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**ASSIGNMENT NO.** 1

**TITLE** Binary Tree Implementation, traversals and operations

**PROBLEM STATEMENT** Create binary tree with n nodes, perform following operations on it:

* Perform inorder/preorder and post order traversal
* Create a mirror image of it
* Find the height of tree
* Copy this tree to another [operator=]
* Count number of leaves, number of internal nodes.
* Erase all nodes in a binary tree. (implement both recursive and non-recursive methods)

**OBJECTIVE** To understand construction of binary tree and its traversal

techniques.

**OUTCOME** At the end of this assignment students will able to construct a

Binary tree and perform basic operations on Binary tree.

**S/W PACKAGES AND** 1. (64-bit)64-BIT Fedora 17 or latest 64-BIT Update of

**HARDWARE**  Equivalent Open source OS

**APPARATUS USED 2.** Programming Tools (64-Bit) Latest Open source update of

Eclipse Programming frame work, TC++, GTK

**Concepts related Theory:**

*Binary tree* is specific type of tree in which each node can have atmost(zero,one,two) twochildren namely left child and right child. Empty tree also a valid binary tree.

In computer science**,** tree traversal is a form of [graph traversal](https://en.wikipedia.org/wiki/Graph_traversal) and refers to the process of visiting each node in a [tree data structure,](https://en.wikipedia.org/wiki/Tree_(data_structure)) exactly once. Such traversals are classified by the order in which the nodes are visited.

***Data structures for tree traversal:***

Traversing a tree involves iterating over all nodes in some manner. Because from a given node there is more than one possible next node then, assuming sequential computation, some nodes must be deferred—stored in some way for later visiting. This is often done via a [stack](https://en.wikipedia.org/wiki/Stack_(abstract_data_type)) (LIFO) or queue (FIFO). As a tree is a self-referential (recursively defined) data structure, traversal can be defined by [recursion](https://en.wikipedia.org/wiki/Recursion)

Depth-first search is easily implemented via a stack, including recursively, while breadth-first search is easily implemented via a queue, including corecursively.

***Depth-first search:***

These searches are referred to as *depth-first search* (DFS), as the search tree is deepened as much as possible on each child before going to the next sibling. For a binary tree, they are defined as display operations recursively at each node, starting with the root.

***Operations of binary tree*:**

* Traversal
* Creation
* Deletion
* Compare
* Merge

***Traversing***: Traversal refers to the process of visiting all the nodes of binary tree once. There arethree ways for traversing binary tree.

**1*.Pre-order:***

* Check if the current node is empty /null
* Display the data part of the root (or current node).
* Traverse the left subtree by recursively calling the pre-order function.
* Traverse the right subtree by recursively calling the pre-order function.

**2.*In-order:***

* Check if the current node is empty/null
* Traverse the left subtree by recursively calling the in-order function.
* Display the data part of the root (or current node).
* Traverse the right subtree by recursively calling the in-order function.

**3.*Post-order:***

* Check if the current node is empty/null
* Traverse the left subtree by recursively calling the post-order function.
* Traverse the right subtree by recursively calling the post-order function.
* Display the data part of the root (or current node).

**Algorithm:**

ALGORITHM INORDERTRAVERSE()

{

1. set top=0, stack[top]=NULL, ptr = root
2. Repeat while ptr!=NULL

2.1 set top=top+1

2.2 set stack[top]=ptr

2.3 set ptr=ptr->left

1. Set ptr=stack[top], top=top-1
2. Repeat while ptr!=NULL

4.1 print ptr->info

4.2 if ptr->right!=NULL then

4.2.1set ptr=ptr->right

4.2.2 goto step 2

4.3 Set ptr=stack[top], top=top-1

}

ALGORITHM PREORDERTRAVERSE()

{

1. set top=0, stack[top]=NULL, ptr = root
2. Repeat while ptr!=NULL

2.1 print ptr -> info

2.2 if (ptr -> right != NULL)

2.2.1 top = top +1

2.2.2 set stack [ top] = ptr -> right

2.3 if ( ptr -> left != NULL)

2.3.1 ptr=ptr -> left

else

2.3.1 ptr=stack[top], top=top-1

}

ALGORITHM POSTORDERTRAVERSE()

{

1. set top = 0, stack [top] = NULL, ptr = root
2. Repeat while ptr!=NULL

2.1 top = top +1 , stack [ top ] = ptr

2.2 if (ptr -> right != NULL)

2.2.1 top = top +1

2.2.2 set stack [ top] = - ( ptr -> right )

2.3 ptr = ptr -> left

1. ptr = stack [top], top = top-1
2. Repeat while ( ptr > 0 )

4.1 print ptr -> info

4.2 ptr = stack [top], top = top-1

5. if (ptr < 0)

5.1 set ptr = - ptr

5.2 Go to step 2

}

Test-Cases

|  |  |  |  |
| --- | --- | --- | --- |
| Description | Input | Output | Result |
| Create Tree  (Enter -1 if no node) | 6 5 7 -1 8 2-1 -1 -1 -1 -1 | - | Pass |
| Preorder traversal | - | 6 5 7 8 2 | Pass |
| Postorder  traversal | - | 2 8 7 5 6 | Pass |
| Inorder  Traversal | - | 7 2 8 5 6 | Pass |
| Height of tree | - | 5 | Pass |

**Conclusion:** After successfully completing this assignment, Students will be able create anExpression tree and performs various operations on Binary tree