Assignment No. 5

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Q.1 Create a Binary Search Tree and perform recursive and non-recursive, insert and search operations.

Binary Search Tree

A binary tree in which each internal node x stores an element such that the element stored in the left subtree of x are less than or equal to x and elements stored in the right subtree of x are greater than or equal to x. This is called binary-search-tree property.

Binary search tree is a node-based binary tree data structure which has the following properties:

1. The left subtree of a node contains only nodes with keys lesser than the node's key.
2. The right subtree of a node contains only nodes with keys greater than the node's key.
3. The left and right subtree each must also be a binary search tree.

Algorithm:

Insert:

Step 1: Create a new BST node and assign values to it.

Step 2: insert (node, data)

i) If root == NULL,

return the new node to the calling function.

ii) if root->data > data

call the insert function with root=>right and assign the return value in root=>right.

root->left = insert(root->left, data)

iii) else

call the insert function with root->left and assign the return value in root=>left.

Root->right = insert(root->right, data)

Step 3: Finally, return the original root pointer to the calling function.

Search:

Step 1: Repeat Steps 2,3 & 4 Until element Not find && Root! = NULL

Step 2: If item Equal to Root Data Then print message item present.

Step 3: Else If item Greater that Equal that Root Data Then Move Root to Right.

Step 4: Else Move Root to Left.

Step 5: Stop

Recursive Traversal:

inorder(temp):

Step 1: If temp != NULL

Step 2: inorder(temp->Left);

Step 3: Print temp->Data

Step 4: inorder(temp->Right);

preorder(temp):

Step 1: If temp != NULL

Step 2: Print temp->Data;

Step 3: preorder(temp->Left);

Step 4: preorder(temp->Right);

postorder(temp):

Step 1: If temp != NULL

Step 2: postorder(temp->Left);

Step 3: postorder(temp->Right);

Step 4: Print temp->Data;

Non-Recursive Traversal:

inorder(temp):

Step 1: while temp!=NULL

i) push(temp),

ii) temp=temp->left

Step 2: while top! = -1

i) r = pop()

ii) print r->data

iii) r = r->right

iv) while r! = NULL

i) push(r)

ii) r = r->left

preorder(temp):

Step 1: while temp! =NULL

i) print temp->data,

ii) push(temp),

iii) temp=temp->left

Step 2: while top=-1

i) r = pop(),

ii) r = r->right,

iv) while r! = NULL

i) print r->data,

ii) push(r),

ii) r = r->left

Program:

```c
#include <stdio.h>
#include <malloc.h>
struct node *st[100];
int top = -1;

// BST operation = create , insert ,traversing and search
struct node
{
    int data;
    struct node *left;
    struct node *right;
} * root;
// ---------------------------------------------
struct node *insert(struct node *temp, int data)
{
    struct node *r;
    r = malloc(sizeof(struct node));
    r->data = data;
    r->left = r->right = NULL;
    if (temp == NULL)
    {
        return r;
    }
    if (temp->data > data)
    {
        temp->left = insert(temp->left, data);
    }
    else
    {
        temp->right = insert(temp->right, data);
    }
    return temp;
}
// ---------------------------------------------
struct node *create(struct node *temp)
{
    struct node *r;
    int i, n, x;
    printf("\n How many nodes you want to insert: ");
    scanf("%d", &n);
    for (i = 0; i < n; i++)
    {
        printf("\nEnter Data for Node: ");
        scanf("%d", &x);
        temp = insert(temp, x);
    }
    return temp;
```

```c
}
// ---------------------------------------------
struct node *search(struct node *temp, int data)
{
    if (temp == NULL)
    {
        printf("\nData is not present");
        return NULL;
    }
    if (temp->data == data)
    {
        printf("\nData is present\n");
        return temp;
    }
    if (temp->data > data)
    {
        return search(temp->left, data);
    }
    else
    {
        return search(temp->right, data);
    }
}
// ---------------------------------------------
void inorder(struct node *temp)
{
    if (temp != NULL)
    {
        inorder(temp->left);
        printf("\t%d", temp->data);
        inorder(temp->right);
    }
}
void preorder(struct node *temp)
{
    if (temp != NULL)
    {
        printf("\t%d", temp->data);
        preorder(temp->left);
        preorder(temp->right);
    }
}
void postorder(struct node *temp)
{
    if (temp != NULL)
    {
        postorder(temp->left);
        postorder(temp->right);
```

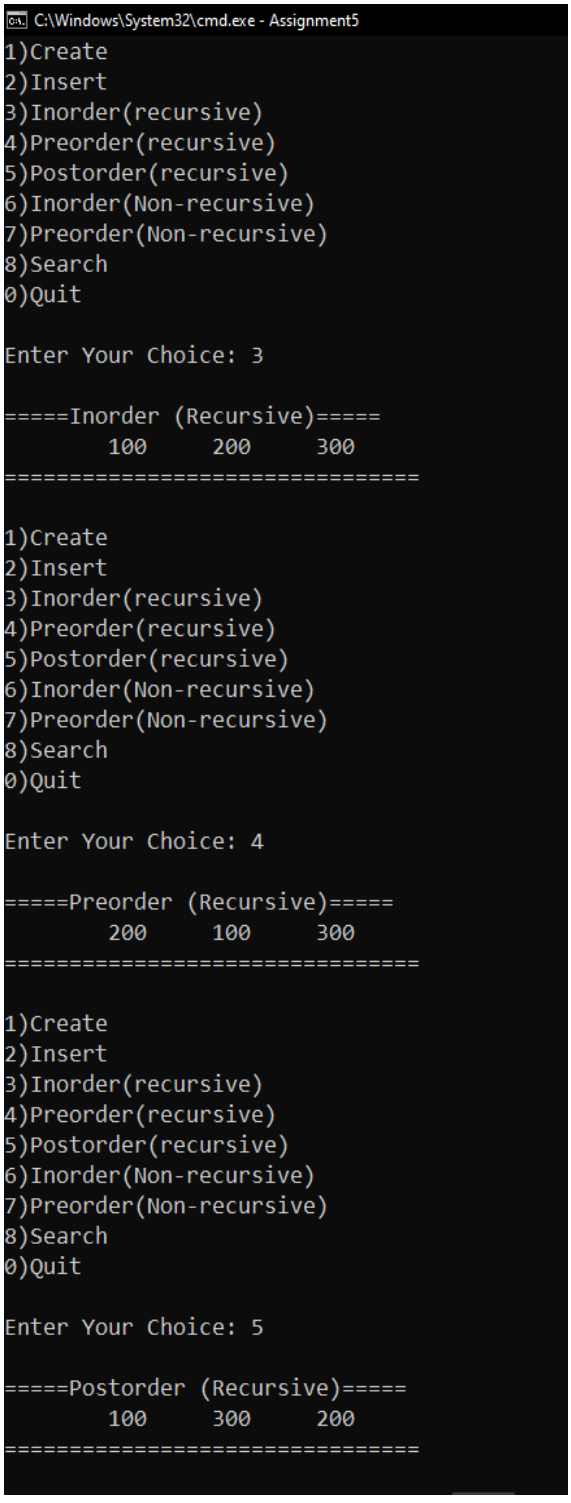
```
        printf("\t%d", temp->data);
    }
}
// -----------------------------------------------
void push(struct node *temp)
{
    st[++top] = temp;
}
struct node *pop()
{
    return st[top--];
}
void inordernr(struct node *temp)
{
    struct node *r;
    while (temp != NULL)
    {
        push(temp);
        temp = temp->left;
    }

    while (top != -1)
    {
        r = pop();
        printf("\t%d", r->data);
        r = r->right;
        while (r != NULL)
        {
            push(r);
            r = r->left;
        }
    }
}
void preordernr(struct node *temp)
{
    struct node *r;
    while (temp != NULL)
    {
        printf("\t%d", temp->data);
        push(temp);
        temp = temp->left;
    }

    while (top != -1)
    {
        r = pop();
        r = r->right;
        while (r != NULL)
```

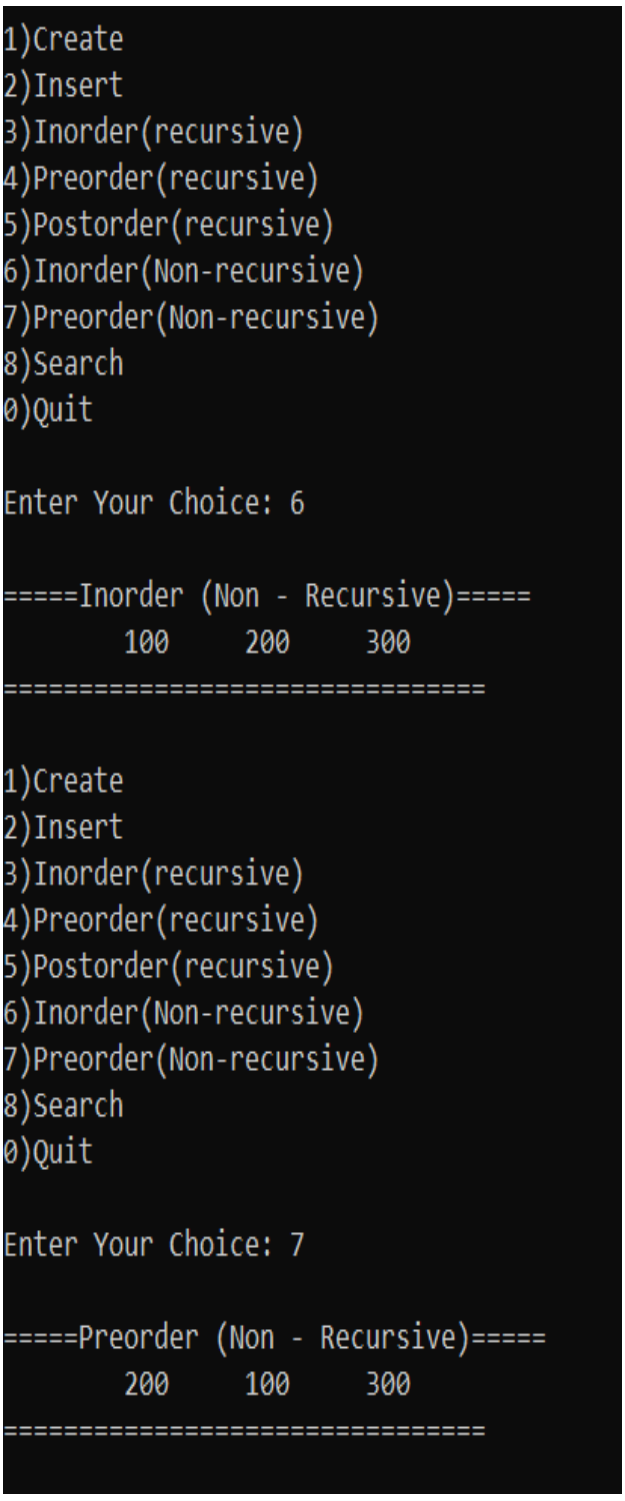
```
        {
            printf("\t%d", r->data);
            push(r);
            r = r->left;
        }
    }
}

void main()
{
    int ch, choice, ele, ins;
    struct node *temp, *temp1;
    root = NULL;
    do
    {
        printf("\n1)Create\n2)Insert\n3)Inorder(recursive)\n4)Preorder(recursi
ve)\n5)Postorder(recursive)\n6)Inorder(Non-recursive)\n7)Preorder(Non-
recursive)\n8)Search\n0)Quit\n\nEnter Your Choice: ");
        scanf("%d", &choice);
        switch (choice)
        {
        case 1:
            temp = root;
            root = create(root);
            temp = root;
            break;
        case 2:
            printf("Enter the data you want to insert: ");
            scanf("%d", &ins);
            insert(temp, ins);
            break;
        case 3:
            printf("\n=====Inorder (Recursive)=====\n");
            inorder(temp);
            printf("\n================================\n");
            break;
        case 4:
            printf("\n=====Preorder (Recursive)=====\n");
            preorder(temp);
            printf("\n================================\n");
            break;
        case 5:
            printf("\n=====Postorder (Recursive)=====\n");
            postorder(temp);
            printf("\n================================\n");
            break;
        case 6:
            printf("\n=====Inorder (Non - Recursive)=====\n");
```

```
            inordernr(temp);
            printf("\n================================\n");
            break;
        case 7:
            printf("\n=====Preorder (Non - Recursive)=====\n");
            preordernr(temp);
            printf("\n================================\n");
            break;
        case 8:
            printf("\nEnter the data do you want to search: ");
            scanf("%d", &ele);
            printf("\n=====Search Result=====\n");
            search(root, ele);
            printf("\n================================\n");
            break;
        default:
            break;
        }
    } while (choice != 0);
}
```

Output:

```
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit

Enter Your Choice: 1

 How many nodes you want to insert: 3

Enter Data for Node: 200

Enter Data for Node: 100

Enter Data for Node: 300
```


C:\Windows\System32\cmd.exe - Assignment5
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit
Enter Your Choice: 3
=====Inorder (Recursive)=====
100 200 300
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit
Enter Your Choice: 4
=====Preorder (Recursive)=====
200 100 300
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit
Enter Your Choice: 5
=====Postorder (Recursive)=====
100 300 200


1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit
Enter Your Choice: 6
=====Inorder (Non - Recursive)=====
100 200 300
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit
Enter Your Choice: 7
=====Preorder (Non - Recursive)=====
200 100 300

```
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit

Enter Your Choice: 2
Enter the data you want to insert: 400

1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit

Enter Your Choice: 3

=====Inorder (Recursive)=====
        100     200     300     400
================================
```

```
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit

Enter Your Choice: 2
Enter the data you want to insert: 150

1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit

Enter Your Choice: 3

=====Inorder (Recursive)=====
        100     150     200     300     400
================================
```

```
1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit

Enter Your Choice: 8

Enter the data do you want to search: 300

=====Search Result=====

Data is present

================================

1)Create
2)Insert
3)Inorder(recursive)
4)Preorder(recursive)
5)Postorder(recursive)
6)Inorder(Non-recursive)
7)Preorder(Non-recursive)
8)Search
0)Quit

Enter Your Choice: 8

Enter the data do you want to search: 250

=====Search Result=====

Data is not present
================================
```