Course 1 Introduction to Databases

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What you'll learn ?

Concepts and principle that underpin how databases work. Plan and execute simple database development project.

- In this course we will be introduced into databases. Learn to distinguish between the different database management systems and basic creation and data selection with SQL.
- Learn how databases work, how to manipulate databases with the help of structured query language and to plan and design simple relational database system (RDBMS)

Learning Objective

1. Explain what are databases and its general use
2. How data are related to each other in databases
3. Differentiate between types of database management system
4. SQL commands to query the data
5. Explain how tables are used to organize data in databases
6. Differentiate types of keys used in table

Model and structure a database according to best practices and create, manage and manipulate data using SQL commands.

Module 1 Course Introduction

- We will learn Django web framework language to connect front end of the web application with our database.

1.1 Introduction to database

Data is everywhere, for instance us visiting a shop and buying a certain product includes data like our location history, what product we buy, whom we interact and our purchase history and so on. This accumulation of pile of data day by day as led to much larger volumes of data to be stored in databases so called BIG DATA.

Whatever the data, the database engineer must have knowledge to perform the below tasks

1. Store the data
2. Form relationships between segments of data
3. Filter the data to show relevant records
4. Search data to return matching records
5. Perform operations like update, change and delete data. (CRUD)

1.2 A day in the life of database engineer

Its like storing recipes of cooking in the dairy by our mothers, which makes it a easy way to lookup desired recipes whenever needed.

Database is like heart of software development, the art to create a data layer and to store data, and make it possible to retrieve useful and accurate responses from the databases makes us a highly professional database engineer to provide simplified solutions to complex problems posted by humans(us).

Q. What technical skills are useful for database engineer ?

A. Code using certain web related languages, work with creating pipelines (CI/CD) that performs the ETL process (Extract, Transform, and Load lot of data).

Q. What are Soft skills required ?

A. Communication and organization

Q. What are challenges faced ?

A. It is easy to overcomplicate solutions, When dealing with data modelling and data storage, You want to rightly cover every use cases, edge cases while solving data related problems.

Q. What we need to focus as a junior database engineer ?

A. Try to focus on here and now needs of data, Start small iterate frequently, write more often. Not only the SQL query output is everything, we need to write frequently in order to show that our output is in what we deploy other than coding, like documentation, updating wiki page of our own solution.

Note: Try to think in the ways to practically deploy the problems and find solutions for real case study instead.

1.3 Databases and Data

Outcome

- Describe the concept of database
- Identify the real world examples of database

- Concept of how data is related in a database

Data : It is facts and figures about anything.

Database : It is a form of electronic storage in which data is organized systematically. Eg: Bank uses databases to store account information.

Types of Databases

- Object oriented
- Graph (stored as node)
- Document databases (stored as JSON)

Could be hosted on cloud and its popular (store, manage and retrieve data in the cloud with lower cost).

Next : Storing and managing data.

How is data related ?

Order table

Order ID	Customer ID	Order Date	Delivery Date
01	C1	02-03-2022	07-03-2022
02	C2	02-03-2022	10-03-2022
03	C3	02-03-2022	14-03-2022
04	C4	02-03-20	
05	C5	02-03-20	

Customer table

Customer ID	First Name	Last Name	Email
C1	Sarah	Hogan	sarahog @email.com
C2	Edris	Morgan	edmor @email.com
C3	John	Duggan	jondugg @email.com
		Langley	katlang @email.com
		Taleb	mishtal @email.com

a link between the data in the tables.

- The above two tables are called entities
- Order table and customer table have information about the order and customer

Customer table

CustomerID	FirstName	LastName	Email
C1	Sarah	Hogan	sarahog@email.com
C2	Edris	Morgan	edmor@email.com
C3	Johnathan	Duggan	jondugg@email.com
C4	Katrina	Langley	katlang@email.com
C5	Mish	Taleb	mishtal@email.com

In relational databases, they're

- The customer id, first name, last name, and email are features (columns) of the customer entity.
- The data's inside each column are called records and are known as rows.
- Every record in an entity is called as an instance.
- The customer id is also called primary key field, since it is a unique data given to identify every customer even though the entity has two or more customer with same last name and so on.

Primary Key : It is field in table that uniquely identifies each instance in the given entity. (customer id in customer table and order id in order table)

Foreign Key: It is a field in order table in which it relates to the primary field key of original table (customer id from order table relates to customer id of customer table)

Relational data: Data is flooded from different sources every day, it is important to organize, process and present it in a meaningful form so that we can make rightful decisions to solve any data related problem.

1. Bar chart
2. Line chart
3. Pie chart
4. Bubble chart

The type of chart to be used depends on following objectives:

- The target audience who will use the information
- The idea you intend to present

- The idea you intend to present
- The goal you wish to achieve

ORACLE Definition

Database : A database is an organized collection of structured information or data that is stored electronically in a computer system. The database is controlled by a database management system. Together the data and database management system along with the applications that are associated with them are called database system.

SQL : SQL is a query language that is used almost by every relational databases to query, manipulate and define data and to provide access control.

Evolution of databases:

From the start IBM with oracle as a major contributor led to Ansi SQL language and first database to be discovered was hierarchical database which has one to many relationship type. And then after network DB came into existence with many to many relationships. And around 1980's relational DB with more structured and organized form of storing data was evolved to carry operations like easy access, manipulation and deliver useful insights. With the growth of todays internet and social media platform it has posted a challenging area of data domain to capture more of unstructured data instead of structured, which led to the evolution of NoSQL Database.

Difference between spreadsheets and database

- Spreadsheets are created for one user to do less manipulation and calculative opinions on data.
- Whereas database are discovered to carry out large volumes of data manipulation and storage and quickly solve complex logic by SQL

Cloud database: The collection and storage of data takes place on the hybrid cloud computing platform. There are two types of cloud database models : traditional and database as a service (DBaaS)

Database Software : Is used to create, edit, maintain database files and records enabling easier file and record creation, data entry, editing, updating and recording.

2. INTRODUCTION TO SQL

Explain what is SQL and outline what is role of SQL

Operations carried out by database engineer : CRUD

SQL : standard language that can be used to interact with all databases. Database management system makes the SQL query to be converted into suitable form such that database can understand the concept and do the required operations.

2.1 SQL usage

Example : Imagine you have been hired as a college student to create a database.

1. Create tables
2. Insert data into the tables
3. Modify data if any changes occurs

Above all is possible with SQL and CRUD operations.

Depending on what SQL can do, it as been subdivided into subsections and sub languages

1. DDL (Data Definition Language): To initially define data, ie to create table etc
    a. Create databases, tables
    b. Alter table
    c. Drop command
2. DML (Data Manipulation Language): It helps to manipulate data
    a. Insert
    b. Update
    c. Delete
3. DQL (Data Query Language): To read or retrieve data we can use DQL command.
    a. SELECT
4. DCL (Data Control Language) : To provide access controls
    a. Grant
    b. Revoke

2.2 Advantages of SQL

- SQL is a bridge between relational databases and user.
- User friendly (less coding)
- Can be able to retrieve and manipulate data.. insert, update, delete
- Standard and portable language (MySQL is used to interact with every relational database and can be a suitable easy access software on any platform)

2.3 SQL Syntax Introduction

Objectives :

- Use of DDL to create database & table
- Use of DML subset to populate and modify data
- Use of DQL to read and query the data within the database

Query | Query History

```sql
/* You are hired to create a college database */

/* Create a table using DDL sublanguage of SQL */

DROP TABLE IF EXISTS student;

CREATE TABLE student (
    column_ID SERIAL PRIMARY KEY,
    first_name VARCHAR(100),
    last_name VARCHAR(100),
    date_of_birth DATE
);

INSERT INTO student (first_name, last_name, date_of_birth)
VALUES
('Chris', 'Hemsworth', '1983-01-20'),
('Robert', 'Downey', '1975-04-12'),
('Chris', 'Evans', '1981-01-28'),
('Natasha', 'Swing', '1983-07-18');

SELECT *
FROM student;
```

UPDATE the incorrectly entered data

UPDATE student
SET date_of_birth = '1980-02-20'
WHERE column_id = 1;

DELETE data from table

DELETE FROM student
WHERE column_id = 4

ALTER - It can be used to add primary key, adding or deleting a column

ALTER TABLE student ADD primary key (column name)
ALTER TABLE student ADD (column name data type(size))

To empty the data inside the table but not to delete the table use **TRUNCATE** command

TRUNCATE TABLE student;

- DCL - User privileges GRANT or REVOKE access
- TCL - Transaction control language - COMMIT (To save all the work you have done in this database), ROLLBACK (to restore a database back to its last committed state)

Table - A table is a most basic type of object in relational database.

Datatype - Every column has a data type, a data type defines the type of data that needs to be stored in each table column. A data type is defined by the use of SQL.

- Numeric (TINYINT, INT, BIGINT, FLOAT, REAL)
- Date and time (DATE, TIME, DATETIME)
- Char and string (CHAR & VARCHAR)
- Binary data types such as (BINARY, VARBINARY)
- Miscellaneous data type
  - CLOB (Character large object - For storing large text in the form of encoding)
  - BLOB (Binary large object - Store images)

Integrity constraints : Every column or rows in a relational database should abide by some rules called Integrity constraints.

1. Key Constraints : The major keys like primary and foreign keys have certain set of rules so that they can help to form meaningful relationships between the data's in a database.

2. Domain Constraints : It defines only the values which are meant to be stored in a column fits the column. Eg: email address cannot be stored under name.

3. Referential Integrity Constraints : This instantiates that there should be a referenced column available to fit the purpose and maintain integrity. Eg: Foreign Key

Key.

Database Structure : A database structure refers to how a data is arranged in a database.

The structure of database consists of certain key components.

- Tables or entities where the data is stored
- Attributes which shows details about the table
- Fields or Columns which captures the attributes
- Record which is one row of details about a table or entity
- Primary key which is a unique identifier of a entity

1. **LOGICAL DATABASE STRUCTURE - (Visual Representation)** The logical way of representing data is by entity relationship diagrams (ERD). They are used to establish a relationship between the entities of a database via instances of the table. The cardinality or types of relationships that can be established are
   a. One to One
   b. One to Many
   c. Many to Many

2. **PHYSICAL DATABASE STRUCTURE -** This is the way of forming relationships between entities via foreign key field.

Types of Keys

Key constraint
Primary key
Foreign Key
Composite Key - combination of two instances so that the uniqueness of this combination is found no where in the database.
Alternate key - Other than primary key like phone number.