Assignment No 3 (B)

<u>Aim:</u> To illustrate the various Binary Tree functions.

<u>Problem Statement :</u> For given expression eg. a-b*c-d/e+f construct inorder sequence and traverse it using postorder traversal(non recursive).

<u>Learning Objectives:</u>

To understand concept of Tree & Binary Tree.

To analyze the working of various Tree operations.

<u>Learning Outcome:</u> Students will be able to use various set of operations on Binary search.

<u>Theory:</u>

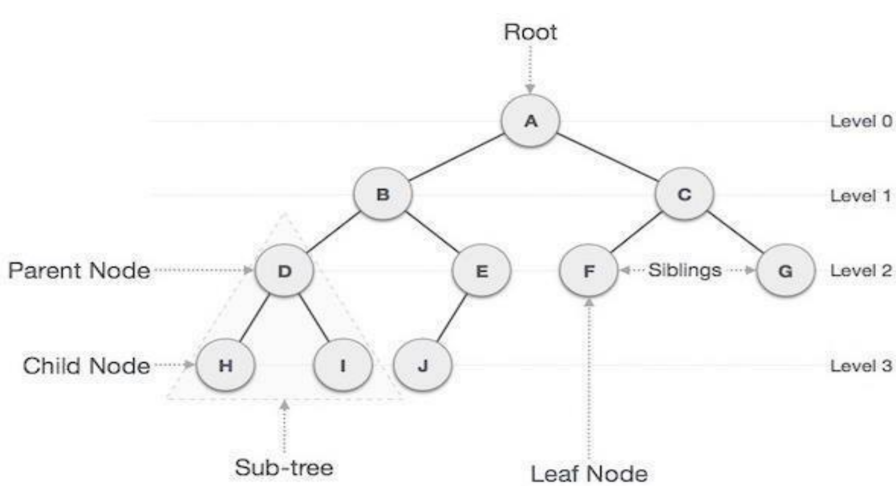
Tree

Tree represents the nodes connected by edges also a class of graphs that is acyclic is termed as trees. Let us now discuss an important class of graphs called trees and its associated terminology. Trees are useful in describing any structure that involves hierarchy. Familiar examples of such structures are family trees, the hierarchy of positions in an organization, and so on.

Binary Tree

A binary tree is made of nodes, where each node contains a "left" reference, a "right" reference, and a data element. The topmost node in the tree is called the root.

Every node (excluding a root) in a tree is connected by a directed edge from exactly one other node. This node is called a parent. On the other hand, each node can be connected to arbitrary number of nodes, called children. Nodes with no children are called leaves, or external nodes. Nodes which are not leaves are called internal nodes. Nodes with the same parent are called siblings.



Insert Operation

The very first insertion creates the tree. Afterwards, whenever an element is to be inserted, first locate its proper location. Start searching from the root node, then if the data is less than the key value, search for the empty location in the left subtree and insert the data. Otherwise, search for the empty location in the right subtree and insert the data.

Traversals

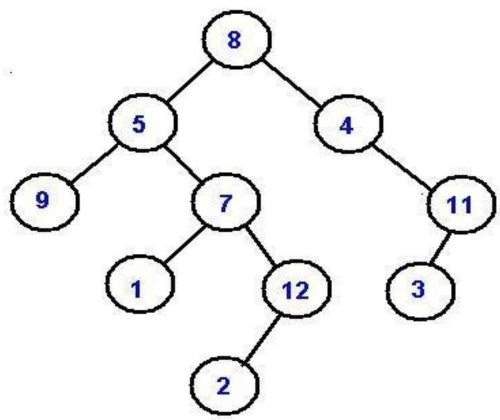
A traversal is a process that visits all the nodes in the tree. Since a tree is a nonlinear data structure, there is no unique traversal. We will consider several traversal algorithms with we group in the following two kinds

- depth-first traversal
- breadth-first traversal

There are three different types of depth-first traversals, :

- PreOrder traversal - visit the parent first and then left and right children;
- InOrder traversal - visit the left child, then the parent and the right child;
- PostOrder traversal - visit left child, then the right child and then the parent;

There is only one kind of breadth-first traversal--the level order traversal. This traversal visits nodes by levels from top to bottom and from left to right. As an example consider the following tree and its four traversals:



PreOrder - 8, 5, 9, 7, 1, 12, 2, 4, 11, 3
InOrder - 9, 5, 1, 7, 2, 12, 8, 4, 3, 11
PostOrder - 9, 1, 2, 12, 7, 5, 3, 11, 4, 8
LevelOrder - 8, 5, 4, 9, 7, 11, 1, 12, 3, 2

Algorithm:

-

Algorithm to insert a node :

Step 1 - Search for the node whose child node is to be inserted. This is a node at some level i, and a node is to be inserted at the level i +1 as either its left child or right child. This is the node after which the insertion is to be made.

Step 2 - Link a new node to the node that becomes its parent node, that is, either the Lchild or the Rchild.

Algorithm to traverse a tree :

- **Inorder traversal**

Until all nodes are traversed −

Step 1 − Recursively traverse left subtree.
Step 2 − Visit root node.

Step 3 − Recursively traverse right subtree.

- **Preorder**

Until all nodes are traversed
– Step 1 − Visit root node.

Step 2 − Recursively traverse left subtree.
Step 3 − Recursively traverse right subtree.

- **Postorder**

Until all nodes are traversed −

Step 1 − Recursively traverse left subtree.
Step 2 − Recursively traverse right subtree.
Step 3 − Visit root node.

Algorithm to copy one tree into another tree :

Step 1 – if (Root == Null)
Then return Null

Step 2 −Tmp = new TreeNode

Step 3 – Tmp->Lchild = TreeCopy(Root->Lchild); Step 4 – Tmp->Rchild = TreeCopy(Root->Rchild); Step 5 – Tmp-Data =

Then return

- S**oftware required:** g++ / gcc compiler- / 64 bit fedora.

Outcome

Learn object oriented programming features.

Understand & implement different operations on tree & binary tree.

Conclusion : Thus we have studied the implementation of various Binary tree operation.

```
#include <iostream>
#include <string.h>
using namespace std;

struct node
{
   char data;
   node *left;
   node *right;
};
class tree
{
   char prefix[20];

public:
   node *top;
   void expression(char[]);
   void display(node *);
   void non_rec_postorder(node *);
   void del(node *);
};
class stack1
{
   node *data[30];
   int top;
```

```
public:
    stack1()
    {
        top = -1;
    }
    int empty()
    {
        if (top == -1)
            return 1;
        return 0;
    }
    void push(node *p)
    {
        data[++top] = p;
    }
    node *pop()
    {
        return (data[top--]);
    }
};
void tree::expression(char prefix[])
{
    char c;
    stack1 s;
    node *t1, *t2;
    int len, i;
    len = strlen(prefix);
    for (i = len - 1; i >= 0; i--)
    {
        top = new node;
        top->left = NULL;
        top->right = NULL;
        if (isalpha(prefix[i]))
        {
```

```
            top->data = prefix[i];
            s.push(top);
        }
        else if (prefix[i] == '+' || prefix[i] == '*' || prefix[i] == '-' || prefix[i] == '/')
        {
            t2 = s.pop();
            t1 = s.pop();
            top->data = prefix[i];
            top->left = t2;
            top->right = t1;
            s.push(top);
        }
    }
    top = s.pop();
}
void tree::display(node *root)
{
    if (root != NULL)
    {
        cout << root->data;
        display(root->left);
        display(root->right);
    }
}
void tree::non_rec_postorder(node *top)
{
    stack1 s1, s2; /*stack s1 is being used for flag . A NULL data implies that the right subtree has
not been visited */
    node *T = top;
    cout << "\n";
    s1.push(T);
    while (!s1.empty())
    {
        T = s1.pop();
        s2.push(T);
        if (T->left != NULL)
```

```
            s1.push(T->left);
        if (T->right != NULL)
            s1.push(T->right);
    }
    while (!s2.empty())
    {
        top = s2.pop();
        cout << top->data;
    }
}
void tree::del(node *node)
{
    if (node == NULL)
        return;
    /* first delete both subtrees */
    del(node->left);
    del(node->right);
    /* then delete the node */
    cout <<endl<<"Deleting node : " << node->data<<endl;
    free(node);
}
int main()
{
    char expr[20];
    tree t;
  cout <<"Enter prefix Expression : ";
    cin >> expr;
    cout << expr;
    t.expression(expr);
    //t.display(t.top);
    //cout<<endl;
    t.non_rec_postorder(t.top);
    t.del(t.top);
    // t.display(t.top);
}
```