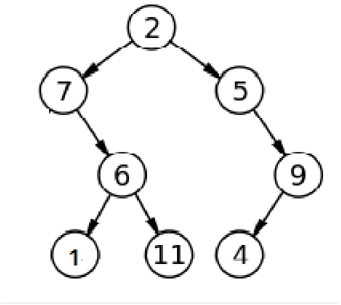
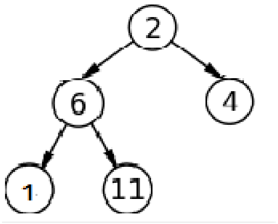
Given a binary tree, how do you remove all the half nodes?

Given A binary Tree, how do you remove all the half nodes (which has only one child)? Note leaves should not be touched as they have both children as NULL.

For example consider the below tree.



Nodes 7, 5 and 9 are half nodes as one of their child is Null. We need to remove all such half nodes and return the root pointer of following new tree.



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

The idea is to use post-order traversal to solve this problem efficiently. We first process the left children, then right children, and finally the node itself. So we form the new tree bottom up, starting from the leaves towards the root. By the time we process the current node, both its left and right subtrees were already processed. Below is the implementation of this idea.

C

```
// C program to remove all half nodes
#include <stdio.h>
#include <stdlib.h>

struct node
{
    int data;
    struct node* left, *right;
};

struct node* newNode(int data)
{
    struct node* node = (struct node*)
                        malloc(sizeof(struct node));
    node->data = data;
    node->left = node->right = NULL;
    return(node);
}

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

// Removes all nodes with only one child and returns
// new root (note that root may change)
struct node* RemoveHalfNodes(struct node* root)
{
    if (root==NULL)
        return NULL;

    root->left  = RemoveHalfNodes(root->left);
    root->right = RemoveHalfNodes(root->right);

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

    /* if current nodes is a half node with left
       child NULL left, then it's right child is
       returned and replaces it in the given tree */
    if (root->left==NULL)
    {
        struct node *new_root = root->right;
        free(root); // To avoid memory leak
        return new_root;
    }


    /* if current nodes is a half node with right
       child NULL right, then it's right child is
       returned and replaces it in the given tree  */
    if (root->right==NULL)
    {
        struct node *new_root = root->left;
        free(root); // To avoid memory leak
        return new_root;
    }

    return root;
}

// Driver program
int main(void)
{
    struct node*NewRoot=NULL;
    struct node *root = newNode(2);
    root->left        = newNode(7);
    root->right       = newNode(5);
    root->left->right = newNode(6);
    root->left->right->left=newNode(1);
    root->left->right->right=newNode(11);
    root->right->right=newNode(9);
    root->right->right->left=newNode(4);

    printf("Inorder traversal of given tree \n");
    printInoder(root);

    NewRoot = RemoveHalfNodes(root);

    printf("\nInorder traversal of the modified tree \n");
    printInoder(NewRoot);
    return 0;
}
```

Java

```
// Java program to remove half nodes
class Node
{
    int data;
    int data;
    Node left, right;

    Node(int item)
    {
        data = item;
        left = right = null;
    }
}

class BinaryTree
{
    Node root;

    void printInorder(Node node)
    {
        if (node != null)
        {
            printInorder(node.left);
            System.out.print(node.data + " ");
            printInorder(node.right);
        }
    }

    // Removes all nodes with only one child and returns
    // new root (note that root may change)
    Node RemoveHalfNodes(Node node)
    {
        if (node == null)
            return null;

        node.left = RemoveHalfNodes(node.left);
        node.right = RemoveHalfNodes(node.right);

        if (node.left == null && node.right == null)
            return node;

        /* if current nodes is a half node with left
         child NULL left, then it's right child is
         returned and replaces it in the given tree */
        if (node.left == null)
        {
            Node new_root = node.right;
            return new_root;
        }

        /* if current nodes is a half node with right
           child NULL right, then it's right child is
           returned and replaces it in the given tree  */
        if (node.right == null)
        {
            Node new_root = node.left;
            return new_root;
        }

        return node;
    }

    // Driver program
    public static void main(String args[])
    {
        BinaryTree tree = new BinaryTree();
        Node NewRoot = null;
        tree.root = new Node(2);
        tree.root.left = new Node(7);
        tree.root.right = new Node(5);
        tree.root.left.right = new Node(6);
        tree.root.left.right.left = new Node(1);
        tree.root.left.right.right = new Node(11);
        tree.root.right.right = new Node(9);
        tree.root.right.right.left = new Node(4);

        System.out.println("the inorder traversal of tree is ");
        tree.printInorder(tree.root);

        NewRoot = tree.RemoveHalfNodes(tree.root);

        System.out.print("\nInorder traversal of the modified tree \n");
        tree.printInorder(NewRoot);
    }
}

// This code has been contributed by Mayank Jaiswal
```

Python

```
# Python program to remove all half nodes

# A binary tree node
class Node:
    # Constructor for creating a new node
    def __init__(self , data):
        self.data = data
        self.left = None
        self.right = None

# For inorder traversal
def printInorder(root):
    if root is not None:
        printInorder(root.left)
        print root.data,
        printInorder(root.right)

# Removes all nodes with only one child and returns
# new root(note that root may change)
def RemoveHalfNodes(root):
    if root is None:
        return None

    # Recur to left tree
    root.left = RemoveHalfNodes(root.left)

    # Recur to right tree
    root.right = RemoveHalfNodes(root.right)

    # if both left and right child is None
    # the node is not a Half node
    if root.left is None and root.right is None:
        return root

    # If current nodes is a half node with left child
    # None then it's right child is returned and
    # replaces it in the given tree
    if root.left is None:
        new_root = root.right
        temp = root
        root = None
        del(temp)
        return new_root

    if root.right is None:
        new_root = root.left
        temp = root
        root = None
        del(temp)
        return new_root

    return root

# Driver Program
root = Node(2)
root.left = Node(7)
root.right = Node(5)
root.right = Node(5)
root.left.right = Node(6)
root.left.right.left = Node(1)
root.left.right.right = Node(11)
root.right.right = Node(9)
root.right.right.left = Node(4)

print "Inorder traversal of given tree"
printInorder(root)

NewRoot = RemoveHalfNodes(root)

print "\nInorder traversal of the modified tree"
printInorder(NewRoot)

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

Output:

```
Inorder traversal of given tree
7 1 6 11 2 5 4 9
Inorder traversal of the modified tree
1 6 11 2 4
```

Time complexity of the above solution is O(n) as it does a simple traversal of binary tree.