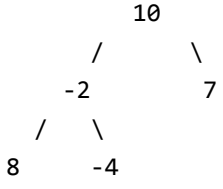
# Find the maximum sum leaf to root path in a Binary Tree

Given a Binary Tree, find the maximum sum path from a leaf to root. For example, in the following tree, there are three leaf to root paths 8->-2->10, -4->-2->10 and 7->10. The sums of these three paths are 16, 4 and 17 respectively. The maximum of them is 17 and the path for maximum is 7->10.




**Solution**

1) First find the leaf node that is on the maximum sum path. In the following code getTargetLeaf() does this by assigning the result to *target_leaf_ref.

2) Once we have the target leaf node, we can print the maximum sum path by traversing the tree. In the following code, printPath() does this.

The main function is maxSumPath() that uses above two functions to get the complete solution.

## C

```
#include<stdio.h>
#include<limits.h>

/* A tree node structure */
struct node
{
    int data;
    struct node *left;
    struct node *right;
};

// A utility function that prints all nodes on the path from root to target_leaf
bool printPath (struct node *root, struct node *target_leaf)
```

```
{
    // base case
    if (root == NULL)
        return false;

    // return true if this node is the target_leaf or target leaf is present in
    // one of its descendants
    if (root == target_leaf || printPath(root->left, target_leaf) ||
            printPath(root->right, target_leaf) )
    {
        printf("%d ", root->data);
        return true;
    }

    return false;
}

// This function Sets the target_leaf_ref to refer the leaf node of the maximum
// path sum.  Also, returns the max_sum using max_sum_ref
void getTargetLeaf (struct node *node, int *max_sum_ref, int curr_sum,
                    struct node **target_leaf_ref)
{
    if (node == NULL)
        return;

    // Update current sum to hold sum of nodes on path from root to this node
    curr_sum = curr_sum + node->data;

    // If this is a leaf node and path to this node has maximum sum so far,
    // then make this node target_leaf
    if (node->left == NULL && node->right == NULL)
    {
        if (curr_sum > *max_sum_ref)
        {
            *max_sum_ref = curr_sum;
            *target_leaf_ref = node;
        }
    }

    // If this is not a leaf node, then recur down to find the target_leaf
    getTargetLeaf (node->left, max_sum_ref, curr_sum, target_leaf_ref);
    getTargetLeaf (node->right, max_sum_ref, curr_sum, target_leaf_ref);
}

// Returns the maximum sum and prints the nodes on max sum path
int maxSumPath (struct node *node)
{
    // base case
    if (node == NULL)
        return 0;
```

```
    struct node *target_leaf;
    int max_sum = INT_MIN;

    // find the target leaf and maximum sum
    getTargetLeaf (node, &max_sum, 0, &target_leaf);

    // print the path from root to the target leaf
    printPath (node, target_leaf);

    return max_sum;  // return maximum sum
}

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

/* Driver function to test above functions */
int main()
{
    struct node *root = NULL;

    /* Constructing tree given in the above figure */
    root = newNode(10);
    root->left = newNode(-2);
    root->right = newNode(7);
    root->left->left = newNode(8);
    root->left->right = newNode(-4);

    printf ("Following are the nodes on the maximum sum path \n");
    int sum = maxSumPath(root);
    printf ("\nSum of the nodes is %d ", sum);

    getchar();
    return 0;
}
```

## Java

```
// Java program to find maximum sum leaf to root path in Binary Tree

// A Binary Tree node
class Node {
```

```
    int data;
    Node left, right;

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

class Maximum {

    int max_no = Integer.MIN_VALUE;
}

class BinaryTree {

    static Node root;
    Maximum max = new Maximum();

    // A utility function that prints all nodes on the
    // path from root to target_leaf
    boolean printPath(Node node, Node target_leaf) {

        // base case
        if (node == null) {
            return false;
        }

        // return true if this node is the target_leaf or target leaf is present in
        // one of its descendants
        if (node == target_leaf || printPath(node.left, target_leaf)
                || printPath(node.right, target_leaf)) {
            System.out.print(node.data + " ");
            return true;
        }

        return false;
    }

    // This function Sets the target_leaf_ref to refer the leaf node of the
    // maximum path sum.  Also, returns the max_sum using max_sum_ref
    void getTargetLeaf(Node node, Maximum max_sum_ref, int curr_sum,
                                            Node target_leaf_ref) {
        if (node == null) {
            return;
        }

        // Update current sum to hold sum of nodes on path from root to this node
        curr_sum = curr_sum + node.data;
```

```
        int a = max_sum_ref.max_no;

        // If this is a leaf node and path to this node has maximum sum so far,
        // the  n make this node target_leaf
        if (node.left == null && node.right == null) {
            if (curr_sum > max_sum_ref.max_no) {
                max_sum_ref.max_no = curr_sum;
                target_leaf_ref = node;

            }
        }

        // If this is not a leaf node, then recur down to find the target_leaf
        getTargetLeaf(node.left, max_sum_ref, curr_sum, target_leaf_ref);
        getTargetLeaf(node.right, max_sum_ref, curr_sum, target_leaf_ref);
        Node node1 = target_leaf_ref;
        if (curr_sum > a && a > 0) {
            printPath(root, target_leaf_ref);
        }
    }

    // Returns the maximum sum and prints the nodes on max sum path
    int maxSumPath(Node node) {

        // base case
        if (node == null) {
            return 0;
        }
        Node target_leaf = null;

        // find the target leaf and maximum sum
        getTargetLeaf(node, max, 0, target_leaf);

        // print the path from root to the target leaf
        //printPath(node, target_leaf);
        return max.max_no;  // return maximum sum
    }

    // driver function to test the above functions
    public static void main(String args[]) {
        BinaryTree tree = new BinaryTree();
        tree.root = new Node(10);
        tree.root.left = new Node(-2);
        tree.root.right = new Node(7);
        tree.root.left.left = new Node(8);
        tree.root.left.right = new Node(-4);
        System.out.println("Following are the nodes on maximum sum path");
        int sum = tree.maxSumPath(root);
        System.out.println("");
        System.out.println("Sum of nodes is : " + sum);
```

```
    }
}

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

Output:

```
Following are the nodes on the maximum sum path
7 10
Sum of the nodes is 17
```

Time Complexity: Time complexity of the above solution is O(n) as it involves tree traversal two times.

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



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