2024

COMPUTER SCIENCE — HONOURS

Paper : CC - 9

(Introduction to Algorithms and Its Applications)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question no.*** **1** and ***any four*** questions from the rest.

1. Answer ***any five*** questions : 2×5

(a) Name the different measures to evaluate the complexity of an algorithm.

(b) Arrange the following computation times according to most preferable choice for a large value of n :

(i) $O(n)$, (ii) $O(\log \log n)$, (iii) $O(n!)$, (iv) $O(2^n)$.

(c) What is a minimum spanning tree? Why is it important?

(d) State the significance of combine step in a divide and conquer algorithm. Explain with an example.

(e) Differentiate between 0-1 Knapsack and Fractional Knapsack problem.

(f) Describe the concept of best-case, average-case and worst-case analysis of algorithms.

(g) State the basic difference between P and NP problems in the context of computational complexity.

(h) How many colors are required to color the vertices of a complete graph? Justify your answer.

2. (a) Explain the divide and conquer approach with a proper pseudo code.

(b) Given the array [3, 6, 8, 10, 1, 2, 1], perform Quick Sort by divide and conquer algorithm to sort the array. Show each step of the process. 5+5

3. (a) Explain the greedy algorithm approach. In what types of problems are they used?

(b) Consider the following items, each with a weight and a value :

- Item 1 : Weight = 2, Value = 10
- Item 2 : Weight = 3, Value = 5
- Item 3 : Weight = 5, Value = 15
- Item 4 : Weight = 7, Value = 7
- Item 5 : Weight = 1, Value = 6
- Item 6 : Weight = 4, Value = 18

You have a Knapsack with a capacity of 15. Use the greedy algorithm to solve the fractional knapsack problem. Show each step of your solution, including the selection of items and the calculation of the total value. (3+1)+6

4. (a) State the problem of matrix chain multiplication.

(b) Compare between Dynamic Programming and Greedy Algorithm.

(c) Let us consider the following four matrices :

A : 2×3; B : 3×4; C : 4×5; D : 5×6.

What are the possible orderings? Which order is optimal? 3+2+5

5. (a) Discuss Floyd-Warshall algorithm.

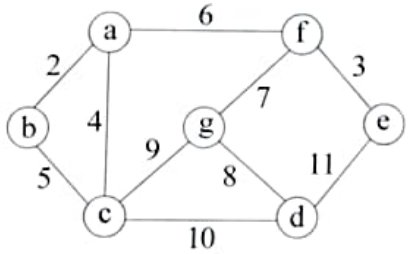
(b) Use the Floyd-Warshall algorithm and find all pairs shortest paths for the following adjacency weighted matrix.

$$\begin{array}{c} \\ A \\ B \\ C \\ D \end{array}\begin{array}{c} \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{bmatrix} 0 & 3 & \infty & 7 \\ 8 & 0 & 2 & \infty \\ 5 & \infty & 0 & 1 \\ 2 & \infty & \infty & 0 \end{bmatrix} \end{array}$$

4+6

6. (a) Write the pseudo code for Kruskal's algorithm.

(b)



Find the minimum spanning tree for the above figure. 5+5

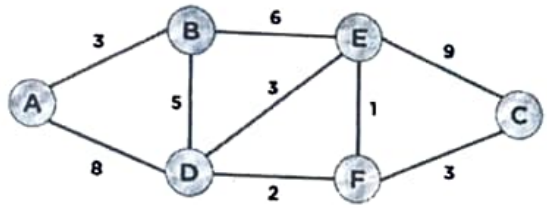
7. (a) Briefly discuss about Travelling Salesman Problem (TSP).

(b) Solve the following Travelling Salesman Problem (TSP) using Dynamic Programming approach. There are four cities A, B, C and D. Start from city A and visit all the cities. The cost matrix is given below :

$$\begin{array}{c} \\ 1\ A \\ 2\ B \\ 3\ C \\ 4\ D \end{array}\begin{array}{c} \begin{array}{cccc} 1 & 2 & 3 & 4 \\ A & B & C & D \end{array} \\ \begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix} \end{array}$$

3+7

8. (a) Find the shortest path from A to C using Dijkstra's Algorithm.



(b) Compare BFS and DFS in terms of Time and Space Complexity. 6+4
