DECEMBER 2024

SQL Mastery: From Beginner to Pro

Short course

SCIENTIA ET PRATIQUE

MTF
INSTITUTE OF MANAGEMENT, TECHNOLOGY & FINANCE

SQL Mastery: From Beginner to Pro

Unlocking the power of SQL

Course: SQL Mastery: From Beginner to Pro

Institution: Institute of Management Technology & Finance (MTF)

Lecturer: Alex, Product Researcher, Research Consultant and Lecturer; PhD in Health Anthropology

SQL Mastery: From Beginner to Pro

Course overview

- Introduction to SQL and SQLite
- Basic SQL Commands – The Foundation
- Retrieving and Manipulating Data
- Advanced Queries and Data Aggregation
- Working with Joins
- Subqueries and Nested Queries
- Modifying Data in SQL
- Optimising and Indexing Your Queries
- Advanced SQL Features

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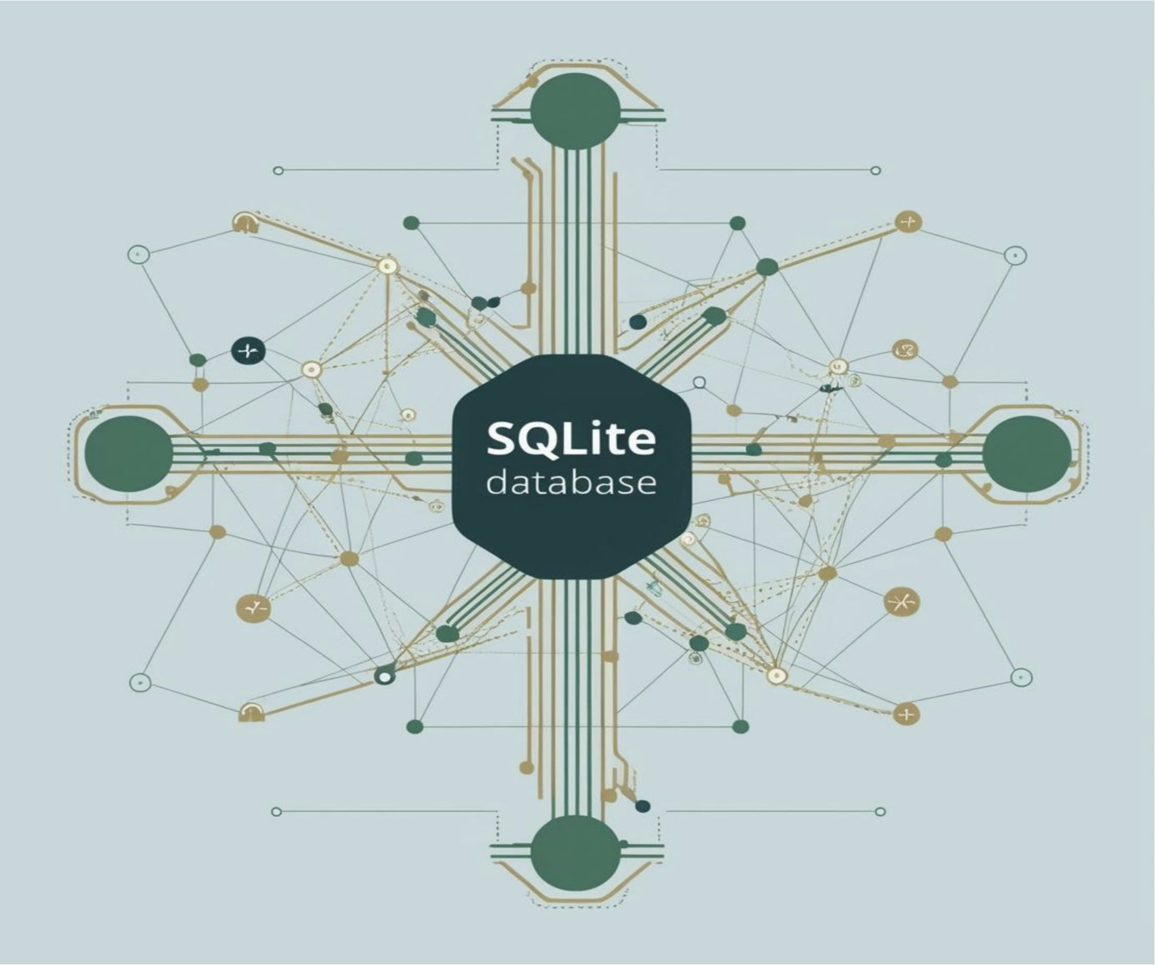
M1: Introduction to SQL and SQLite

What is SQL

- SQL stands for Structured Query Language
- It’s a domain-specific language for managing relational databases
- SQL is used to:
  - Create and modify databases
  - Query data
  - Insert, update, and delete records
- Examples of databases: MySQL, PostgreSQL, Oracle, SQLite
- SQL is universal across relational database systems



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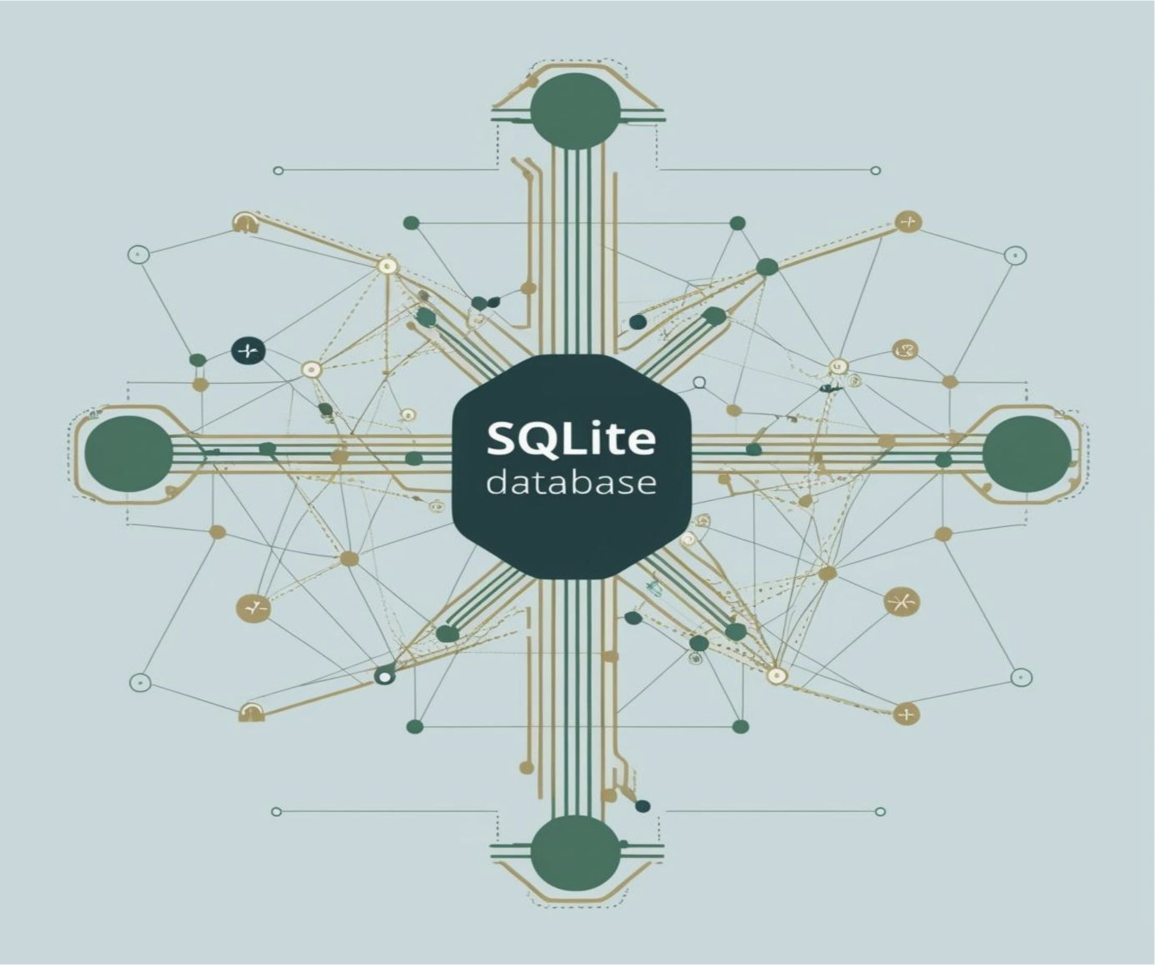
M1: Introduction to SQL and SQLite

Why SQL is Important for Business

- Marketing: SQL helps analyse customer behaviours and optimise campaigns.
- Finance: SQL is essential for tracking financial transactions and generating reports.
- Data Analytics: Extracts valuable business insights from large datasets.
- Operations: SQL can help streamline and automate workflows.
- Data-driven Decision Making: Businesses can make more informed decisions by analysing their data with SQL.



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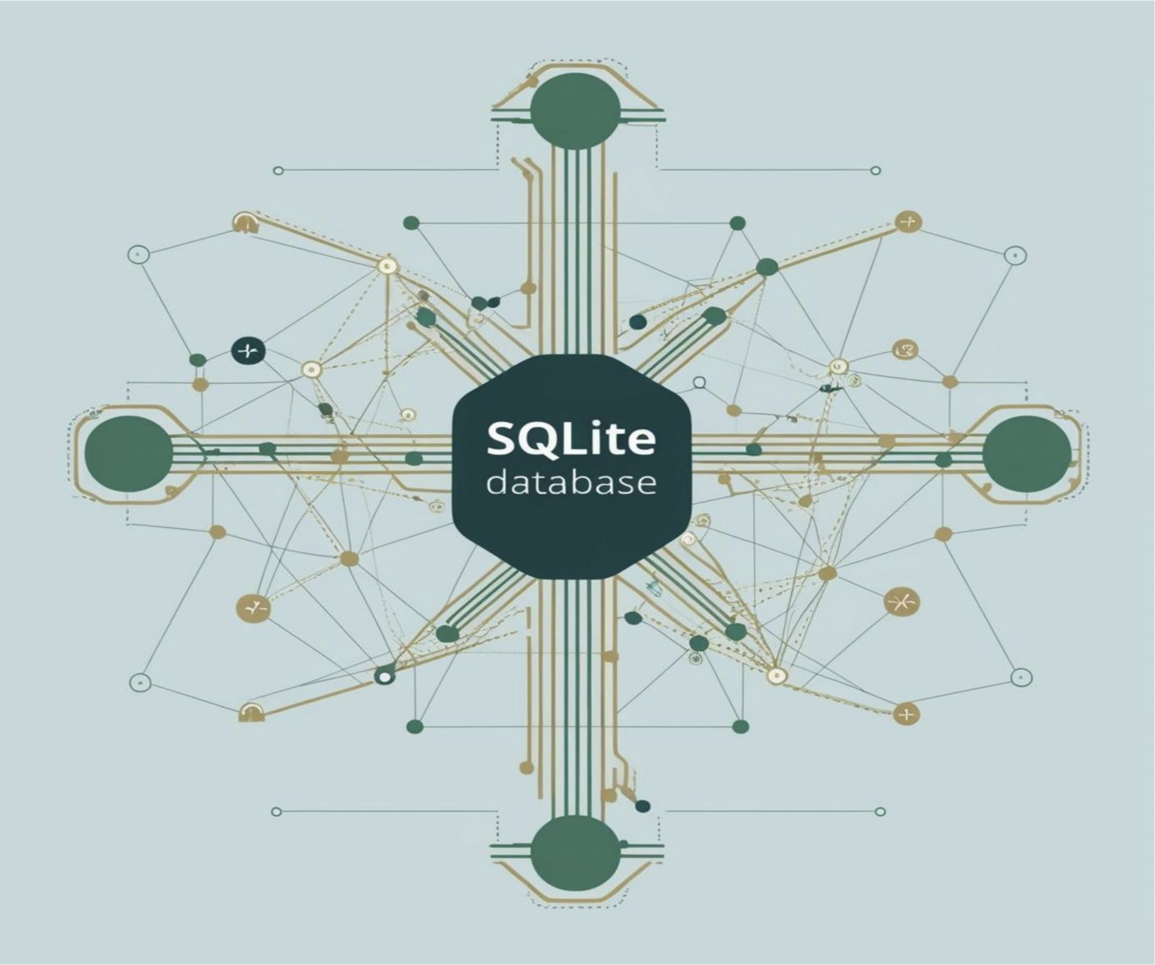
M1: Introduction to SQL and SQLite

What is SQLite

- SQLite is a self-contained, serverless SQL database engine
- Open-source and free to use
- Designed for embedded database applications
- Easy to install and use
- Ideal for development, testing, and small-scale applications
- SQLite works on multiple platforms: Windows, Mac, Linux, and mobile devices



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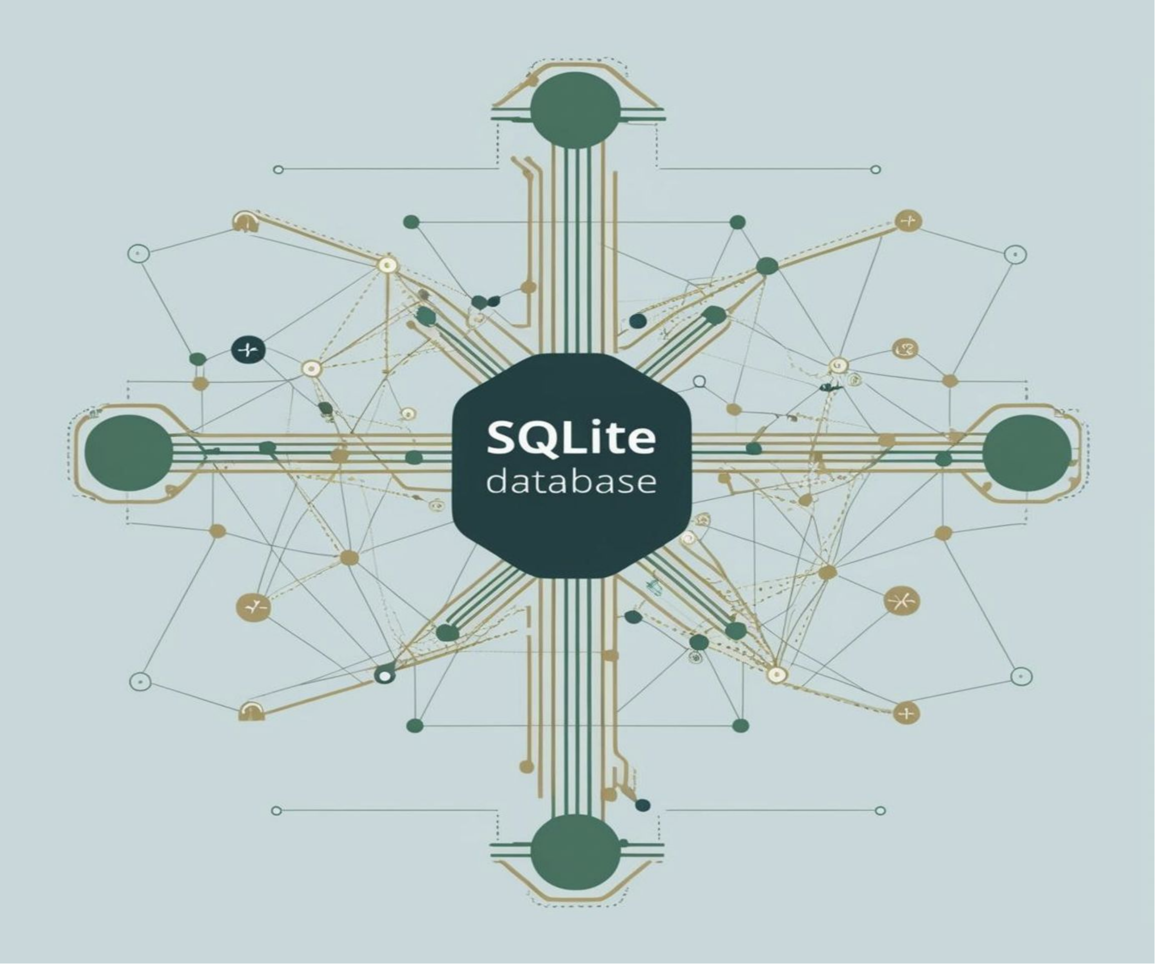
M1: Introduction to SQL and SQLite

Setting Up SQLite

- Download the document: Module 1: Setting up SQLite, and follow the instructions.
- Video: Module1_Access SQLite CLI



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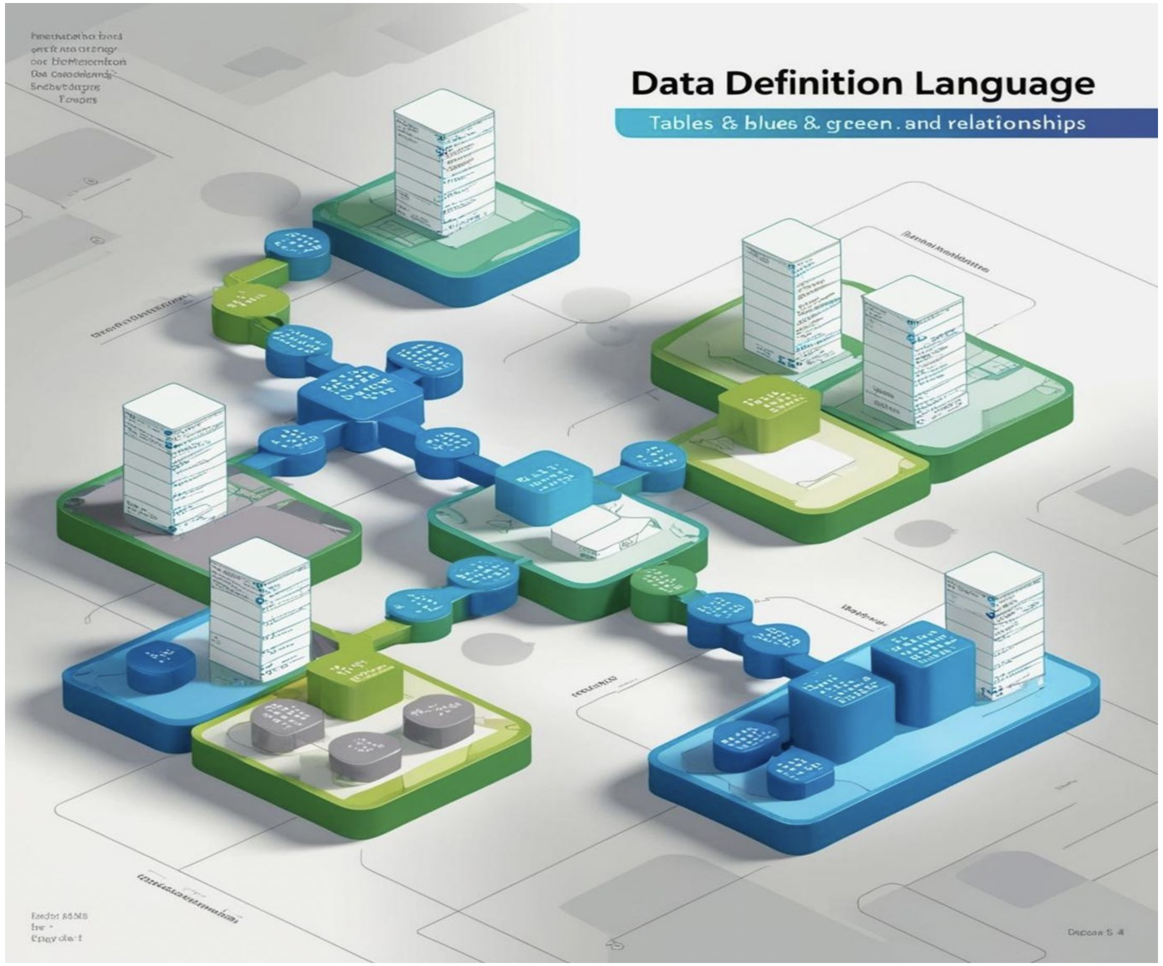
M2: Basic SQL Commands: The Foundation

SQL commands can be divided into three main categories:

- Data Definition Language (DDL): Used to define the structure of the database (e.g., CREATE, ALTER, DROP).
- Data Manipulation Language (DML): Used to manipulate data within the database (e.g., INSERT, UPDATE, DELETE).
- Data Query Language (DQL): Used to query data (e.g., SELECT).



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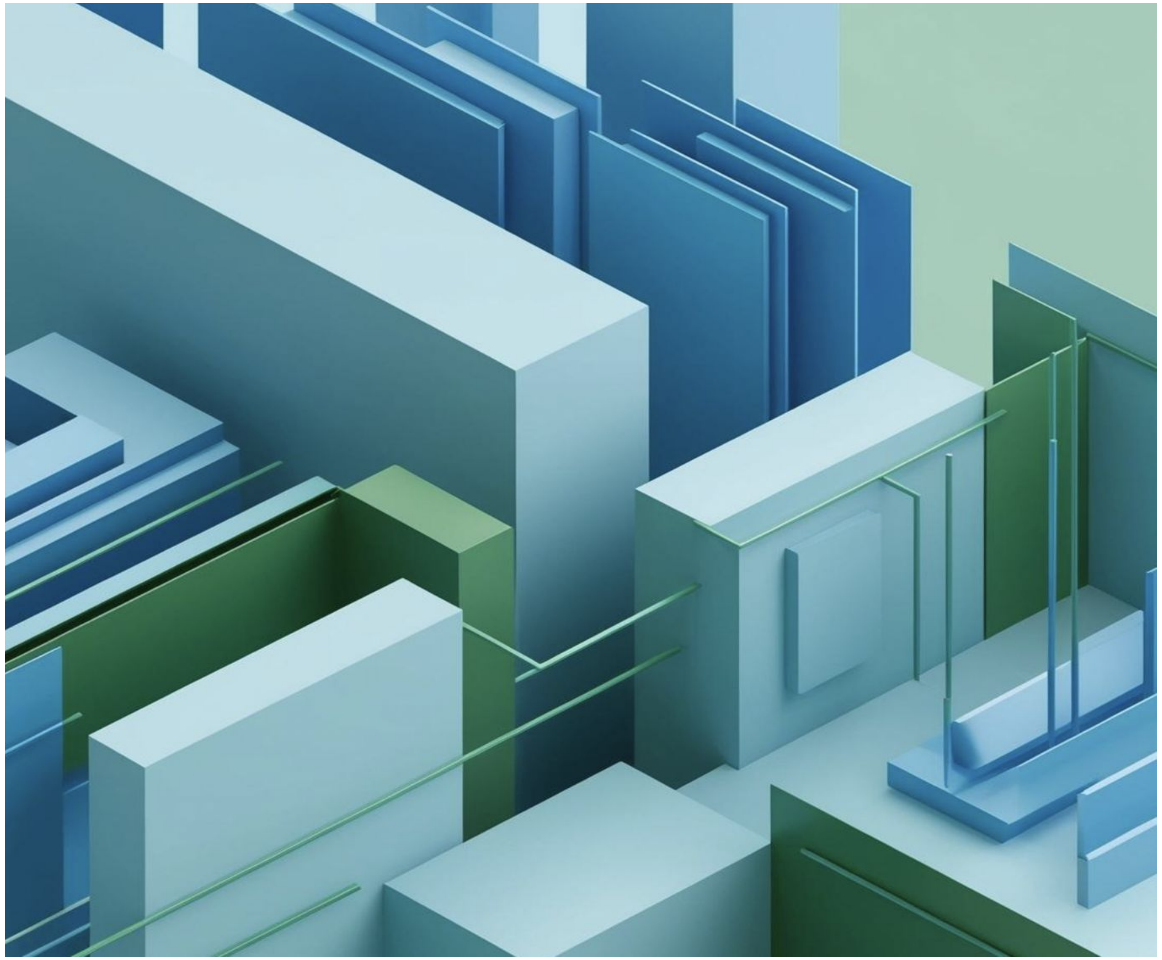
M2: Basic SQL Commands: The Foundation

CREATE DATABASE, CREATE TABLE, INSERT INTO

- Create a database:
  - Syntax: CREATE DATABASE database_name;
- Create a table:
  - Syntax: CREATE TABLE table_name (column1 datatype, column2 datatype, ...);
- Insert data:
  - Syntax: INSERT INTO table_name (column1, column2, ...) VALUES (value1, value2, ...);



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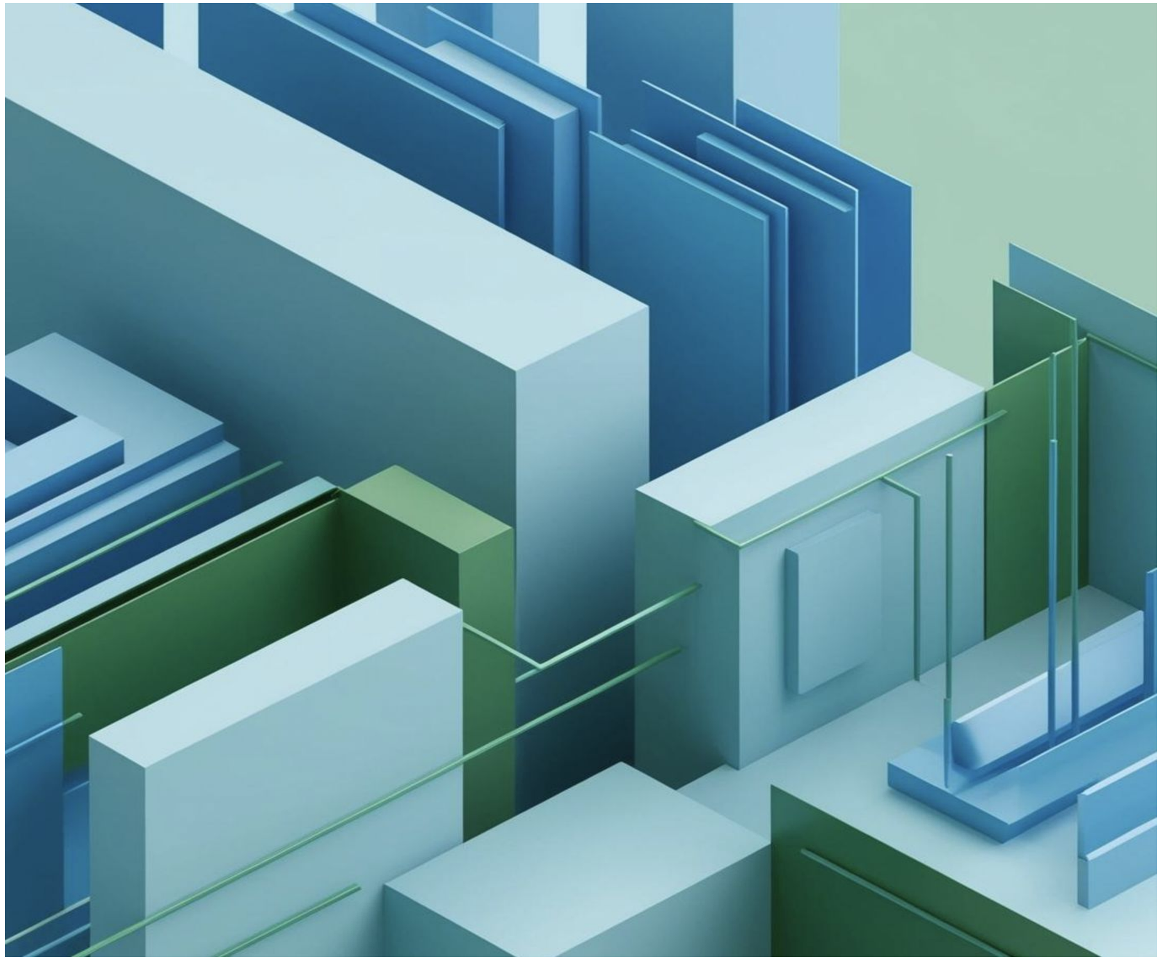
M2: Basic SQL Commands: The Foundation

Exercise 1: Creating Databases and Tables

- **Objective:** Create a database and table for a simple business use case.
- Step 1: Create a new database called business_db.
- Step 2: Create a table called products with the following columns:
  - product_id (integer, primary key)
  - product_name (text)
  - price (decimal, with two decimal places)
  - quantity (integer)



M2: Basic SQL Commands: The Foundation

Exercise 2: Inserting Data

- **Objective:** Add sample product data to your products table.
- Step 1: Insert data for at least 3 products with their product_name, price, and quantity.
- Step 2: Verify that data was inserted correctly by using the SELECT * FROM products; command.

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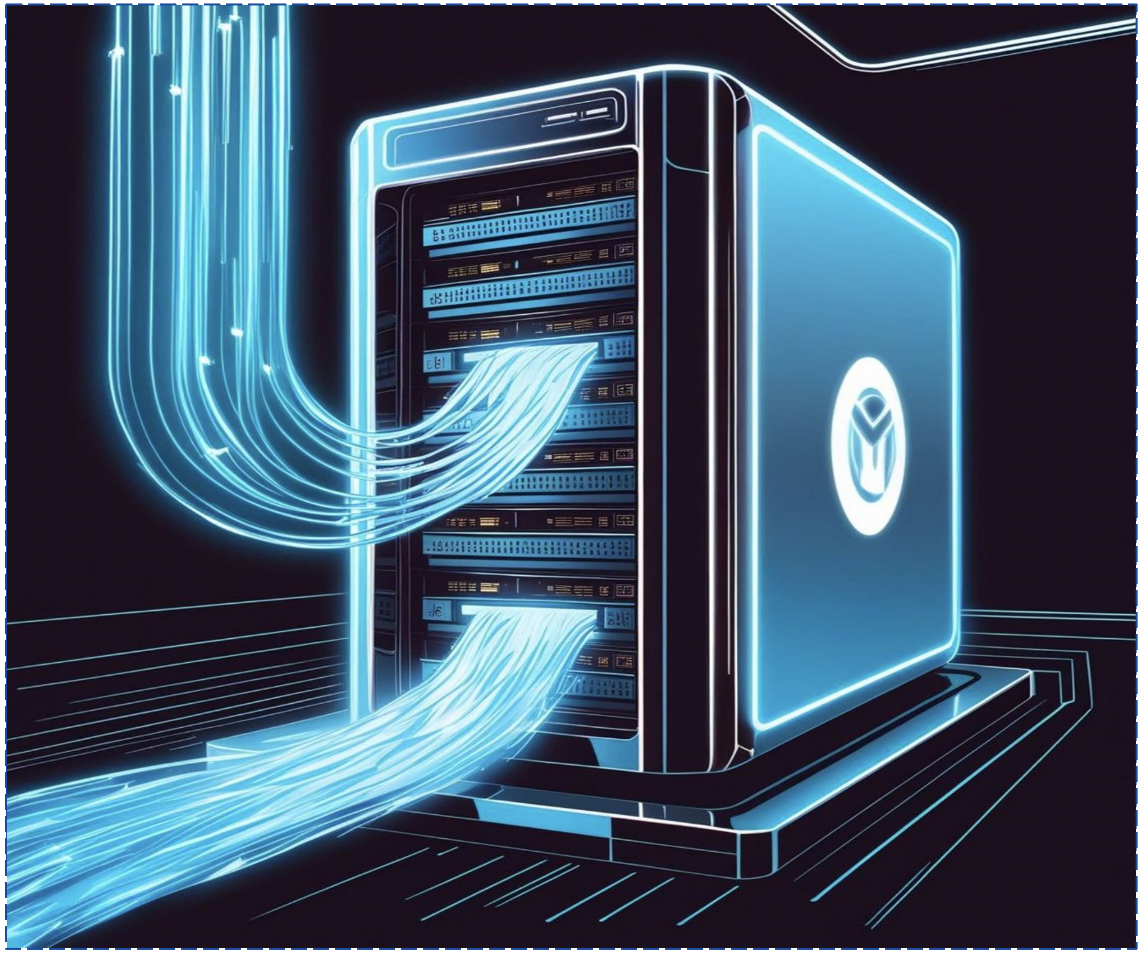
M3: Retrieving and Manipulating Data

This module covers essential SQL commands for querying and manipulating data:

- Basic Queries with SELECT
- Filtering Data with WHERE and Operators
- Sorting Data with ORDER BY
- Limiting Data with LIMIT



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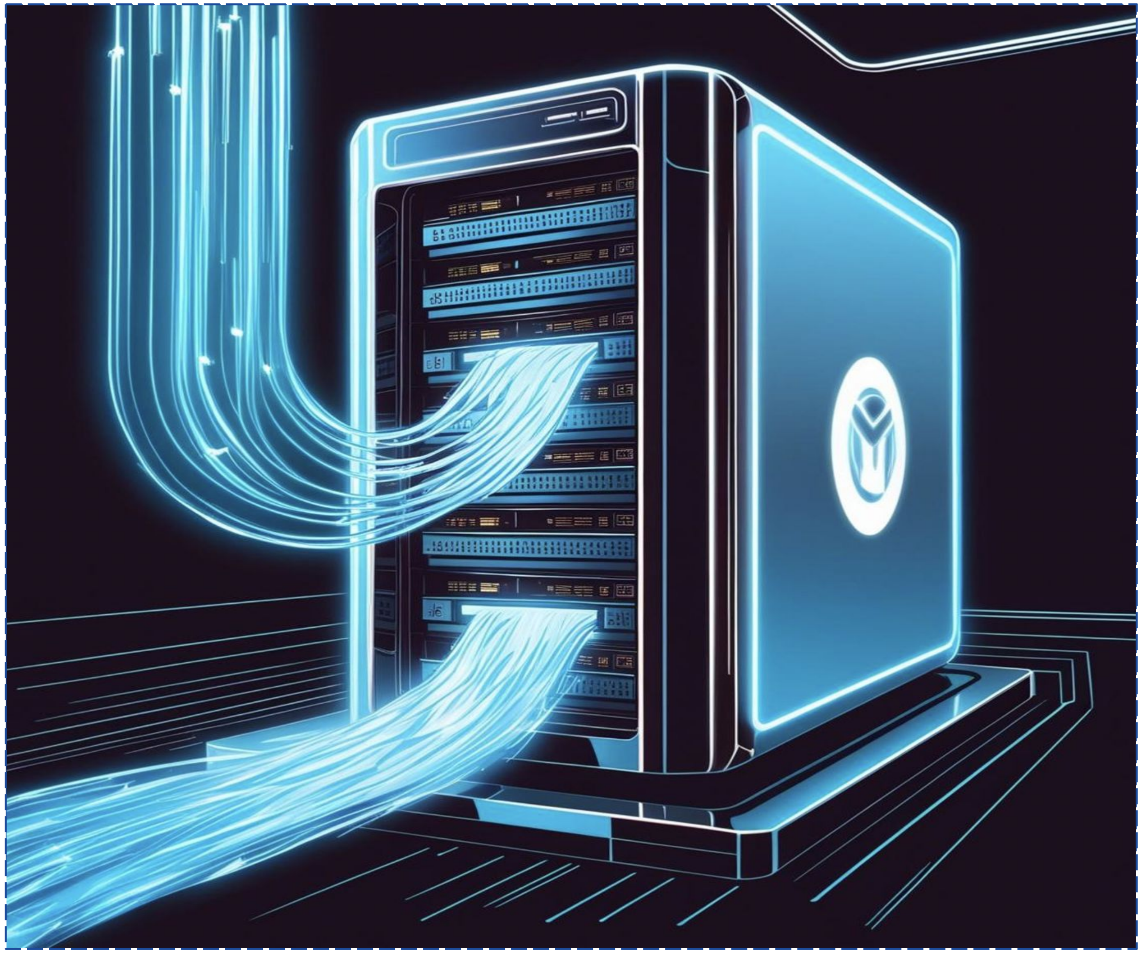
M3: Retrieving and Manipulating Data

Basic Queries with SELECT

- Syntax: SELECT column1, column2, ... FROM table_name;
- To select all columns: SELECT * FROM table_name;
- Filters results based on a condition: SELECT column1, column2 FROM table_name WHERE condition;
- Sorts the result set: SELECT column1, column2 FROM table_name ORDER BY column1 [ASC|DESC];



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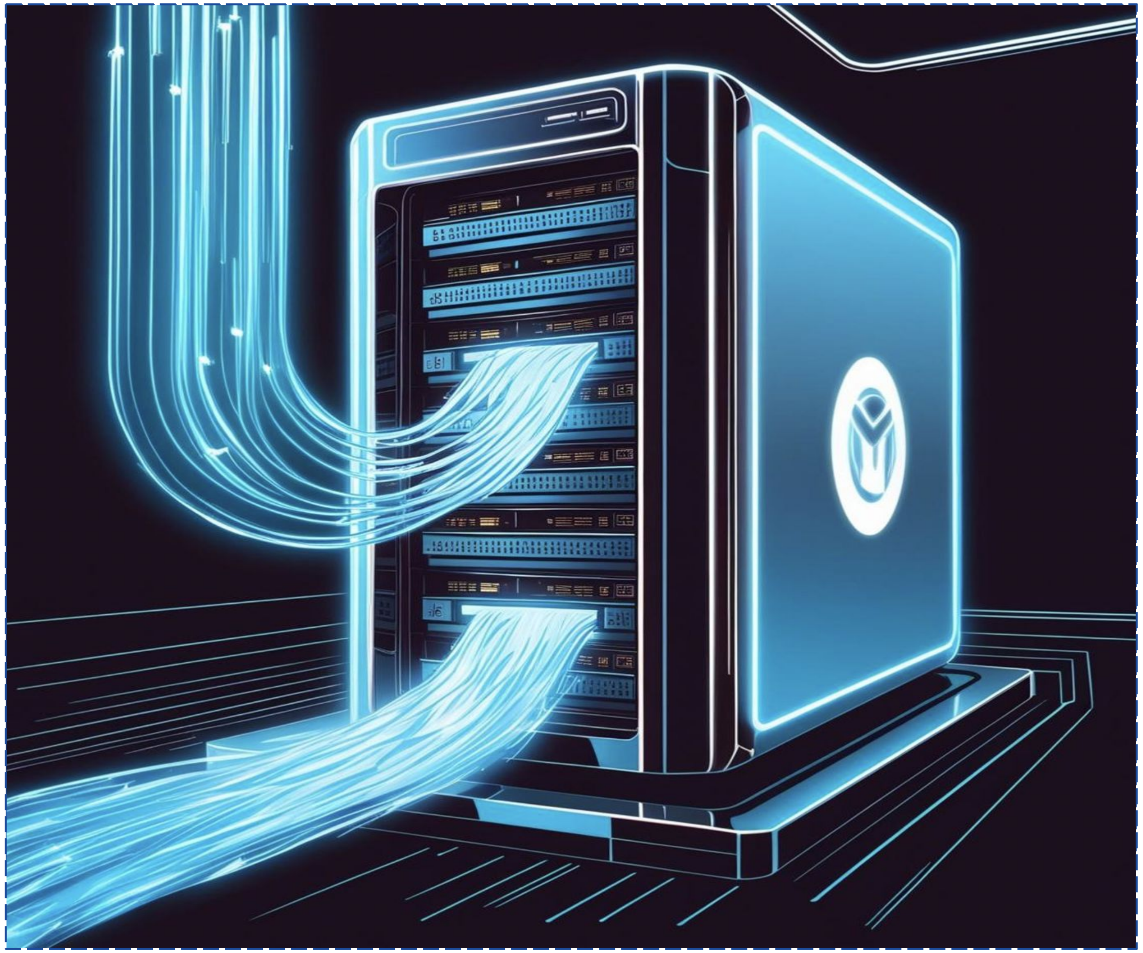
M3: Retrieving and Manipulating Data

Exercise 3: Basic Queries with SELECT

- Objective: Retrieve all products from your products table and sort them by price.
- Step 1: Use the SELECT command to retrieve all columns from the products table.
- Step 2: Sort the products by the price column in descending order to show the most expensive items first.



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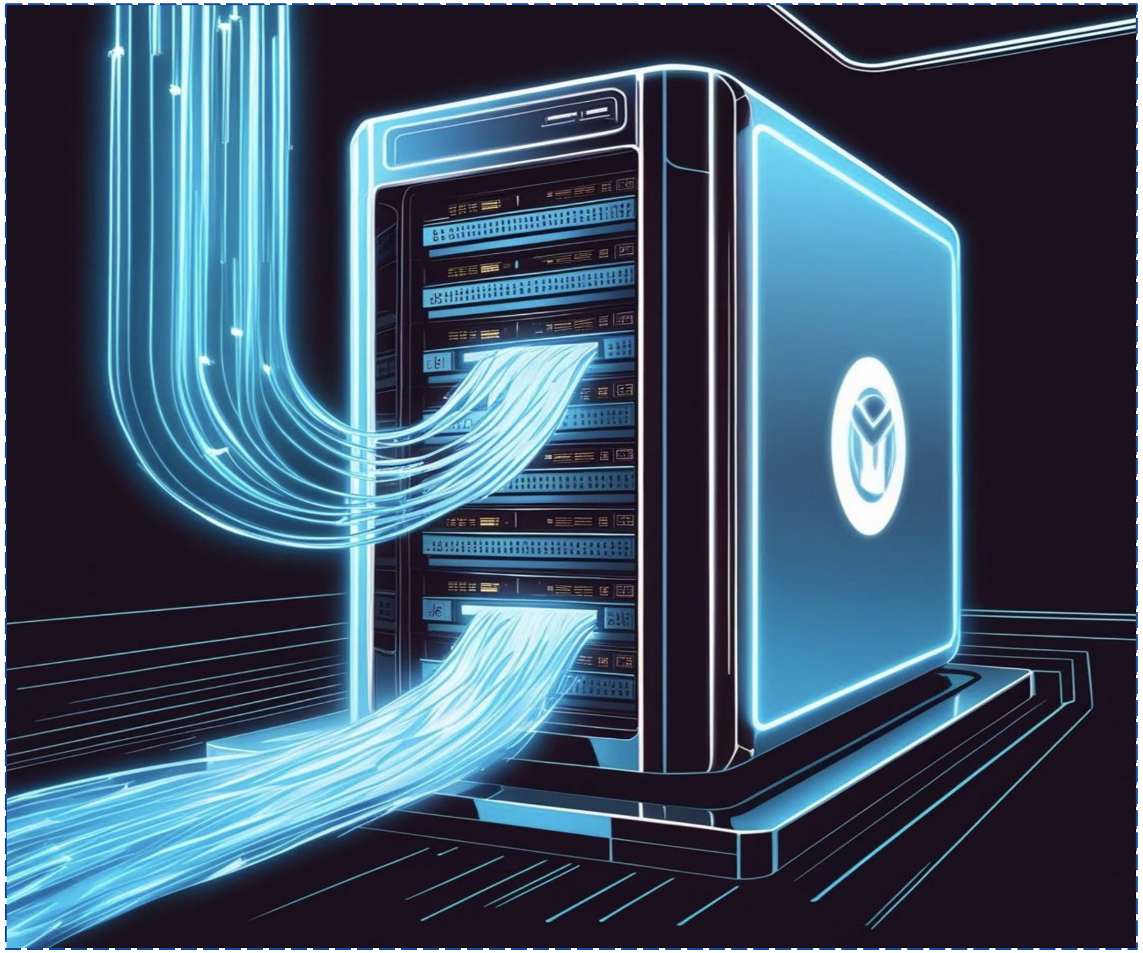
M3: Retrieving and Manipulating Data

Filtering Data with WHERE and Operators

- Comparison Operators:
  - =: Equal to
  - <> or !=: Not equal to
  - >: Greater than
  - <: Less than
  - >=: Greater than or equal to
  - <=: Less than or equal to
- Logical Operators:
  - AND: Combines multiple conditions.
  - OR: At least one condition must be true.
  - NOT: Reverses a condition.



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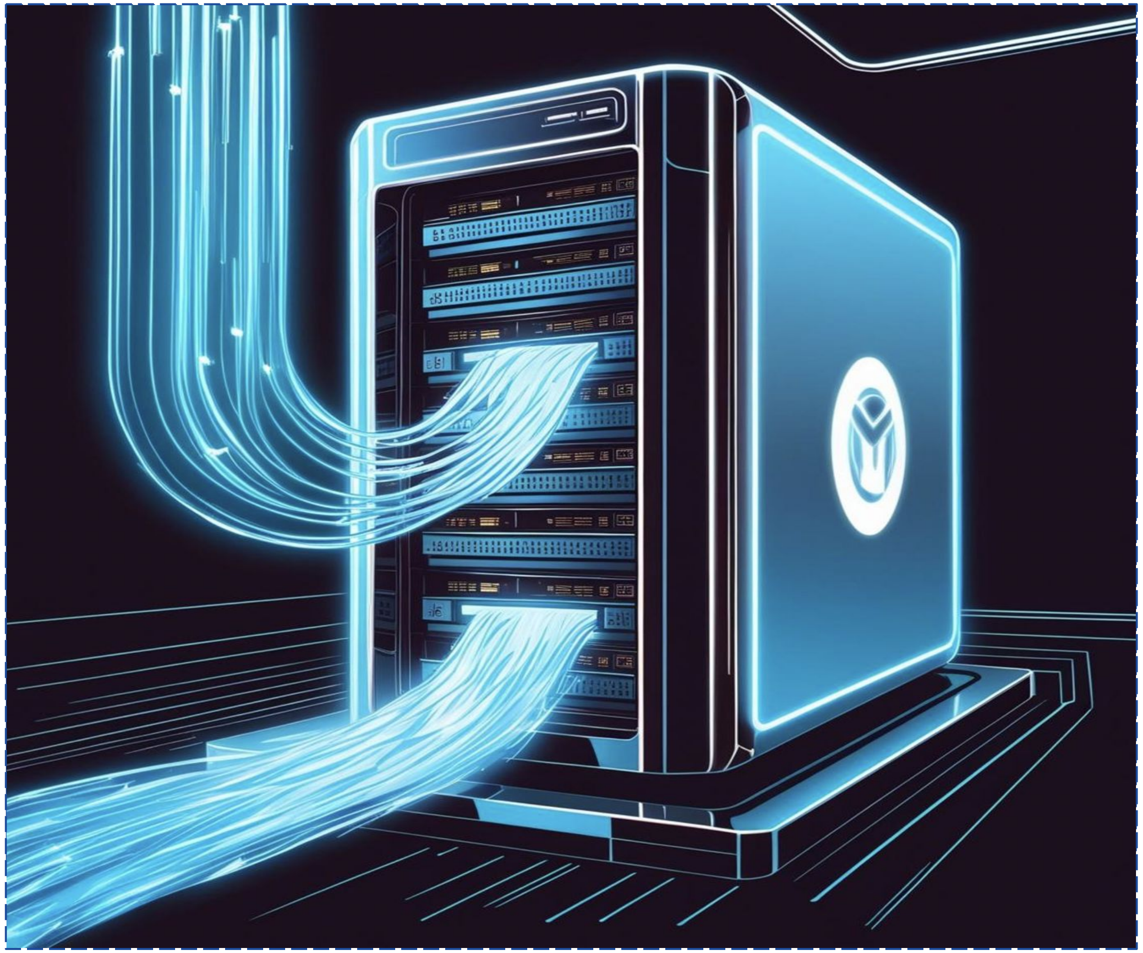
M3: Retrieving and Manipulating Data

Exercise 4: Filtering and Sorting Data

- Objective: Filter products based on specific conditions and sort the results.
- Step 1: Retrieve products with a price greater than $0.60.
- Step 2: Sort the results by `quantity` in ascending order.



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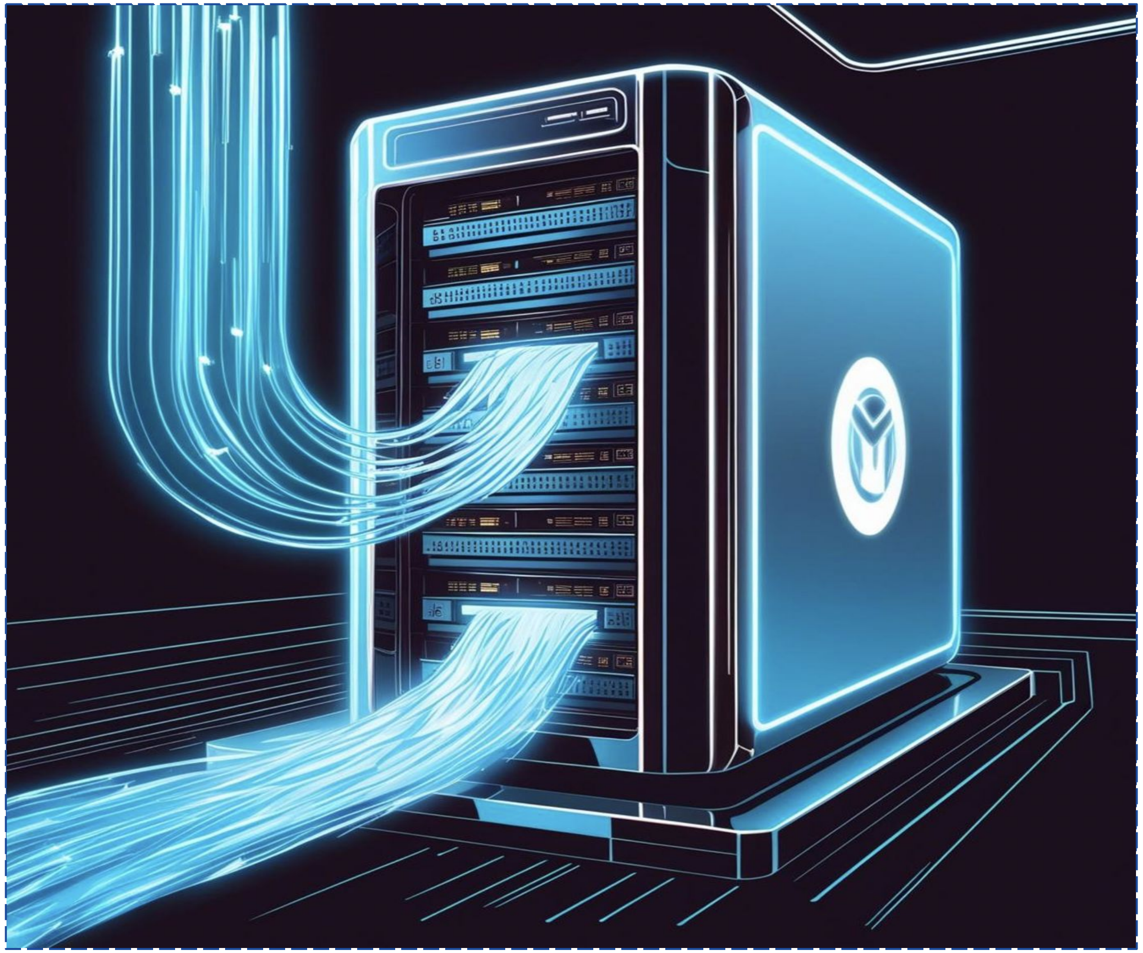
M3: Retrieving and Manipulating Data

Limiting Data with LIMIT

- Restricts the number of rows returned by the query:

  ```
  SELECT column1, column2 FROM table_name LIMIT number;
  ```



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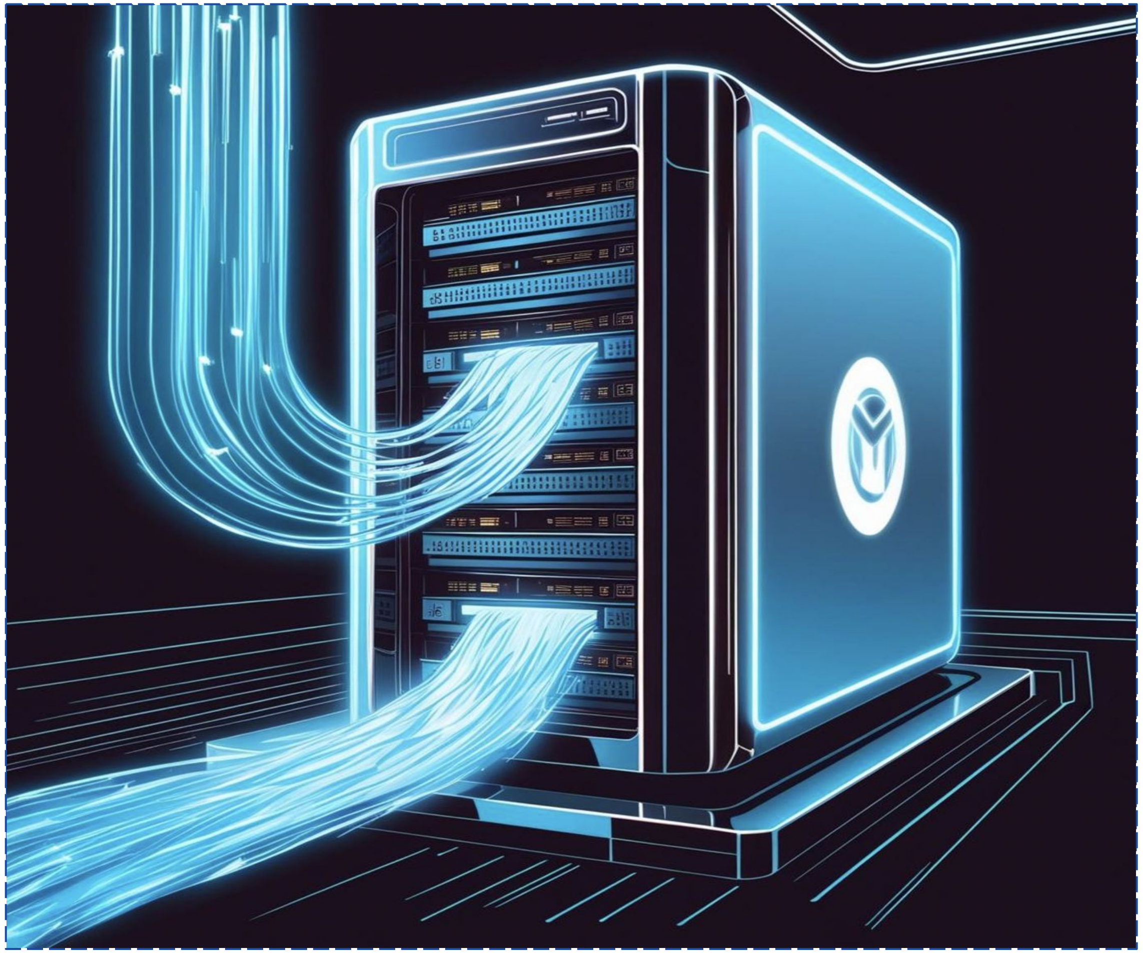
M3: Retrieving and Manipulating Data

Exercise 5: Limiting Data with LIMIT

- Objective: Retrieve only the first product from the products table.
- Step 1: Use the LIMIT clause to restrict the number of rows returned to 1.



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M4: Advanced Queries and Data Aggregation

This module focuses on aggregation SQL features:

- Aggregate Functions: COUNT(), SUM(), AVG(), MIN(), MAX()
- Grouping Data: GROUP BY
- Filtering Grouped Data: HAVING

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M4: Advanced Queries and Data Aggregation

Aggregate Functions:

- COUNT(): Returns the number of rows in a set.
- SUM(): Returns the total sum of a numeric column.
- AVG(): Returns the average value of a numeric column.
- MIN(): Returns the smallest value in a column.
- MAX(): Returns the largest value in a column.

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M4: Advanced Queries and Data Aggregation

Exercise 6: Aggregate Functions

- Objective: Calculate the total and average price of all products in the table.
- Step 1: Use the `SUM()` function to calculate the total price of all products.
- Step 2: Use the `AVG()` function to calculate the average price of the products.

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M4: Advanced Queries and Data Aggregation

Grouping Data with GROUP BY

- SELECT column, aggregate_function(column) FROM table GROUP BY column;

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M4: Advanced Queries and Data Aggregation

Exercise 7: Grouping Products by Category and Filtering Results

- Objective: Find the number of products in each category and filter the results to show only those categories that have more than 2 products.
- Step 1: Use `GROUP BY` to group the products by category.
- Step 2: Use `COUNT()` to find the number of products in each category.
- Step 3: Filter the groups where the count is greater than 2 using the `HAVING` clause.

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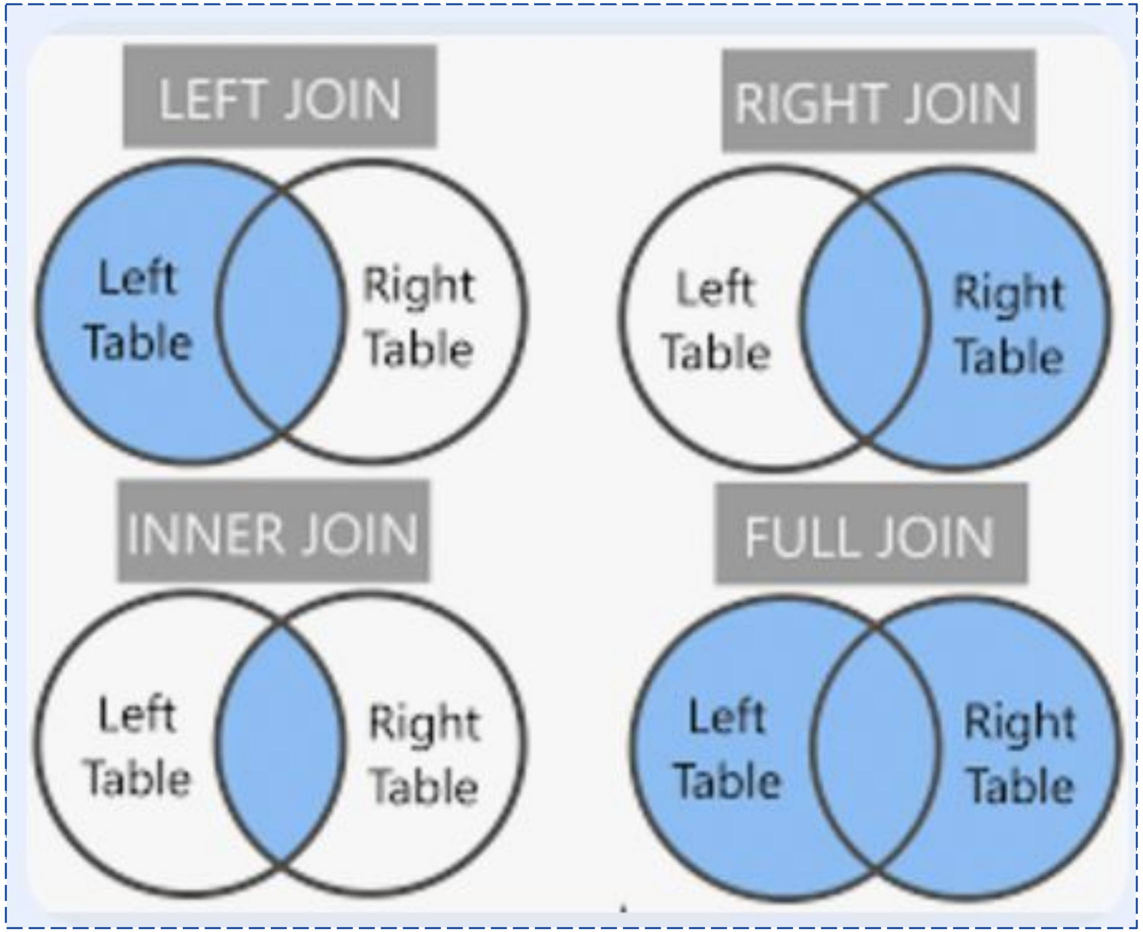
M5: Working with Joins

Joins in SQL allow you to combine rows from two or more tables based on a related column.

Types of Joins:

- INNER JOIN: Returns only matching rows from both tables.
- LEFT JOIN: Returns all rows from the left table and matching rows from the right table.
- RIGHT JOIN: Returns all rows from the right table and matching rows from the left table.
- FULL OUTER JOIN: Returns all rows when there is a match in either left or right table.



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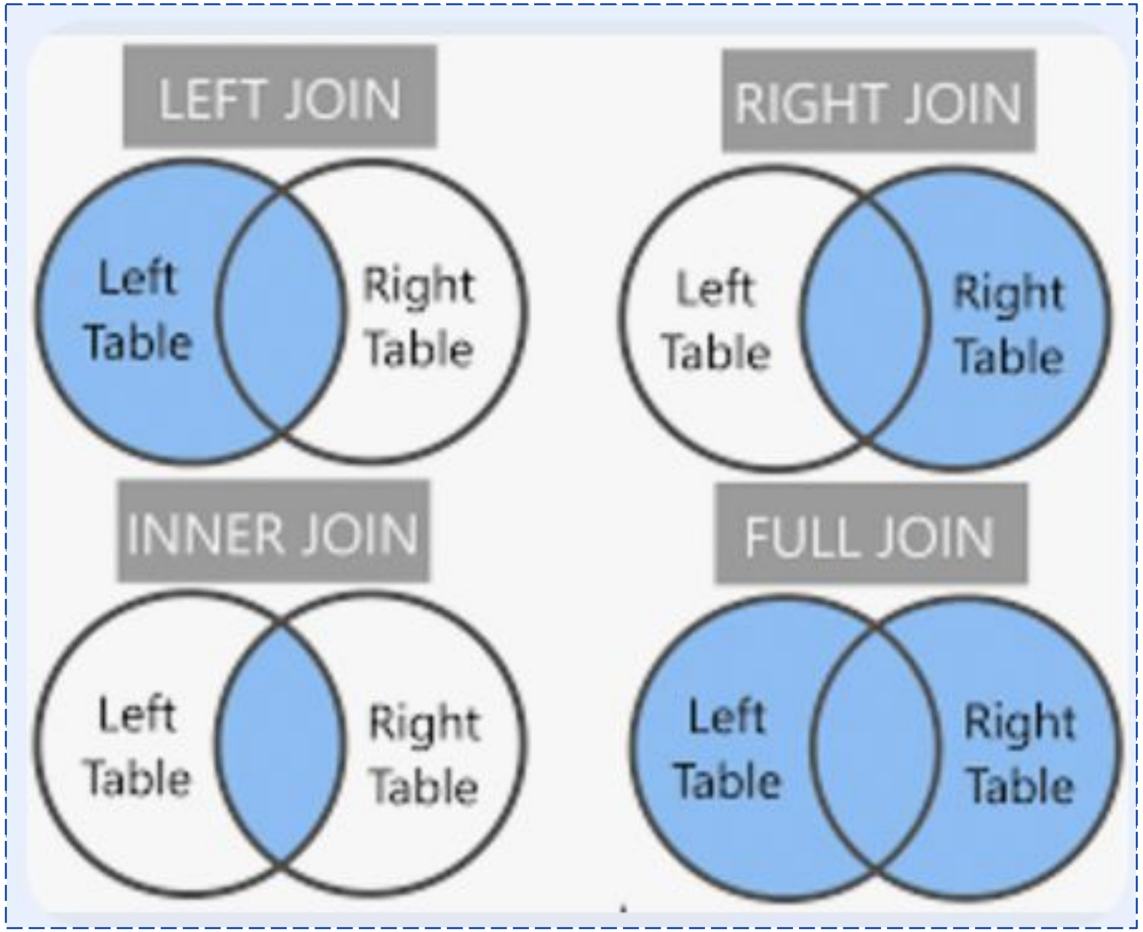
M5: Working with Joins

Exercise 8: Introduction to Joins

- Objective: Join two tables: Products and Categories.
- Step 1: Use INNER JOIN to match products with their categories.



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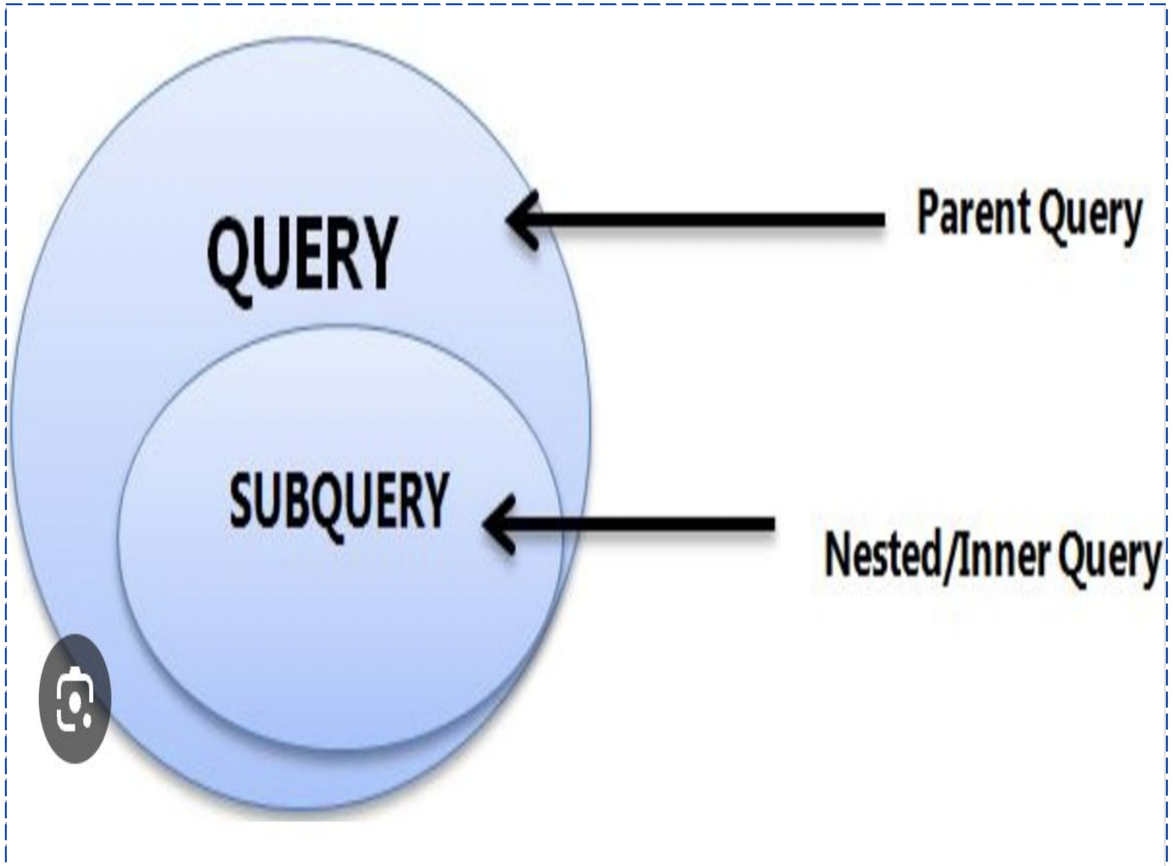
M6: Subqueries and Nested Queries

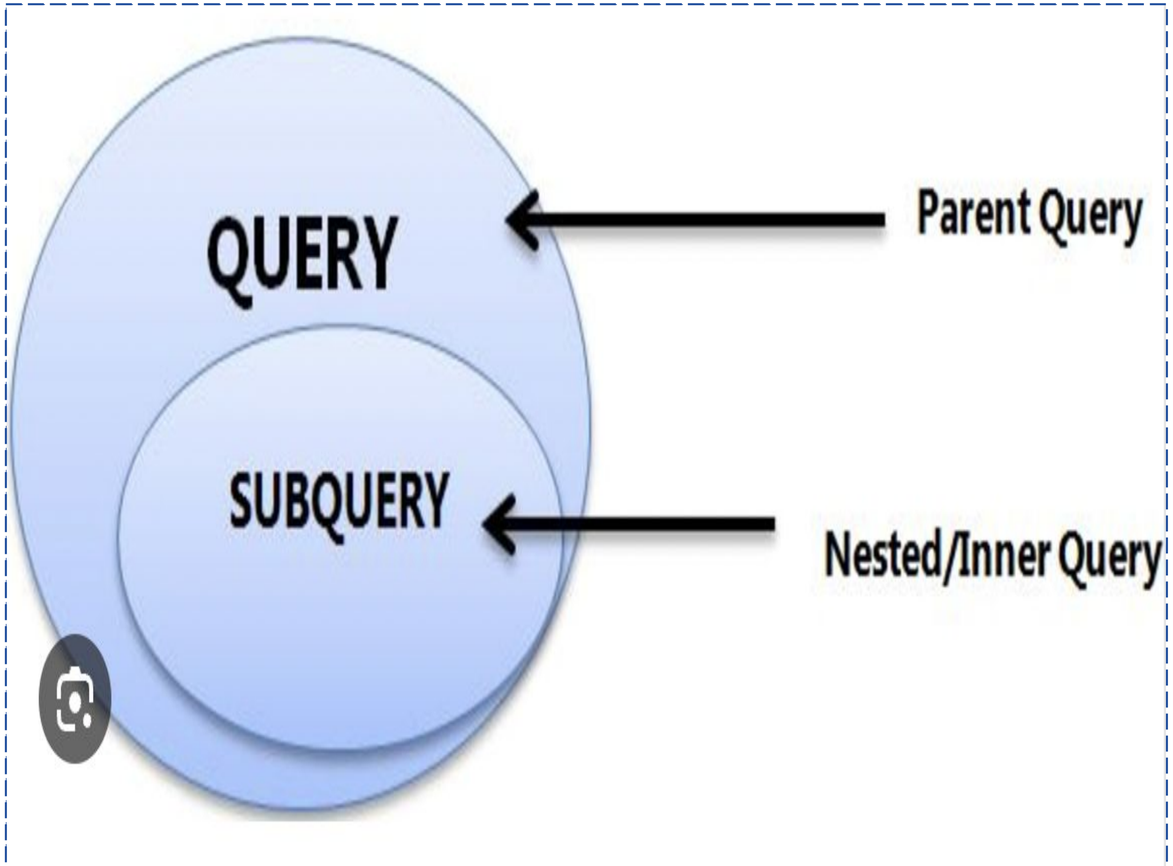
- Subqueries: A query within another query.
- Types of Subqueries:
  - Inline Subqueries: A subquery that returns a single value to be used in the main query.
  - Nested Subqueries: A subquery that returns a result set which can be used by another subquery.
  - Correlated Subqueries: A subquery that references a column from the outer query.



M6: Subqueries and Nested Queries

Inline Subqueries

- Definition: An inline subquery is a simple subquery that returns a single value.
- Use Case: It's used in `SELECT`, `WHERE`, or `HAVING` clauses to filter or modify the result set.
- Syntax: `SELECT column1, column2 FROM table WHERE column2 > (SELECT AVG(column2) FROM table);`



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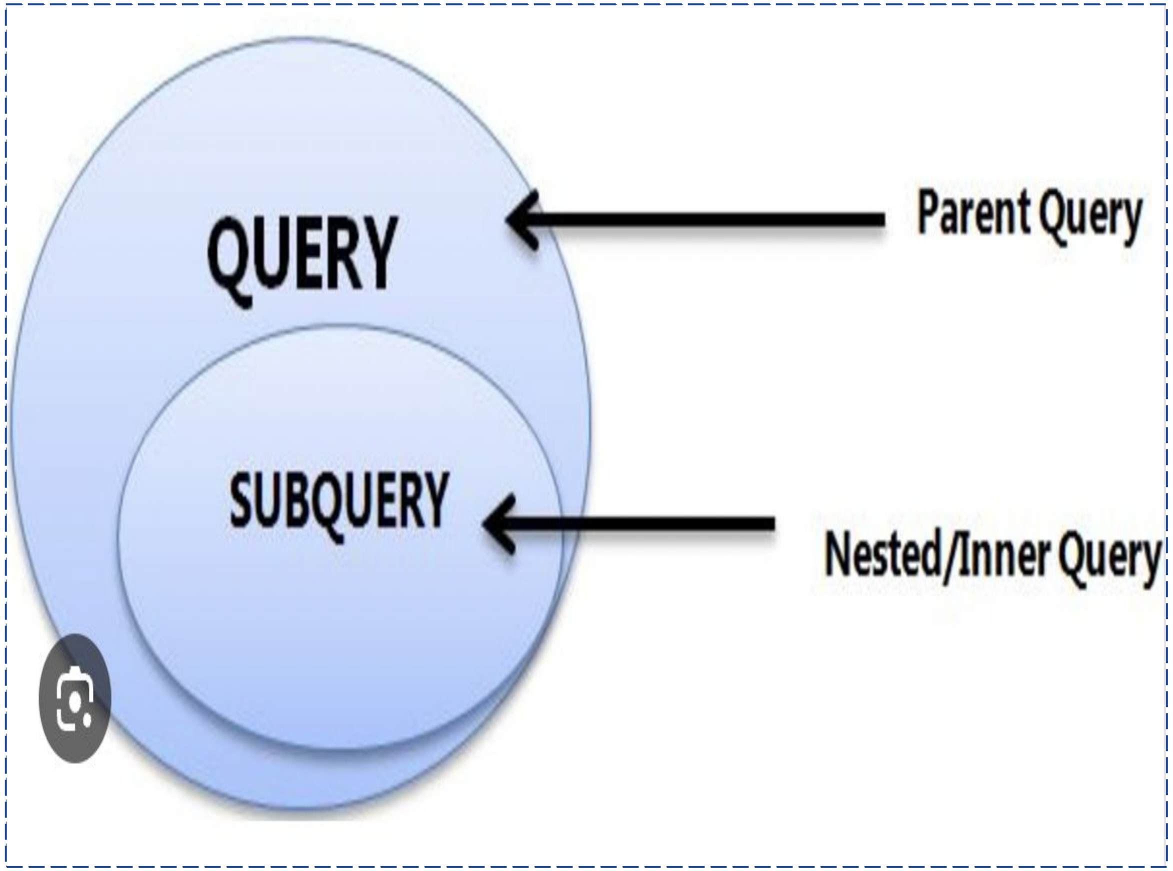
M6: Subqueries and Nested Queries

Nested Subqueries

- Definition: A nested subquery returns a result set, which can be used by the outer query.
- Use Case: It’s used to retrieve a list of values that can be compared to other values.
- Syntax: SELECT column1, column2 FROM table1
- WHERE column2 IN (SELECT column3 FROM table2 WHERE column4 = 'value');



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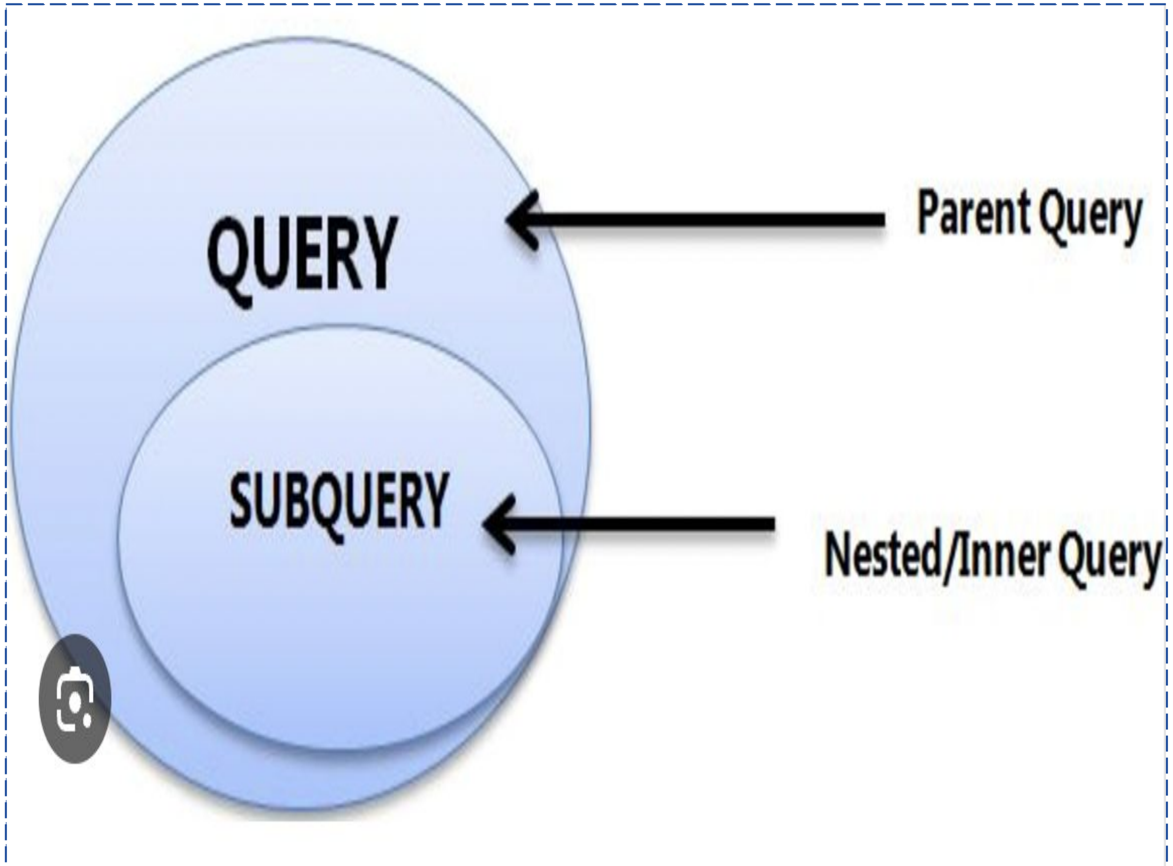
M6: Subqueries and Nested Queries

Correlated Subqueries

- Definition: A correlated subquery refers to columns from the outer query. It is evaluated for each row processed by the outer query.
- Use Case: Correlated subqueries are used when the inner query depends on the values of the outer query.
- Syntax: `SELECT column1, column2 FROM table1 t1 WHERE column2 > (SELECT AVG(column2) FROM table1 t2 WHERE t1.column3 = t2.column3);`



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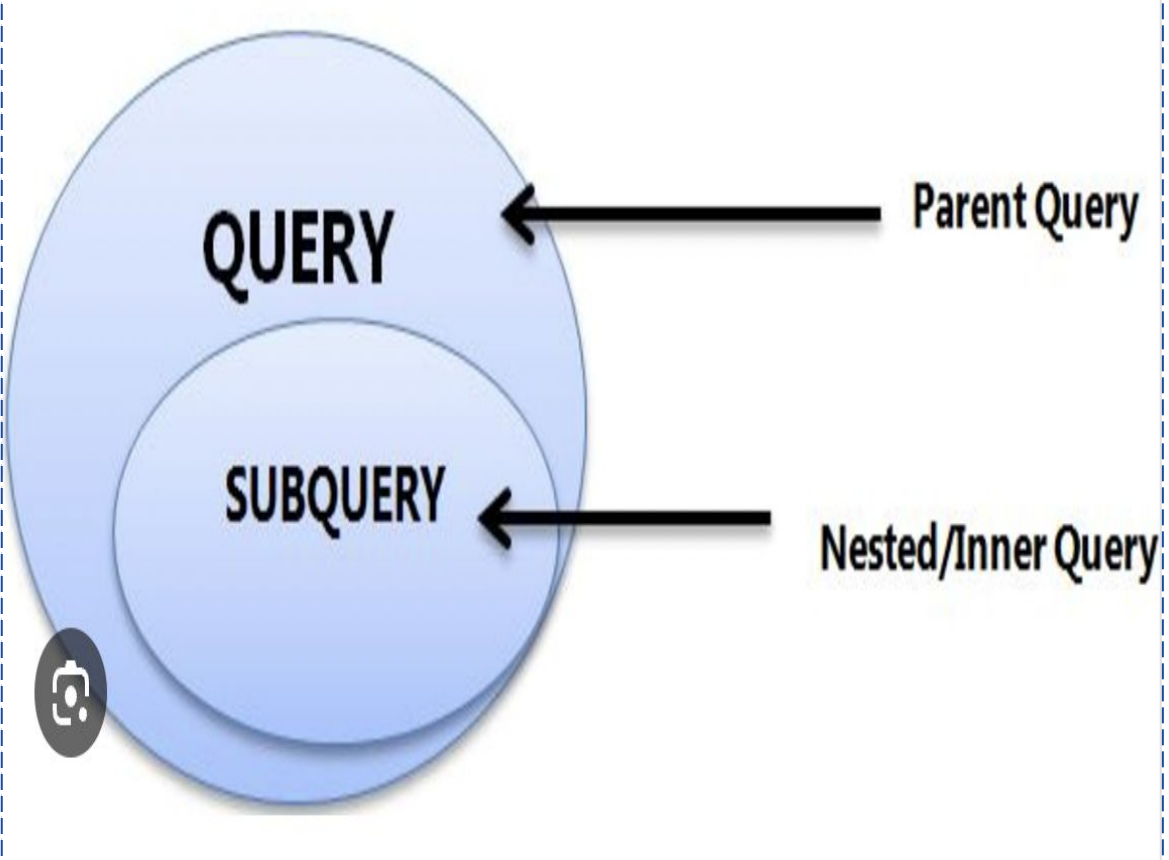
M6: Subqueries and Nested Queries

Exercise 10: Writing Subqueries

- Objective: Write a query that retrieves products with the highest price from each category using subqueries.
- Step 1: Retrieve the highest price for each category using a subquery.
- Step 2: Use the subquery to filter products with the highest price.



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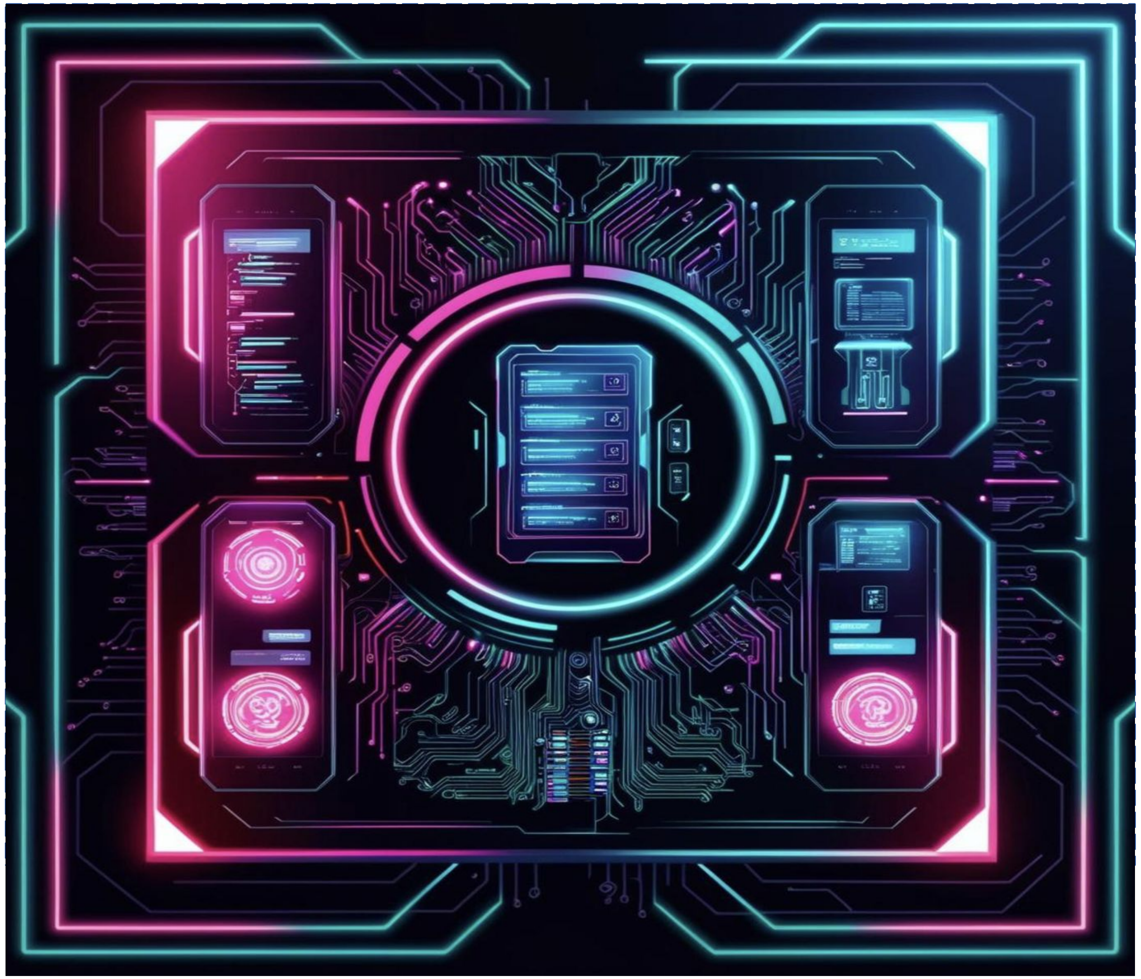
M7: Modifying Data in SQL

Modifying Data: The core of DML (Data Manipulation Language)

- UPDATE: Modifies existing data.
- DELETE: Removes data.

Key Concepts:

- Atomicity: Changes must be complete or not happen at all.
- Consistency: Data must remain valid according to constraints.
- Isolation: Transactions are independent of each other.
- Durability: Once committed, changes are permanent.



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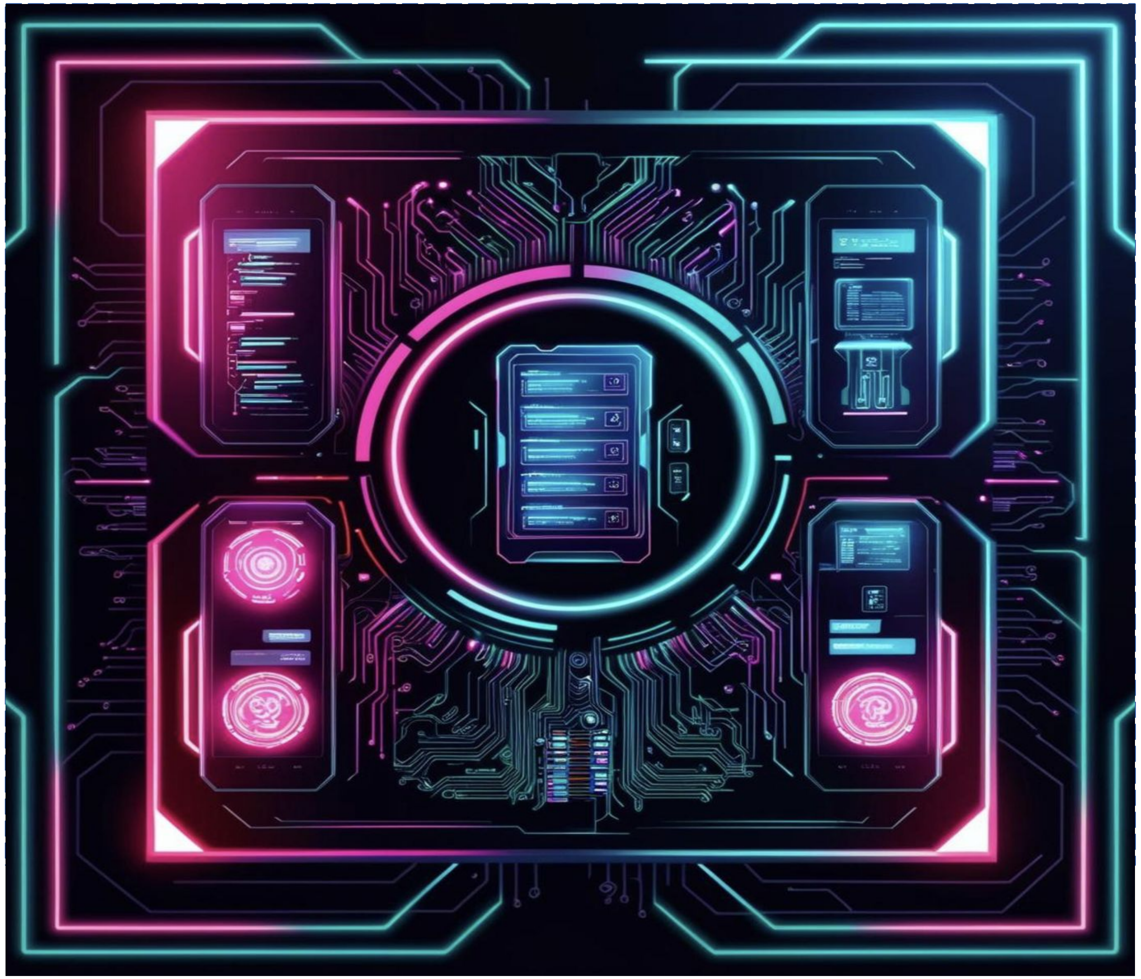
M7: Modifying Data in SQL

UPDATE

- Syntax: `UPDATE table_name SET column_name = value WHERE condition;`
- Modifies existing data.
- Use WHERE clause to specify the rows to update.
- Always be cautious with UPDATE to avoid unintended changes.



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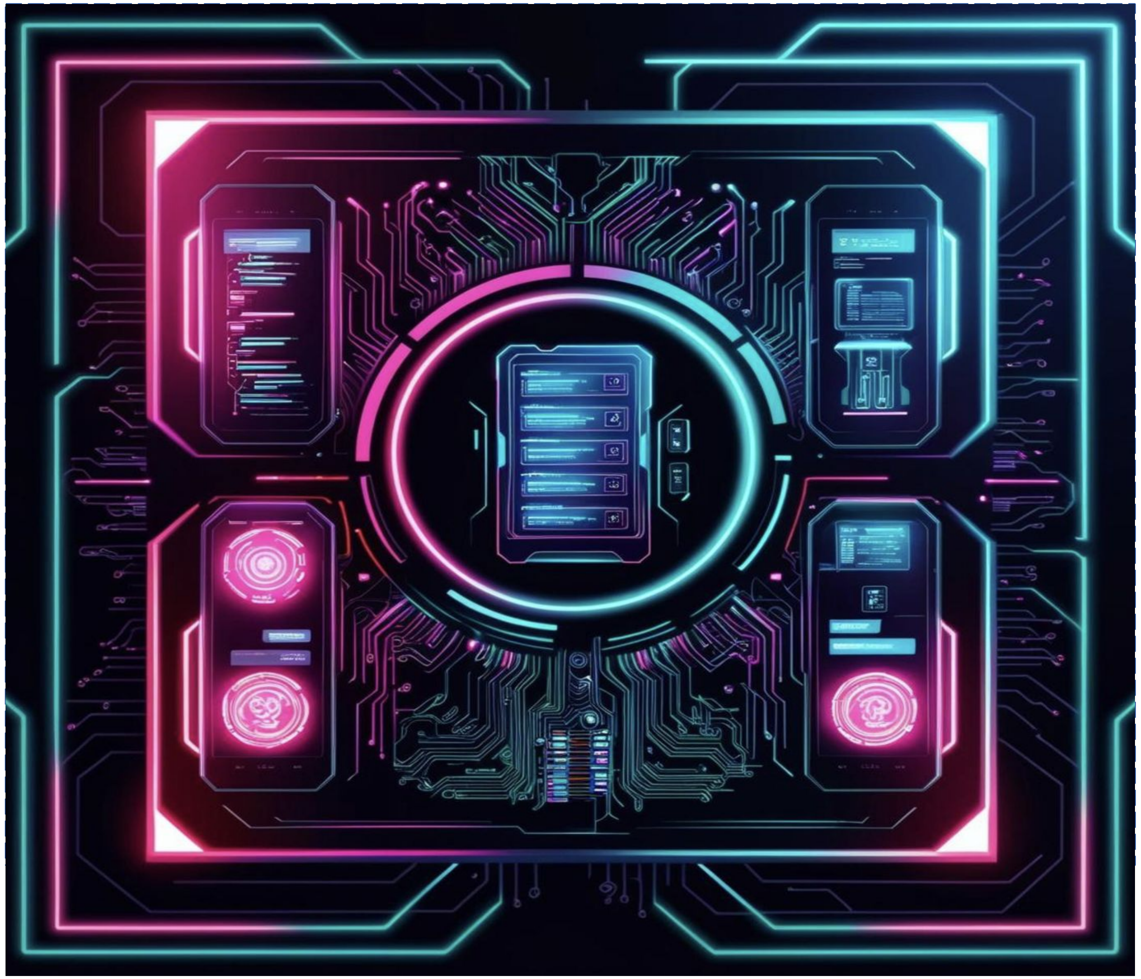
M7: Modifying Data in SQL

DELETE

- Syntax: `DELETE FROM table_name WHERE condition;`
- Deletes records based on a condition.
- Without `WHERE`, all rows will be deleted (use with caution).
- It’s possible to delete all data in a table without dropping the table.



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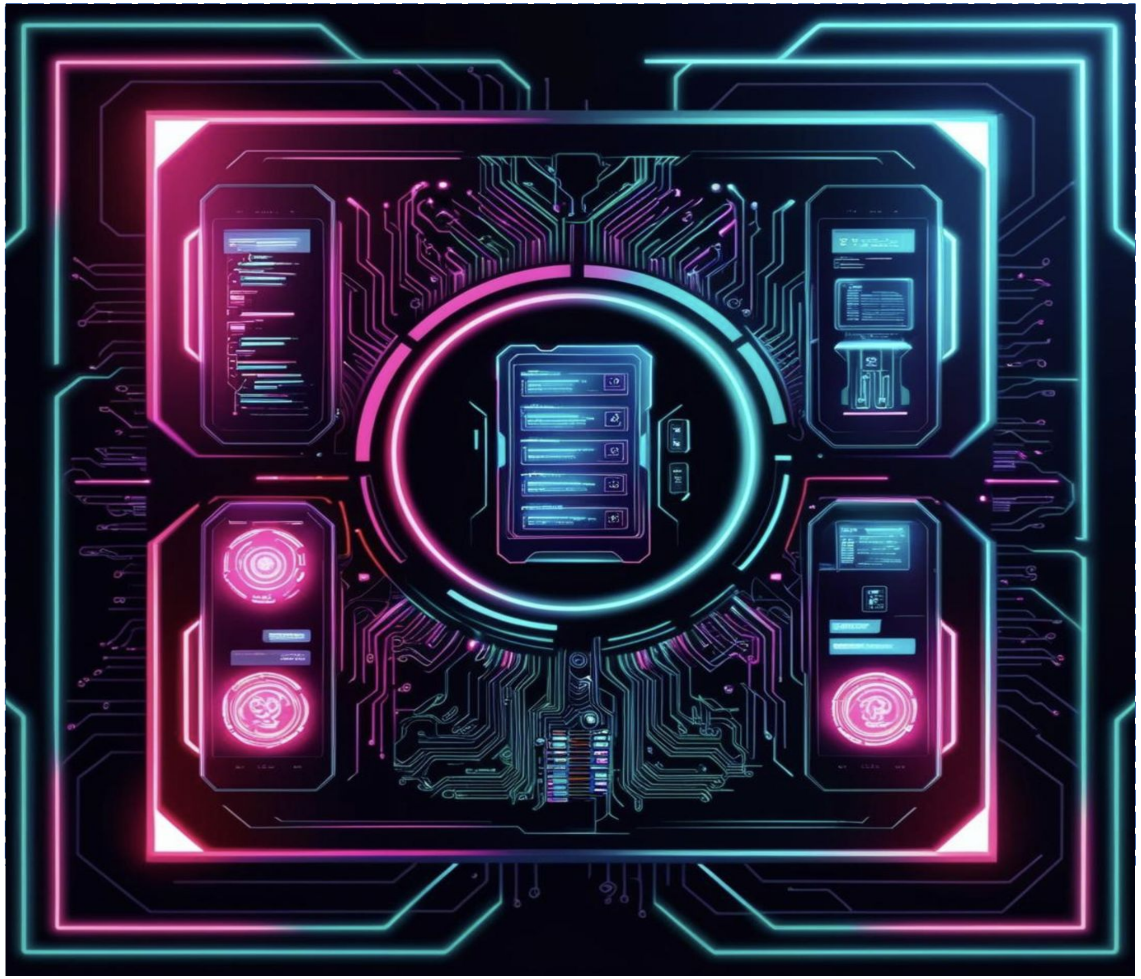
M7: Modifying Data in SQL

Exercise 11: Updating and Deleting Data

- Objective: Modify and remove data in the products table.
- Task 1: Update product prices for specific categories.
- Task 2: Delete products that are obsolete.



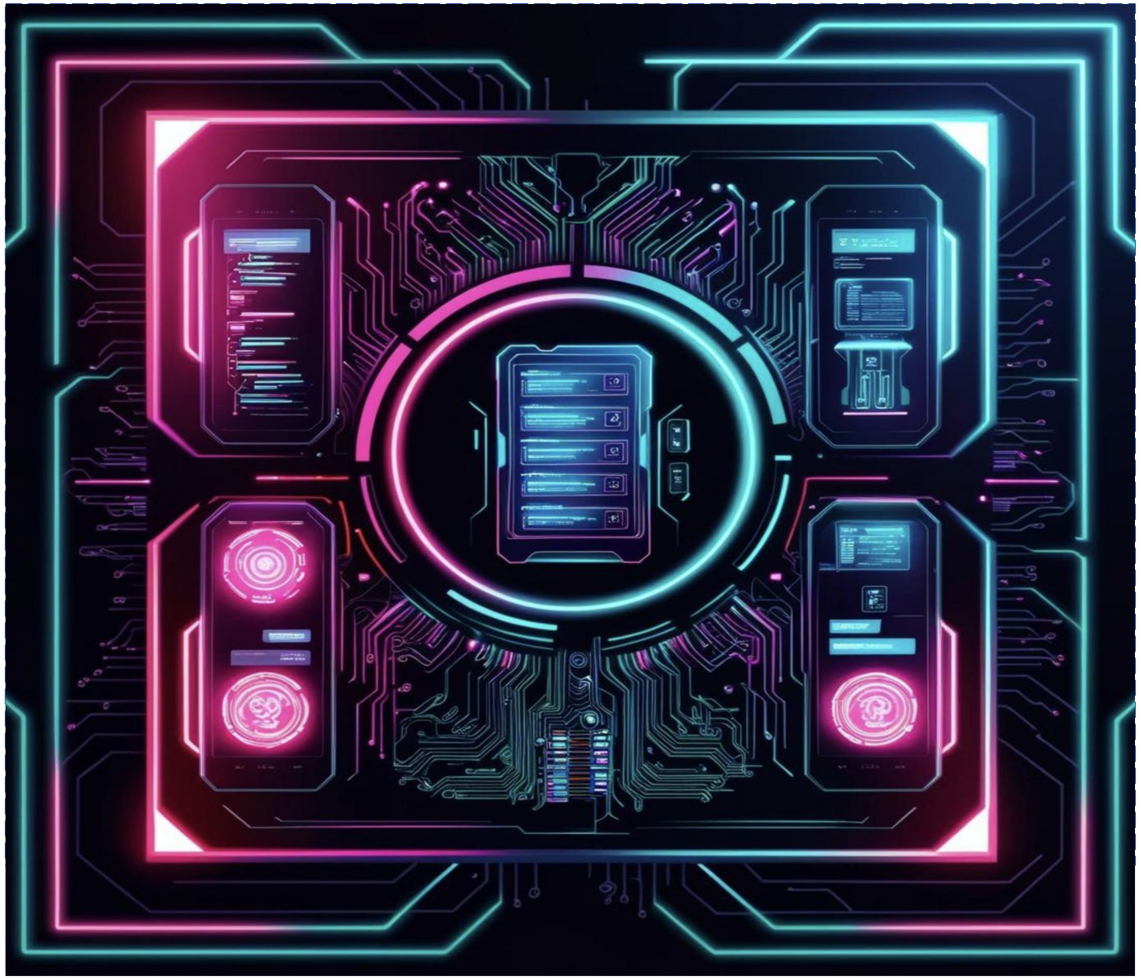
M7: Modifying Data in SQL

What is a Transaction?

- A sequence of SQL operations that are treated as a single unit.
- Either all operations are committed or none.

ACID Properties:

- Atomicity: All or nothing.
- Consistency: Data remains valid after the transaction.
- Isolation: Each transaction is independent.
- Durability: Once committed, changes are permanent.



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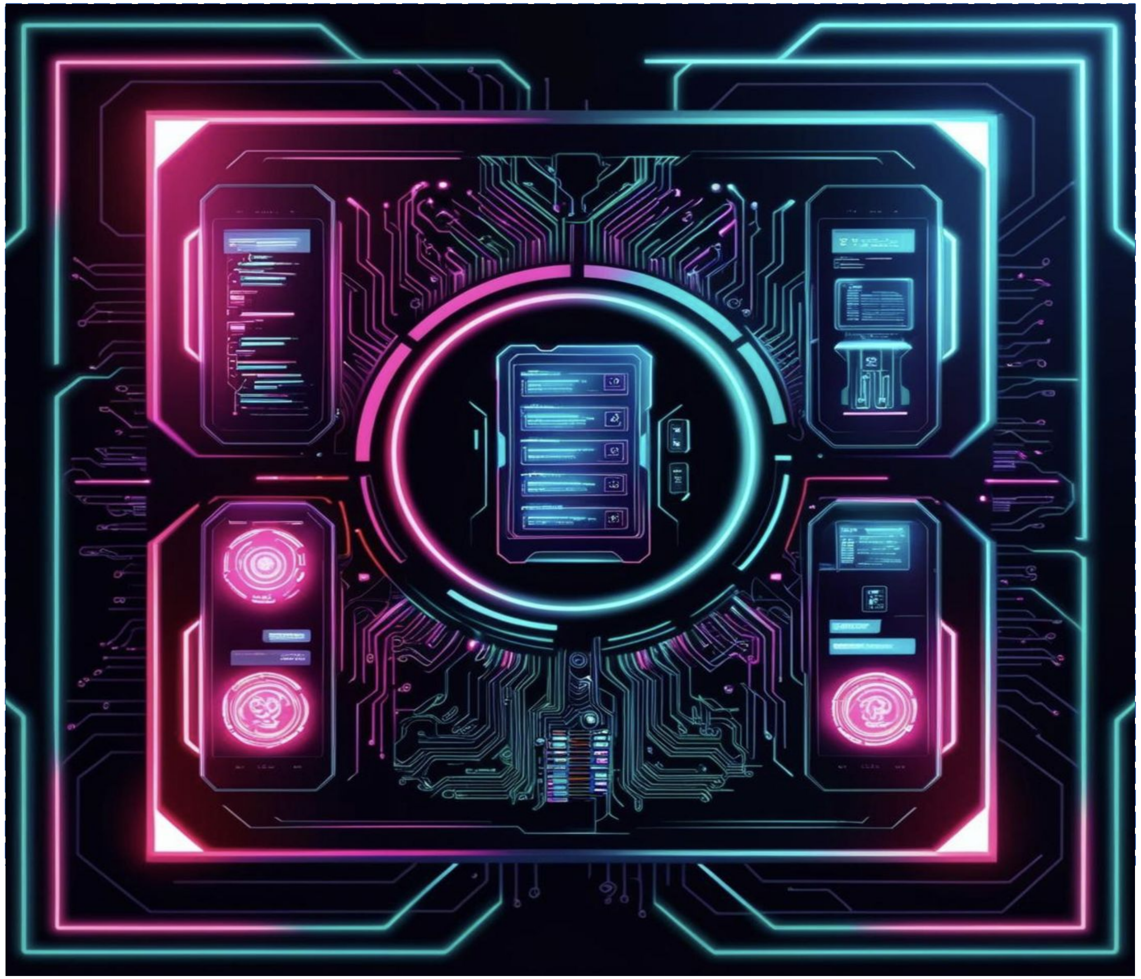
M7: Modifying Data in SQL

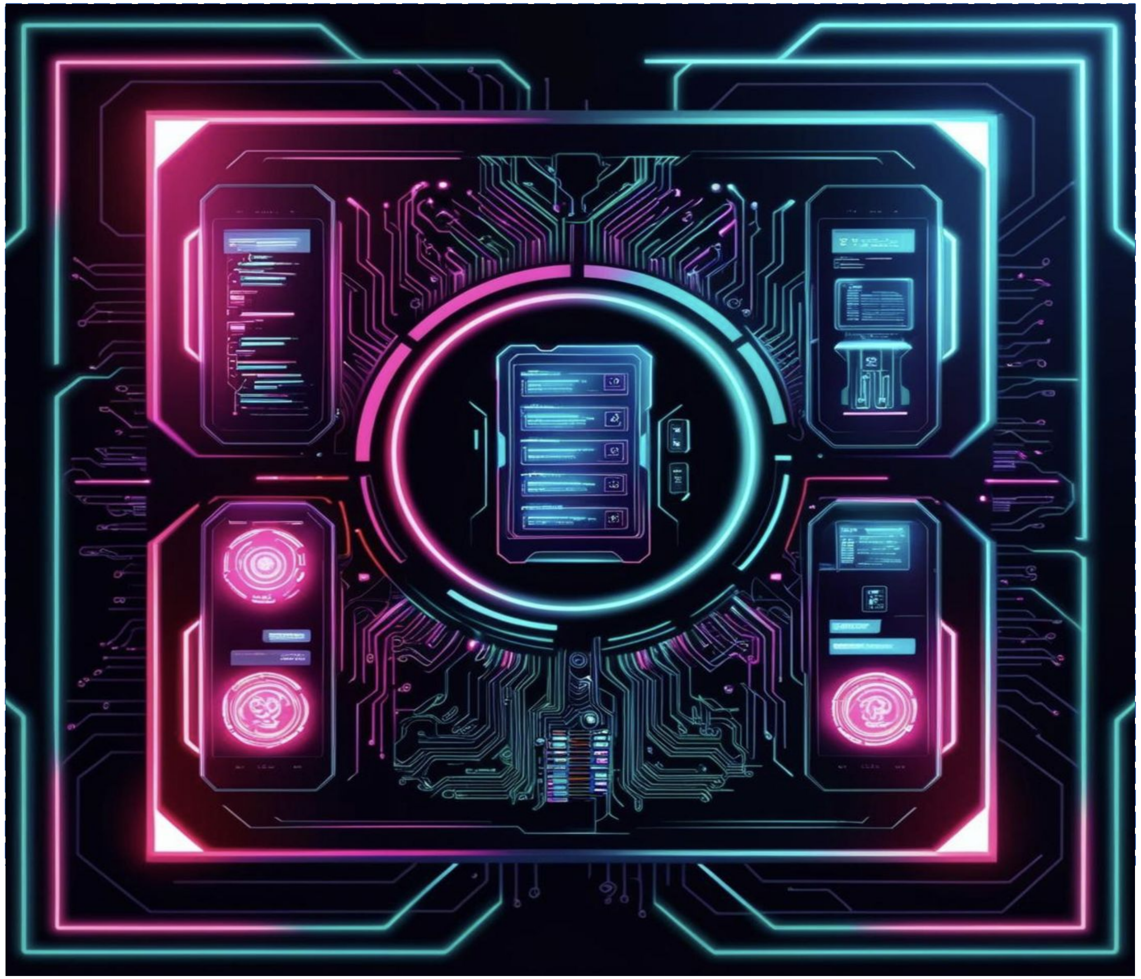
- BEGIN: Starts a transaction.
- COMMIT: Makes all changes permanent.
- ROLLBACK: Reverts changes if something goes wrong.



M7: Modifying Data in SQL

Exercise 12: Transactions in SQL

- Objective: Use transactions to update multiple product records.
- Task: Implement a transaction that adjusts product prices based on categories.



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M8: Optimising and Indexing Your Queries

- Query optimisation: Speed up your database queries.
- Indexes: A powerful tool for improving query performance.
- Performance: Understanding how to analyse and optimise your SQL queries.
- Indexing: Reduces search time by organising data.
- EXPLAIN: A tool to understand how SQL queries are executed.

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M8: Optimising and Indexing Your Queries

What is an Index?

- A data structure that helps speed up data retrieval.
- Indexes are created on one or more columns in a table.

Types of Indexes:

- Single-Column Index: Index on a single column.
- Composite Index: Index on multiple columns.
- Unique Index: Ensures that all values in the indexed column(s) are unique.

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M8: Optimising and Indexing Your Queries

Creating Indexes

- Basic Syntax to Create an Index: `CREATE INDEX index_name ON table_name (column1, column2);`

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M8: Optimising and Indexing Your Queries

Exercise 13: Creating Indexes

- Objective: Create indexes on frequently queried columns.
- Task 1: Create an index on the name column in the products table.
- Task 2: Create a composite index on category_id and price columns.

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M8: Optimising and Indexing Your Queries

Viewing Indexes

- List All Indexes: `SELECT name FROM sqlite_master WHERE type = 'index';`
- List Indexes for a Specific Table: `SELECT name FROM sqlite_master WHERE type = 'index' AND tbl_name = 'table_name';`
- Describe a Specific Index: `PRAGMA index_info('idx_index_name');`

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M8: Optimising and Indexing Your Queries

- EXPLAIN: A tool used to display the execution plan of a query.
- Syntax: `EXPLAIN SELECT column_name FROM table_name WHERE condition;`
- EXPLAIN Output:
  - Type: The join type used.
  - Rows: Estimated number of rows the query will examine.
  - Extra: Additional information on the query execution.

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M8: Optimising and Indexing Your Queries

Query Optimisation Techniques

- Query Optimisation: The process of improving the efficiency of a SQL query.
- Goal: Minimise the time and resources required to execute a query.
- Techniques:
- Use indexes: Speed up searches on large tables.
- Avoid SELECT : Only retrieve the columns you need.
- Use proper JOIN types: Avoid unnecessary CROSS JOINs or FULL OUTER JOINs.
- EXPLAIN Command: Analyses how SQL queries are executed.

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M9: Advanced SQL Features

- Working with Views to simplify complex queries.
- Using Triggers and Stored Procedures for automating tasks.

Key concepts:

- Views: Virtual tables for easier querying.
- Triggers: Automatically execute SQL code in response to events.
- Stored Procedures: Reusable SQL code for commonly executed tasks.

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M9: Advanced SQL Features

What is a View?

- A virtual table based on the result of a query.
- Views simplify complex queries by hiding the complexity.
- Can be used in place of a table in queries.

Advantages of Views:

- Data security (restrict access to sensitive columns).
- Simplifies complex joins and aggregations.
- Reduces redundant queries.

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M9: Advanced SQL Features

Creating and Using Views

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

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M9: Advanced SQL Features

Exercise 14: Using Views

- Objective: Create a view that combines product data with supplier information.
- Task 1: Write a SELECT query that joins the products table with the suppliers table.
- Task 2: Create a view named product_supplier_view based on that query.
- Task 3: Query the view to display product and supplier information.

M9: Advanced SQL Features

What is a Trigger?

- A database object that automatically executes a SQL statement when a certain event occurs.
- Events: Insert, update, or delete operations.
- Purpose: Automate tasks, such as updating related data or logging changes.

What is a Stored Procedure?

- A precompiled set of SQL statements that can be executed as a unit.
- Can accept input parameters and return output.
- Helps automate repetitive tasks.

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M9: Advanced SQL Features

Creating Triggers

Syntax: CREATE TRIGGER trigger_name AFTER INSERT ON table_name FOR EACH ROW BEGIN -- SQL commands END;

M9: Advanced SQL Features

Exercise 15: Triggers and Stored Procedures

- Objective: Create a trigger that automatically updates stock after a product is sold.
- Task 1: Create a sales table.
- Task 2: Create a trigger to update the stock level in the products table when a sale occurs.

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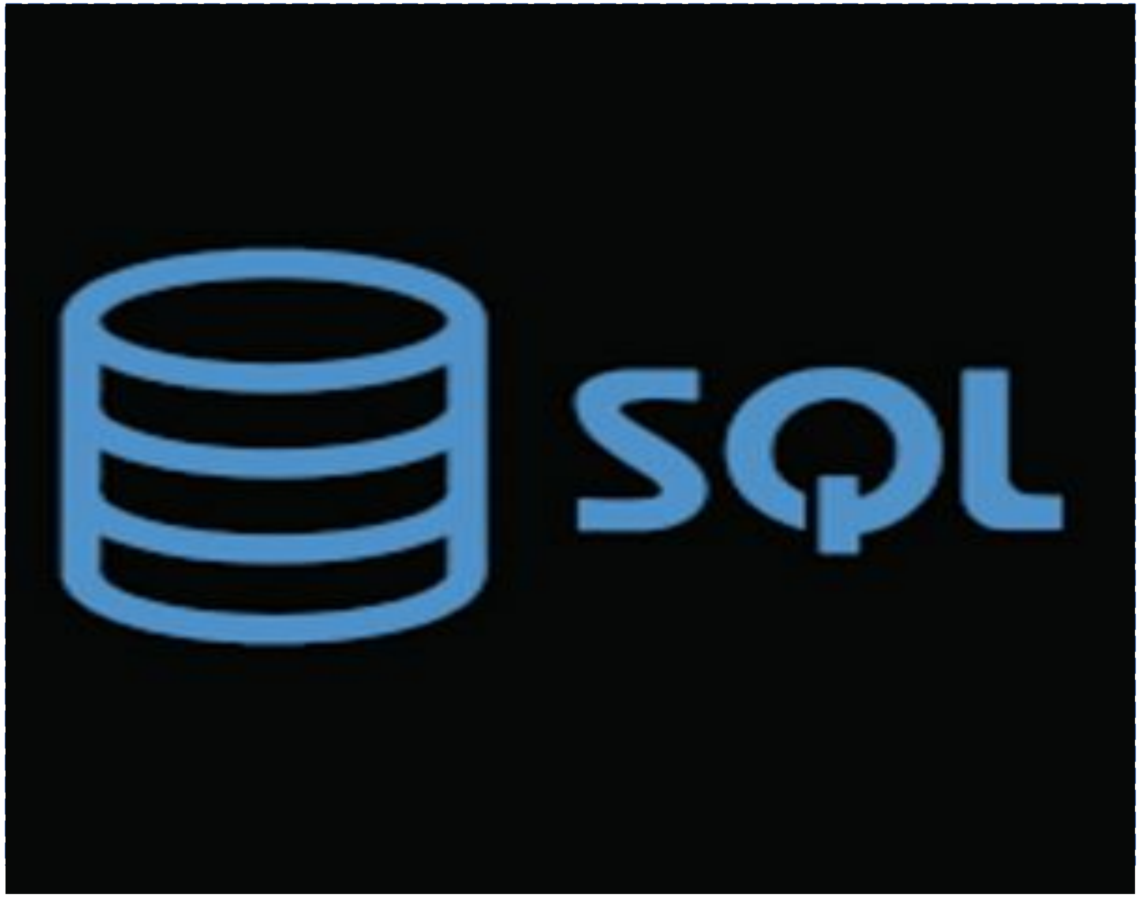
M10: Final Project

- Build a complete business database for a fictional e-commerce store.
- Use SQL techniques learned throughout the course.
- Create tables, insert data, write queries, and generate reports.



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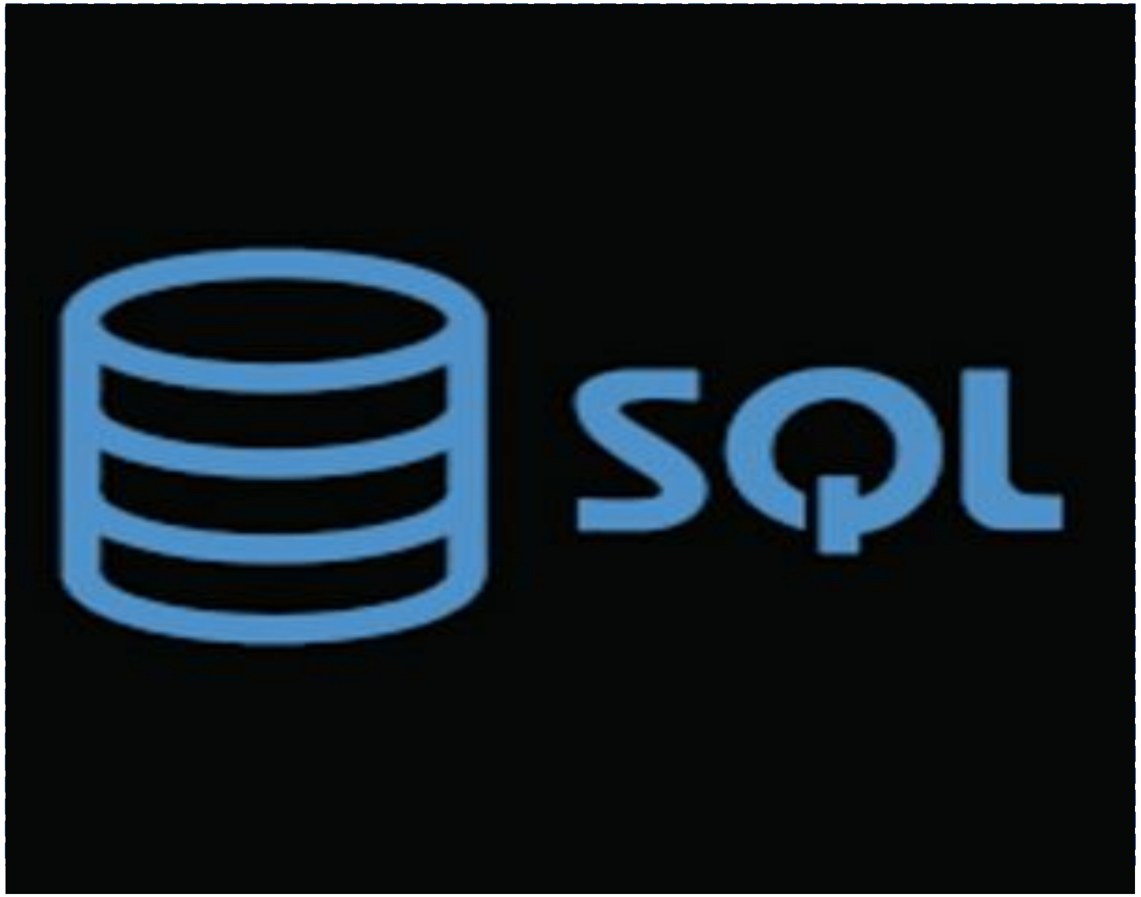
M10: Final Project

Project Overview: E-Commerce Business Database

- Designing the structure
- Create tables
- Inserting the data
- Write at least 5 different queries to analyse sales, customers, and payments. These queries should cover:
    - Sales by product.
    - Revenue by category.
    - Orders by customer.
    - Unpaid orders report.
    - Payments report.



SQL Mastery: From Beginner to Pro

Bonus Section: Recommended Resources

Free Online Resources:

- SQLZoo (Interactive Learning Platform)
- Khan Academy – SQL Basics
- W3Schools SQL Tutorial
- LeetCode SQL Challenges
- SQL Bolt

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Community Forums and Discussion Platforms:

- Stack Overflow – SQL Tag
- Reddit – r/SQL
- SQLServerCentral

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Blogs for Continuous Learning:

- SQLServerCentral Blog
- SQL Performance Blog by SQLServerPerformance
- Use The Index, Luke! (Blog)

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Additional Tools to Practice SQL:

- DB Fiddle
- SQL Fiddle

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