National Institute of Technology Mizoram

Mid - Semester Examination, Even Semester - 2023

Design and Analysis of Algorithms (CSE 1402)

4th Semester (CSE) Full Marks: 30 marks Duration: 1 hour 30 mins

Answer all 3 (Three) Questions, All Questions carry same Marks
(3 * 10 = 30 Marks)

QUESTION 1

(a) Given a set of n points on the 2D plane. Derive an efficient algorithm to find the pair of points whose distance is minimum. [6]

(b) Compute the asymptotic time complexity of the algorithm proposed above. [4]

QUESTION 2

(a) Given two lists of numbers, check whether the two lists are identical or not. If A and B are the two lists, then for them to be identical: (i) A and B must have the same number of elements, and (ii) All the elements in A must be in B and vice versa. [5]

(b) Give an algorithm to find all the connected components in an undirected graph. [5]

QUESTION 3

(a) Differentiate between Breadth First Search and Depth First Search. [3]

(b) Prove that $o(g(n)) \cap \omega(g(n))$ is the empty set. [3]

(c) For each of the following recurrences, give an expression for the runtime T (n) if the recurrence can be solved with the Master Theorem. Otherwise, indicate that the Master Theorem does not apply. [2+2]

(i) $T(n) = 4T(n/2) + n^2$

(ii) $T(n) = T(n/2) + 2^n$

——— BEST OF LUCK ———

National Institute of Technology Mizoram
End – Semester Examination, Even– 2022-23
Design and Analysis of Algorithms (CSL 1402)

B.Tech 4th Sem CSE **Full Marks: 50 marks** **Duration: 2:30 hours**

Answer All Questions
(5x10 = 50 Marks)

1. There are n cities and there are roads in between some of the cities. Somehow all the roads are damaged simultaneously. We have to repair the roads to connect the cities again. There is a fixed cost to repair a particular road. Derive an efficient algorithm to find out the minimum cost to connect all the cities by repairing roads. Input is in matrix(city) form, if city[i][j] = 0 then there is not any road between city i and city j, if city[i][j] = a > 0 then the cost to rebuild the path between city i and city j is a. [10]

2. Given weights and values of n items, put these items in a bag of capacity W to get the maximum total value in the bag. In other words, given two integer arrays val[0..n-1] and wt[0..n-1] which represent values and weights associated with n items respectively. Also given an integer W which represents the bag capacity, derive an algorithm to find out the maximum value subset of val[] such that sum of the weights of this subset is smaller than or equal to W. You cannot break an item, either pick the complete item, or don't pick it. Also, compute the complexity of the algorithm. [7 + 3]

3. (a) What is the difference between a greedy algorithm and a dynamic programming algorithm? [3]
(b) Describe how you can determine if two algorithms are equivalent. [2]
(c) How do you analyze the space complexity of an algorithm? [2]
(d) Differentiate between NP and NP-hard problems. [3]

4. Give an efficient algorithm to find the contiguous subarray within a given array of integers that has the largest sum. [10]
Example 1:
Input: nums = [-2,1,-3,4,-1,2,1,-5,4]
Output: 6
Explanation: The subarray [4,-1,2,1] has the largest sum 6.

Example 2:
Input: nums = [1]
Output: 1
Explanation: The subarray [1] has the largest sum 1.

Example 3:
Input: nums = [5,4,-1,7,8]
Output: 23
Explanation: The subarray [5,4,-1,7,8] has the largest sum 23.

5. Explain Dijkstra's algorithm to find single source shortest paths in a weighted directed graph. Also, prove that the algorithm is correct. [5 + 5]

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