10B11CI411: Fundamentals of Algorithms

Course Credit: 4
Semester: IV

Introduction

In this course you will learn several fundamental principles of algorithm design: divide-and-conquer methods, graph algorithms, practical data structures (heaps, hash tables, search trees), randomized algorithms, and more.Particular emphasis is given to algorithms for sorting, searching, and string processing. Fundamental algorithms in a number of other areas are covered as well, including geometric and graph algorithms. The course will concentrate on developing implementations, understanding their performance characteristics, and estimating their potential effectiveness in applications.

Course Objectives (Post-conditions)
Knowledge objectives:

- Strengthen higher level cognitive skills of analysis, creation and evaluation.
- Strengthen ability of data abstraction and problem solving using computers.
- Strengthen ability to express solutions to problems clearly and precisely.
- Strengthen ability to design and evaluate ADTs, non-linear temporary and persistent data structures and also related algorithms.
- Introduce students to some domain specific data structures and related algorithms in various domains

Application objectives:

1. Application to Job scheduling in OS
2. Application to Routing in network
3. Application to Range assignment, TSP
4. Application to Online games Chess, Sudoku, CCS etc.

Expected Student Background (Preconditions)

Data Structures
Topics Outline:

S NO	Topics	Hrs
1	**Introduction:** Algorithmic thinking, Models of computation, Integer arithmetic, Square roots, Newton's method, Euclid's method	6
2	**Evaluation of algorithm:** Computational complexity, order notations, recurrences, Master′s theorem	6
3	**Sorting:** Insertion sort, merge sort, Heaps and heap sort, Quick sort, Linear sort, priority queue, order	6

	statistics, lower bounds for sorting	
4	**Searching:** Balanced tree, red-black tree, Skip list, Hashing, universal and perfect hashing, lower bounds for searching	5
5	**Graph:** representation and algorithms, Breadth-first search (BFS), Depth-first search (DFS), topological sorting, Shortest Paths, Single-source shortest paths problem, Dijkstra, Bellman-Ford,Spanning Trees	6
6	**Pattern matching & text search:** brute force, Rabin Krap, Automata based method, trie, compact trie, patricia, suffix tree.	4
7	**Dynamic Programming:** Concept, Longest common subsequence, shortest paths, Chain matrix multiplication, Coin denomination, edit distance, knapsack, TSP, etc..	6
8	**P –NP:** classes of P and NP, NP-hard, NP-complete, reduction, Back tracking and 3-SAT, Branch and bound and TSP.	3
	Total	42

References

1. Aho, Hopcraft, Ullman : Data Structures and Algorithms
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein: Introduction to Algorithms,
3. S. Dasgupta, C. Papadimitrou, U. Vazirani: Algorithms

Evaluation Scheme:

S.No	Examination	Marks
1	T-1	15
2	T-2	25
3	T-3	35
4	*Internal Marks	25

*Internal Marks Breakdown:

Assignments 9 marks (3x3)

Quizzes 12 marks (3x4)

Regularity 4 Marks