MMTE-002

M. Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE) [M. Sc. (MACS)]
Term-End Examination
June, 2024

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 Hours   *Maximum Marks : 50*

Note **:** (i) *There are **six** questions in this paper.*

    (ii) *The **sixth** question is **compulsory**. Do any **four** questions from question one to question five.*

    (iii) *Calculators are not allowed.*

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1. (a) Illustrate the working of the function PARTITION of the quicksort algorithm using the array and using the last element as PIVOT :   5

     < 35, 22, 11, 45, 26, 71, 82, 37 >

(b) Write the steps to search the numbers 18 and 45 in the binary search tree in figure 1 :   5
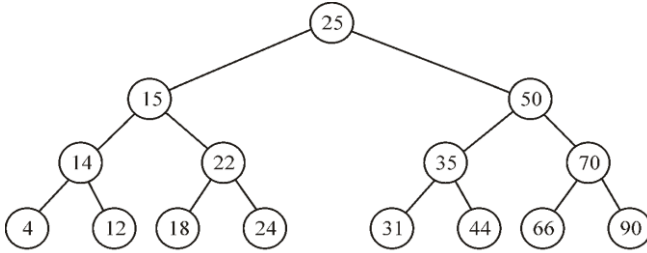

Fig. 1

2. (a) Show the results of inserting the keys below in order into an empty B-tree of minimum degree 2 :   5

2, 5, 4, 3, 6, 9, 8, 7, 1, 2

(b) Determine the LCS of (1, 1, 1, 1, 1, 0, 0, 1, 1, 1) and (1, 0, 1, 0, 0, 1, 1, 0, 1, 0) using dynamic programming approach, showing all the steps.   5

3. (a) Construct a Huffman code for the following data :   4

Character	Frequency
A	24
B	12
C	10
D	8
E	8
F	6
G	4

(b) Find the minimal spanning tree for the graph in figure 2 using Kruskal's algorithm :   6
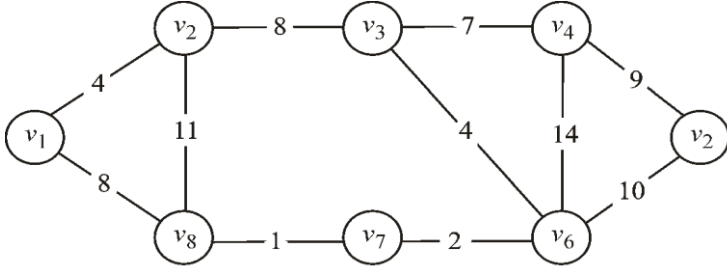

Fig. 2

4. (a) Apply the breadth first algorithm to the graph in figure 3 with v_1 as the source vertex :
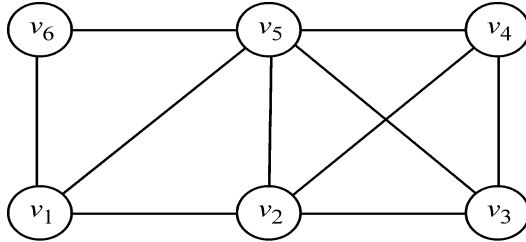

Fig. 3

For each stage of the algorithm, give :   7

(i) $d(v)$, $\pi(v)$ for each vertex where $d(v)$ is the distance from the source vertex to the vertex v and $\pi(v)$ is the predecessor vertex of v.

(ii)   White and gray vertices in the form of sets.

P. T. O.

(iii) Vertices in the queue

Also give the breadth first tree.

(b) Explain the string matching problem with an example.   3

5. (a) Use the extended-Euclidean algorithm, with $a = 991$ and $b = 53$, to find their gcd. show all the steps of the algorithm.   7

(b) Analyse the following algorithm and express the run time in O-notation.   3

(i)   sum = 0

(ii) For $i = 1$ to n do

(iii)   For $j = i$ to n do

(iv)   sum = sum + 1

(v)   End For

(vi) End For

6. Which of the following statements are true and which are false ? Justify your answer with short proof or a counter example.   10

(a) $3^n = O(2^n)$

(b) The worst case running time for the Quicksort algorithm is $O(n \log n)$.

(c) Every min-heap is a binary search tree.

(d) The minimum spanning tree of any graph is unique.

(e) Any optimal solution to the activity-selection problem can be obtained by using a Greedy algorithm which successively selects a compatible activity of the shortest duration.

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