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MCS-211

MASTER OF COMPUTER APPLICATION (MCA) (NEW)

Term-End Examination

June, 2022

MCS-211 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours *Maximum Marks : 100*

(Weightage : 70%)

Note : *Question No. 1 is compulsory. Attempt any three from the rest.*

1. (a) Calculate the time complexity of the following program fragments using Big Oh notation : 5

(i) For $(i = 0; i < n; i++)$

$a[i] = 0;$

for $(i = 0; i < n; i++)$

for $(j = 0, j < n; j++)$;

$A[i] = A[i] + A[j]$

(ii) For $(i = 1; i \leq n; i = i * 2)$.

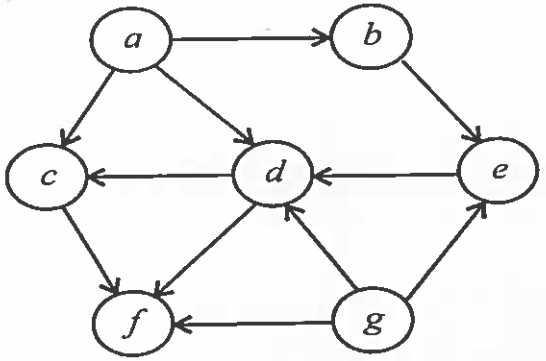
{

$x = x + i;$

}

(b) Explain the working principle of Floyd-Warshall's algorithm. 5

(c) Define topological ordering of a graph. Write the algorithm to find topological ordering of the following graph. Calculate the complexity of the algorithm : 10

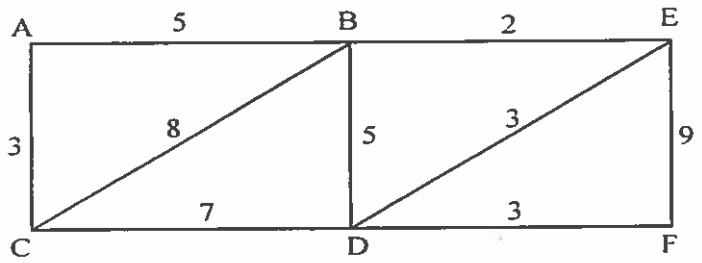


(d) Define the substitution method to solve a recurrence relation.

(d) Solve the following recurrence relation using substitution method : 10

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

(e) Write Kruskal's algorithm to find minimum cost spanning tree of the following graph : 10



Show complexity analysis of the algorithm and all the intermediate steps.

2. (a) Describe the most commonly used data structure for implementing Dijkstra single source shortest path algorithm. 5

(b) Prove that "Subpaths of the shortest path in a single source shortest path algorithm are also the shortest paths." 5

(c) Apply Bubble sort algorithm for the following list of numbers : 10

12	65	45	15	25	30	20	18	7

Calculate its best case and worst case time complexities.

3. (a) Write and explain the procedure to find a solution to maximum bipartite matching problem with the help of an example. 7

(b) List one algorithm each for the following time complexities : 3

(i) $O(m \log n)$

(ii) $O(\log n)$

(iii) $O(n^2)$

(c) Find the optimal solution to the following instance of a fractional Knapsack problem. Show step-by-step running of the algorithm : 10

Number of objects = 5

Capacity of a knapsack W = 15

P_i = Profit of an object i

w_i = Weight of an object i

$(P_1, P_2, P_3, P_4, P_5) = (15, 30, 40, 35, 55)$

$(w_1, w_2, w_3, w_4, w_5) = (5, 9, 3, 7, 2)$

4. (a) Explain the concept of rolling hash function applied in Rabin-Karp algorithm for string matching problem with the help of an example. 10

   (b) Differentiate between greedy approach and dynamic approach to solve an optimization problem. 4

   (c) Formulate the following problems as optimization and decision problems : 6

   (i) Traveling salesperson problem

   (ii) Graph coloring problem

5. (a) Explain the concept of non-deterministic algorithm with the help of an example. List the problems which belong to non-deterministic class of complexity. 8

(b) Whether the following is in correct order ? 2

$1, \log n, n\, n \log n, \quad n^2, 2^n\, n!$

(c) Construct an optimal Huffman tree and Huffman code for each character for the following set of frequencies :

A : 20, B : 25, C : 10, D : 8, E : 7,
F : 12, G : 10.

Show all the intermediate steps. 10