

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

M.A./M.Sc. FIRST SEMESTER EXAMINATION, MARCH 2022

FIRST YEAR [BATCH 2021-23]

Computer Science & Machine Intelligence

Paper : III [CC3]

Date : 23/03/2022

Time : 11 am – 1 pm

Full Marks : 50

Answer **any five** questions of the following:

[5×10]

1. a) Briefly discuss the Heapify and Build heap procedure and also mention their respective time complexity.

b) Explain potential method of amortized analysis of an algorithm with example.

[5+5]

2. a) Show the red-black tree that results after each of the integer keys 16, 4, 8, 2, 13, 19, 27, 5, 38 and 50 are inserted, in that order, into an initially empty red black tree. Clearly show the tree that results after each insertion and make clear any rotations that must be performed.

b) Solve the following recurrence relation.

$$T(1) = \theta(1) \text{ and } T(n) = \sum_{i=1}^{n-1} T(i) + 1$$

[5+5]

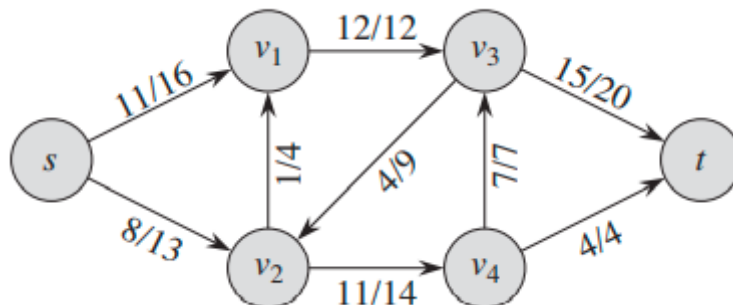
3. a) Explain reduction. Why it is useful in computational complexity?

b) “Monte Carlo randomized algorithm might produce incorrect result with very less probability.” – Justify the statement with proper analysis of an example problem.

[(2+2)+6]

4. a) Differentiate between backtracking and branch and bound algorithms.

b) What is the flow across the cut $(\{s, v_2, v_4\}, \{v_1, v_3, t\})$ of the following flow network? What is the capacity of this cut?



c) What do you mean by Fibonacci Heap? Explain it with an example.

[3+(2+2)+3]

5. a) Compute the prefix function for the pattern aabaabaaa using KMP string matching algorithm.

b) A file contains the following characters with the frequencies as shown. If Huffman Coding is used for data compression, determine Huffman Code for each character and Length of Huffman encoded message (in bits)

Characters	R	K	M	V	C	S	M	I
Frequencies	12	14	5	17	9	11	4	16

[5+5]

6. a) "Decision version of a problem is preferred than optimization version of the same problem in NP completeness". Justify the statement with an example.
- b) How would you modify Strassen's algorithm to multiply $n \times n$ matrices in which n is not an exact power of 2? [5+5]
7. a) Consider an undirected graph with vertices labeled from 0 to 7 with the following edges. 0-1, 0-6, 0-7, 1-4, 1-6, 1-7, 2-3, 2-4, 2-5, 3-4, 3-6, 3-7, 5-6 Run BFS on the graph starting at node 0 and exploring edges incident to a vertex in numerical order of the labels of the vertex at the other end. Draw the BFS tree of the discovered edges produced by this algorithm.
- b) Solve the following 0-1 knapsack problem using dynamic programming. Number of items = 4, Maximum capacity of the knapsack = 5 units, Weight of each item = 2,3,4,5 units respectively, Profit of each item = 3,4,5,6 units respectively. [5+5]

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