# Week 1: Introduction & Foundational Skills (Focus on Project Relevance)

This week, we'll be diving into the exciting world of SQL and databases! We'll explore what SQL is used for, how it benefits web applications, and the building blocks of databases: tables, columns, and data types. But most importantly, we'll get our hands dirty by creating a basic database structure for our upcoming Expense Tracker project!

## Learning Objectives:

Understand the purpose and applications of SQL, particularly for web applications.

Identify the fundamental components of a database: tables, columns, and data types.

Design a basic database schema for our Expense Tracker project.

Instructions

This assignment is designed to be completed in approximately 2 hours.

\*\*What you'll need:\*\*

Access to a computer with internet access

A text editor (Microsoft Word document)

Drawing software (e.g. Draw.io, visual paradigm) for the bonus question.

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## Submission:

Save your completed assignment as a document (e.g., .docx, pdf)

Submit your document through the designated course platform.

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## Part 1: Understanding SQL (30 minutes)

\*\*Question 1. Research\*\*

Use online resources like websites or PowerPoint slides.

\*\*1.1.\*\* In a single Word document, summarize your findings in a short paragraph (3-5 sentences).

Web Applications:

A web application is a computer program that utilizes web browsers and web technology to perform tasks over the Internet. It is a software program residing on the internet, accessible through your web browser, sparing you from the complexities of the conventional download process on your computer or phone. For a web application to operate, it needs a web server, application server and database. Web servers manage the requests that come from a client, while the application server completes the requested task, a database stores any necessary information. Web Applications include online forms, shopping carts, word processors, spreadsheets, video and photo editing, file conversion, file scanning, and email programs etc.

Imagine a dynamic website like an online store. How do you think SQL plays a role in managing data behind the scenes? Consider how product information, user accounts, and order details might be stored and accessed.

In a dynamic website like an online store, SQL (Structured Query Language) plays a crucial role in managing data behind the scenes. The following is how it typically handles various aspects of data management:

1. **Product Information:**
   * **Database Schema:** There would likely be a database table dedicated to storing product information. This table would have columns such as product ID, name, description, price, category, stock quantity, etc.
   * **Operations:** SQL queries would be used to insert new products, update existing product details (like price or stock quantity), delete products, or retrieve product information based on various criteria (e.g., category, price range).
2. **User Accounts:**
   * **Database Schema:** User account details would typically be stored in a separate table. This table would include columns such as user ID, username, email, password (often hashed for security), shipping address, payment information (in encrypted form), etc.
   * **Operations:** SQL queries would manage user account creation, authentication (checking credentials during login), updating user profiles, and retrieving user information.
3. **Order Details:**
   * **Database Schema:** Orders would typically be stored in multiple tables to handle complexities like order items, shipping details, payment status, etc. There might be tables for orders, order items (connecting products to orders), shipping information, and payments.
   * **Operations:** SQL queries would handle placing orders, updating order status (e.g., processing, shipped), retrieving order history for users, calculating total sales, and managing inventory (deducting stock when an order is placed).

**Concurrency and Transactions:**

* SQL databases ensure data integrity and consistency, especially in scenarios where multiple users might be accessing or modifying data simultaneously. Techniques like transactions (BEGIN TRANSACTION, COMMIT, ROLLBACK) help maintain database integrity when operations involve multiple steps.

**Scalability and Performance:**

* SQL databases can handle large datasets efficiently through indexing, query optimization, and partitioning. This is crucial for dynamic websites that may experience high traffic and frequent data updates.

\*\*1.2.\*\* Write a short explanation (3-5 sentences) in your document about the role of SQL in web applications.

SQL plays a critical role in web applications by providing a standardized language for managing and querying structured data stored in databases. SQL can be used to extract and analyze data for generating reports and performing analytics. Websites can use SQL queries to gather insights on user behavior, traffic patterns, and other metrics. Websites often need to store data such as user information, product details, blog posts, comments, etc, SQL is used to create databases and tables to store this structured data efficiently. SQL is used to query the database to retrieve specific data based on certain criteria, for example, when a user logs into a website, SQL queries can be used to retrieve the user's information from the database.

\*\*1.3.\*\* List 3 benefits of using SQL for web applications.

1. SQL is universal
2. SQL can process large volumes of data
3. SQL helps to consolidate data and develop an individual’s skillsets

\*\*1.4.\*\* Think about efficiency, data organization, and data retrieval capabilities. Briefly explain each benefit in your document (1-2 sentences per benefit).

1. SQL is universal:

You can find SQL in almost every database and the language is prominent enough that learning it also enhances other skills. This is because it isn't just databases that use SQL, cloud storage providers and eCommerce platforms also use SQL as an essential framework.

1. SQL can process large volumes of data:

Large data sets are no longer just used by large companies but relatively small organizations also use and maintain significant amounts of data. While storing, sorting through and presenting large amounts of data in an easily digestible format can be challenging to achieve in spreadsheet software, SQL excels in this area and can allow you to work with large data sets without the program crashing.

1. SQL helps to consolidate data and develop an individual’s skillsets:

All teams within organizations have their own individual data needs. Regardless of the team, the relevant data might be in a variety of data sets across the organization, as opposed to being in one centralized location, learning SQL helps to consolidate data from these multiple sources and to convert these data sets to meet a team's needs.

\*\*1.5.\*\* List any 3 Database Management Systems.

1. MySQL
2. Microsoft SQL Server
3. PostgreSQL

## Part 2: Database Fundamentals (45 minutes)

\*\*Question 2.1: Tables\*\*

Think about how data is organized in rows and columns.

In your document, define a database table and explain its similarity to a spreadsheet (2-3 sentences).

A database table is a collection of related data organized into rows (also called records or tuples) and columns (also called fields or attributes). Each row represents a single entity (such as a person, product, or transaction), and each column represents a specific piece of information about that entity. Both database tables and spreadsheets use a grid structure composed of rows and columns and Users can enter, edit, and delete data directly within cells in both database tables and spreadsheets.

\*\*Question 2.2: Columns\*\*

Consider different types of data like text, numbers, and dates.

Define "columns" and provide an example with an explanation (2-3 sentences) in your document.

Columns are vertical segments of data in a table of a database that stores specific attributes of the data set.

Example:

Customer Information System: In a retail business’s customer information system, the various characteristics or attributes of the customers are stored in a database.  A column in this database might include “Customer Name”, “Phone Number”, or “Email Address”.

Data Types: Why are data types important in a database? Briefly explain 3 common data types (e.g. Text, Number, Date).

Data types are important in database for the following reasons:

1. Data types are most times associated with constraints (e.g., NOT NULL, UNIQUE, PRIMARY KEY) that enforce additional rules on the data stored in a database. These constraints ensure data quality by preventing invalid data from being inserted into the database, thereby maintaining the accuracy and reliability of the stored information.

2. Data types enforce rules on what kind of data can be stored in each column of a database table. This helps maintain data integrity by ensuring that only appropriate and valid data is stored.

3. Different data types occupy different amounts of storage space in a database. Choosing appropriate data types can optimize storage efficiency.

4. Data types define how data is represented and interpreted by applications that interact with the database. Consistent data types make it easier to develop and maintain applications that use the database.

Explanation of Data Types:

* **Text:** Text data types are used to store textual information such as names, descriptions, or any other alphanumeric data. It includes VARCHAR (variable-length character) and CHAR (fixed-length character). VARCHAR is flexible and only uses as much storage as needed for the data, while CHAR always uses the specified length, padding with spaces if necessary.
* **Number:** Number data types are used for storing numeric values such as integers or decimals. Integers are whole numbers and Decimals are fixed-point numbers with exact precision.
* **Date:** Date and time data types are used for storing temporal information. It is usually in the following variants:

DATE: A date in the format YYYY-MM-DD.

DATETIME(fsp): A combination of date and time in the format YYYY-MM-DD HH:MI:SS.

TIMESTAMP(fsp): A timestamp in the format YYYY-MM-DD HH:MI:SS.

TIME(fsp): A time in the format HH:MI:SS.

YEAR: A four-digit year ranging from 1901 to 2155, and including 0000.

\*\*Question 2.3: Data Types\*\*

Think about how data types ensure data integrity and efficient storage.

Explain the importance of data types and provide brief explanations of 3 common types (2-3 sentences each) in your document.

Importance of Data Types:

1 .Data Integrity: Data types ensure data integrity by making sure data are collected and stored accurately, as well as being contextually accurate to the model at hand.

2. Data storage: data types are foundational in data storage because they optimize storage efficiency, ensure data integrity, support application compatibility, and enhance indexing and query performance. Choosing appropriate data types based on the nature of the data being stored and the requirements of the application is crucial for designing robust and efficient databases.

## Part 3: Expense Tracker Database Design (45 minutes)

\*\*3.1. Planning:\*\*

We'll be building an Expense Tracker application. What kind of data do you think we'll need to track? List at least 5 data points relevant to our project.

Kinds of Data Required For Expense Tracker Application

1. Expense Details: The expense tracker application will need details of category of expense, cost (amount) incurred, payment method (cash, credit card, debit card), date expense was incurred etc.

2.Analytics and Reports: A report of Monthly/Yearly summaries of Total expenses or incomes per month or year.

3.User Information: User ID: Unique identifier for each user (if the application supports multiple users).

\* Consider information like expense amount, date, and category.

\* List your identified data points in your document.

Data Points Relevant to our Project:

 Date: The date when each expense occurred. This helps users track spending over time and identify patterns.

 Category: The category of each expense (e.g., groceries, utilities, transportation). This allows users to understand where their money is going.

 Expense Amount: The monetary value of each expense. Essential for calculating totals and budgets.

 Payment Method: How each expense was paid (e.g., cash, credit card, debit card). This helps users manage different accounts and payment methods.

 Merchant: The name of the merchant or place where the expense was incurred. This provides additional context and helps with organizing expenses

\*\*3.2. Tables:\*\*

Considering the data points you listed, design a basic database schema with one main table (likely named "Expenses").

\* Define the columns needed for this table.

\* Assign appropriate data types to each column based on the kind of data it will hold. (e.g., amount: number, date: date, category: text)

In your document, create a table structure that includes:

\* Table name (e.g., Expenses)

\* Column names (e.g., expense\_id, amount, date, category)

\* Data type for each column (e.g., INT, DECIMAL, DATE, TEXT)

## Bonus:

Sketch a simple Entity Relational Diagram (ERD) of your table structure, including column names and data types.

Use drawing software or a simple table format to visually represent your schema.

\*\* Remember: There might be multiple ways to design your database schema. The goal is to understand the concepts and create a logical structure to store our expense tracking data.

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