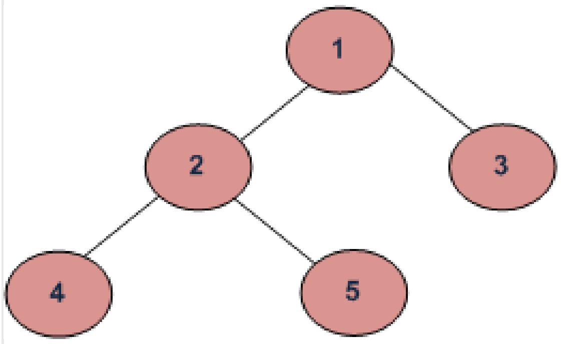
Find Minimum Depth of a Binary Tree

Given a binary tree, find its minimum depth. The minimum depth is the number of nodes along the shortest path from root node down to the nearest leaf node.

For example, minimum height of below Binary Tree is 2.



Note that the path must end on a leaf node. For example, minimum height of below Binary Tree is also 2.

```
          10
        /
      5
```

We strongly recommend you to minimize your browser and try this yourself first.

The idea is to traverse the given Binary Tree. For every node, check if it is a leaf node. If yes, then return 1. If not leaf node then if left subtree is NULL, then recur for right subtree. And if right subtree is NULL, then recur for left subtree. If both left and right subtrees are not NULL, then take the minimum of two heights.

Below is implementation of the above idea.

C++

```
// C++ program to find minimum depth of a given Binary Tree
#include<bits/stdc++.h>
using namespace std;

// A BT Node
struct Node
```

```
{
    int data;
    struct Node* left, *right;
};

int minDepth(Node *root)
{
    // Corner case. Should never be hit unless the code is
    // called on root = NULL
    if (root == NULL)
        return 0;

    // Base case : Leaf Node. This accounts for height = 1.
    if (root->left == NULL && root->right == NULL)
       return 1;

    // If left subtree is NULL, recur for right subtree
    if (!root->left)
       return minDepth(root->right) + 1;

    // If right subtree is NULL, recur for right subtree
    if (!root->right)
       return minDepth(root->left) + 1;

    return min(minDepth(root->left), minDepth(root->right)) + 1;
}

// Utility function to create new Node
Node *newNode(int data)
{
    Node *temp = new Node;
    temp->data  = data;
    temp->left  = temp->right = NULL;
    return (temp);
}

// Driver program
int main()
{
    // Let us construct the Tree shown in the above figure
    Node *root        = newNode(1);
    root->left        = newNode(2);
    root->right       = newNode(3);
    root->left->left  = newNode(4);
    root->left->right = newNode(5);
    cout << minDepth(root);
    return 0;
}
```

Java

```
/* Java implementation to find minimum depth
   of a given Binary tree */
```

```
/* Class containing left and right child of current
node and key value*/
class Node
{
    int data;
    Node left, right;
    public Node(int item)
    {
        data = item;
        left = right = null;
    }
}
public class BinaryTree
{
    //Root of the Binary Tree
    Node root;

    int minimumDepth()
    {
        return minimumDepth(root);
    }

    /* Function to calculate the minimum depth of the tree */
    int minimumDepth(Node root)
    {
        // Corner case. Should never be hit unless the code is
        // called on root = NULL
        if (root == null)
            return 0;

        // Base case : Leaf Node. This accounts for height = 1.
        if (root.left == null && root.right == null)
            return 1;

        // If left subtree is NULL, recur for right subtree
        if (root.left == null)
            return minimumDepth(root.right) + 1;

        // If right subtree is NULL, recur for right subtree
        if (root.right == null)
            return minimumDepth(root.left) + 1;

        return Math.min(minimumDepth(root.left),
                        minimumDepth(root.right)) + 1;
    }

    /* Driver program to test above functions */
    public static void main(String args[])
    {
        BinaryTree tree = new BinaryTree();
        tree.root = new Node(1);
        tree.root.left = new Node(2);
        tree.root.right = new Node(3);
        tree.root.left.left = new Node(4);
        tree.root.left.right = new Node(5);

        System.out.println("The minimum depth of "+
          "binary tree is : " + tree.minimumDepth());
    }
}
```

Python

```
# Python program to find minimum depth of a given Binary Tree

# Tree node
class Node:
    def __init__(self , key):
        self.data = key
        self.left = None
        self.right = None

def minDepth(root):
    # Corner Case.Should never be hit unless the code is
    # called on root = NULL
    if root is None:
        return 0

    # Base Case : Leaf node.This acoounts for height = 1
    if root.left is None and root.right is None:
        return 1

    # If left subtree is Null, recur for right subtree
    if root.left is None:
        return minDepth(root.right)+1

    # If right subtree is Null , recur for left subtree
    if root.right is None:
        return minDepth(root.left) +1

    return min(minDepth(root.left), minDepth(root.right))+1

# Driver Program
root = Node(1)
root.left = Node(2)
root.right = Node(3)
root.left.left = Node(4)
root.left.right = Node(5)
print minDepth(root)

# This code is contributed by Nikhil Kumar Singh(nickzuck_007)
```

Output:

```
2
```

Time complexity of above solution is O(n) as it traverses the tree only once.
Thanks to Gaurav Ahirwar for providing above solution.

The above method may end up with complete traversal of Binary Tree even when the topmost leaf is close to root. A **Better Solution** is to do Level Order Traversal. While doing traversal, returns depth of the first encountered leaf node. Below is implementation of this solution.

C

```
// C++ program to find minimum depth of a given Binary Tree
#include<bits/stdc++.h>
using namespace std;

// A Binary Tree Node
struct Node
{
    int data;
    struct Node *left, *right;
};

// A queue item (Stores pointer to node and an integer)
struct qItem
{
   Node *node;
   int depth;
};

// Iterative method to find minimum depth of Bianry Tree
int minDepth(Node *root)
{
    // Corner Case
    if (root == NULL)
        return 0;

    // Create an empty queue for level order tarversal
    queue<qItem> q;

    // Enqueue Root and initialize depth as 1
    qItem qi = {root, 1};
    q.push(qi);

    // Do level order traversal
    while (q.empty() == false)
    {
       // Remove the front queue item
       qi = q.front();
       q.pop();
```

```
        // Get details of the remove item
        Node *node = qi.node;
        int depth = qi.depth;

        // If this  is the first leaf node seen so far
        // Then return its depth as answer
        if (node->left == NULL && node->right == NULL)
           return depth;

        // If left subtree is not NULL, add it to queue
        if (node->left != NULL)
        {
           qi.node  = node->left;
           qi.depth = depth + 1;
           q.push(qi);
        }

        // If right subtree is not NULL, add it to queue
        if (node->right != NULL)
        {
           qi.node  = node->right;
           qi.depth = depth+1;
           q.push(qi);
        }
    }
    return 0;
}

// Utility function to create a new tree Node
Node* newNode(int data)
{
    Node *temp = new Node;
    temp->data = data;
    temp->left = temp->right = NULL;
    return temp;
}

// Driver program to test above functions
int main()
{
    // Let us create binary tree shown in above diagram
    Node *root = newNode(1);
    root->left = newNode(2);
    root->right = newNode(3);
    root->left->left = newNode(4);
    root->left->right = newNode(5);

    cout << minDepth(root);
    return 0;
}
```

Python

```
# Python program to find minimum depth of a given Binary Tree

# A Binary Tree node
class Node:
    # Utility to create new node
    def __init__(self , data):
        self.data = data
        self.left = None
        self.right = None

def minDepth(root):
    # Corner Case
    if root is None:
         return 0

    # Create an empty queue for level order traversal
    q = []

    # Enqueue root and initialize depth as 1
    q.append({'node': root , 'depth' : 1})

    # Do level order traversal
    while(len(q)>0):
        # Remove the front queue item
        queueItem = q.pop(0)

        # Get details of the removed item
        node = queueItem['node']
        depth = queueItem['depth']
        # If this is the first leaf node seen so far
        # then return its depth as answer
        if node.left is None and node.right is None:
            return depth

        # If left subtree is not None, add it to queue
        if node.left is not None:
            q.append({'node' : node.left , 'depth' : depth+1})

        # if right subtree is not None, add it to queue
        if node.right is not None:
            q.append({'node': node.right , 'depth' : depth+1})

# Driver program to test above function
# Lets construct a binary tree shown in above diagram
root = Node(1)
root.left = Node(2)
root.right = Node(3)
root.left.left = Node(4)
root.left.right = Node(5)
print minDepth(root)
```

```
# This code is contributed by Nikhil Kumar Singh(nickzuck_007)
```

Output:

```
2
```

Thanks to Manish Chauhan for suggesting above idea and Ravi for providing implementation.

Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above

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javatics • a month ago

Can we also do this in the following way? It seems to give correct output

```
public int getMinimumHeight(BinaryTreeNode root){
                if(root==null)
                        return 0;
                int left=getMinimumHeight(root.getLeft());
                int right=getMinimumHeight(root.getRight());

                return (1+Math.min(left, right));
        }
```

• Reply • Share ›

Amit Agarwal → javatics • 22 days ago

this will not handle the case ..as given that the path should end in leaf node. ex:

1
2 null
this should return 2 but ur code will return 1.

• Reply • Share ›

Musarrat_123 • a month ago

```
void minDepthUtil(Node *root,int level,int& minHeight)
{
        if(!root) return;

        if(!root->left && !root->right && level < minHeight)
            minHeight = level;

        minDepthUtil(root->left,level+1,minHeight);
        minDepthUtil(root->right,level+1,minHeight);
}

int minDepth(Node* root)
{
    if(!root) return 0;
    int minHeight = INT_MAX;
    minDepthUtil(root,1,minHeight);
    return minHeight;
}
```

Reply • Share ›

.NetGeek • 2 months ago

C# Implementation: http://ideone.com/8BXpYx

Reply • Share ›

Abhishek Jaiswal • 3 months ago

Just 3 Lines
http://ideone.com/oBhfvI

```
int minDepth(Node *root)
{
    if(!root) return INT_MAX;
    if(!root->left && !root->right) return 1;
    return min(minDepth(root->left), minDepth(root->right)) + 1;
}
```

1 • Reply • Share ›

.oDaniel → Abhishek Jaiswal • 19 days ago

You forgot NULL tree

```
int minDepth(Node *root)
{
    if(!root) return 0;
    return minDepthRecur(root);
}

int minDepthRecur(Node *root)
{
    if(!root) return INT_MAX;
    if(!root->left && !root->right) return 1;
    return min(minDepthRecur(root->left), minDepthRecur(root->right)) + 1;
}
```

Reply • Share ›

Abhishek Jaiswal ➦ .oDaniel • 9 days ago

See in the ideone link in the main function I have this line
if(!root) cout <<"empty\n";
else cout << minDepth(root);

which takes care of NULL tree.

^ | v • Reply • Share ›

Sonam Gupta ➦ Abhishek Jaiswal • 2 months ago

you need to add the case when either left subtree is null or right subtree is null. Otherwise you may end up picking a path that does not end at leaf node.

^ | v • Reply • Share ›

Abhishek Jaiswal ➦ Sonam Gupta • 2 months ago

That case is already taken care of I am returning INTMAX. that type of path will not be counted.
Try such test cases in ideone link

^ | v • Reply • Share ›

Sonam Gupta ➦ Abhishek Jaiswal • 2 months ago

correct.. I didn't notice that you are returning INT_MAX. Nice implementation.

^ | v • Reply • Share ›

Abhishek Jaiswal ➦ Sonam Gupta • 2 months ago

thanks :)

^ | v • Reply • Share ›

Shobhit Shekhar • 3 months ago

easy implementation using STL
http://ideone.com/MR9ygc

^ | v • Reply • Share ›

Akshay • 4 months ago

@GeeksforGeeks

tree.root= new Node(1);

tree.root.left= new Node(2);

tree.root.left.left= new Node(3);

tree.root.left.left.left= new Node(4);

tree.root.left.left.left.left= new Node(5);

For this input, the first method gives wrong output look into that.

It should give 5 as output.

Please change the code to:-

// If left subtree is NULL, recur for right subtree

if (root.left == null&&root.right!=null)

return minimumDepth(root.right) + 1;

// If right subtree is NULL, recur for left subtree

if (root.right == null&&root.left!=null)

return minimumDepth(root.left) + 1;

• Reply • Share ›

GeeksforGeeks Mod → Akshay • 4 months ago

Thanks for pointing this out. We have updated the code.

• Reply • Share ›

Nutella • 4 months ago

Well commented and more intuitive code here is the link --> http://paste.ubuntu.com/161948... :) :)

• Reply • Share ›

Vikas Gupta • 5 months ago

I am still confused, why this line of code is required.

// If left subtree is NULL, recur for right subtree

if (!root->left)

return minDepth(root->right) + 1;

// If right subtree is NULL, recur for right subtree

if (!root->right)

return minDepth(root->left) + 1;

Anyone please help me in understanding this.

• Reply • Share ›

Sonam Gupta → Vikas Gupta • 2 months ago

It is because the minimum path should always end at a leaf node. If we'll remove this line of code the minimum path will not end at leaf node always. For Example:

consider a tree with only two nodes with 1 as root and 2 as its left child. Without the above lines of code that you have mentioned, the minimum height returned will be 1 but it should be 2.

1 ^ | v • Reply • Share ›

Vikas Gupta → Sonam Gupta • 5 days ago

Got it. Thanks.

^ | v • Reply • Share ›

Nutella → Vikas Gupta • 4 months ago

I can try!!! The line you mentioned covers the case of skew tree.If Suppose the tree is like

```
1
\
2
\
3
```

If the line you pointed not included than equation will be 1+min(Min_height_of_left,Min_height_of_right) which will return 1 as minimum height for the tree above as height of left subtree at 1 is 0(so 1+Min_height of left) which is clearly wrong as we can see minimum height should be 3.So if any of the subtree is not present we have to include that seperatly.See my code it is much more intuitive (http://paste.ubuntu.com/161948...)

1 ^ | v • Reply • Share ›

Deepak Prajapati • 5 months ago

```
int minDepth(Node *root,int pathcost)
{
// Corner Case
if (root == NULL)
return 0;
else if(root->left==NULL&&root->right==NULL){
return pathcost;
}else if(root->left!=NULL&&root->right==NULL){
return minDepth(root->left,pathcost+1);
}else if(root->left==NULL&&root->right!=NULL){
return minDepth(root->right,pathcost+1);
}else{
return min(minDepth(root->right,pathcost+1),minDepth(root->right,pathcost+1));

}
return 0;
}
```

see more

^ | v • Reply • Share ›

^ | ˅ • Reply • Share ›

Sachin Singh • 5 months ago

My solution is here.

http://ideone.com/nsPVOS

^ | ˅ • Reply • Share ›

Akshat Misra • 6 months ago

// If left subtree is NULL, recur for right subtree

if (root.left != null)

return minimumDepth(root.right) + 1;

// If right subtree is NULL, recur for right subtree

if (root.right != null)

return minimumDepth(root.left) + 1;

The above section in first Java solution is wrong

It should be modified to :

// If left subtree is NULL, recur for right subtree

if (root.left == null)

return minimumDepth(root.right) + 1;

// If right subtree is NULL, recur for right subtree

if (root.right == null)

return minimumDepth(root.left) + 1;

1 ^ | ˅ • Reply • Share ›

Vyacheslav • 6 months ago

Hi!

I guess both the Algorithm will work even without these extra if checks, when you call only one NOT NULL branch..

^ | ˅ • Reply • Share ›

Vyacheslav ➦ Vyacheslav • 6 months ago

Ah, right, They are needed. Thank you Ayan

^ | ˅ • Reply • Share ›

Ayushrazz Choudhary • 7 months ago

```
int mindeft(struct node *root)
{
if(root==NULL)
return INT_MAX;
if(!root->lchild && !root->rchild)
return 1;
return 1+min(mindeft(root->lchild),mindeft(root->rchild));
}
```

Reply • Share ›

surbhijain93 • 7 months ago

```
int minDepth(node *root,int *min,int count)

{

if(root==NULL)

return 0;

if(root->left==NULL && root->right==NULL)

{

if(*min>count)

*min=count;

}

minDepth(root->left,min,count+1);

minDepth(root->right,min,count+1);

return *min;

}
```

Reply • Share ›

r2t2 • 8 months ago

Here's my code in Java. It compiles fine on my machine but the webIDE complains about a missing ">".

http://code.geeksforgeeks.org/...

Reply • Share ›

m3ghd007 • 10 months ago

int minDepth(Node *root)

int minDepth(Node* root)
{
return (root == NULL) ? 0 : min(minDepth(root->left), minDepth(root->right)) + 1;
}

Only this is sufficient.
Intermediate 3 checks are redundant.

• Reply • Share ›

r2t2 m3ghd007 • 8 months ago

Actually, this violates the rule that the path of minDepth terminates in a leaf node. It was my first solution as well but realized the error.

• Reply • Share ›

Dev • 10 months ago

Level order traversal using Java

http://code.geeksforgeeks.org/...

• Reply • Share ›

Subi114 • a year ago

Won't this simply work?

private static int MinHeightFinder(TreeNode root) {

if(root == null)
return 0;

return Math.min(MinHeightFinder(root.getLeft()), MinHeightFinder(root.getRight())) + 1;

}

• Reply • Share ›

Ayan Subi114 • 10 months ago

That would be wrong. Consider the following example:
1
/ \
2 3
/ \ \
4 5 6

The min height of this tree is 3. However, your function would return 2 as the min. Since, node 3 doesn't have a left child, and would return min(0,1)+1 which is 1 and is wrong. Node 3 should actually return 2. A similar Does that make sense?

• Reply • Share ›

Hiccup Subi114 • a year ago

This solution will work but we care about optimization. Think that tree is pretty deep and we are going deeper than looking near to root. This is not good in practice.

Any way in your approach we end up using system stack but suggested approach uses queue which is better. As soon as we get leaf we stop as our goal is to find
minimum depth.
This is level order/ BFS traversal.

Hope you now clear.

1 • Reply • Share ›

r2t2 Hiccup • 8 months ago

@Hiccup, if the question asked for maxDepth instead of minDepth, would DFS be better? or is there anything better than DFS?

• Reply • Share ›

Sahil • a year ago

Why can't we simply store the level being traversed in a variable rather than storing depth along with each node? We can simply return the level being traversed + 1 on finding a leaf node.

• Reply • Share ›

Hiccup Sahil • a year ago

You can do that with extra work. You need a marker element in a queue. This will
seperate levels. As soon as you see maker after getting front from queue you increase level. This will work.

But above solution is also good as int space is not huge for each item..and we push item in queue on demand basic and do not allocate for all nodes up front

Hope now you clear...

• Reply • Share ›

Tyrion • a year ago

In recursive solution, except the first if condition remaining if conditions are redundant.

1 • Reply • Share ›

vinit • a year ago

why do we need this extra code ? Why can't we have a check for NULL in the function itself (ex: if (root == NULL) return 0, and call 1+ min(left, right)directly ?
// If left subtree is NULL, recur for right subtree
if (!root->left)
return minDepth(root->right) + 1;

// If right subtree is NULL, recur for right subtree
if (!root->right)
return minDepth(root->left) + 1;

^ | ˅ • Reply • Share ›

Dev • a year ago

If you are using recursion, would this following snippet not work?

```
public int minLevel(Node node) {
if(node == null) return 0;
int left = maxLevel(node.left);
int right = maxLevel(node.right);
return Math.min(left, right)+1;
}
```

^ | ˅ • Reply • Share ›

Luis Gomez → Dev • a year ago

your approach is good and will work, but using BFS instead of DFS works better for this case.

use BFS and break the loop when you find a node that does not add a any node to the queue (either left or right)

^ | ˅ • Reply • Share ›

Dev → Luis Gomez • a year ago

Thanks for the reply. I tried that as well Here is the code for it:

http://code.geeksforgeeks.org/...

^ | ˅ • Reply • Share ›

nitin • a year ago

Another approach using recursion -
http://ideone.com/oJMH2D
Time Complexity - O(n)

^ | ˅ • Reply • Share ›

Tomer Ben David • a year ago

How about this scala impl? https://github.com/tomer-ben-d...

^ | ˅ • Reply • Share ›

code down • a year ago

For first solution, it might be a good idea to have corner case in main function and other code in a util function, so that we don't execute the corner case in every recursive call.

^ | ˅ • Reply • Share ›

Manish Chauhan • a year ago

Use level order traversal. In worst case it will be "n" but will find the solution much faster for unbalanced trees.

4 • Reply • Share ›

Ravi Manish Chauhan • a year ago

C++ code http://code.geeksforgeeks.org/...

2 • Reply • Share ›

GeeksforGeeks Mod Manish Chauhan • a year ago

Thanks for suggesting this solution. We will soon be adding it to the original post.

1 • Reply • Share ›

Mysterious Mind GeeksforGeeks • a year ago

@GeeksforGeeks improved DFS (Backtracking) http://code.geeksforgeeks.org/...