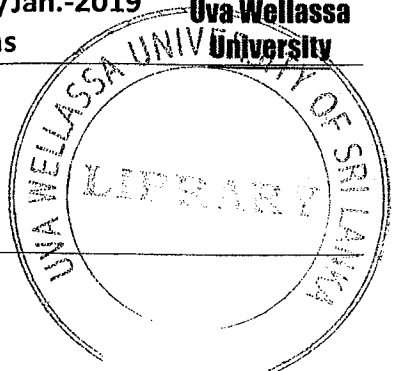
Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
300 level 2nd Semester Examination – Dec.-2018/Jan.-2019
IIT302-2 Data Structures and Algorithms



Instructions to candidates
Number of questions: Four (04)
Time allocation: Two (02) hours
Mark allocation: 100
Answer all questions.

1.

a.

i. Define the two (02) terms **Data Structures** and **Algorithms.** (2 mark)

ii. Describe the importance of Data Structures and Algorithms (3 mark)

b.

i. Why asymptotic notations are used? (1 mark)

ii. What are the three (03) asymptotic notations? Briefly describe any two (02). (6 mark)

c. The Tower of Hanoi is a mathematical game. The game consists of 3 rods, and n disks of different sizes which can slide onto any rod. The puzzle starts with the disks stack in ascending order of size on rod number 1 (the smallest disk is on the top). The objective of the game is to move the entire stack to rod number 3, obeying the following rules:

1. Only one disk can be moved at a time.
2. Each move consists of taking the upper disk from one of the rods and sliding it onto another rod, on top of the other disks that may already be present on that rod.
3. No disk may be placed on top of a smaller disk.

Write an algorithm using the recursive technique to output a series of moves which solve the Tower of Hanoi problem. (4 mark)

d. List four (04) types of Recursion and briefly describe any two (02) of them using examples. (6 mark)

e. For each of the following recurrences, give an expression for the runtime T (n) if the recurrence can be solved with the Master Theorem.

i. $T(n) = 3T\left(\frac{n}{4}\right) + n \log n$

ii. $T(n) = 3T\left(\frac{n}{3}\right) + \frac{n}{2}$

iii. $T(n) = 6T\left(\frac{n}{3}\right) + n^2 \log n$ (3 mark)

(112)

2.

a.

i. Using Figure 1 as a model, illustrate the result of each operation in the sequence PUSH(S, 4), PUSH(S, 1), PUSH(S, 3), POP(S), PUSH(S, 8), and POP(S) on an initially empty stack S stored in array S[1 . . 6]. (6 mark)

ii. Using Figure 1 as a model, illustrate the result of each operation in the sequence ENQUEUE(S, 4), ENQUEUE(S, 1), ENQUEUE(S, 3), DEQUEUE(S), ENQUEUE(S, 8), and DEQUEUE(S) on an initially empty queue S stored in array S[1 . . 6]. (6 mark)

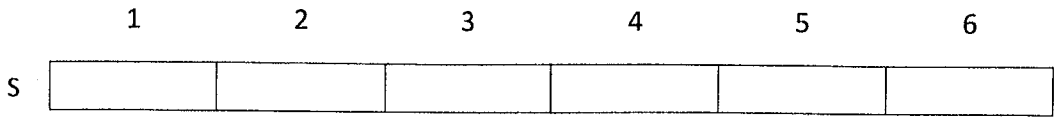


Figure 1: model

b.

i. Write the algorithm for inserting a node at the beginning of the singly linked list. (4 mark)

ii. Write the algorithm for deleting a node from the beginning of the singly linked list. (4 mark)

c. State the similarities and differences between arrays and linked lists. (5 mark)

3.

a.

i. Describe how Divide and Conquer strategy works. (3 mark)

ii. Write an algorithm for 'Merge Sort'. Illustrate the operation of merge sort on the following array stating all the steps.
A = {3,41,52,26,38,57,9,49,16} (6 mark)

b.

i. Explain **Quick Sort** using an algorithm. (5 mark)

ii. What is **Pivot** and how do you determine the pivot value? Discuss the purpose of having the pivot element in quick sort. (5 mark)

c. Determine the complexity of **Insertion Sort** algorithm. Sort the given array using insertion sort algorithm depicting all the steps clearly.
data={12,23,45,67,50,89,33,50} (6 mark)

4.

a.

i. What is 'Binary Search Tree (BST)'? Discuss the characteristics of BST. (4 mark)

ii. Consider the following integer array
[10,30,22,45,34,56,78,45,67,74,31,12,54,17,37]

Create a binary tree for above mentioned dataset. Clearly mention the steps that you followed during the process. (4 mark)

Use Following figure 2(binary tree) to answer question b and c.

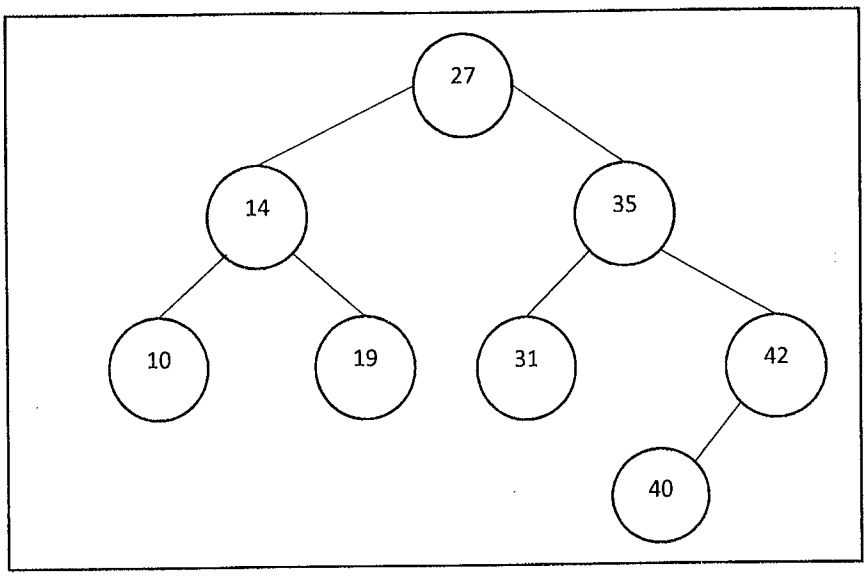


Figure 2: binary tree

b. Perform given operations on above figure 2. Clearly indicate the steps that you followed during the operation.

i. Insert 21
ii. Delete 10
iii. Delete 42
iv. Search maximum value (8 mark)

c. Perform following traversals on above figure 2.

i. Pre Order Travers
ii. Post Order Traverse
iii. In order Travers (9 mark)