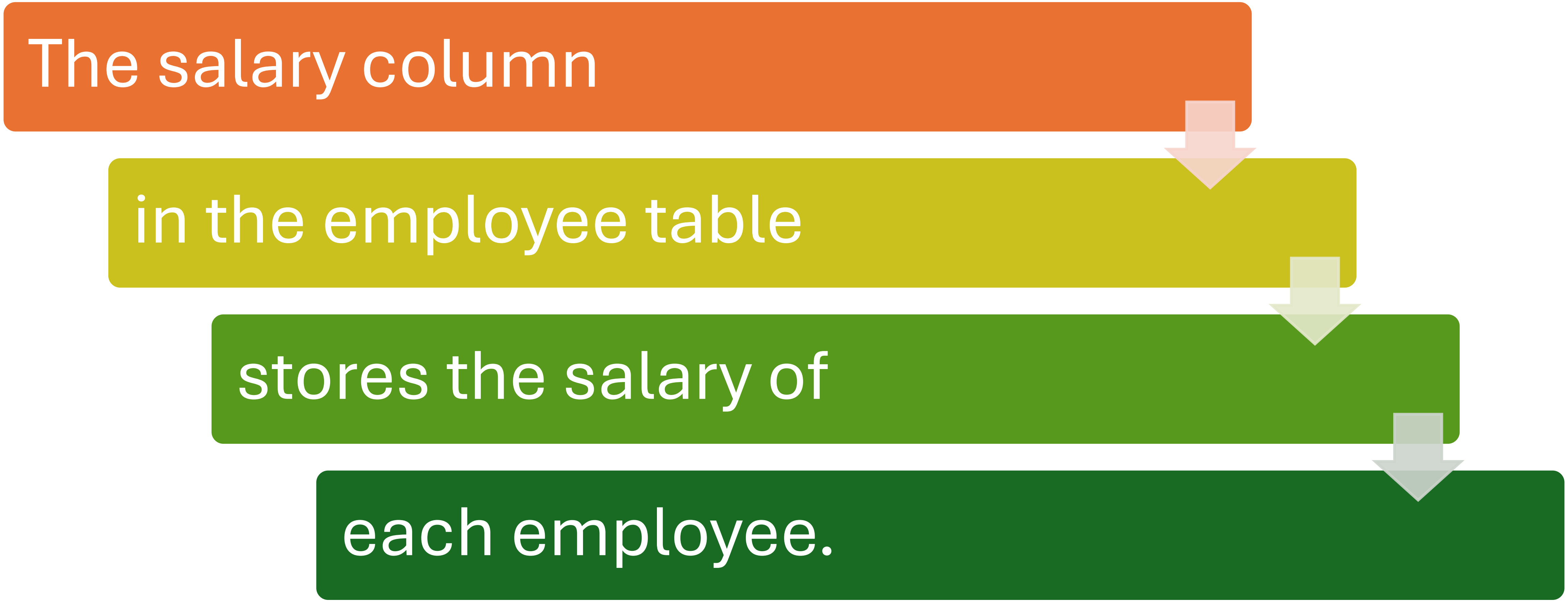
a set of data values

of a particular type,

one for each row

of the table

Column Example



The salary column

in the employee table

stores the salary of

each employee.

Column

```
SELECT employee_id, first_name, last_name, email, hire_date, salary
FROM hr.employees;
```

Column

```sql
ALTER TABLE hr.employees
ADD COLUMN phone_number VARCHAR(20);
```

Selecting Data from a Table

```
SELECT employee_id, first_name, last_name, email, hire_date,
salary FROM hr.employees;
```

Updating Data in a Table

```
UPDATE hr.employees
SET salary = 55000.00
WHERE employee_id = 1;
```

Deleting Data from a Table

```sql
DELETE FROM hr.employees
WHERE employee_id = 1;
```

Adding a Column to a Table

```
ALTER TABLE hr.employees
ADD COLUMN phone_number VARCHAR(20);
```

Dropping a Column from a Table

```
ALTER TABLE hr.employees
DROP COLUMN phone_number;
```

Dropping a Table

```
DROP TABLE hr.employees;
```

Dropping a Schema

```
DROP SCHEMA hr CASCADE;
```

Dropping a Database

DROP DATABASE

Data Types

Define the kind of data that

Can be stored in each column

Constraints enforce rules on the data.

Data Types

SERIAL:

Auto-incrementing integer,

often used for primary keys.

VARCHAR(n):

Variable-length character string.

Data Types

TEXT:

Variable-length character string

with no specific maximum length.

INTEGER: Whole number.

Data Types

DATE:

Calendar date (year, month, day).

TIMESTAMP:

Date and time.

Data Types

BOOLEAN:

True or false.

NUMERIC(p, s):

Exact numeric of selectable precision.

Constraints

⚠ Constraints are rules

Applied to columns

✓ To ensure

Data integrity

Constraints

PRIMARY KEY:

Uniquely identifies each row in a table.

FOREIGN KEY:

Ensures referential integrity between tables.

Constraints

NOT NULL:

Ensures that a column cannot have a NULL value.

UNIQUE:

Ensures that all values in a column are unique.

Constraints

CHECK:

Ensures that values in a column

satisfy a specific condition.

Numeric Types

INTEGER or INT

Whole numbers.

Numeric Types

SERIAL:

Auto-incrementing integer

often used for primary keys

Numeric Types

NUMERIC(precision, scale):

Exact numeric values with a specified precision and scale.

FLOAT, REAL, DOUBLE PRECISION:

Floating-point numbers.

Integer Types

smallint:

Stores 2-byte integer values.

Range:

-32768 to 32767.

Integer Types

integer:

Stores 4-byte integer values.

Range:

-2147483648 to 2147483647.

Integer Types

bigint:

Stores 8-byte integer values.

Range:

-9223372036854775808 to

9223372036854775807

Integer Types

```
CREATE TABLE numeric_example (
    id serial PRIMARY KEY,
    small_number smallint,
    medium_number integer,
    large_number bigint
);
```

Integer Types

```
INSERT INTO numeric_example (small_number,
medium_number, large_number) VALUES (100, 20000,
3000000000);
```

Serial Types

serial:

Auto-incrementing 4-byte integer.

bigserial:

Auto-incrementing 8-byte integer.

Serial Types

```
CREATE TABLE serial_example (
    id serial PRIMARY KEY,
    big_id bigserial
);
```

Decimal and Floating-Point Types

Decimal or numeric:

Variable precision number.

Real:

4-byte floating point number.

Decimal and Floating-Point Types

Double precision:

8-byte floating point number.

Decimal and Floating-Point Types

```
CREATE TABLE decimal_example (
    decimal_value decimal(10, 2),
    real_value real,
    double_value double precision
);
```

Decimal and Floating-Point Types

```
INSERT INTO decimal_example
(decimal_value, real_value, double_value)
VALUES (12345.67, 1.23, 123456789.123456);
```

Character Types

CHAR(n):

Fixed-length character string.

Character Types

VARCHAR(n):

Variable-length character string

with a maximum length of n.

Character Types

TEXT:

Variable-length

character string

with no specific length limit.

Fixed-Length Character

char(n):

Fixed length, blank-padded

```
CREATE TABLE char_example (
    fixed_length char(10)
);
```

Fixed-Length Character

```
INSERT INTO char_example (fixed_length)
VALUES ('abc');
```

Variable-Length Character

varchar(n):

Variable length with a limit.

text:

Variable unlimited length.

Variable-Length Character

```
CREATE TABLE varchar_example (
    variable_length varchar(50),
    unlimited_length text
);
```

Variable-Length Character

```
INSERT INTO varchar_example
(variable_length, unlimited_length)
VALUES ('Hello, World!', 'This is a long text field.');
```

Date/Time Types

DATE:

Calendar date (year, month, day).

TIME [WITHOUT TIME ZONE]:

Time of day (hours, minutes, seconds).

Date/Time Types

TIMESTAMP [WITHOUT TIME ZONE]:

Date and time.

INTERVAL:

Time interval.

Boolean Type

BOOLEAN:

Logical Boolean

TRUE or FALSE

Binary Data Types

BYTEA

Binary data

byte array

Array Types

PostgreSQL supports

Arrays of any data type

INTEGER[]

TEXT[]

Array Types

```
-- Stores a list of values

CREATE TABLE array_example (
    integer_array integer[],
    text_array text[]
);
```

Array Types

```
INSERT INTO array_example
(integer_array, text_array)
VALUES ('{1, 2, 3}', '{"apple", "banana", "cherry"}');
```

JSON (JavaScript Object Notation)

Stores

JSON data

as text.

JSON Example

```
CREATE TABLE json_example (
    json_data json
);

INSERT INTO json_example (json_data) VALUES ('{"name": ”Dev", "age": 30, "city": "New York"}');
```

JSONB

Stores JSON data in

Binary format

For faster processing

JSONB Example

```
CREATE TABLE jsonb_example (
    jsonb_data jsonb
);

INSERT INTO jsonb_example (jsonb_data) VALUES ('{"name":
”Dev", "age": 25, "city": "San Francisco"}');
```

Constraints

Constraints are rules applied

To table columns

To enforce data integrity

Ensure the accuracy

Reliability of the data

NOT NULL Constraint

Ensures that a column cannot have a NULL value.

```
CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    first_name VARCHAR(50) NOT NULL,
    last_name VARCHAR(50) NOT NULL
);
```

UNIQUE Constraint

Ensures that all values in a column are unique.

```
CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    email VARCHAR(100) UNIQUE
);
```

PRIMARY KEY Constraint

A combination of NOT NULL and UNIQUE.

Uniquely identifies each row in a table.

```
CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    first_name VARCHAR(50) NOT NULL,
    last_name VARCHAR(50) NOT NULL
);
```

FOREIGN KEY Constraint

Ensures the referential integrity of the data in one table to match values in another table.

```
CREATE TABLE departments (
    department_id SERIAL PRIMARY KEY,
    department_name VARCHAR(50) NOT NULL
);
```

FOREIGN KEY Constraint

```
CREATE TABLE employees (
   employee_id SERIAL PRIMARY KEY,
   first_name VARCHAR(50) NOT NULL,
   last_name VARCHAR(50) NOT NULL,
   department_id INTEGER REFERENCES
 departments(department_id)
);
```

CHECK Constraint

Ensures that all values in a column satisfy a specific condition.

```
CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    salary NUMERIC(8, 2) CHECK (salary > 0)
);
```

DEFAULT Constraint

Sets a default value for a column when no value is specified.

```
CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    hire_date DATE DEFAULT CURRENT_DATE
);
```

Primary Key

A Column

Combination of columns

Uniquely identifies

each row in a table

Primary Key

Each table can have

only one primary key,

which can consist of

single or multiple columns.

Single Column Primary Key

```
CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    first_name VARCHAR(50),
    last_name VARCHAR(50)
);
```

Composite Primary Key

```
CREATE TABLE project_assignments (
    employee_id INTEGER,
    project_id INTEGER,
    PRIMARY KEY (employee_id, project_id)
);
```

Foreign Key

A foreign key is

a column (or a combination of columns)

Establishes a link between

data in two tables.

Foreign Key

Ensures that the value in

Foreign key column(s)

Must match values in

Referenced primary key column(s)

of another table.

Foreign Key Example

```
CREATE TABLE departments (
    department_id SERIAL PRIMARY KEY,
    department_name VARCHAR(50)
);
```

Foreign Key Example

```
 CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    first_name VARCHAR(50),
    last_name VARCHAR(50),
    department_id INTEGER,
    FOREIGN KEY (department_id) REFERENCES departments(department_id)
);
```

Foreign Key with ON DELETE CASCADE

Ensures When a row in

Referenced table is deleted,

All related rows in

Referencing table are deleted.

Foreign Key with ON DELETE CASCADE

```
CREATE TABLE employees (
    employee_id SERIAL PRIMARY KEY,
    first_name VARCHAR(50),
    last_name VARCHAR(50),
    department_id INTEGER,
    FOREIGN KEY (department_id) REFERENCES departments(department_id) ON DELETE CASCADE
);
```

Filtering and Sorting Data

WHERE Clause

```
SELECT * FROM employees WHERE department_id = 1;
```

- Retrieves all columns and rows
- from the employees table
- where the department_id is 1.

Multiple Conditions with AND

```
SELECT * FROM employees
WHERE department_id = 1 AND salary > 50000;
```

- Retrieves rows from the employees table
- where the department_id is 1 and
- the salary is greater than 50000.

Using OR in WHERE Clause

```
SELECT * FROM employees WHERE department_id = 1 OR
department_id = 2;
```

- Retrieves rows from the employees table
- where the department_id is either 1 or 2.

Using IN Operator

```
SELECT * FROM employees WHERE department_id IN (1, 2);
```

- Retrieves rows from the employees table
- where the department_id is 1 or 2.

Using LIKE Operator for Pattern Matching

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

- Retrieves rows from the employees table
- where the first_name starts with 'J'.

Ordering Results with ORDER BY

```
SELECT * FROM employees ORDER BY last_name ASC;
```

- Retrieves all columns and rows
- from the employees table and
- sorts the results by last_name
- in ascending order (ASC)

Ordering Results with DESC

```
SELECT * FROM employees ORDER BY salary DESC;
```

- Retrieves all columns and rows
- from the employees table and
- sorts the results by salary in
- descending order (DESC)

Aggregate Functions

Perform calculations on

Multiple rows

To return

Single value

Aggregate Functions

COUNT:

```
SELECT COUNT(*) FROM employees;
```

- Returns the number of rows
- in the employees table

SUM

```
SELECT SUM(salary) FROM employees;
```

- Returns the sum of
- all salary values
- in the employees table.

AVG

```
SELECT AVG(salary) FROM employees;
```

- Returns the average
- salary value in
- the employees table.

MIN

- SELECT MIN(salary) FROM employees;

- Returns the minimum
- salary value in
- the employees table.

MAX

- SELECT MAX(salary) FROM employees;

- Returns the maximum
- salary value in
- the employees table

Summary

Filtering and sorting data

Essential capabilities in SQL

For retrieving specific subsets of data

Arranging them in a desired order

Summary

Aggregate functions provide

Powerful tools for calculating

Summary statistics or

Performing calculations

Across multiple rows of data.

Summary

UNDERSTANDING THESE CONCEPTS

CRUCIAL FOR EFFECTIVE DATA MANIPULATION

ANALYSIS IN DATABASE OPERATIONS