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3 (Sem-4/CBCS) CSC HC 1

2023

**COMPUTER SCIENCE**

(Honours Core)

Paper : CSC-HC-4016

**(Design and Analysis of Algorithms)**

Full Marks : 60

Time : Three hours

**The figures in the margin indicate full marks for the questions.**

1. (a) Define dynamic programming. 1
- (b) Insertion sort is faster than merge sort. 1  
(State True or False)
- (c) Routing in network relies on algorithm. 1  
(State True or False)

Contd.

(d) Quick sort is a 1

- (i) greedy algorithm
- (ii) divide and conquer algorithm
- (iii) dynamic programming algorithm
- (iv) backtracking algorithm

*(Choose the correct option)*

(e) What is the advantage of recursive approach than an iterative approach ? 1

- (i) Consumes less memory
- (ii) Consumes more memory
- (iii) Less code and easy to implement
- (iv) More code has to be written

*(Choose the correct option)*

(f) What is the time complexity of depth first search algorithms ? 1

- (i)  $O(VE)$
- (ii)  $O(E \log V)$
- (iii)  $O(V \log E)$
- (iv)  $O(V + E)$

*(Choose the correct option)*

(g) When we say that an algorithm  $X$  is asymptotically more efficient than  $Y$  it means ? 1

- (i)  $X$  will always be better for small inputs
- (ii)  $X$  will always be better for large inputs
- (iii)  $Y$  will always be better for small inputs

(iv) X will always be better for all inputs

(Choose the correct option)

2. (a) What do you mean by amortized analysis ? 2

(b) Analyse the time complexity of the following segment 2

```
for (i=0; i<N; i++) {  
    for (j=N/2; j>0; j--) {  
        sum ++;  
    }  
}
```

(c) What is minimum spanning tree ? Name the algorithms used for constructing minimum spanning tree.

1+1=2

(d) State the rules followed by a red black tree. 2

3. Answer **any three** of the following :

5×3=15

(a) Distinguish between dynamic programming and greedy method.

(b) Explain how recursive algorithms are analysed with an example.

(c) What are the advantages and disadvantages of divide and conquer approach ?

(d) Define theta ( $\theta$ ) notation. Prove that the function  $f(x) = 5x^4 + 7x + 3$  is  $\theta(x^4)$ . 2+3=5

(e) Prove that running time of binary search algorithm in worst case is  $O(\log_2 N)$ .

4. (a) Write the algorithm for merge sort and analyse its complexity for all cases.

4+2+2+2=10

Or

Use quick sort technique to sort the numbers 7 11 14 6 9 4 3 12 in ascending order. Illustrate the output of each pass clearly. 10

- (b) Given a test  $T[0 \dots N-1]$  and a pattern  $P[0 \dots M-1]$  where  $N > M$ , write an algorithm to print all occurrence of  $P[ ]$  in  $T[ ]$ . 10

Or

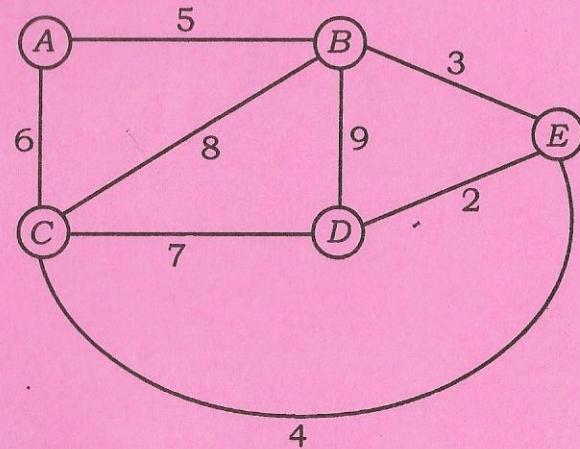
Write algorithms for insertion and deletion in a red black tree. 5+5=10

- (c) Write algorithm for breadth-first search and mention its time and space complexity. Discuss the difference between breadth-first search and depth-first search algorithms.

5+5=10

Or

Discuss the differences between Kruskal's and Prim's algorithms. Apply Prim's algorithm to find the minimum spanning tree for the following graph : 5+5=10



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