Dr. Nitin Gupta - 5/12/2022 (118)

National Institute of Technology, Hamirpur
Department of Computer Science and Engineering
B.Tech. DD (Section B) 5th Sem (End-term Examination)
CS - 311 Analysis and Design of Algorithms

Time: 3 hrs **Max. Marks 50**

Instructor: Nitin Gupta

For all problems, expand every function that your are calling. Further, if you include any new algorithm in your solution, please also include a brief English description of what the algorithm does.

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1. (10 Marks) Write a recursive algorithm for 'Binary Search'. Identify the recurrence relation and solve with the help of Master's theorem to find the time complexity of your algorithm. Moreover, draw the recursion tree for an array of your choice having ten elements for the worst case.

2. (10 marks) Write Bellman-Ford algorithm to find single source shortest path in a graph. Can we have a graph in which a negative weighted cycle is not reachable from source 'S'? **If no**, then why it is not possible and is that mean, Bellman–Ford algorithm will always detect negative weight cycle, if one exists. Otherwise, **if yes**, then can Bellman-Ford algorithm detect that unreachable cycle from 'S' and what final value will be returned by the algorithm? Elaborate by considering an example.

3. (10 Marks) A newspaper agent having headquarter at "A" daily drops the newspaper to the area assigned in such a way that he has to cover all the houses in the respective area with minimum travel cost and come back to "A". Compute the minimum travel cost and the path he should proceed in order to get the minimum cost. The distance between two areas is same in each opposite directions, forming an undirected graph. Distance between areas (in Mtr.):
   A to B: 70; A to C: 30; A to D: 75; B to C: 80; B to D: 20; and C to D: 90.

4. (10 Marks) Consider the problem of Task scheduling with deadline.

Task	T1	T2	T3	T4	T5	T6	T7	T8	T9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

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Find out the feasible subset of tasks which can be finished in a given deadline and can gain maximum profit, with **both methods** discussed in one of the classes. Compare both methods in terms of their complexity, limitations and advantages etc.

5. (10 Marks) Recall *reduction* learnt in one of the classes, let you have an efficient algorithm for *Depth First Search* (DFS). Design an efficient algorithm using DFS to find the shortest Path from "a" to every other node in Fig. 1. Further, also consider that the graph is implemented using an *Adjacency list* which stores nodes in the alphabetic order. Show the whole procedure in detail.

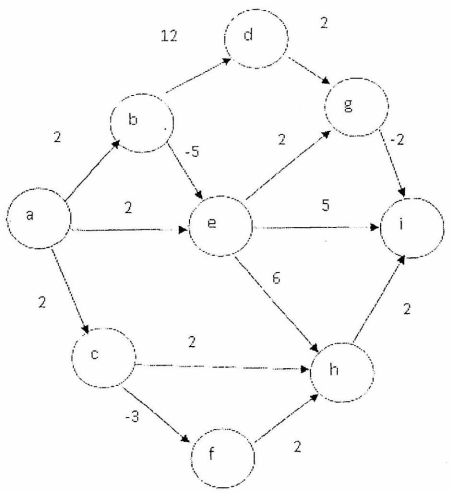

Figure 1: Graph to Find Shortest Path

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