DSC10/DSC03/GE7a: DESIGN AND ANALYSIS OF ALGORITHMS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Design and Analysis of Algorithms	**4**	**3**	**0**	**1**	**Pass in Class XII**	Data Structures

Course Objectives

The course is designed to develop understanding of different algorithm design techniques and use them for problem solving. The course shall also enable the students to verify correctness of algorithms and analyze their time complexity.

Learning Outcomes

On successful completion of the course, students will be able to:

- Compute and compare the asymptotic time complexity of algorithms.
- Use appropriate algorithm design technique(s) for solving a given problem.

Syllabus

Unit 1 **(8 hours)**

Searching, Sorting, Selection: Linear Search, Binary Search, Insertion Sort, Selection Sort, Bubble Sort, Heapsort, Linear Time Sorting, running time analysis and correctness.

Unit 2 **(5 hours)**

Graphs: Review of graph traversals, graph connectivity, testing bipartiteness, Directed Acyclic Graphs and Topological Ordering, Minimum Spanning Trees.

Unit 3 **(8 hours)**

Divide and Conquer: Introduction to divide and conquer technique, Merge Sort, Quick Sort, Randomised quicksort, Maximum-subarray problem, Strassen's algorithm for matrix multiplication.

Unit 4 **(5 hours)**

Greedy algorithms: Introduction to the Greedy algorithm design approach, application to minimum spanning trees, fractional knapsack problem, and analysis of time complexity.

Unit 5 **(5 hours)**

Dynamic Programming: Introduction to the Dynamic Programming approach, application to subset sum, integer knapsack problems, and analysis of time complexity.

Unit 6 **(4 hours)**

Hash Tables Hash Functions, Collision resolution schemes.

Essential/recommended readings

1. Cormen, T.H., Leiserson, C.E., Rivest, R. L., Stein C. Introduction to Algorithms, 4th edition, Prentice Hall of India, 2022.

2. Kleinberg, J., Tardos, E. Algorithm Design, 1st edition, Pearson, 2013.

Additional references

1. Basse, S., Gelder, A. V., Computer Algorithms: Introduction to Design and Analysis, 3rd edition, Pearson, 1999.

Practical List (If any): (30 Hours)

1. Write a program to sort the elements of an array using Insertion Sort (The program should report the number of comparisons).
2. Write a program to sort the elements of an array using Merge Sort (The program should report the number of comparisons).
3. Write a program to sort the elements of an array using Heap Sort (The program should report the number of comparisons).
4. Write a program to multiply two matrices using the Strassen's algorithm for matrix multiplication
5. Write a program to sort the elements of an array using Radix Sort.
6. Write a program to sort the elements of an array using Bucket Sort.

7. Display the data stored in a given graph using the Breadth-First Search algorithm.
8. Display the data stored in a given graph using the Depth-First Search algorithm.
9. Write a program to determine a minimum spanning tree of a graph using the Prim's algorithm.
10. Write a program to implement Dijkstra's algorithm to find the shortest paths from a given source node to all other nodes in a graph.
11. Write a program to solve the weighted interval scheduling problem.
12. Write a program to solve the 0-1 knapsack problem.

For the algorithms at S.No 1, 2 and 3 , test run the algorithm on 100 different input sizes varying from 30 to 1000. For each size find the number of comparisons averaged on 10 different input instances; plot a graph for the average number of comparisons against each input size. Compare it with a graph of nlogn.

DSC-A3/DSE: DATA MINING-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Data Mining - I	4	3	0	1	Passed 12th class with Mathematics	Programming using Python

Course Objectives

This course aims to introduce data mining techniques and their application on real-life datasets. The students will learn to pre-process the dataset and make it ready for application of data mining techniques. The course will focus on three main techniques of data mining i.e. Classification, Clustering and Association Rule Mining. Different algorithms for these techniques

c. Compare density distribution for features age and passenger fare
d. Use a pair plot to show pairwise bivariate distribution

4. Using Titanic dataset, do the following

   a. Find total number of passengers with age less than 30
   b. Find total fare paid by passengers of first class
   c. Compare number of survivors of each passenger class

5. Download any dataset and do the following

   a. Count number of categorical and numeric features
   b. Remove one correlated attribute (if any)

   c. Display five-number summary of each attribute and show it visually

Project: Students are encouraged to work on a good dataset in consultation with their faculty and apply the concepts learned in the course.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DSC11/DSC05/GE3a: DATABASE MANAGEMENT SYSTEMS

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Database Management Systems	**4**	**3**	**0**	**1**	Pass in Class XII	NIL

Course Objectives

The course introduces the students to the fundamentals of database management system and its architecture. Emphasis is given on the popular relational database system including data

models and data manipulation. Students will learn about the importance of database structure and its designing using conceptual approach using Entity Relationship Model and formal approach using Normalization. The importance of file indexing and controlled execution of transactions will be taught. The course would give students hands-on practice of structured query language in a relational database management system and glimpse of basic database administration commands.

Learning outcomes

On successful completion of the course, students will be able to:

● Use database management system software to create and manipulate the database.

● Create conceptual data models using entity relationship diagrams for modeling real-life situations and designing the database schema.

● Use the concept of functional dependencies to remove redundancy and update anomalies.

● Apply normalization theory to get a normalized database scheme.

● Write queries using relational algebra, a procedural language.

Syllabus

Unit 1 **(5 hours)**

Introduction to Database: Purpose of database system, Characteristics of database approach, data models, database management system, database system architecture, three-schema architecture, components of DBMS, data independence, and file system approach vs database system approach.

Unit 2 **(7 hours)**

Entity Relationship Modeling: Conceptual data modeling - motivation, entities, entity types, attributes, relationships, relationship types, constraints on relationship, Entity Relationship diagram notation.

Unit 3 **(7 hours)**

Relational Data Model: Update anomalies, Relational Data Model - Concept of relations, schema-instance distinction, keys, relational integrity constraints, referential integrity and foreign keys, relational algebra operators and queries.

Unit 4 **(12 hours)**

Structured Query Language (SQL): Querying in SQL, DDL to create database and tables, table constraints, update database-update behaviors, DML, aggregation functions group by and having clauses, retrieve data from the database, generate and query views. Access and manipulate databases using ODBC. Basic Database administration SQL commands.

Unit 5 **(10 hours)**

Database Design: Mapping an Entity Relationship model to relational database, functional dependencies and Normal forms, 1NF, 2NF, 3NF and BCNF decompositions and desirable properties of them.

Unit 6 **(4 hours)**

Data Storage and Indexes: Need of file indexes, file organizations, index structures, single- and multi-level indexing, concurrent execution of transactions, ACID properties,.

Essential/recommended readings

1. Elmasri, R., Navathe, B. S. Fundamentals of Database Systems, 7th Edition, Pearson Education, 2015.

2. Krogh, J. W. MySQL Connector/Python Revealed: SQL and NoSQL Data Storage Using MySQL for Python Programmers, Apress, 2018.

3. Murach J. Murach's MySQL, 3rd edition, Pearson, 2019.

Additional References

1. Ramakrishnan, R., Gehrke J. Database Management Systems, 3rd Edition, McGraw Hill, 2014.

2. Silberschatz, A., Korth, H. F., Sudarshan S. Database System Concepts, 7th Edition, McGraw Hill, 2019.

3. Connolly, T. M., Begg, C. E. Database Systems: A Practical Approach to Design, Implementation, and Management, 6th edition, Pearson, 2019.

Practicals (30 hours)

Create and use the following student-course database schema for a college to answer the given queries using the standalone SQL editor.

Here, Rollno (ADMISSION) and SID (ADMISSION) are foreign keys. Note that course type may have two values viz. Fulltime and Parttime and a student may enroll in any number of courses

1. Retrieve names of students enrolled in any course.
2. Retrieve names of students enrolled in at least one part time course.
3. Retrieve students' names starting with letter 'A'.
4. Retrieve students' details studying in courses 'computer science' or 'chemistry'.
5. Retrieve students' names whose roll no either starts with 'X' or 'Z' and ends with '9'
6. Find course details with more than N students enrolled where N is to be input by the user.
7. Update student table for modifying a student name.
8. Find course names in which more than five students have enrolled
9. Find the name of youngest student enrolled in course 'BSc(P)CS'
10. Find the name of most popular society (on the basis of enrolled students)
11. Find the name of two popular part time courses (on the basis of enrolled students)
12. Find the student names who are admitted to full time courses only.
13. Find course names in which more than 30 students took admission
14. Find names of all students who took admission to any course and course names in which at least one student has enrolled
15. Find course names such that its teacher-in-charge has a name with 'Gupta' in it and the course is full time.
16. Find the course names in which the number of enrolled students is only 10% of its total seats.
17. Display the vacant seats for each course
18. Increment Total Seats of each course by 10%
19. Add enrollment fees paid ('yes'/'No') field in the enrollment table.
20. Update the date of admission for all the courses by 1 year.
21. Create a view to keep track of course names with the total number of students enrolled in it.
22. Count the number of courses with more than 5 students enrolled for each type of course.
23. Add column Mobile number in student table with default value '9999999999'
24. Find the total number of students whose age is > 18 years.
25. Find names of students who are born in 2001 and are admitted to at least one part time course.

Create and use the following student-society database schema for a college to answer the given (sample) queries using the standalone SQL editor.

II. Do the following database administration commands:

Create user, create role, grant privileges to a role, revoke privileges from a role, create index

DSC12/DSC06/GE6a: COMPUTER NETWORKS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Computer Networks	**4**	**3**	**0**	**1**	Pass in Class XII	NIL

Course Objectives

The course objectives of this paper are to:

• Understand the concepts behind computer networks and data communication.

• Learn the different types of networks, network topologies and their characteristics.

• Learn the working of protocols used at various layers.

• Understand the utility of different networking devices.

Learning Outcomes

Upon successful completion of the course, students will be able to:

• differentiate between various types of computer networks and their topologies.

• understand the difference between the OSI and TCP/IP protocol suit.

• distinguish between different types of network devices and their functions.

• design/implement data link and network layer protocols in a simulated networking environment.

Syllabus

Unit 1 **(8 hours)**

Introduction:

Types of computer networks, Internet, Intranet, network topologies (bus, star, ring, mesh, tree, hybrid topologies), network classifications. layered architecture approach, OSI Reference Model, TCP/IP Reference Model. Transmission Modes: simplex, half duplex and full duplex, network devices and their role.

Unit 2 **(9 hours)**

Physical Layer:

Analog signal, digital signal, the maximum data rate of a channel, transmission media (guided transmission media, wireless transmission, satellite communication), multiplexing (frequency division multiplexing, time-division multiplexing, wavelength division multiplexing). Guided Media (Wired) (Twisted pair, Coaxial Cable, Fiber Optics. Unguided Media (Radio Waves, Infrared, Micro-wave, Satellite).

Unit 3 **(10 hours)**

Data Link and MAC Layer:

Data link layer services, error detection and correction techniques, error recovery protocols (stop and wait, go back n, selective repeat), multiple access protocols with collision detection, MAC addressing, Ethernet..

Unit 4 **(8 hours)**

Network layer:

Networks and Internetworks, virtual circuits and datagrams, addressing, subnetting, Dijkstra Routing algorithm, Distance vector routing, Overview of Network Layer protocols- (ARP, IPV4, ICMP, RARP, IPV6)

Unit 5 **(10 hours)**

Transport and Application Layer:

Process to process Delivery- (client-server paradigm, connectionless versus connection-oriented service); User Datagram Protocols, TCP/IP protocol, Flow Control. FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), Telnet (Remote login protocol), WWW (World Wide Web), HTTP (HyperText Transfer Protocol), URL (Uniform Resource Locator), DNS, DHCP, BOOTP.

Essential/recommended readings

1. Tanenbaum, A.S. & Wethrall, D.J.. Computer Networks, 5th edition, Pearson Education, 2012.

2. Forouzan, B. A.. Data Communication and Networking, 4th edition, McGraw-Hill Education, 2017.

Additional References

1. Comer, D. E.. Computer Networks and Internet, 6th edition, Pearson education, 2015.

2. Stallings, W., Data and Computer Communications, 10th edition, Pearson education India, 2017.

Practicals.

Introduce students to any network simulator tool and do the following:

1. To Study basic network command and Network configuration commands.

2. To study and perform PC to PC communication.

3. To create Star topology using Hub and Switch.

4. To create Bus, Ring, Tree, Hybrid, Mesh topologies.

5. Perform an initial Switch configuration.

6. Perform an initial Router configuration.

7. To implement Client Server Network.

8. To implement connection between devices using a router.

9. To perform remote desktop sharing within LAN connection.