1637

(Roll No.···)

M.Sc./II Sem. - 2014

INFORMATICS - Paper IT-22

Data Structure and Design of Algorithm

Time: 3 hours *Maximum Marks: 75*

(Write your Roll No. on the top immediately on receipt of this question paper)

Attempt five questions in all. Question No. **1** *is compulsory*

Q.1(a) Consider you have two sorted arrays of size n and m. Write an algorithm to merge the two sorted arrays and hence produce a third sorted array. What is the time complexity of your algorithm? Mention any assumptions that you have made. [8 + 2]

(b) Write a function that merges two linked lists into one. You may consider that the node is consisting of an integer element. Mention clearly what should be the prototype of the function that you have written. [5]

Q.2 Declare a suitable structure (in C language) that can represent a node of a Binary Search Tree. (Assume you are storing an integer in each node). Implement functions for the following tasks. (You need not write functions to get user data). Only write the proper function definitions.

(a) Insert an node in the BST

(b) Given the BST and a "target" value, search the tree to see if it contains the target. If the target is found the function returns 1 or if it is not found the function returns 0.

(c) Write a function to return the minimum value which is stored in the BST.

[3 + 4 + 4 + 4]

Q.3 (a) Briefly describe "Knapsack Problem". Consider you have 3 objects of weights 18, 15, 10 and a knapsack of capacity 20. The profits associated with the objects are 25, 24, 15. You may put fractional parts of the objects in the knapsack. Build the feasible and optimal solution for this instance. Write an algorithm, to show how you have achieved your solution. [10]

(b) Write an algorithm for binary search. Hence calculate the time complexity of your algorithm. [5]

Q.4(a)Use Floyd's algorithm for the shortest Paths problem to construct the matrix D which contains the lengths of the shortest paths and the matrix P which contains the highest indices of the intermediate vertices on the shortest paths for the following graphs (Fig.1). Show the action step by

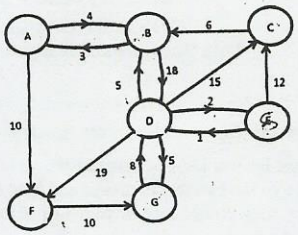

Figure 1:

step. [10]

(b)List all of the different orders in which we can multiply five matrices A_1, A_2 , A_3 , A_4 , and A_5. Find the optimal order and its cost for evaluating the product $A_1 \times A_2 \times A_3 \times A_4 \times A_5$ where A_1 is (10×4), A_2 is (4×5), A_3 is (5×20), A_4 is (20×2), A_5 is (2×50). [5]

Q.5(a)Use Mergesort to sort the following list. Show the action step by step.

123 34 189 56 150 12 9 240

[5]

Give also the tree of recursive calls.

(b)Show that the recurrence equation for the worst-case time complexity for Mergesort is given by

$$W(n) = W\left(\lfloor \frac{n}{2} \rfloor\right) + W\left(\lceil \frac{n}{2} \rceil\right) + n - 1$$

[5]

(c) Use Quicksort to sort the following list. Show the action step by step.

123 34 189 56 12 9 240

[5]

Q.6(a)One of the most famous sequences in computer science (and nature) is the Fibonacci sequence, which is defined by the recurrence [10]

$$f(n) = f(n-1)+f(n-2), \quad f(0)=0, \quad f(1)=1.$$

Show that

$$f(n) = \frac{1}{\sqrt{5}}\left[\left(\frac{1+\sqrt{5}}{2}\right)^n - \left(\frac{1-\sqrt{5}}{2}\right)^n\right]$$

Without using this formula, argue that

$$(1.5)^{n-2} \leq f(n) \leq 2^{n-1}, \quad n \geq 1$$

(b)Solve the following recurrence [5]

$$(i)t_n = 7t_{n/2}, \quad n > 1 \text{ and power of } 2 \ \&t_1 = 1.$$

$$(ii)t_n = t_{n-1} + \frac{2}{n}, \quad n > 1, \quad t_1 = 0$$