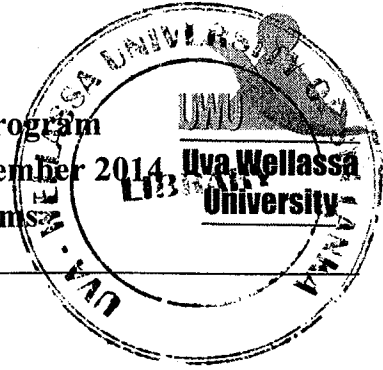


Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Computer Science and Technology Degree Program
2nd Year 2nd Semester Examination - August/September 2014
CST 225-2 Data Structures and Algorithms



Number of questions: Five (05)

Answer All questions

Time Allocation: Two(02) hours

Mark allocation: 100 mark

1.

- a. Why do we need algorithms? Justify your answer.
- b. Explain the RAM model assuming that the generic single processor is available. Using the RAM model, analyze the total running time of the following algorithm with necessary steps in each statement.

```
1 for j =2 to length[A]
2 do key = A[j]
3 Insert A[j] into the sorted sequence A[1..j-1]
4 i=j-1
5 While i > 0 and A[i] > key
6 do A[i+1] = A[i]
7 i =i-1
8 A[i+1] = key
```

- c. Prove the following equations.

i. $T(n) = 3n^2 + n$ is $\Omega(n^2)$

ii. $T(n) = n^3$ is $\Omega(n^2)$ with $c = 1$ and $n_0 = 1$

iii. $T(n) = \sqrt{n}$ is $\Omega(\ln n)$

iv. $T(n) = n$ is not $\Omega(n^2)$

- d. Define 'Recursive Relation' using Factorial 8 (8!).

The number of bacteria in a colony doubles every hour. If the colony begins with ten (10) bacteria, how many will be present in 12 hours? Create a recursive relation to determine the answer.

(20 mark)

2.

- a. Briefly explain how '**Bubble Sort**' works.
- b. Write an algorithm to bubble sort a given array of size n and analyze the complexity of the algorithm using O (big O) notation for the worst case.
- c. Determine the complexity of '**Insertion Sort**' algorithm. Sort the given array using insertion sort algorithm depicting all the steps.
data = {12, 23, 45, 67, 50, 89, 33, 50}
- d. Compare and contrast the complexity of Bubble Sort and Insertion Sort algorithms considering the O (big O) notation.
- e. Which algorithm mentioned in Part d is faster? Justify your answer considering the difference of two algorithms.

(20 mark)

3.

- a. Describe how '**Divide and Conquer**' strategy works.
- b. 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}
- c. Explain '**Quick Sort**' using an algorithm. What is '**pivot**' and how do you determine the pivot value? Discuss the purpose of having the pivot element in the quick sort.
- d. Illustrate the operation of quick sort on the following array. Note: Changes of the pivot value must be stated clearly).
B = {3, 41, 52, 26, 38, 57, 9, 49, 16}
- e. Explain the basic idea of '**Binary Search**' algorithm assuming that the binary search for key q in the array A [1 .. n].

(20 mark)

4.

- a. Discuss the characteristics of Binary Search Tree (BST).
- b. Write an algorithm to search for a given key value in a BST.
- c. Modify the algorithm you created in part 'b.' to insert a given value to a BST.
- d. What are the main methods of traversing through a BST? Write the number sequence of the BST given in Figure 01 when traversing using the above mentioned methods.
- e. Find the successor for separately removing the values 30, 53 and 72 of the BST given in Figure 01.

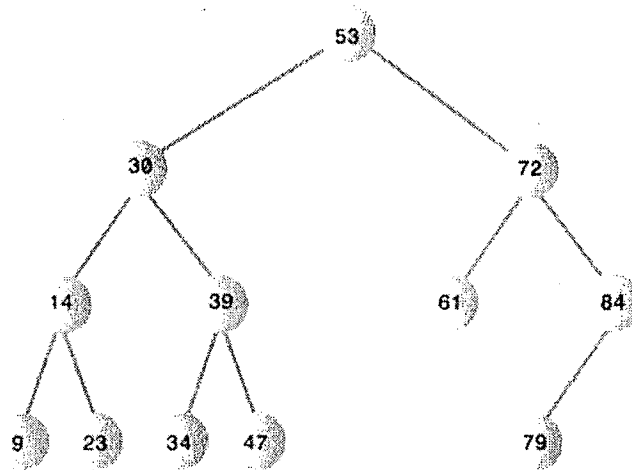


Figure 01: Binary Search Tree

(20 mark)

5.

- a. What is '**Hashing**' and explain how it works with the help of '**Hash-Table**'?
- b. What is meant by '**Collision Resolution**'?
- c. You are given a set of values as (2344, 4234, 2832, 430, 29, 397, 3918, 1456, 176, 2013), a hash table of size 11 and hash function $h(i) = i \text{ mode } 11$. Draw the resultant tables after inserting the values in the given order with each of these collision resolution strategies.
 - i. Separate Chaining.
 - ii. Linear Probing.
- d. What are the '**Heap**' properties? Illustrate '**Min-Heap**' and the underlying array using an example.
- e. Given that an array of eight (08) elements: 15, 19, 10, 17, 20, 23, 55 and 35. Sort the array in ascending order using heap sort mechanism with necessary steps.

(20 mark)