Teaching Guidelines for

Database Technologies

PG-DAC September 2022

Objective: To introduce students to RDBMS and NoSQL Databases and facilitate hands-on experience on SQL (using MySQL) and MongoDB.

Prerequisites: Working knowledge of Windows and Linux, familiarity with programming.

Text Book:

- Murach's MySQLby Joel Murach / Shroff Publisher

References:

- Database System Concepts by Abraham Silberschatz, Henry Korth and S. Sudarshan / McGraw Hill
- Database Design and Relational Theory: Normal Forms and All That Jazz by C. J. Date (Author) / O'Reilly
- Fundamentals of Database System by Shamkant B. Navathe, Ramez Elmasri / Pearson
- MySQL: The Complete Reference by Vikram Vaswani / McGraw Hill
- SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management by Andreas Meier and Michael Kaufmann / Springer
- MongoDB: The Definitive Guide by Shannon Bradshaw, Eoin Brazil and Kristina Chodorow / O'Reilly
- http://bigdata.stratebi.com/?language=en

Session 1:

Lecture

Introduction to DBMS, Basic Database Terminology
Types of DBMS: Relational, Object Relational and NoSQL Databases
Introduction to MySQL, MySQL Clients (Monitor, Shell, Workbench)

Session 2:

Lecture

Data Models (Conceptual, Logical, Physical)
Database Design, Entity-Relationship Diagram (ERD)
Codd’s 12 rules for RDBMS
Introduction to SQL, Categories of SQL Commands: DDL, DML, DCL, DTL/TCL
DDL (CREATE/ALTER/DROP/TRUNCATE)

Session 3:

Lecture

Data Redundancy, Data Anomalies, Functional Dependency
Normalization, Need for Normalization
Normal Forms (1st NF, 2nd NF, 3rd NF, BCNF) with examples, Introduction to 4th and 5th NF DML (INSERT/UPDATE/DELETE)

Session 4:

Lecture

MySQL Data Types, Database Constraints (Primary Key, Unique, Not Null, Foreign Key, Default, Check*)
Aggregate Functions, Grouping Things Together (Group By, Having)
LIKE Operator, DISTINCT, Sorting (Order by clause)
BETWEEN… AND Operators, Comparing Nulls (IS NULL/IS Not NULL), IN/NOT IN

Session 5:

Lecture

Relational Algebra Operations (Selection, Projection, Union, Intersect*, Minus*, Cross/Cartesian)
Joins (Eqvi, Inner, Outer, Natural, Cross), SQL Standard Syntax for Joins
Copying table structure/data, Sequences (AUTO_INCREMENT)

Session 6:

Lecture

Subquery, Correlated Subquery, EXISTS/NOT EXISTS
TCL Commands (Commit/Rollback/Savepoint), DCL Commands (GRANT/REVOKE/GRANT OPTION) Views, Types of Views, Simple and Complex Views

Session 7:

Indexes, Benefit of Indexes, Type of Indexes, Temporary Tables
ACID Properties, Concept of Database Instance and Schema
MySQL Storage Engines (InnoDB, MyISAM and others),

Session 8:

Lecture

Introduction to MySQL Programming, Use of MySQL Programs, Introduction to Stored Procedures, Benefits of Stored Procedures Procedure Parameters (IN, OUT and INOUT).

Session 9:

Lecture

Flow Control Statements (LOOP, WHILE and REPEAT)
Using above statements in Stored Procedures/Functions
Conditional Statements (IF, IF-ELSE-THEN, SWITCH CASE)
Example of each type of statement

Session 10:

Lecture
Loop constructs (ITERATE, LEAVE)
Functions with and without parameters
MySQL Built-in functions (string, numeric, date etc.)

Session 11:
Lecture
Cursors (Asensitive, Insensitive, Read only, Nonscrollable)
Cursors example and real time use

Session 12:
Triggers (BEFORE, AFTER), New and Old trigger variables
Trigger Examples and real time use

Session 13:
Lecture
Error Handling and Exceptions, Types of Handler Actions, How to write Handler
Defining and handling exceptions in Stored Procedures and Functions

Session 14:
Lecture
Introduction to NoSQL database, Features of NoSQL Database
Structured vs. Semi-structured and Unstructured Data
Difference between RDBMS and NoSQL databases
CAP Theorem, BASE Model
Categories of NoSQL Databases: Key-Value Store, Document Store, Column-Oriented, Graph
Introduction to MongoDB, Features of MongoDB
MongoDB command interface and MongoDB compass

Session 15 & 16:
Lecture
MongoDB Documents & Collections
RDBMS & MongoDB analogies: relations/tables => collections; tuples/records => documents
JSON and BSON documents
Performing CRUD (CREATE, READ, UPDATE, DELETE) Operations, UPSERT
MongoDB – Operators, Sorting, Indexing