



**EAST WEST UNIVERSITY**  
**Department of Computer Science and Engineering**  
**B.Sc. in Computer Science and Engineering Program**  
**Assignment - 2, Spring 2021 Semester**

**Course:** CSE 207- Data Structures, Section-2  
**Instructor:** Dr. Maheen Islam, Associate Professor, CSE Department  
**Full Marks:** 110  
**Submission Time:** May 08,2021

**Question-1: [10 Marks]**

Should arrays or linked lists be used for the following types of applications? Support your justification.

- Many search operations in sorted list.
- Many search operations in Unsorted list.

**Question-2: [10 Marks]**

One of the methods to calculate the square root of a number is Newton's method. The formula for Newton's method is

$$\text{squareRoot}(\text{num}, \text{ans}, \text{tol}) = \begin{cases} \text{ans} & \text{if } |\text{ans}^2 - \text{num}| \leq \text{tol} \\ \text{squareRoot}(\text{num}, (\text{ans}^2 + \text{num}) / (2 \times \text{ans}), \text{tol}) & \text{otherwise} \end{cases}$$

Write the pseudocode for a recursive algorithm to compute a square root using Newton's method. Verify your algorithm by using it to manually calculate the following test cases:  $\text{squareRoot}(5, 2, 0.01)$  and  $\text{squareRoot}(4, 2, 0.01)$ . *Note:* in the formula, tol is an abbreviation for *tolerance*.

**Question-3: [10 Marks]**

The algorithm that determines the length of the prefix expression is given below. This algorithm needs to return the length of the expression. Here, the base case is finding an operand. From the definition of the problem, we know that each operand is one character long. The minimum length of a prefix expression is therefore three: one for the operator and one for each operand. As we recursively decompose the expression, we continue to add the size of its combined expressions until we have the total length.

```
Algorithm findExprLen (exprIn)
  Recursively determine the length of a prefix expression.
  Pre  exprIn is a valid prefix expression
  Post length of expression returned
1 if (first character is operator)
  General Case: First character is operator
  Find length of first prefix expression
  1 set len1 to findExprLen (exprIn + 1)
  2 set len2 to findExprLen (exprIn + 1 + len2)
2 else
  Base case--first char is operand
  1 set len1 and len2 to 0
3 end if
4 return len1 + len2 + 1
end findExprLen
```

Given the algorithm, compute the length of the prefix expression  $*+AB/CD$ . Show the recursive steps that are executed.

**Question-4: [10 Marks]**

Write a program that generates all binary strings without consecutive 1's. Use recursive function to generate the strings.

Thus, given an integer K, the task is to print all binary strings of size k without consecutive binary 1's.

Examples:

**Input :** K = 3

**Output :** 000 , 001 , 010 , 100 , 101

**Input :** K = 4

**Output :** 0000 0001 0010 0100 0101 1000 1001 1010

**Question-5: [5 Marks]**

A binary tree has eight nodes. The postorder and inorder traversals of the tree are given below. Draw the tree.

Postorder: FECHGDBA

Inorder: FCEABHGD

**Question-6: [5 Marks]**

Draw the expression tree and find the prefix and postfix expressions for the following infix expression:

$(C + D + A \ B) \times (E + F)$

**Question-7: [5 Marks]**

Draw the expression tree and find the infix and prefix expressions for the following postfix expression:

$A \ B \times \ C \ D \ / \ + \ E \ F \ - \times$

**Question-8: [5 Marks]**

Find the missing factor (the question mark) in the following recursive definition of the maximum number of nodes based on the height of a binary tree. Justify your answer.

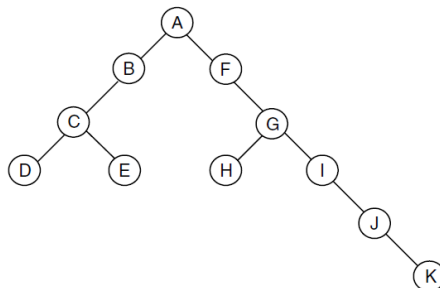
$$N(H) = \begin{cases} 1 & \text{if } H = 1 \\ N(H - 1) + ? & \text{if } H \geq 2 \end{cases}$$

**Question-9: [10 Marks]**

The balance factor of a binary tree is the difference in height between its left and right subtrees.

$$B = H_L - H_R$$

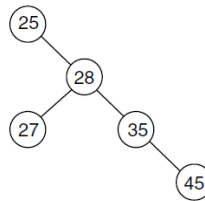
- a. What is the balance factor of the tree in the below figure?



- b. Write a C function to compute the balance factor of a binary tree. If it is called initially with the root pointer, it should determine the balance factor of the entire tree. If it is called with a pointer to a subtree, it should determine the balance factor for the subtree.

**Question-10: [10 Marks]**

The binary search tree in the figure below was created by starting with a null tree and entering data from the keyboard. In what sequence were the data entered? If there is more than one possible sequence, identify the alternatives.



**Question-11: [10 Marks]**

**Write** a program to convert an array into a Binary Search Tree by inserting the elements as nodes in BST, processing elements in the given order in the array. Also find the height of the created Binary Search Tree.

**Example:**

**Input :** Input array size: 7

Input array elements: 4 6 2 7 9 8 3

**Output :** Height of BST = 4

**Question-12: [10 Marks]**

When writing BST algorithms, you need to be able to print the tree in a hierarchical order to verify that the algorithms are processing the data correctly. Write a print function that can be called to print the tree. The printed output should contain the node level number and its data. Present the tree using a bill-of-materials format, as shown in Figure below, for several popular breeds of dogs recognized by the American Kennel Club (AKC).

```

1. Labrador
  2. German Shepherd
    3. Cocker Spaniel
      4. Beagle
      4. Dachshund
        5. Dalmatian
    3. Golden Retriever
  2. Rottweiler
    3. Poodle
    3. Shetland Sheepdog
  
```

**Question-13: [10 Marks]**

- a. Create an AVL tree using the following data entered as a sequential set. Show the balance factors in the resulting tree: 7 10 14 23 33 56 66 70 80.
- b. Delete the node 56 and 14.