



## **Experiment No. 8: Binary Search Tree Operations**

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**Aim : Implementation of Binary Search Tree ADT using Linked List.**

**Objective:**

- 1) Understand how to implement a BST using a predefined BST ADT.
- 2) Understand the method of counting the number of nodes of a binary tree.

**Theory:**

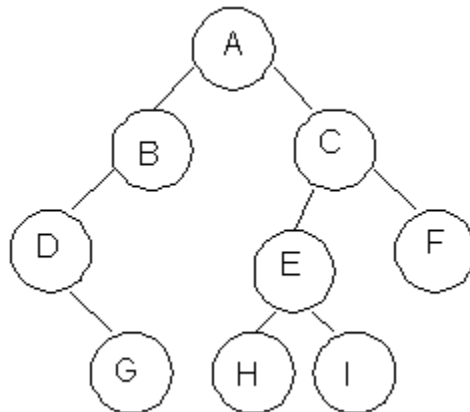
A binary tree is a finite set of elements that is either empty or partitioned into disjoint subsets. In other words node in a binary tree has at most two children and each child node is referred as left or right child.

Traversals in tree can be in one of the three ways : preorder, postorder, inorder.

### **Preorder Traversal**

Here the following strategy is followed in sequence

1. Visit the root node R
2. Traverse the left subtree of R
3. Traverse the right sub tree of R





Description	Output
Visit Root	A
Traverse left sub tree – step to B then D	ABD
Traverse right sub tree – step to G	ABDG
As left subtree is over. Visit root , which is already visited so go for right subtree	ABDGC
Traverse the left subtree	ABDGCHE
Traverse the right sub tree	ABDGCHEI F

### Inorder Traversal

Here the following strategy is followed in sequence

1. Traverse the left subtree of R
2. Visit the root node R
3. Traverse the right sub tree of R

Description	Output
Start with root and traverse left sub tree from A-B-D	D
As D doesn't have left child visit D and go for right subtree of D which is G so visit this.	DG
Backtrack to D and then to B and visit it.	DGB
Backtrack to A and visit it	DGBA
Start with right sub tree from C-E-H and visit H	DGBAH
Now traverse through parent of H which is E and then I	DGBAHEI
Backtrack to C and visit it and then right subtree of E which is F	DGBAHEICF



### Postorder Traversal

Here the following strategy is followed in sequence

1. Traverse the left subtree of R
2. Traverse the right sub tree of R
3. Visit the root node R

Description	Output
Start with left sub tree from A-B-D and then traverse right sub tree to get G	G
Now Backtrack to D and visit it then to B and visit it.	GD
Now as the left sub tree is over go for right sub tree	GDB
In right sub tree start with leftmost child to visit H followed by I	GDBHI
Visit its root as E and then go for right sibling of C as F	GDBHIEF
Traverse its root as C	GDBHIEFC
Finally a root of tree as A	GDBHIEFCA

### **Algorithm**

Algorithm: PREORDER(ROOT)

Input : Root is a pointer to root node of binary tree

Output : Visiting all the nodes in preorder fashion.

Description : Linked structure of binary tree

1. ptr=ROOT
2. if ptr!=NULL then  
visit(ptr)  
PREORDER(LSON(ptr))\  
PREORDER(RSON(ptr))  
End if



3. Stop

Algorithm: INORDER(ROOT)

Input : Root is a pointer to root node of binary tree

Output : Visiting all the nodes in inorder fashion.

Description : Linked structure of binary tree

1. ptr=ROOT
2. if ptr!=NULL then  
    INORDER (LSON(ptr))  
    visit(ptr)  
    INORDER (RSON(ptr))  
    End if
3. Stop

Algorithm: POSTORDER(ROOT)

Input : Root is a pointer to root node of binary tree

Output : Visiting all the nodes in postorder fashion.

Description : Linked structure of binary tree

1. ptr=ROOT
2. if ptr!=NULL then  
    PREORDER(LSON(ptr))  
    PREORDER(RSON(ptr))  
    visit(ptr)  
    End if
3. Stop

**Code:**

```
#include <stdio.h>
```



```
#include <stdlib.h>

struct node {
    int data;
    struct node *leftChild, *rightChild;
};

struct node *root = NULL;

struct node *newNode(int item){
    struct node *temp = (struct node *)malloc(sizeof(struct node));
    temp->data = item;
    temp->leftChild = temp->rightChild = NULL;
    return temp;
}

void insert(int data){
    struct node *tempNode = (struct node*) malloc(sizeof(struct node));
    struct node *current;
    struct node *parent;
    tempNode->data = data;
    tempNode->leftChild = NULL;
    tempNode->rightChild = NULL;

    //if tree is empty
    if(root == NULL) {
        root = tempNode;
```



```
} else {  
    current = root;  
    parent = NULL;  
    while(1) {  
        parent = current;  
  
        //go to left of the tree  
        if(data < parent->data) {  
            current = current->leftChild;  
  
            //insert to the left  
            if(current == NULL) {  
                parent->leftChild = tempNode;  
                return;  
            }  
        }  
        //go to right of the tree  
    } else {  
        current = current->rightChild;  
  
        //insert to the right  
        if(current == NULL) {  
            parent->rightChild = tempNode;  
            return;  
        }  
    }  
}
```



```
    }  
    }  
    }  
}  
  
struct node* search(int data){  
    struct node *current = root;  
    printf("\n\nVisiting elements: ");  
    while(current->data != data) {  
        if(current != NULL) {  
            printf("%d ",current->data);  
  
            //go to left tree  
            if(current->data > data) {  
                current = current->leftChild;  
            } //else go to right tree  
            else {  
                current = current->rightChild;  
            }  
  
            //not found  
            if(current == NULL) {  
                return NULL;  
            }  
        }  
    }  
}
```



```
    }  
    }  
}  
return current;  
}
```

// Inorder Traversal

```
void inorder(struct node *root){  
    if (root != NULL) {  
        inorder(root->leftChild);  
        printf("%d -> ", root->data);  
        inorder(root->rightChild);  
    }  
}
```

// Preorder Traversal

```
void preorder(struct node *root){  
    if (root != NULL) {  
        printf("%d -> ", root->data);  
        preorder(root->leftChild);  
        preorder(root->rightChild);  
    }  
}
```





// Postorder Traversal

```
void postorder(struct node *root){  
    if (root != NULL) {  
        printf("%d -> ", root->data);  
        postorder(root->leftChild);  
        postorder(root->rightChild);  
    }  
}
```

```
int main(){  
    insert(10);  
    insert(14);  
    insert(19);  
    insert(26);  
    insert(27);  
    insert(31);  
    insert(33);  
    insert(35);  
    insert(42);  
    insert(44);  
    printf("Insertion done\n");  
    printf("\nPreorder Traversal: ");  
    preorder(root);
```



```
printf("\nInorder Traversal: ");  
  
inorder(root);  
  
printf("\nPostorder Traversal: ");  
  
postorder(root);  
  
struct node* k;  
  
k = search(35);  
  
if(k != NULL)  
  
    printf("\nElement %d found", k->data);  
  
else  
  
    printf("\nElement not found");  
  
return 0;  
  
}
```

### Output:

```
Insertion done  
  
Preorder Traversal: 10 -> 14 -> 19 -> 26 -> 27 -> 31 -> 33 -> 35 -> 42 -> 44 ->  
Inorder Traversal: 10 -> 14 -> 19 -> 26 -> 27 -> 31 -> 33 -> 35 -> 42 -> 44 ->  
Postorder Traversal: 10 -> 14 -> 19 -> 26 -> 27 -> 31 -> 33 -> 35 -> 42 -> 44 ->  
  
Visiting elements: 10 14 19 26 27 31 33  
Element 35 found  
-----
```

**Conclusion:** Binary trees have many applications in computer science, including data storage and retrieval, expression evaluation, network routing, and game AI.