CS106: Design and Analysis of Algorithms

Credits: 4 (3-1-0)

Course Objective:

To understand the importance of algorithm and its complexity

To analyze the complexity of an algorithm in terms of time and space complexities

To design and implement various programming paradigms and its complexity

Course Outcome:

Ability to analyze the time and space complexity, given an algorithm

Apply the techniques of algorithm in solving real world problems

Systematic development of an algorithm for solving a problem

Syllabus

Module - 1

Introduction

Role of Algorithm in computing

Growth of Functions (Asymptotic notations, standard notations and common functions)

Best Case, Worst Case, Average Case

Recurrences, solution of recurrences by substitution

recursion tree and Master methods

Design & Analysis of Divide and conquer algorithms, Quick sort, Heapsort : Heaps, Building a heap, The heapsort algorithm, Priority Queue, Binary search, Lower bounds for sorting.

Module - 2

Dynamic programming algorithms (Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence)

Greedy Algorithms - (Activity- selection Problem, Elements of Greedy strategy, Fractional knapsac problem, Huffman codes).

Data structure for disjoint sets:- Disjoint set operations, Linked list representation, Disjoint set forests.

Module - 3

Graph Algorithms: Graph and their Representations, Breadth first and depth-first search, Minimum Spanning Trees, Kruskal and Prim's algorithms, single- source shortest paths (Bellman-ford and Dijkstra's algorithms), All-pairs shortest paths (Floyd – Warshall Algorithm) ,Back tracking, Branch and Bound.

Fast Fourier Transform, string matching (Rabin-Karp algorithm)

NP – Completeness(Polynomial time, Polynomial time verification, NP - Completeness and reducibility, NP-Complete problems (without Proofs), Approximation algorithms (Vertex-Cover Problem, Traveling Salesman Problem).

Text Books:

- Introduction to Algorithms, third edition, The MIT Press, (2009). Cormen, T H, C E Leiserson, R L Rivest, and C Stein.

Reference Books:

- Algorithms , Cengage Learning,(2008), Jerome L Paul, Kenneth A Berman.
- Computer Algorithms: Introduction to Design & Analysis, third edition, Pearson Education, (2009),Sara Baase, Allen Van Gelder.
- Fundamentals of Algorithm, 2ndEdition,Universities Press, (2008),Horowitz & Sahani.
- Algorithm Design : Foundations, Analysis And Internet Examples ,first edition, Wiley India,(2010), Goodrich, Tamassia.

Evaluation:

1. Quizzes: 15%
2. Mid Term: 30%
3. End Term Exam: 50%
4. Teacher's Assessment: 5%

CS404: Design and Analysis of Algorithms Lab

Credits: 2 (0-0-3)

Course Objective:

The objective of this lab is to design the solution of a problem in an optimal way so that the time complexity and memory usage of the solution must be minimized.

Course Outcome:

Systematic development of a solution to solve a problem.

Analyze the space requirement during implementation of the solution.

The overall time complexity of the solution.

Syllabus

Write here the specific instruction(s) required to carry out the lab experiments

Lab-1 Introduction

Lab-2 Recursion

Lab-3 Divide and Conquer approach

Lab-4 Divde and Conquer (Cont..)

Lab-5 Dynamic Programming

Lab-6 Greedy Approach

Lab-7 Disjoint Set data structure

Lab-8 Graph algorithms

Lab-9 Graph Algorithms (cont..)

Lab-10 Backtracking