FF No. : 654

CS2227 ::Database Management Systems

Course Prerequisites: Data structures, Discrete Mathematics

Course Objectives:

1. To introduce the fundamentals of different data modeling techniques.

2. To design and development of relational database management systems.

3. To Study the theory behind database systems, the issues that affect their functionality and performance

4. To design of query languages and the use of semantics for query optimization.

5. To understand the latest trends of data management systems.

Credits: 4   **Teaching Scheme Theory: 3** Hours/Week

Tut: NA

Lab: **2** Hours/Week

Course Relevance: The course emphasizes on the fundamentals of database modeling and design, the languages and models provided by the database management systems, and database system implementation techniques. The goal is to provide an in-depth and up-to-date presentation of the most important aspects of database systems and applications, and related technologies.

SECTION-I

Topics and Contents

Introduction: Need of Database Management Systems, Evolution, Database System Concepts and Architecture, Database Design Process
Data Modeling: Entity Relationship (ER) Model, Extended ER Model, Relational Model, Codd's Rules;
Database Design: Need of Normalization, Functional Dependencies, Inference Rules, Functional Dependency Closure, Minimal Cover, Decomposition Properties, Normal Forms: 1NF, 2NF, 3NF and BCNF, Multi-valued Dependency, 4NF, Relational Synthesis Algorithms
Query Languages: Relational Algebra, SQL: DDL, DML, Select Queries, Set, String, Date and Numerical Functions, Aggregate Functions ,Group by and Having Clause, Join Queries, Nested queries, DCL, TCL, PL/SQL: Procedure, Function, Trigger, Mapping of Relational Algebra to SQL

SECTION-II

Topics and Contents

Storage and Querying: Storage and File structures, Indexed Files, Single Level and Multi Level Indexes; Query Processing, Query Optimization
Transaction Management: Basic concept of a Transaction, ACID Properties, State diagram, Concept of Schedule, Serializability – Conflict and View, Concurrency Control Protocols, Recovery techniques
Parallel and Distributed Databases: Architecture, I/O Parallelism, Interquery, Intraquery, Intraoperation and Interoperation Parallelism, Types of **Distributed** Database Systems, Distributed Data Storage, Distributed Query Processing
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Databases, Types of NOSQL Databases, BASE properties, CAP theorem, Big Data, HADOOP: HDFS, MapReduce.
Data Warehousing: Architecture and Components of Data Warehouse, Warehouse Schemas, OLAP

List of Practicals: (Any Six)
1) Create a database with appropriate constraints using DDL and populate/modify it with the help of DML.
2) Design and Execute "SELECT" queries using conditional, logical, like/not like, in/not in, between...and, is null/is not null operators in where clause, order by, group by, aggregate functions, having clause, and set operators. Use SQL single row functions for date, time, string etc.
3) Write equijoin, non equijoin, self join and outer join queries. Write queries containing single row / multiple row / correlated sub queries using operators like =, in, any, all, exists etc. Write DML queries containing sub queries. Study a set of query processing strategies.
4) Write PL/SQL blocks to implement all types of cursor.
5) Write useful stored procedures and functions in PL/SQL to perform complex computation.
6) Write and execute all types of database triggers in PL/SQL.
7)Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.
8) Create a database with suitable example using MongoDB and implement Inserting and saving document, Removing document, Updating document
9) Execute at least 10 queries on any suitable MongoDB database that demonstrates following querying techniques:find and findOne, Query criteria, Type-specific queries

10) Implement Map Reduce operation with suitable example using MongoDB.

List of Tutorial (Any 6)
1) Draw ER Diagram for any information system application
2) Draw Extended ER Diagram for any information system application
3) Convert ER Diagram to Relational Model
4) Convert EER Diagram to Relational Model
5) Solving the Queries using Relational Algebra
6) Normalization using Minimal Cover,
7) Normalization using Synthesis Algorithm
8) Creation of Data warehouse for any organisation.
9) OLAP & OLTP
10) Advanced SQL

List of Projects:
Designing and Implementing a Small-scale Relational DBMS
Phase 1: SQL interpreter
Phase 2: Persistent data management
Phase 3: Relational Operations

List of Course Seminar Topics:
1. Object and Object-Relational Databases
2. XML data model, XML documents and associated languages
3. Database Security
4. Modern Storage Architectures
5. Google Cloud- SQL Databases
6. Google Cloud- NOSQL Databases
7. Amazon Databases
8. Oracle NoSQL Database
9. Cassandra DB
10. Data Center Engineering

List of Course Group Discussion Topics:
1. RDBMS Vs NOSQL
2. ER model Vs UML diagrams
3. Normalized vs unnormalized database
4. OLTP Vs OLAP
5. Data Warehouse Vs Data Lake
6. RDBMS and OODBMS
7. Neo4J and GraphBase
8. DynamoDB Vs Voldemort
9. Google File System (GFS) Vs HDFS (Hadoop Distributed File System)
10. Hive SQL Vs Pig Latin

List of Home Assignments:
Design:
1. Suppose you want to build a video site similar to YouTube. Identify disadvantages of keeping data in a file-processing system. Discuss the relevance of each of these points to the storage of actual video data, and to metadata about the video, such as title, the user who uploaded it, tags, and which users viewed it.
2. Illustrate data model that might be used to store information in a social-networking system such as Facebook
3. Describe the circumstances in which you would choose to use embedded SQL rather than SQL alone or only a general-purpose programming language.
4. Give the DTD and XML Schema for Library Management System. Give a small example of data corresponding to this DTD and XML. Write ten queries in Xpath and XQuery
5. If you were designing a Web-based system to make airline reservations and sell airline tickets, which DBMS architecture would you choose? Why? Why would the other architectures not be a good choice? Design a schema and show a sample database for that application. What types of additional information and constraints would you like to represent in the schema? Think of several users of your database, and design a view for each.

Case Study:
1. PostgreSQL
2. Oracle
3. IBM DB2 Universal Database
4. Microsoft SQL Server
5. SQLite database

Blog
1. OLAP tools from Microsoft Corp. and SAP
2. Views in database
3. Dynamic SQL and Embedded SQL
4. Active databases and Triggers

5. SQL injection attack

Surveys

1. Keyword queries used in Web search are quite different from database queries. List key differences between the two, in terms of the way the queries are specified, and in terms of what is the result of a query.

2. List responsibilities of a database-management system. For each responsibility,explain the problems that would arise if the responsibility were not discharged

3. List reasons why database systems support data manipulation using a declarative query language such as SQL, instead of just providing a a library of C or C++ functions to carry out data manipulation

4. Consider a bank that has a collection of sites, each running a database system. Suppose the only way the databases interact is by electronic transfer of money between themselves, using persistent messaging.Would such a system qualify as a distributed database? Why?

5. Data warehousing products coupled with database systems

Suggest an assessment Scheme:
MSE:10 ESE:10 HA:10 CP:10 Lab:10 Seminar:15 GD: 15 CVV:20

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan; "Database System Concepts"; 6th Edition, McGraw-Hill Education

2. Ramez Elmasri, Shamkant B. Navathe; "Fundamentals of Database Systems"; 7th Edition, Pearson

Reference Books:

1. Thomas M. Connolly, Carolyn E. Begg," Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition ;Pearson

2. Raghu Ramakrishnan, Johannes Gehrke; "Database Management Systems", 3rd Edition; McGraw Hill Education

3. Kristina Chodorow, MongoDB The definitive guide, O'Reilly Publications, ISBN: 978-93-5110-269-4, 2nd Edition.

4. Dr. P. S. Deshpande, SQL and PL/SQL for Oracle 10g Black Book, DreamTech.

5. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication. 6. Reese G., Yarger R., King T., Williums H, Managing and Using MySQL, Shroff Publishers and Distributors Pvt. Ltd., ISBN: 81 - 7366 - 465 – X, 2nd Edition.

7. Dalton Patrik, SQL Server – Black Book, DreamTech Press.

8. Eric Redmond, Jim Wilson, Seven databases in seven weeks, SPD, ISBN: 978-93-5023-918-6.

9. Jay Kreibich, Using SQLite, SPD, ISBN: 978-93-5110-934-1, 1st edition.

Moocs Links and additional reading material:
https://nptel.ac.in/courses/106/105/106105175/
https://onlinecourses.nptel.ac.in/noc21_cs04/preview
https://www.datacamp.com/courses/introduction-to-sql
Oracle MOOC: PL/SQL Fundamentals - Oracle APEX

Course Outcomes:
1)Design and draw ER and EER diagrams for real life applications.
2)Transform conceptual schema of high level data model into implementation data model
3)Apply the concepts of normalization to develop the quality relational data model
4)Formulate queries in relational algebra, SQL and write PL/SQL blocks.
5)Acquaint with physical database file structures
6)Identify the use of database techniques such as NOSQL

CO PO Map
CO1: PO2 CO2:PO3 CO3:PO5 CO4:PO9 CO5:PO10 CO6:PSO15

CO attainment levels
CO1:1 CO2:4 CO3:2 CO4:4 CO5:3 Co6:5

Future Courses Mapping:
Advanced databases
Big Data Management
Cloud Databases
Database Administrator

Job Mapping:
Database Engineer
SQL developer
PL/SQL developer