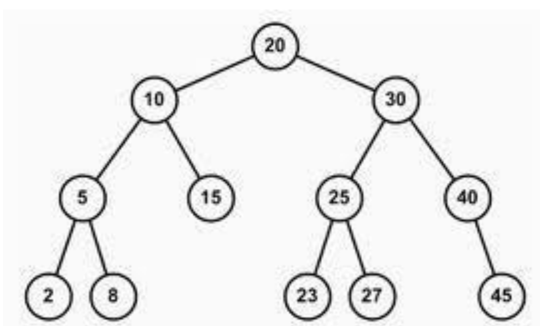
MAYANK GUPTA 20BCE1538

Programme	:	**B.Tech**	Semester	:	**Fall 2021-22**
Course	:	**Data structures and Algorithms**	Code	:	**CSE2003**
Faculty	:	**Dr.V.Vani**	Slot	:	**L27+L28**

AIM Depth First Search and Breadth First Search

AIM

1. Consider the below tree with 12 nodes, start from the root node and explore all the nodes in each level and reach the node 45.




```
#include <iostream>
#include <queue>

template <typename T>
class BinaryTreeNode {
  public:
   T  data;
   BinaryTreeNode<T> *left;
   BinaryTreeNode<T> *right;

   BinaryTreeNode(T data) {
      this->data = data;
      left = NULL;
      right = NULL;
   }
   BinaryTreeNode() {
      if (left) delete left;
      if (right) delete right;
```

```
    }
};

using namespace std;
bool searchInBST(BinaryTreeNode<int> *root , int k) {
	// Write your code here
    if(root==NULL){
        return false;
    }
    if(root->data==k){
        return true;
    }
    else if(root->data>k){
        	return searchInBST(root->left ,k);
    }
    else if(root->data<k){
        return searchInBST(root->right ,k);
    }

}

BinaryTreeNode<int> *takeInput() {
    int rootData;
    cin >> rootData;
    if (rootData == -1) {
        return NULL;
    }
    BinaryTreeNode<int> *root = new BinaryTreeNode<int>(rootData);
    queue<BinaryTreeNode<int> *> q;
    q.push(root);
    while (!q.empty()) {
        BinaryTreeNode<int> *currentNode = q.front();
        q.pop();
        int leftChild, rightChild;
        cin >> leftChild;
        if (leftChild != -1) {
            BinaryTreeNode<int> *leftNode = new BinaryTreeNode<int>(leftChild);
            currentNode->left = leftNode;
            q.push(leftNode);
        }
        cin >> rightChild;
        if (rightChild != -1) {
            BinaryTreeNode<int> *rightNode =
                new BinaryTreeNode<int>(rightChild);
            currentNode->right = rightNode;
            q.push(rightNode);
        }
    }
```

```
    return root;
}
void printLevelWise(BinaryTreeNode<int> *root) {
        // Write your code here
    queue<BinaryTreeNode<int>*> pendingNode;
    pendingNode.push(root);
    while(!pendingNode.empty()){
        BinaryTreeNode<int> *front=pendingNode.front();
            pendingNode.pop();
        cout<<front->data<<":";
        if(front->left!=NULL){
            cout<<"L:"<<front->left->data;
            pendingNode.push(front->left);
        }
        else{
            cout<<"L:"<<-1;
        }
        cout<<",";
        if(front->right!=NULL){
            cout<<"R:"<<front->right->data;
            pendingNode.push(front->right);
        }
        else{
            cout<<"R:"<<-1;
        }
        cout<<endl;
    }
}
int main() {
    BinaryTreeNode<int> *root = takeInput();
    int k;
    cin >> k;
    cout << ((searchInBST(root, k)) ? "true" : "false")<<endl;
    printLevelWise(root);
    if(searchInBST(root,k)){
        printLevelWise(root);
    }
    else{
        cout<<"Element not present";
    }
    delete root;
}
```

BFS algorithm

A standard BFS implementation puts each vertex of the graph into one of two categories:

- Visited
- Not Visited

The purpose of the algorithm is to mark each vertex as visited while avoiding cycles.

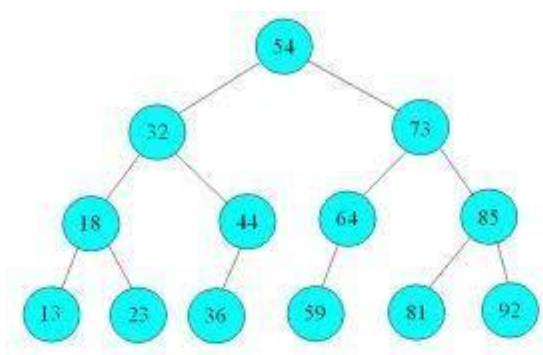
The algorithm works as follows:

- Start by putting any one of the graph's vertices at the back of a queue.
- Take the front item of the queue and add it to the visited list.
- Create a list of that vertex's adjacent nodes. Add the ones which aren't in the visited list to the back of the queue.
- Keep repeating steps 2 and 3 until the queue is empty.
- The graph might have two different disconnected parts so to make sure that we cover every vertex, we can also run the BFS algorithm on every node

```
true
20:L:10,R:30
10:L:5,R:15
30:L:25,R:40
5:L:2,R:8
15:L:-1,R:-1
25:L:23,R:27
40:L:-1,R:45
2:L:-1,R:-1
8:L:-1,R:-1
23:L:-1,R:-1
27:L:-1,R:-1
45:L:-1,R:-1
```

AIM

2. Consider the below tree with 13 nodes, start from the root node and explore all the nodes and reach the node 92 using DFS.




```
#include <iostream>
#include <queue>

template <typename T>
class BinaryTreeNode {
  public:
   T  data;
   BinaryTreeNode<T> *left;
   BinaryTreeNode<T> *right;
```

```
    BinaryTreeNode(T data) {
        this->data = data;
        left = NULL;
        right = NULL;
    }
    BinaryTreeNode() {
        if (left) delete left;
        if (right) delete right;
    }
};

using namespace std;
bool searchInBST(BinaryTreeNode<int> *root , int k) {
	// Write your code here
    if(root==NULL){
        return false;
    }
    if(root->data==k){
        return true;
    }
    else if(root->data>k){
            return searchInBST(root->left ,k);
    }
    else if(root->data<k){
        return searchInBST(root->right ,k);
    }

}

BinaryTreeNode<int> *takeInput() {
    int rootData;
    cin >> rootData;
    if (rootData == -1) {
        return NULL;
    }
    BinaryTreeNode<int> *root = new BinaryTreeNode<int>(rootData);
    queue<BinaryTreeNode<int> *> q;
    q.push(root);
    while (!q.empty()) {
        BinaryTreeNode<int> *currentNode = q.front();
        q.pop();
        int leftChild, rightChild;
        cin >> leftChild;
        if (leftChild != -1) {
            BinaryTreeNode<int> *leftNode = new BinaryTreeNode<int>(leftChild);
            currentNode->left = leftNode;
            q.push(leftNode);
        }
```

```
        cin >> rightChild;
        if (rightChild != -1) {
            BinaryTreeNode<int> *rightNode =
                new BinaryTreeNode<int>(rightChild);
            currentNode->right = rightNode;
            q.push(rightNode);
        }
    }
    return root;
}
void inorder(BinaryTreeNode<int> *tree)
{
    if (tree != NULL)
    {
        inorder(tree->left);
        cout << tree->data << " ";
        inorder(tree->right);
    }
}
int main() {
    BinaryTreeNode<int> *root = takeInput();
    int k;
    cin >> k;
    cout << ((searchInBST(root, k)) ? "true" : "false")<<endl;
    if(searchInBST(root,k)){
        inorder(root);
    }
    else{
        cout<<"Element not present";
    }
    delete root;
}
```

```
true
13 18 23 32 36 44 54 59 64 73 81 85 92
```

Depth First Search Algorithm

A standard DFS implementation puts each vertex of the graph into one of two categories:

- Visited
- Not Visited

The purpose of the algorithm is to mark each vertex as visited while avoiding cycles.

The DFS algorithm works as follows:

- Start by putting any one of the graph's vertices on top of a stack.
- Take the top item of the stack and add it to the visited list.

- Create a list of that vertex's adjacent nodes. Add the ones which aren't in the visited list to the top of the stack.
- Keep repeating steps 2 and 3 until the stack is empty.