DEPARTMENT OF
COMPUTERSCIENCE & ENGINEERING
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ASSIGNMENT 6

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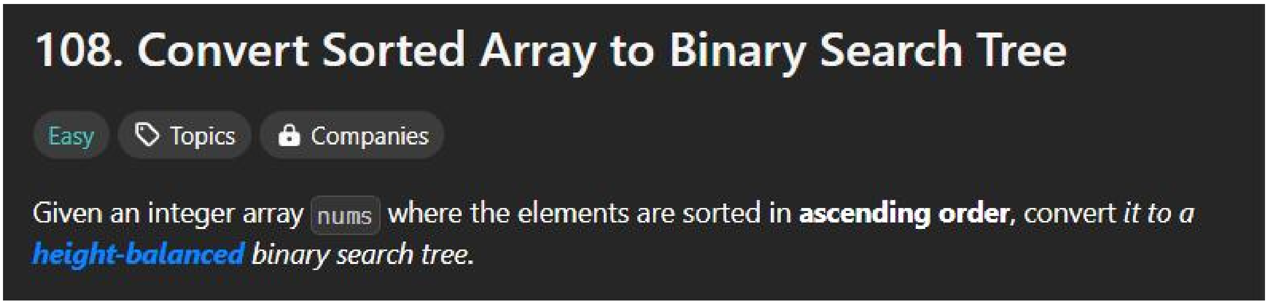
Branch: CSE **Section: 22BCS_IOT_605 B**
Semester: 6th **DOP:19-03-2025**
Subject: Advanced Programming Lab-II **Subject Code: 22CSP-351**

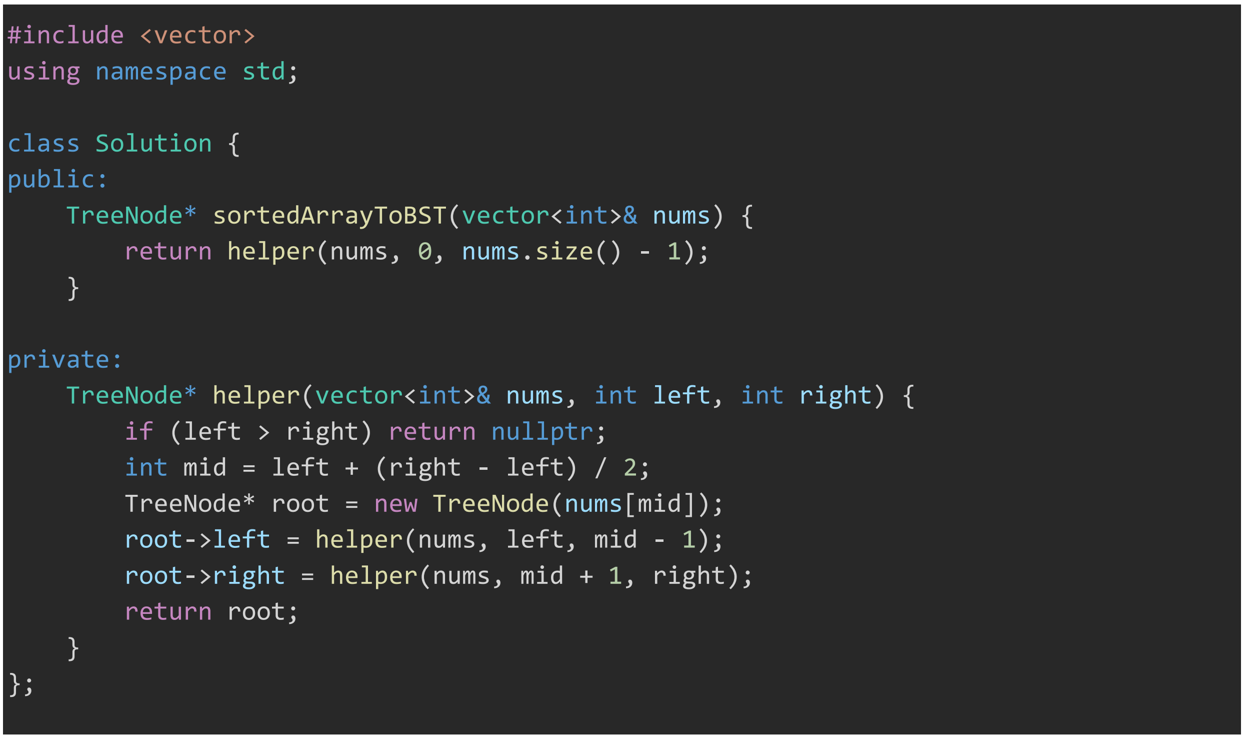
Question 1



108. Convert Sorted Array to Binary Search Tree

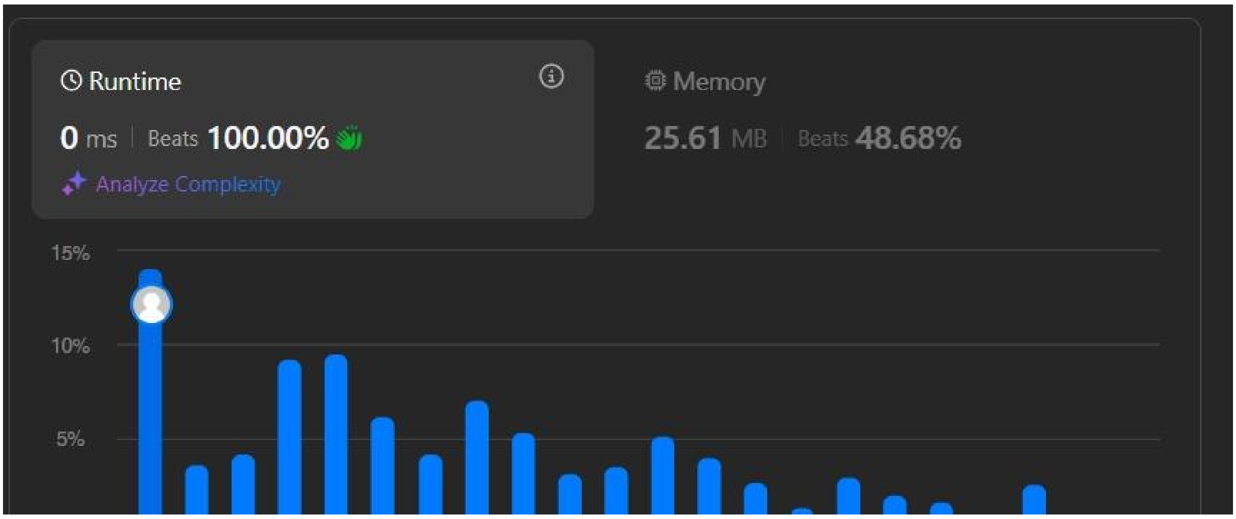
Given an integer array `nums` where the elements are sorted in **ascending order**, convert *it to a* ***height-balanced*** *binary search tree.*

Code:



```cpp
#include <vector>
using namespace std;

class Solution {
public:
    TreeNode* sortedArrayToBST(vector<int>& nums) {
        return helper(nums, 0, nums.size() - 1);
    }

private:
    TreeNode* helper(vector<int>& nums, int left, int right) {
        if (left > right) return nullptr;
        int mid = left + (right - left) / 2;
        TreeNode* root = new TreeNode(nums[mid]);
        root->left = helper(nums, left, mid - 1);
        root->right = helper(nums, mid + 1, right);
        return root;
    }
};
```

Output:



Runtime

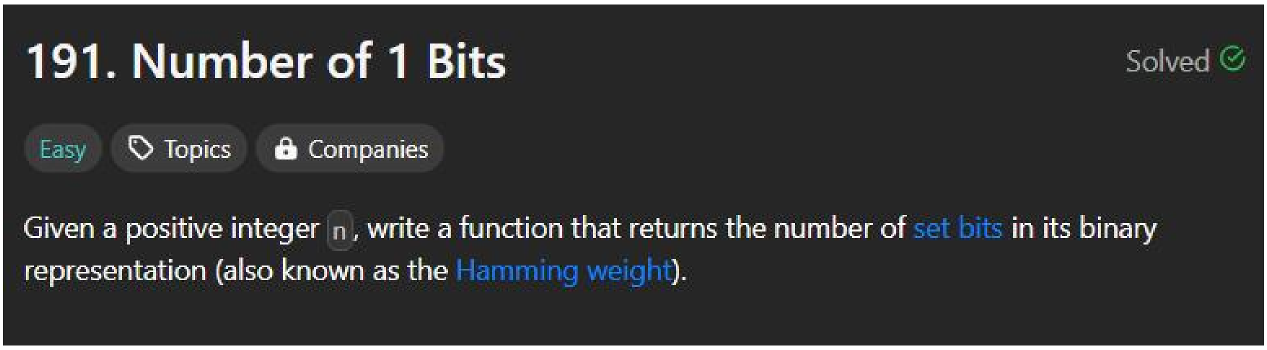
0 ms | Beats 100.00%

Analyze Complexity

Memory

25.61 MB | Beats 48.68%

Question 2

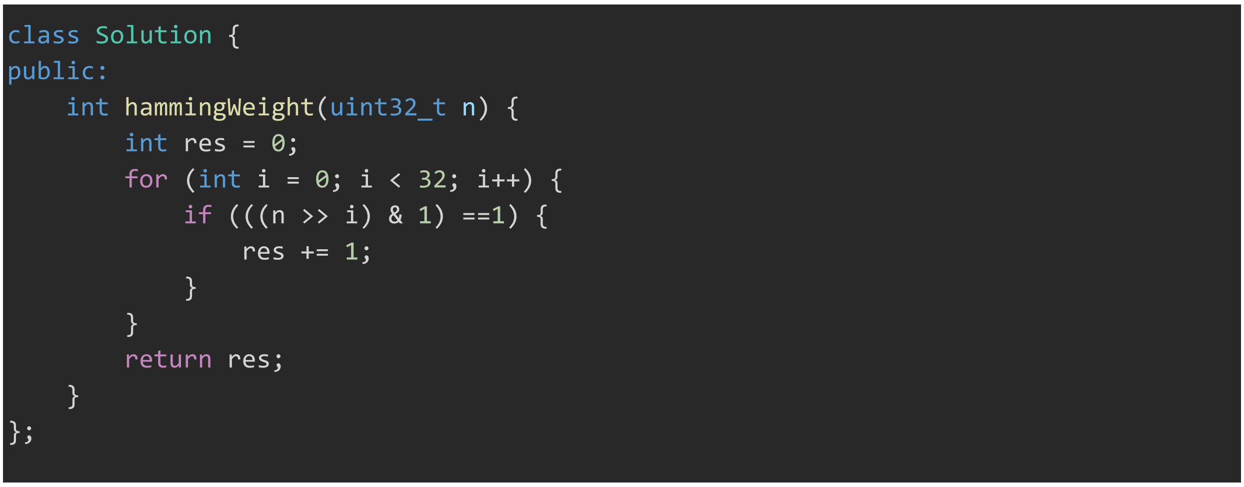


191. Number of 1 Bits

Solved

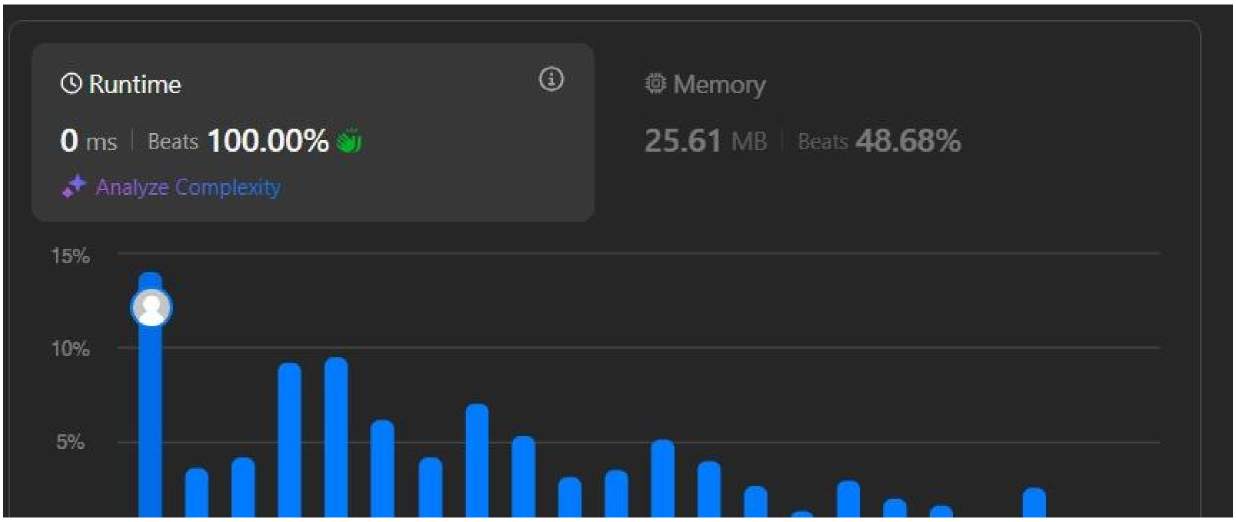
Given a positive integer `n`, write a function that returns the number of set bits in its binary representation (also known as the Hamming weight).

Code:



```
class Solution {
public:
    int hammingWeight(uint32_t n) {
        int res = 0;
        for (int i = 0; i < 32; i++) {
            if (((n >> i) & 1) ==1) {
                res += 1;
            }
        }
        return res;
    }
};
```

Output:



Runtime

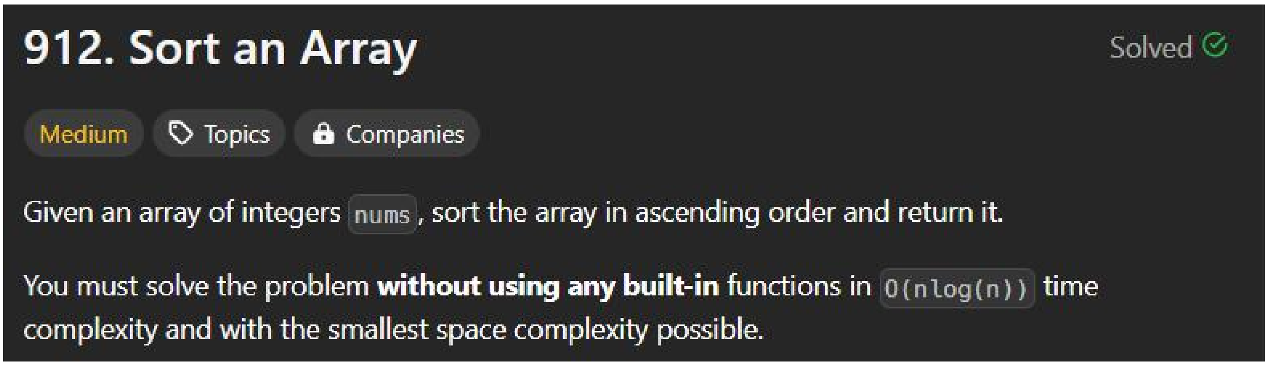
0 ms | Beats 100.00%

Analyze Complexity

Memory

25.61 MB | Beats 48.68%

Question 3



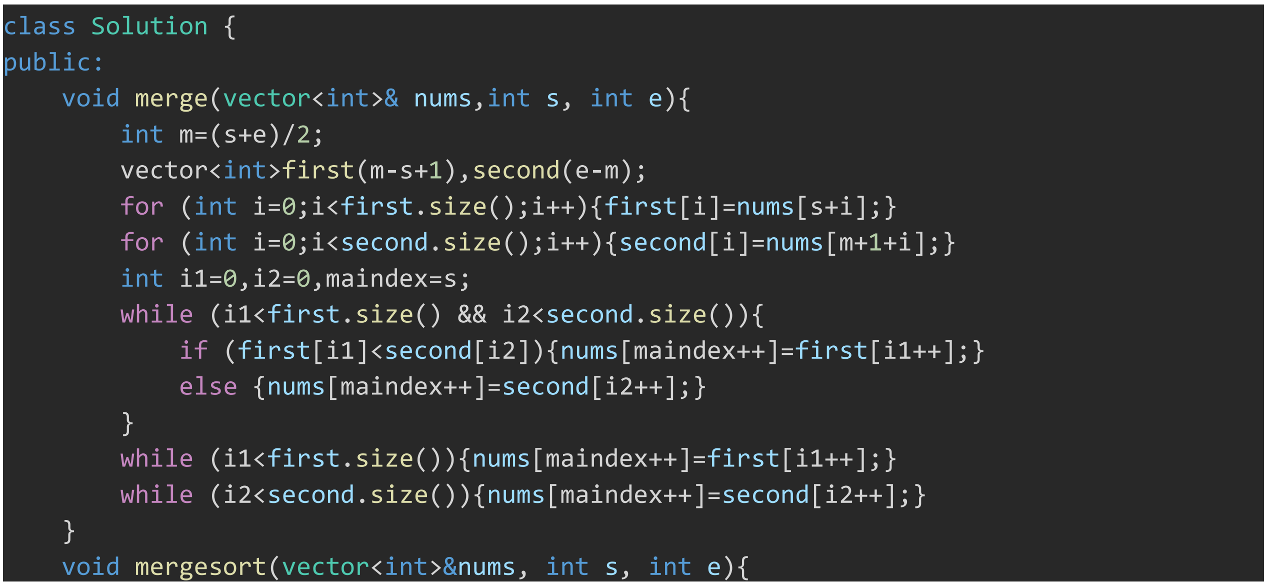
912. Sort an Array

Solved ✓

Given an array of integers `nums`, sort the array in ascending order and return it.

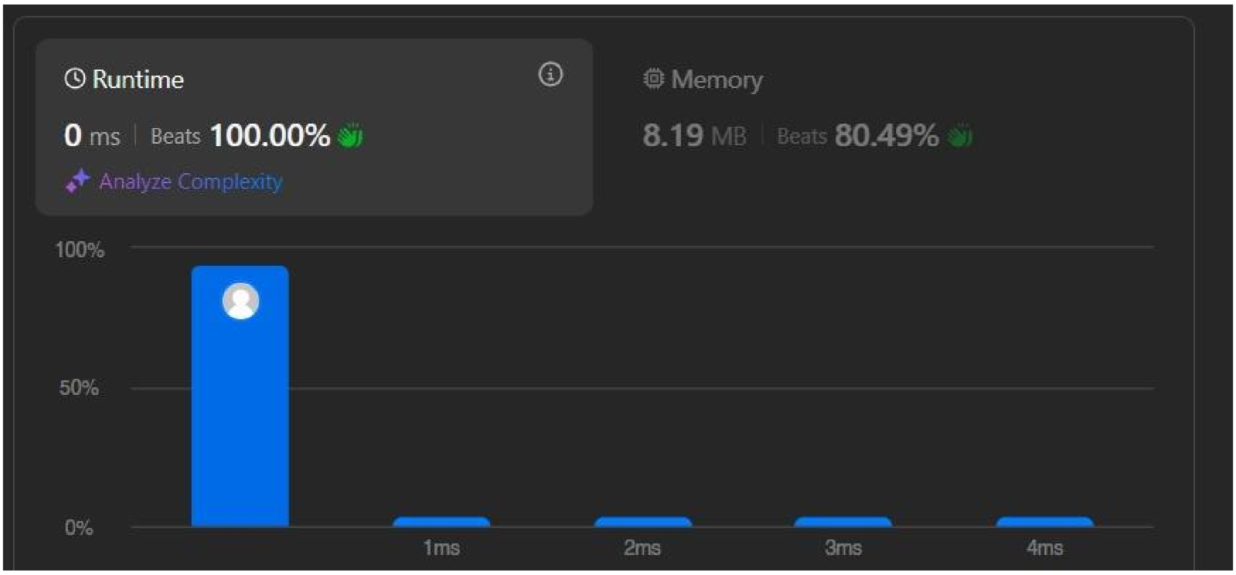
You must solve the problem **without using any built-in** functions in `O(nlog(n))` time complexity and with the smallest space complexity possible.

Code:



```
class Solution {
public:
    void merge(vector<int>& nums,int s, int e){
        int m=(s+e)/2;
        vector<int>first(m-s+1),second(e-m);
        for (int i=0;i<first.size();i++){first[i]=nums[s+i];}
        for (int i=0;i<second.size();i++){second[i]=nums[m+1+i];}
        int i1=0,i2=0,maindex=s;
        while (i1<first.size() && i2<second.size()){
            if (first[i1]<second[i2]){nums[maindex++]=first[i1++];}
            else {nums[maindex++]=second[i2++];}
        }
        while (i1<first.size()){nums[maindex++]=first[i1++];}
        while (i2<second.size()){nums[maindex++]=second[i2++];}
    }
    void mergesort(vector<int>&nums, int s, int e){
        if (s>=e){return ;}
        int m=(s+e)/2;
        mergesort(nums,s,m);
        mergesort(nums,m+1,e);
        merge(nums,s,e);
    }
    vector<int> sortArray(vector<int>& nums) {
        mergesort(nums,0,nums.size()-1);
        return nums;
    }
};
```

Output:



Runtime

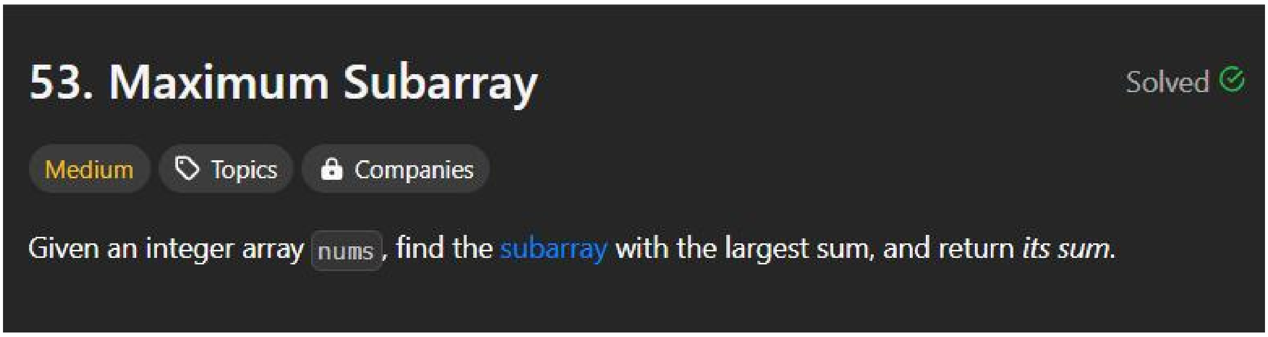
0 ms | Beats 100.00%

Analyze Complexity

Memory

8.19 MB | Beats 80.49%

Question 4



53. Maximum Subarray

Solved ✓

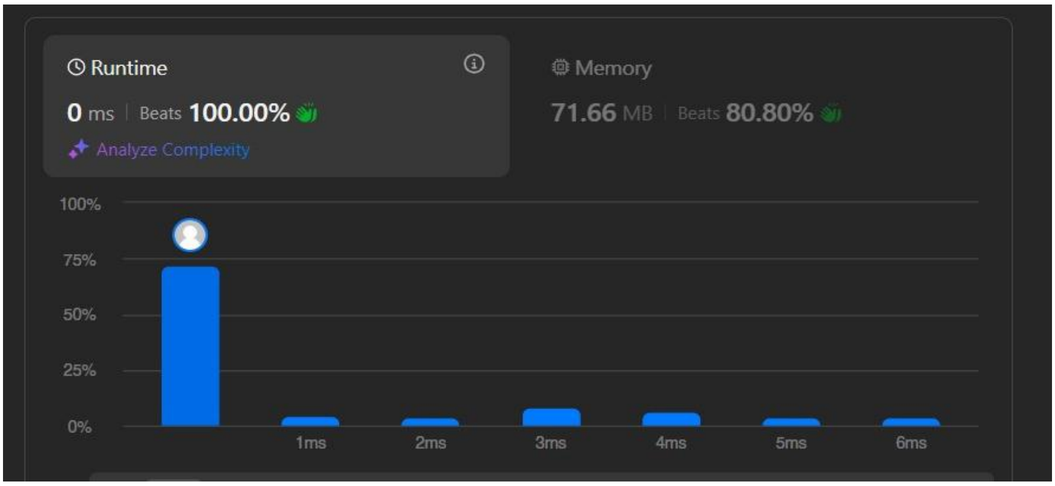
Given an integer array `nums`, find the subarray with the largest sum, and return *its sum*.

Code:

```
class Solution {
```

```
public:
    int maxSubArray(vector<int>& nums) {
        int result = nums[0];
        int curr_sum = nums[0];


        for(int i=1;i<nums.size();i++){
            if(nums.size()==1){
                return nums[i];
            }
            curr_sum= max(nums[i],curr_sum+nums[i]);
            result= max(result,curr_sum);
        }

        return result;
    }
};
```

Output:



Runtime

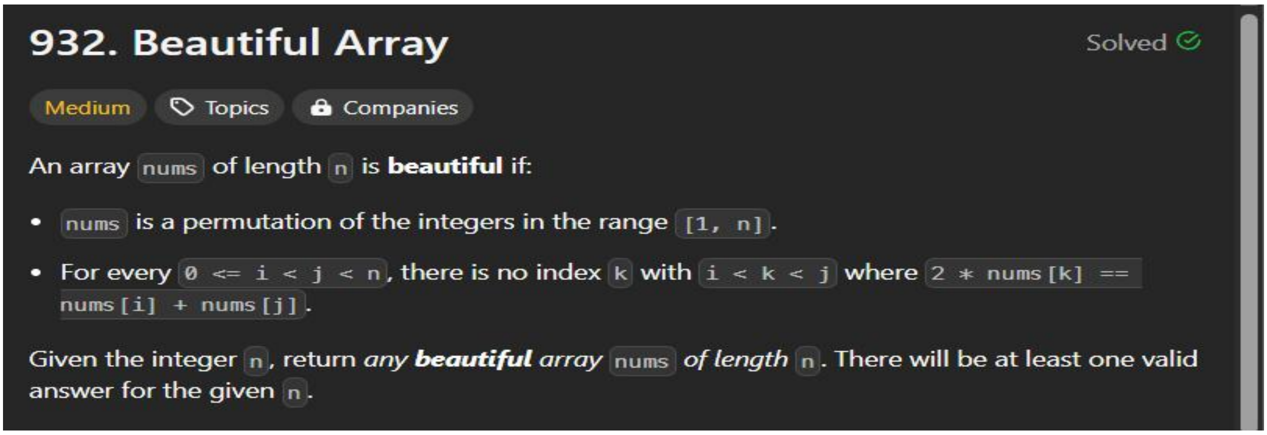
0 ms | Beats 100.00%

Analyze Complexity

Memory

71.66 MB | Beats 80.80%

Question 5



932. Beautiful Array

Solved

Medium | Topics | Companies

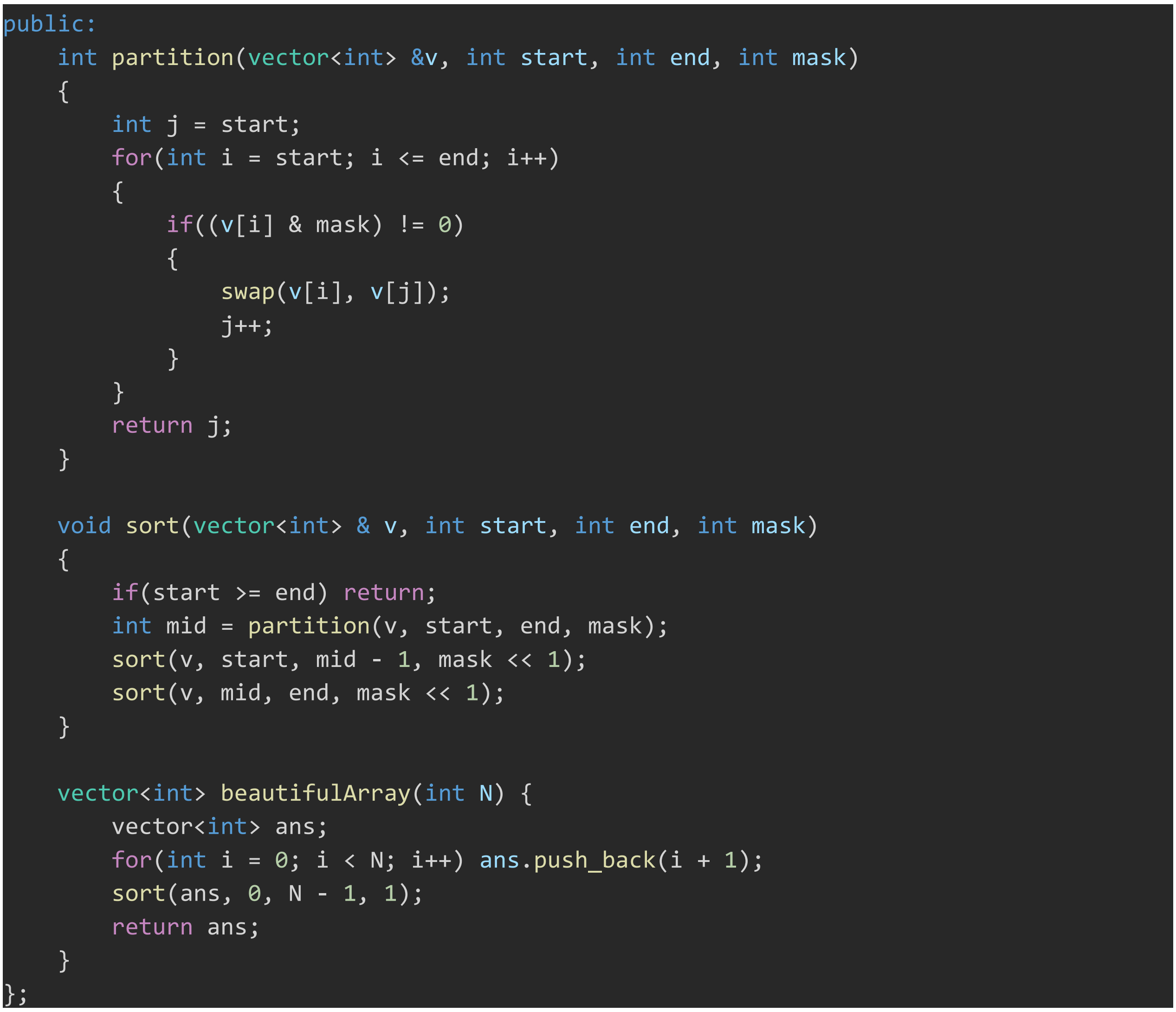
An array `nums` of length `n` is **beautiful** if:

- `nums` is a permutation of the integers in the range `[1, n]`.
- For every `0 <= i < j < n`, there is no index `k` with `i < k < j` where `2 * nums[k] == nums[i] + nums[j]`.

Given the integer `n`, return *any **beautiful** array* `nums` *of length* `n`. There will be at least one valid answer for the given `n`.

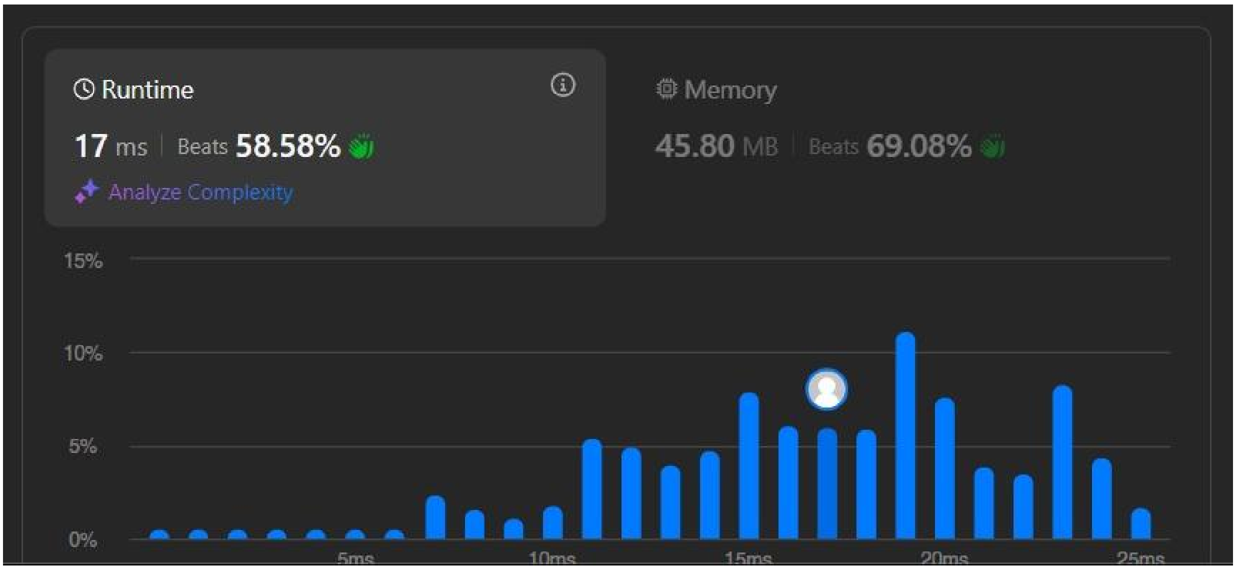
Code:

```
class Solution {
```



```
public:
    int partition(vector<int> &v, int start, int end, int mask)
    {
        int j = start;
        for(int i = start; i <= end; i++)
        {
            if((v[i] & mask) != 0)
            {
                swap(v[i], v[j]);
                j++;
            }
        }
        return j;
    }

    void sort(vector<int> & v, int start, int end, int mask)
    {
        if(start >= end) return;
        int mid = partition(v, start, end, mask);
        sort(v, start, mid - 1, mask << 1);
        sort(v, mid, end, mask << 1);
    }

    vector<int> beautifulArray(int N) {
        vector<int> ans;
        for(int i = 0; i < N; i++) ans.push_back(i + 1);
        sort(ans, 0, N - 1, 1);
        return ans;
    }
};
```

Output:



Runtime

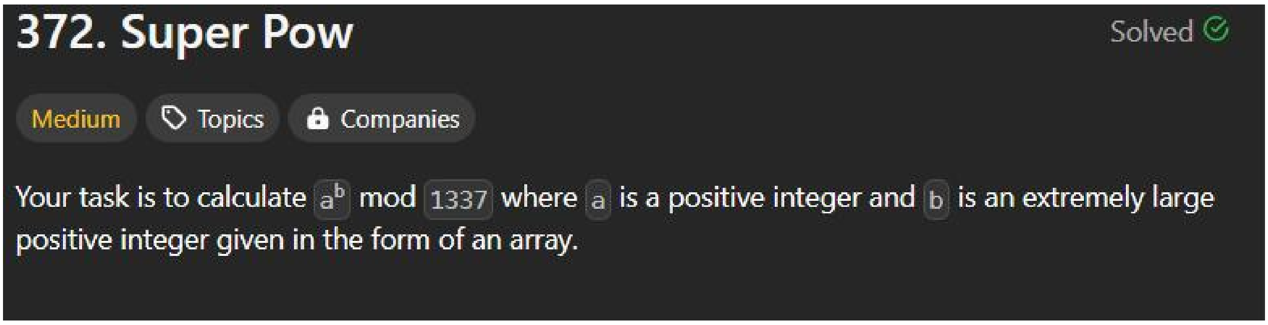
17 ms | Beats 58.58%

Analyze Complexity

Memory

45.80 MB | Beats 69.08%

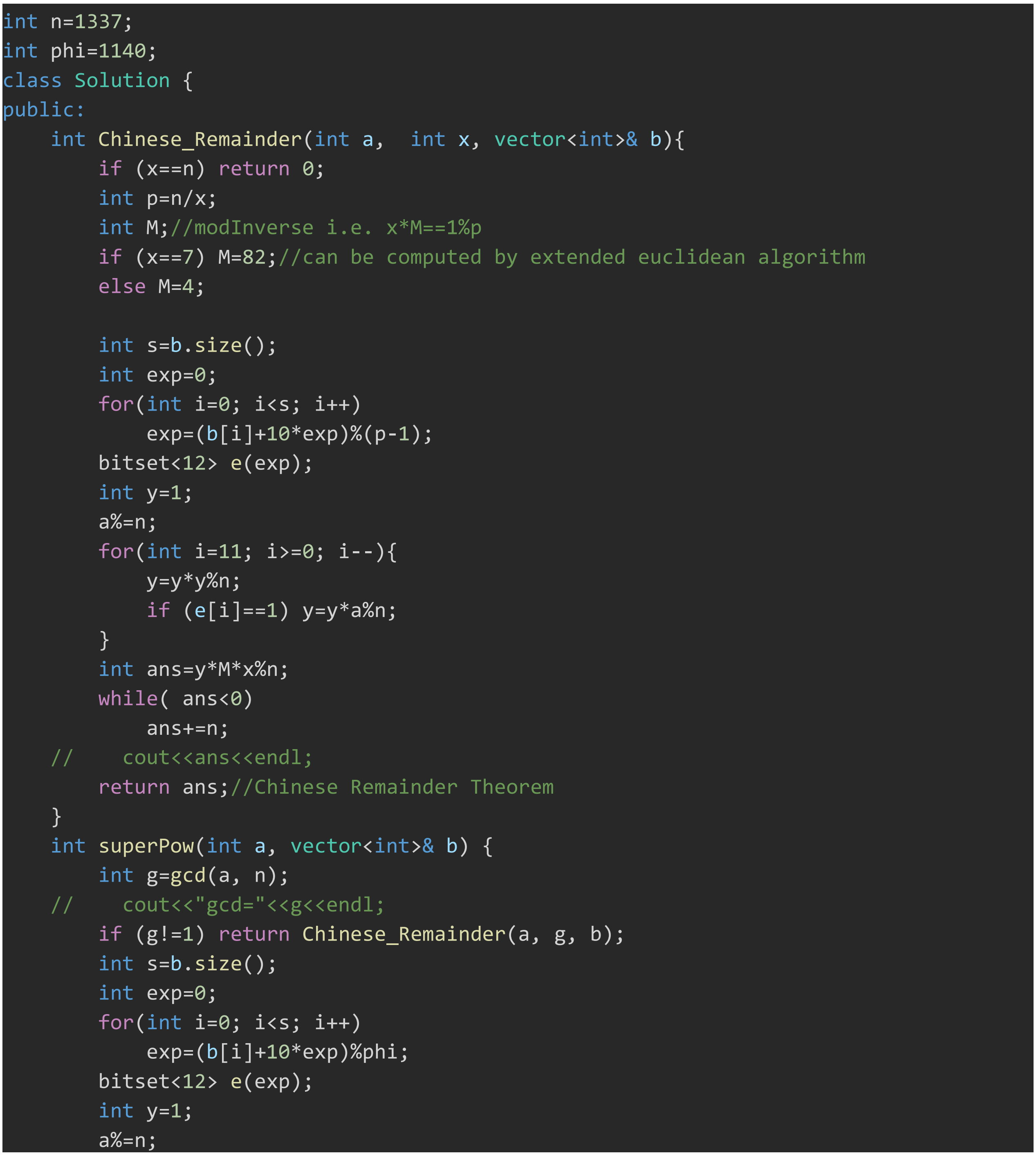
Question 6



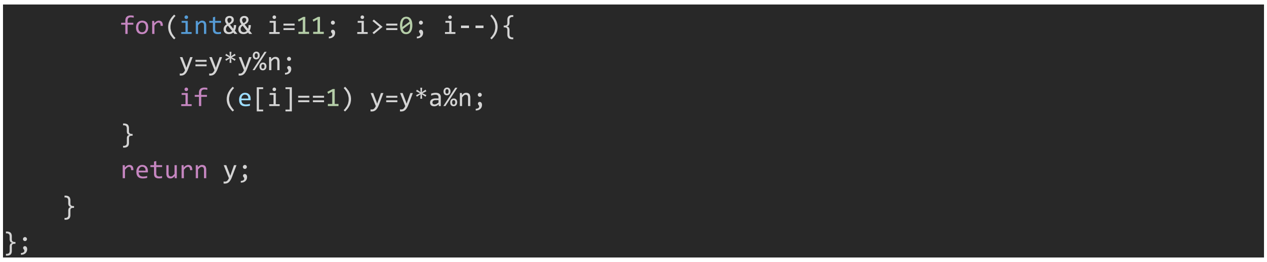
372. Super Pow

Your task is to calculate a^b mod 1337 where a is a positive integer and b is an extremely large positive integer given in the form of an array.

Code

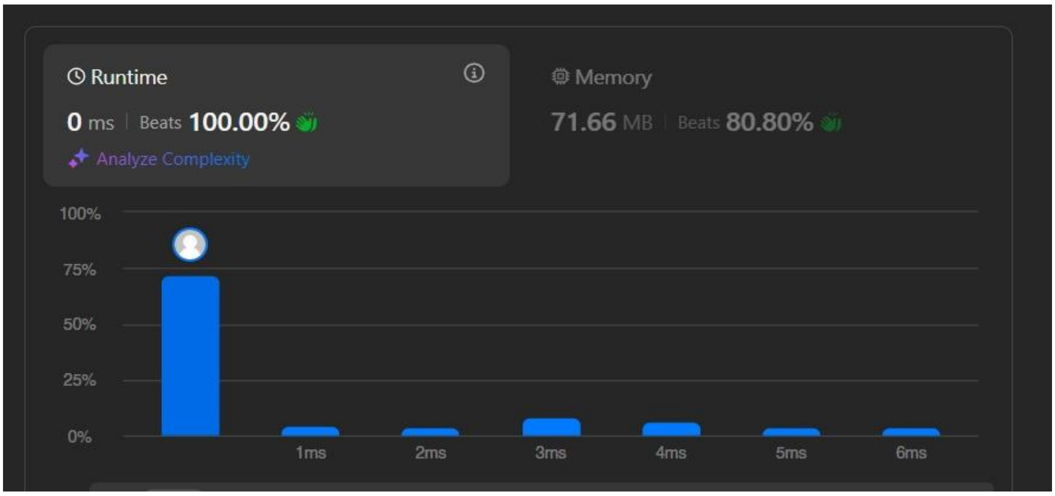


```
int n=1337;
int phi=1140;
class Solution {
public:
    int Chinese_Remainder(int a,  int x, vector<int>& b){
        if (x==n) return 0;
        int p=n/x;
        int M;//modInverse i.e. x*M==1%p
        if (x==7) M=82;//can be computed by extended euclidean algorithm
        else M=4;

        int s=b.size();
        int exp=0;
        for(int i=0; i<s; i++)
            exp=(b[i]+10*exp)%(p-1);
        bitset<12> e(exp);
        int y=1;
        a%=n;
        for(int i=11; i>=0; i--){
            y=y*y%n;
            if (e[i]==1) y=y*a%n;
        }
        int ans=y*M*x%n;
        while( ans<0)
            ans+=n;
    //    cout<<ans<<endl;
        return ans;//Chinese Remainder Theorem
    }
    int superPow(int a, vector<int>& b) {
        int g=gcd(a, n);
    //    cout<<"gcd="<<g<<endl;
        if (g!=1) return Chinese_Remainder(a, g, b);
        int s=b.size();
        int exp=0;
        for(int i=0; i<s; i++)
            exp=(b[i]+10*exp)%phi;
        bitset<12> e(exp);
        int y=1;
        a%=n;
```



```
        for(int&& i=11; i>=0; i--){
            y=y*y%n;
            if (e[i]==1) y=y*a%n;
        }
        return y;
    }
};
```

OUTPUT:



Runtime

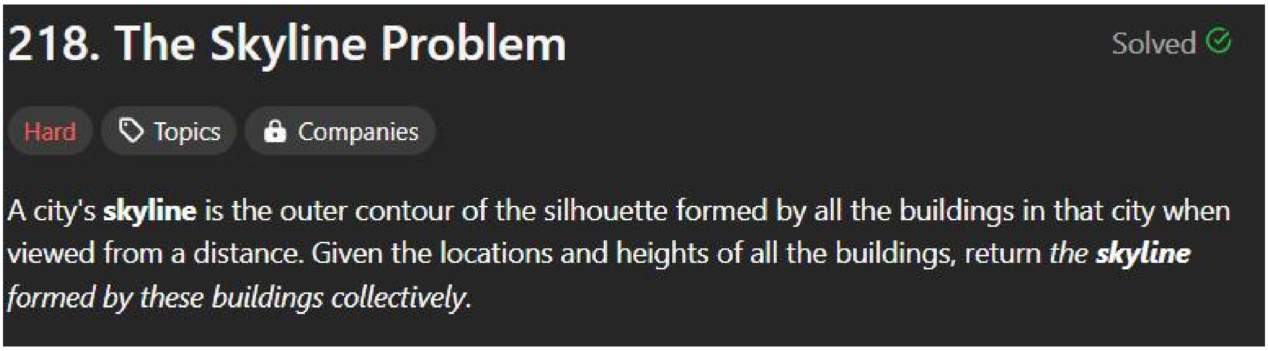
0 ms | Beats 100.00%

Analyze Complexity

Memory

71.66 MB | Beats 80.80%

Question 7



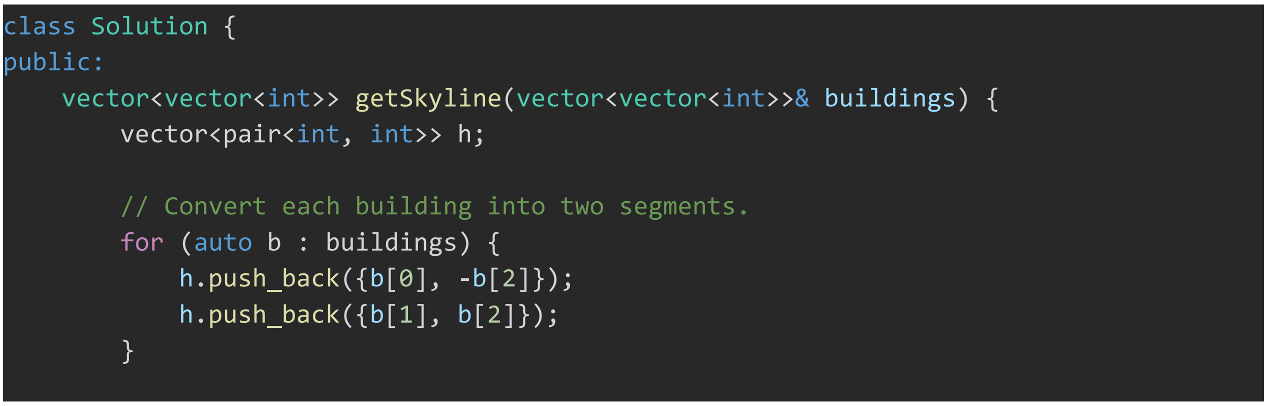
218. The Skyline Problem

Solved ✓

Hard | Topics | Companies

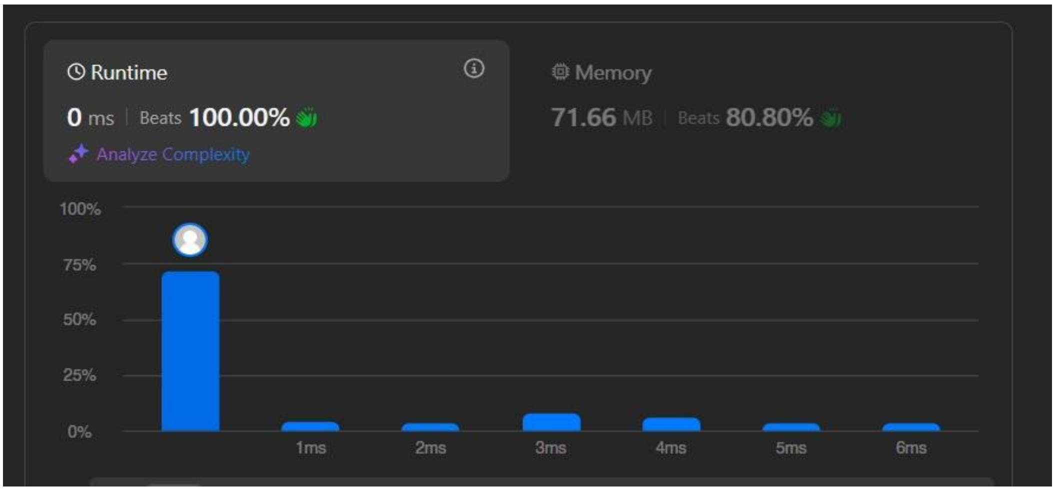
A city's **skyline** is the outer contour of the silhouette formed by all the buildings in that city when viewed from a distance. Given the locations and heights of all the buildings, return *the **skyline** formed by these buildings collectively.*

CODE:



```
class Solution {
public:
    vector<vector<int>> getSkyline(vector<vector<int>>& buildings) {
        vector<pair<int, int>> h;

        // Convert each building into two segments.
        for (auto b : buildings) {
            h.push_back({b[0], -b[2]});
            h.push_back({b[1], b[2]});
        }
        // Sort the segments.
        sort(h.begin(), h.end());
        int prev = 0, cur = 0;

        multiset<int> m;
        vector<vector<int>> res;

        m.insert(0);
        for (auto i:h) {

            // If i.second is less than zero, then it means it is left boundary.
            if (i.second < 0) {
                m.insert(-i.second);
            } else { // else it is right boundary.
                m.erase(m.find(i.second));
            }

            cur = *m.rbegin();

            // If current maximum height is not equal to maximum previuous height, it
is a key point.
            if (cur != prev) {
                res.push_back({i.first, cur});
                prev = cur;
            }
        }
        return res;
}
};
```

Output:



Runtime

0 ms | Beats 100.00%

Analyze Complexity

Memory

71.66 MB | Beats 80.80%