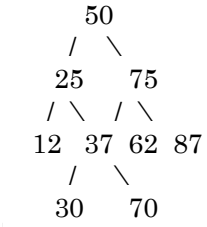
Tilt in C++

```
#include <iostream>
#include <cstdlib> // for abs function
using namespace std;

// Definition of a binary tree node
struct Node {
    int data;
    Node* left;
    Node* right;

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

// Function to display the binary tree (for debugging purposes)
void display(Node* node) {
    if (node == nullptr) {
        return;
    }

    string str = "";
    str += (node->left == nullptr) ? "." : to_string(node->left->data);
    str += " <- " + to_string(node->data) + " -> ";
    str += (node->right == nullptr) ? "." : to_string(node->right->data);
    cout << str << endl;

    display(node->left);
    display(node->right);
}

// Function to calculate the height of the binary tree
int height(Node* node) {
    if (node == nullptr) {
        return -1;
    }

    int lh = height(node->left);
    int rh = height(node->right);

    return max(lh, rh) + 1;
}

// Global variable to store the tilt of the entire tree
int tilt = 0;

// Function to calculate the tilt of the binary tree
int calculateTilt(Node* node) {
    if (node == nullptr) {
        return 0;
    }

    int ls = calculateTilt(node->left);
    int rs = calculateTilt(node->right);
```

Tree Structure:



Dry Run with Tilt Values

Let's go **bottom-up** and calculate each node's tilt with its left and right subtree sums:

Node	Left Sum	Right Sum	Node Tilt = abs(L - R)
12	0	0	0
30	0	0	0
37	30	0	30
25	12	67 (37+30)	55
70	0	0	0
62	0	70	70
87	0	0	0
75	132	87	45
50	104	294	190

Total Tilt:

0 (12)
+ 0 (30)
+ 30 (37)
+ 55 (25)
+ 0 (70)
+ 70 (62)
+ 0 (87)
+ 45 (75)
+ 190 (50)
= **390**

Output:

Tilt of the binary tree: 390

```
    int ltilt = abs(ls - rs);
    tilt += ltilt;

    int sum = ls + rs + node->data;
    return sum;
}

int main() {
    // Hardcoded tree construction
    Node* root = new Node(50);
    root->left = new Node(25);
    root->left->left = new Node(12);
    root->left->right = new Node(37);
    root->left->right->left = new Node(30);
    root->right = new Node(75);
    root->right->left = new Node(62);
    root->right->left->right = new Node(70);
    root->right->right = new Node(87);

    // Calculate the tilt of the tree
    calculateTilt(root);

    // Output the tilt value
    cout << "Tilt of the binary tree: " << tilt << endl;

    // Clean up dynamically allocated memory
    delete root->left->left;
    delete root->left->right->left;
    delete root->left->right;
    delete root->left;
    delete root->right->left->right;
    delete root->right->left;
    delete root->right->right;
    delete root->right;
    delete root;

    return 0;
}
```

Tilt of the binary tree: 390