NANYANG TECHNOLOGICAL UNIVERSITY
School of Electrical & Electronic Engineering

IE2108 Data Structures and Algorithms

Tutorial No. 5 (Sem 1, AY2022-2023)

1. Traverse the binary tree shown in Figure 1: (a) in preorder; (b) in inorder; (c) in postorder. Show the content of the traversal for each algorithm.

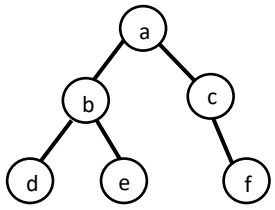

Figure 1

2. **(Understanding the execution of a recursive algorithm.)** For the binary search tree shown in Figure 2, trace the execution of the algorithm `BSTinsert_recurs(.)` step-by-step.

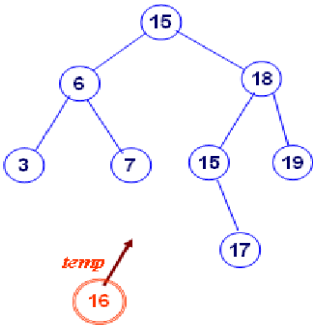

Figure 2

```
BSTinsert_recurs(root, temp) {
  if (temp.data ≤ root.data) {
    if (root.left == null)
      root.left = temp
    else
      BSTinsert_recurs(root.left,temp)
  }
  else { // goes to right subtree
    if (root.right == null)
      root.right = temp
    else
      BSTinsert_recurs (root.right, temp)
  }
}
```

3. The following algorithm is used to compute the number of leaves in a binary tree. Is this algorithm correct? If it is, prove it; if it is not, make an appropriate correction.

```
Input: a binary tree T
Output: the number of leaves in T
Algorithm LeafCounter(T)
  // Computes recursively the number of leaves in a binary tree
  if (T == null)
    return 0
  else
    return LeafCounter(T.left) + LeafCounter(T.right)
```

4. **(Understanding the design of a recursive algorithm.)** The binary tree is recursive in nature. The tree traversal algorithms that we discussed in the lecture exemplify the basic fact that we are led to consider recursive algorithms for binary trees. That is, we process a tree by processing the root node and (recursively) its subtrees. Based on this understanding and following the definition of the height of a given binary tree, devise an algorithm for calculating the height of a tree.

5. Consider the binary tree in Figure 3. Determine the heights of the left and right sub-trees at
   i. node 1
   ii. node 4
   iii. node 3
   iv. node 5

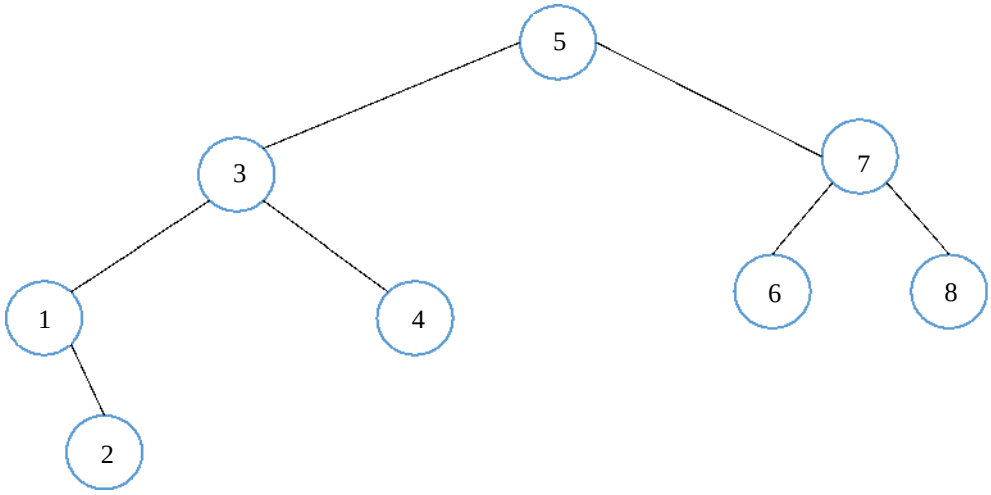

Figure 3

6. Consider the AVL tree shown in Figure 4. Show the steps taken to balance the tree when

   i. 14 is inserted
   ii. 23 is inserted
   iii. 70 is inserted

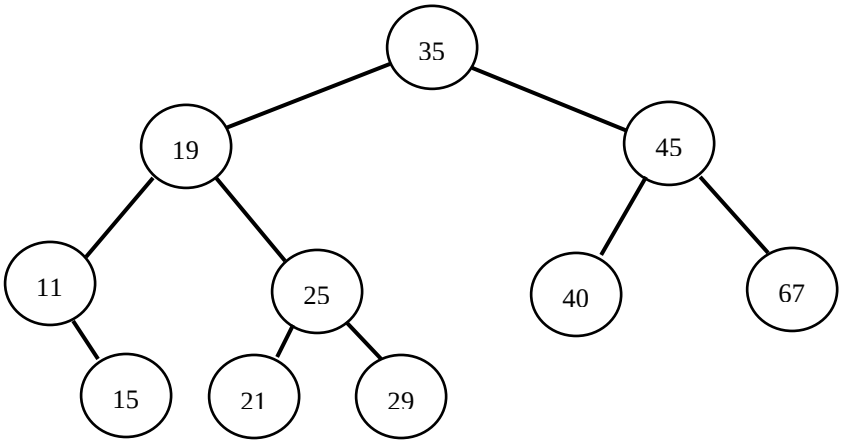

Figure 4