NATIONAL INSTITUTE OF TECHNOLOGY
JAMSHEDPUR, JHARKHAND – 831014
Department of Computer Applications
THIRD SEMESTER 2021-2022
Course Handout

Dated: 16-08-2021

Course Code : CA3303

Course Title : Design and Analysis of Algorithms

Course Structure : 3-1-0

Course Instructor : Dr. D. K. Shaw

Course Description:

This course is designed to teach you, at the graduate level, algorithm design and analysis paradigms, advanced data structures and their use in efficient algorithms, graph algorithms, the theory of NP-completeness, and some specialized topics (to be determined based on student input).

OBJECTIVE

- To introduce basic concepts of algorithms
- To introduce mathematical aspects and analysis of algorithms
- To introduce sorting and searching algorithms
- To introduce various algorithmic techniques
- To introduce algorithm design methods

Module-1 Introduction 8 hours

Introduction:
What is an Algorithm? (T2:1.1), Algorithm specification (T2:1.2), Analysis framework (T1:2.1), Performance analysis: Space complexity, Time complexity (T2:1.3).
Asymptotic Notations:
Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), and Little-oh notation (o), Mathematical analysis of iterative and recursive algorithms with examples (T1:2.2, 2.3, 2.4). Important Problem Types: Sorting, Searching, String processing, Graph Problems, Combinatorial Problems.

Module-2 Divide and Conquer 8 hours

Divide and Conquer:
General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum (T2:3.1, 3.3, 3.4), Merge sort, Quick sort (T1:4.1, 4.2), Strassen's matrix multiplication (T2:3.8), Advantages and Disadvantages of divide and conquer.
Decrease and Conquer Approach:
Topological Sort. (T1:5.3).

Module-3 Greedy Method 8 hours

Greedy Method:
General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines (T2:4.1, 4.3, 4.5).
Minimum cost spanning trees:
Prim's Algorithm, Kruskal's Algorithm (T1:9.1, 9.2).
Single source shortest paths:
Dijkstra's Algorithm (T1:9.3).
Optimal Tree problem:
Huffman Trees and Codes (T1:9.4).
Transform and Conquer Approach:
Heaps and Heap Sort (T1:6.4).

Module-4 Dynamic Programming 8 hours

Dynamic Programming:
General method with Examples, Multistage Graphs (T2:5.1, 5.2).
Transitive Closure:
Warshall's Algorithm.
All Pairs Shortest Paths:
Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem ((T1:8.2, 8.3, 8.4), Bellman-Ford Algorithm (T2:5.4), Travelling Salesperson problem (T2:5.9).

Module-5 Backtracking 8 hours

Backtracking:
General method (T2:7.1), N-Queens problem (T1:12.1), Sum of subsets problem (T1:12.1), Graph coloring (T2:7.4), Hamiltonian cycles (T2:7.5).
Branch and Bound:
Assignment Problem, Travelling Salesperson problem (T1:12.2), 0/1 Knapsack problem (T2:8.2, T1:12.2):
NP-Complete and NP-Hard problems:
Basic concepts, non-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes (T2:11.1).

TEXTBOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2. Ellis Horowitz, Satraj Sahni and Rajasekaran, "Computer Algorithms in C++", 2nd Edition, 2014, Universities Press

REFERENCE BOOKS:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", MIT Press, Cambridge, MA, USA, 2001.
2. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press", 2015
3. S.K. Basu, "Design Methods and Analysis of Algorithms", Prentice Hall of India Pvt. Ltd., 2013.
4. V.K. Pallaw, "Design and Analysis of Algorithms", Asian Book Pvt. Ltd., 2012.

Course Instructor
CA3303