Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Department of Information Technology

COURSE CODE: DJS22ITL302

COURSE NAME: Data Structure Laboratory

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DATE:

CLASS: II-Batch1

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Experiment No. 06

CO/LO: CO1

Aim: To implement BST and various operations.

Theory: A binary search tree is a (BST) binary tree datastructure where each node has atmost two child nodes. The value of each node is such that the value of root and value of nodes in right subtree is greater than the value of root.

Advantages :-

1. Searching and Retrieval
2. Caching
3. Expression tree

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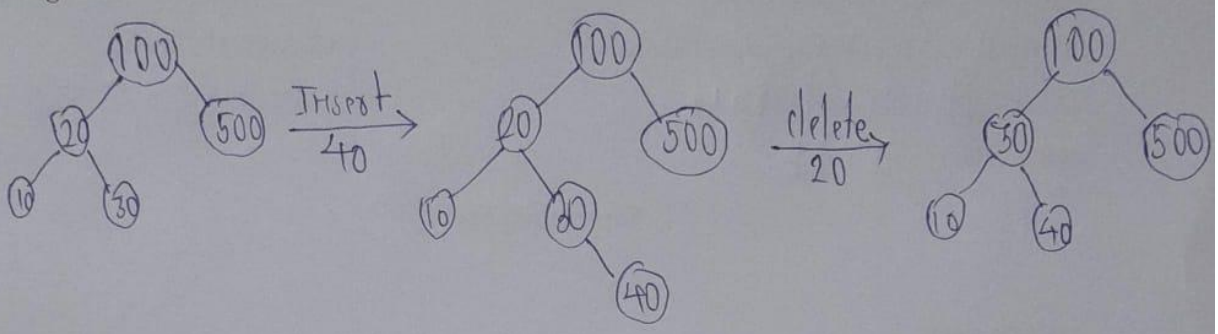
Diagram:



Conclusion :

Hence we have implemented binary search tree and its various operations.

```c
#include <stdio.h>
#include <conio.h>
#include <stdlib.h>
#include <stdbool.h>
#include <math.h>

struct node
{
    int data;
    struct node *left;
    struct node *right;
} *root = NULL, *newnode;

void insertAt(struct node *new, struct node *t)
{
    if (root == NULL)
    {
        root = newnode;
    }
    else if (t->data > new->data)
    {
        if (t->left == NULL)
        {
            t->left = new;
        }
        else
        {
            insertAt(new, t->left);
        }
    }
    else if (t->data < new->data)
    {
        if (t->right == NULL)
        {
            t->right = new;
        }
        else
        {
            insertAt(new, t->right);
        }
    }
}

void insert(int n)
{
    newnode = (struct node *)malloc(sizeof(struct node));
    newnode->data = n;
    newnode->left = NULL;
    newnode->right = NULL;
    insertAt(newnode, root);
}

void display(struct node *temp)
{
    if (temp != NULL)
    {
        display(temp->left);
        printf("%d\n", temp->data);
        display(temp->right);
    }
}

int ancestor(struct node *root, int n1, int n2)
{
    if (root->data > n1 && root->data > n2)
    {
        ancestor(root->left, n1, n2);
    }
    else if (root->data < n1 && root->data < n2)
    {
        ancestor(root->right, n1, n2);
    }
    else if (root->data > n1 && root->data < n2)
    {
        return root->data;
```

```c
}
}

void displayrange(struct node *temp, int n1, int n2)
{
    if (temp != NULL)
    {
        displayrange(temp->left, n1, n2);
        if (temp->data > n1 && temp->data < n2)
        {
            printf("%d\n", temp->data);
        }
        displayrange(temp->right, n1, n2);
    }
}

int heightTree(struct node *root)
{
    int ans;
    if (root == NULL)
    {
        return 0;
    }
    else
    {
        int leftHeight = heightTree(root->left);
        int rightHeight = heightTree(root->right);
        if (leftHeight > rightHeight)
        {
            ans = leftHeight + 1;
        }
        else
        {
            ans = rightHeight + 1;
        }
    }
    return ans;
}

void smallest(struct node *root)
{
    if (root->left != NULL)
    {
        smallest(root->left);
    }
    else
    {
        printf("%d", root->data);
    }
}

void largest(struct node *root)
{
    if (root->right != NULL)
    {
        largest(root->right);
    }
    else
    {
        printf("%d", root->data);
    }
}

bool balancedbst(struct node *root, int height)
{
    int leftHeight = 0, rightHeight = 0;
    int l = 0, r = 0;
    if (root == NULL)
    {
        height = 0;
        return 1;
    }
    l = balancedbst(root->left, leftHeight);
    r = balancedbst(root->right, rightHeight);
    height = (leftHeight > rightHeight ? leftHeight : rightHeight) + 1;
```

```c
if ((leftHeight - rightHeight >= 2) || (rightHeight - leftHeight >= 2))
        return 0;
    else
        return l && r;
}

void main()
{
    int ch;
    int n;
    printf("number of lement in the tree");
    scanf("%d", &n);
    printf("enter the elements");
    int a[n];
    for (int i = 0; i < n; i++)
    {
        scanf("%d", &a[i]);
        insert(a[i]);
    }
    do
    {
    printf("\nEnter the operation:\n1.ancestor\n2.hieght of the tree\n3.display range\n 4.smallest \n5.largest \n6.balanced \n7.Exit");
    scanf("%d",&ch);
    switch (ch)
    {
    case 1:
    {
        int n1;
        int n2;
        printf("enter the two numbers of which ancestor has to be found");
        scanf("%d%d", &n1, &n2);
        printf("Ancestor of %d and %d :%d", n1, n2, ancestor(root, n1, n2));
    }
    break;
    case 2:
    {
        printf("the hieght of the tree is :%d", heightTree(root));
    }
    break;
    case 3:
    {
        int n1;
        int n2;
        printf("enter the two numbers");
        scanf("%d%d", &n1, &n2);
        printf("the numbers between the two numbers in a tree are:");
        displayrange(root, n1, n2);
    }
    break;
    case 4:
    {
        printf("the smallest number of the tree is:");
        smallest(root);
    }
    break;
    case 5:
    {
        printf("the largest number of the tree is");
        largest(root);
    }
    break;
    case 6:
    {
        if (balancedbst(root, heightTree(root)))
            printf("The tree is balanced");
        else
            printf("The tree is not balanced");
    }
    break;
    }
        } while (ch != 7);
}
```

Output :

```
Enter the operation:
1)ancestor
2)hieght of the tree
3)display range
 4)smallest
5)largest 6)balanced
7)Exit
1
enter the two numbers of which ancestor has to be found 76 105
Ancestor of 76 and 105 :80
Enter the operation:
1)ancestor
2)hieght of the tree
3)display range
 4)smallest
5)largest 6)balanced
7)Exit
2
the hieght of the tree is :4
Enter the operation:
1)ancestor
2)hieght of the tree
3)display range
 4)smallest
5)largest 6)balanced
7)Exit
3
enter the two numbers 25 82
the numbers between the two numbers in a tree are:32
40
76
80
```

```
Enter the operation:
1)ancestor
2)hieght of the tree
3)display range
 4)smallest
5)largest 6)balanced
7)Exit
4
the smallest number of the tree is:16
Enter the operation:
1)ancestor
2)hieght of the tree
3)display range
 4)smallest
5)largest 6)balanced
7)Exit
5
the largest number of the tree is105
Enter the operation:
1)ancestor
2)hieght of the tree
3)display range
 4)smallest
5)largest 6)balanced
7)Exit
6
The tree is balanced
Enter the operation:
1)ancestor
2)hieght of the tree
3)display range
 4)smallest
5)largest 6)balanced
7)Exit
7
```

```
number of lement in the tree 10
enter the elements
40 32 80 95 105 76 23 82 16 25
```