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IOT-609/B

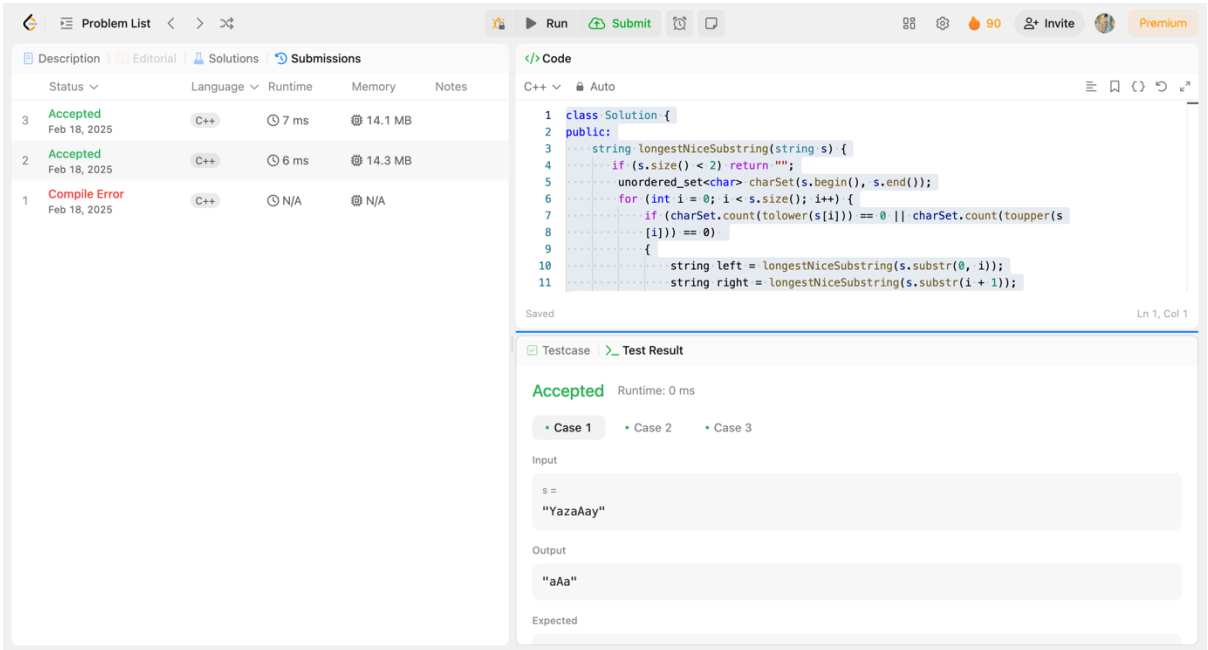
Advance Programming

Assignment 4

1. **Longest Nice Substring:**

CODE:

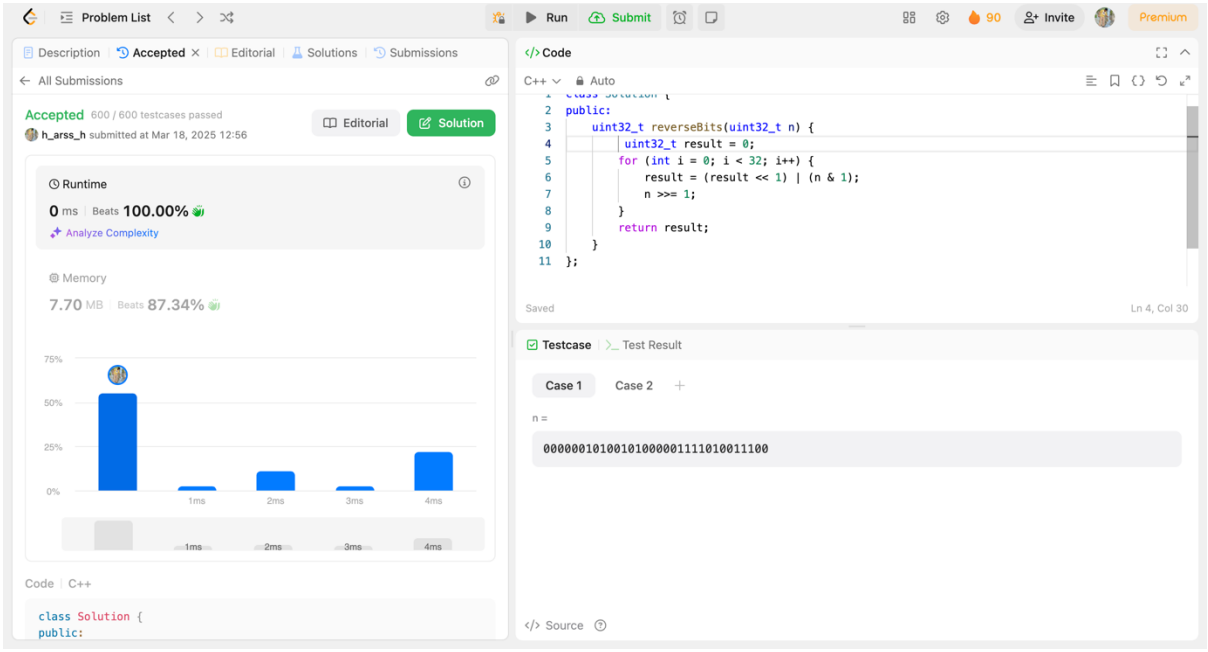
```
class Solution {
public:
  string longestNiceSubstring(string s) {
    if (s.size() < 2) return "";
     unordered_set<char> charSet(s.begin(), s.end());
     for (int i = 0; i < s.size(); i++) {
       if (charSet.count(tolower(s[i])) == 0 || charSet.count(toupper(s
       [i])) == 0)
       {
         string left = longestNiceSubstring(s.substr(0, i));
         string right = longestNiceSubstring(s.substr(i + 1));
         return left.size() >= right.size() ? left : right;
       }
     }
     return s;
  }
};
```



2. **Reverse Bits:**

CODE:

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

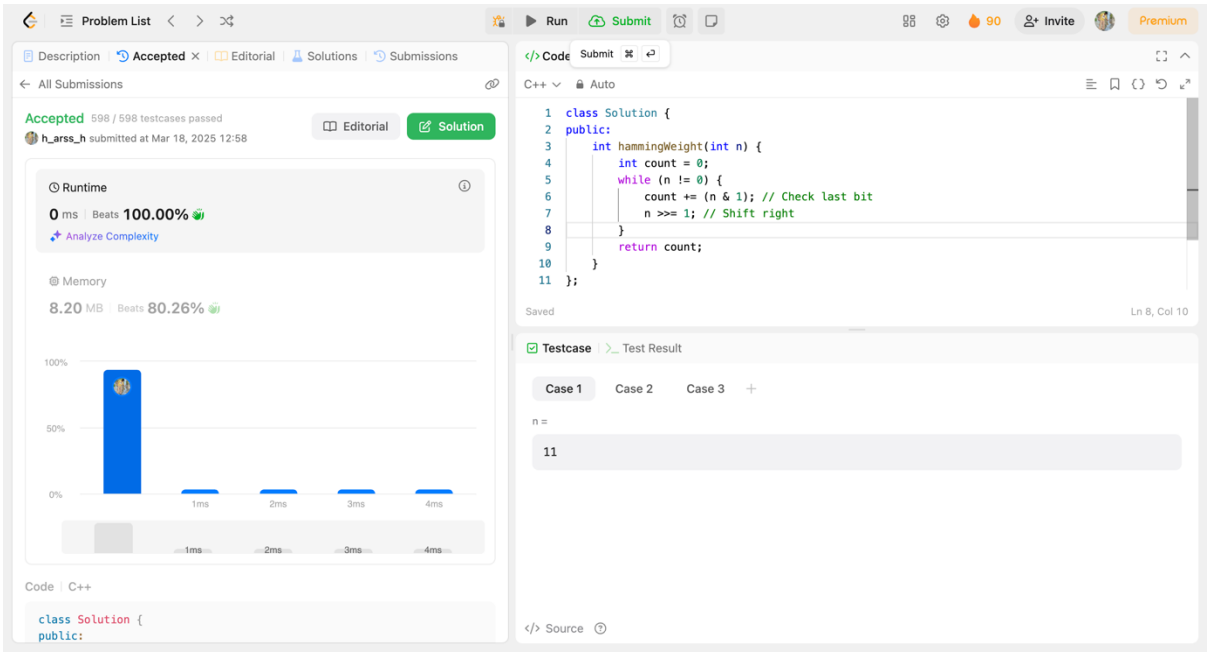


3. **Number of 1 Bits:**

CODE:

```
class Solution {
public:
    int hammingWeight(int n) {
        int count = 0;
        while (n != 0) {
```

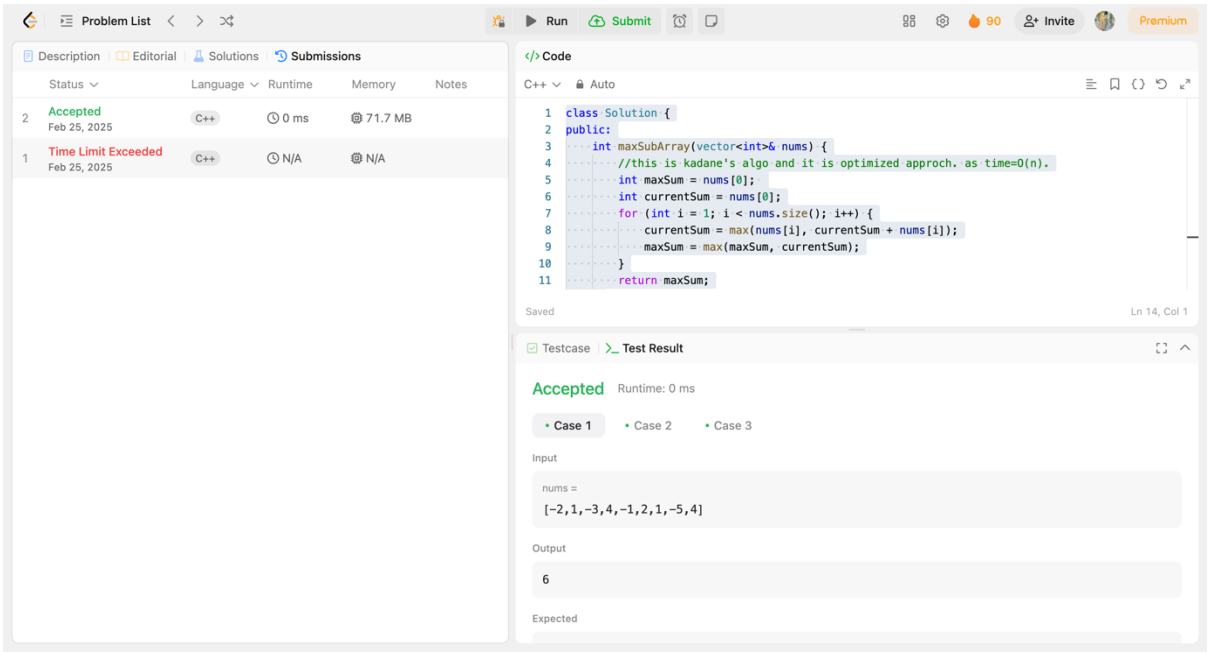
```
        count += (n & 1); // Check last bit
        n >>= 1; // Shift right
    }
    return count;
  }
};
```



4. **Maximum Subarray:**

CODE:

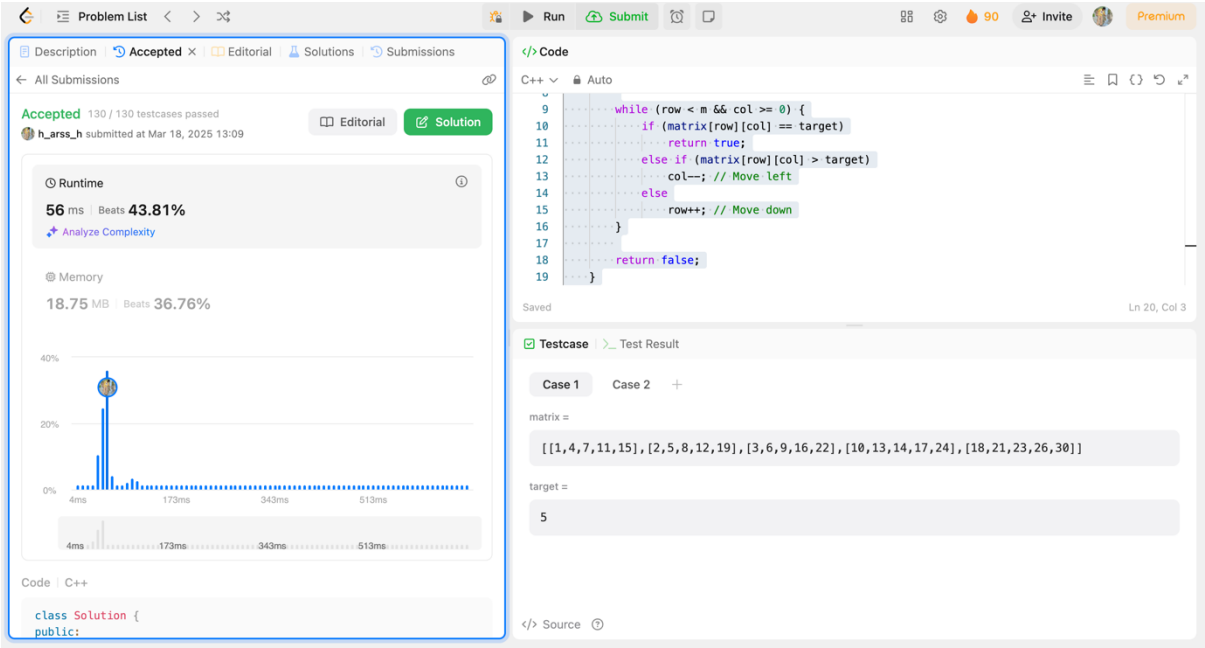
```
class Solution {
public:
  int maxSubArray(vector<int>& nums) {
    int maxSum = nums[0];
    int currentSum = nums[0];
    for (int i = 1; i < nums.size(); i++) {
      currentSum = max(nums[i], currentSum + nums[i]);
      maxSum = max(maxSum, currentSum);
    }
    return maxSum;
  }
};
```



5. Search a 2D Matrix II:

CODE:

```
class Solution {
public:
  bool searchMatrix(vector<vector<int>>& matrix, int target) {
    int m = matrix.size();
    int n = matrix[0].size();

    int row = 0, col = n - 1; // Start from top-right

    while (row < m && col >= 0) {
      if (matrix[row][col] == target)
        return true;
      else if (matrix[row][col] > target)
        col--; // Move left
      else
        row++; // Move down
    }

    return false;
  }
};
```

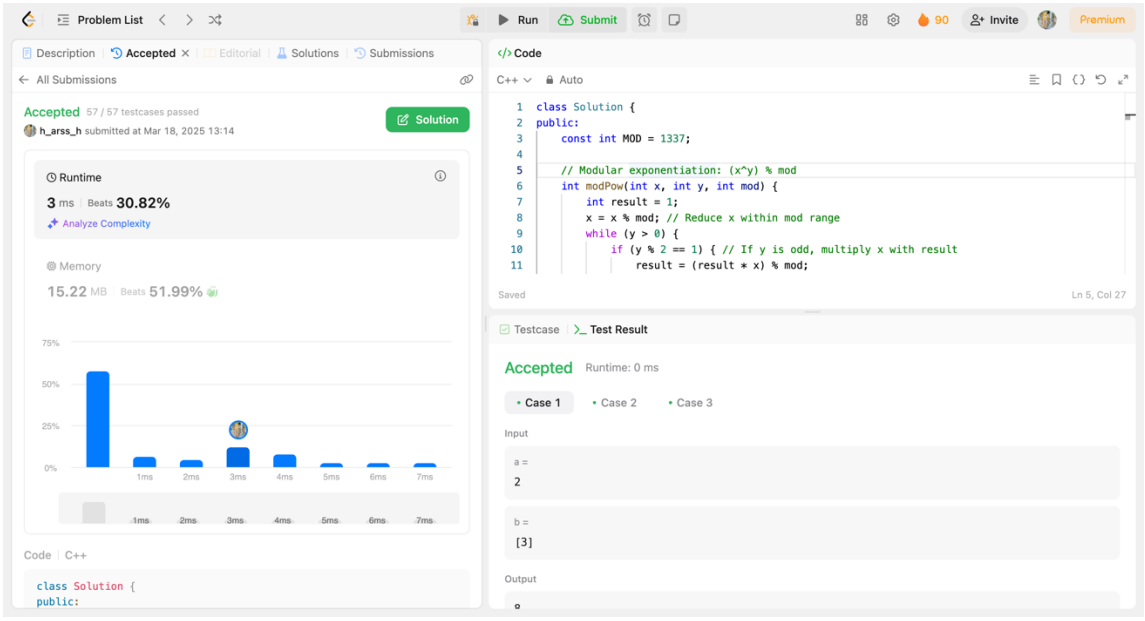


6. **Super Pow:**

CODE:

```
class Solution {
public:
    const int MOD = 1337;
    int modPow(int x, int y, int mod) {
        int result = 1;
        x = x % mod;
        while (y > 0) {
            if (y % 2 == 1) {
                result = (result * x) % mod;
            }
            x = (x * x) % mod; // Square x
            y /= 2; // Reduce y
        }
        return result;
    }
    int superPow(int a, vector<int>& b) {
        if (b.empty()) return 1; // Base case
        int lastDigit = b.back();
        b.pop_back(); // Remove last digit
        int part1 = modPow(superPow(a, b), 10, MOD);
```

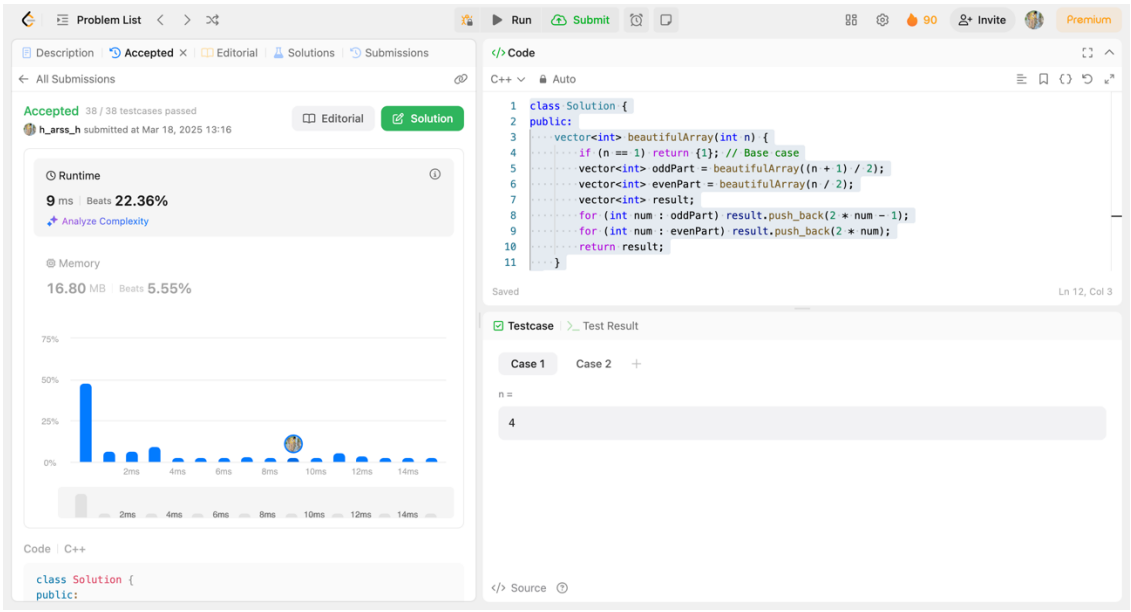
```
        int part2 = modPow(a, lastDigit, MOD);
        return (part1 * part2) % MOD;
    }
};
```



7. Beautiful Array:

CODE:

```
class Solution {
public:
    vector<int> beautifulArray(int n) {
        if (n == 1) return {1}; // Base case
        vector<int> oddPart = beautifulArray((n + 1) / 2);
        vector<int> evenPart = beautifulArray(n / 2);
        vector<int> result;
        for (int num : oddPart) result.push_back(2 * num - 1);
        for (int num : evenPart) result.push_back(2 * num);
        return result;
    }
};
```

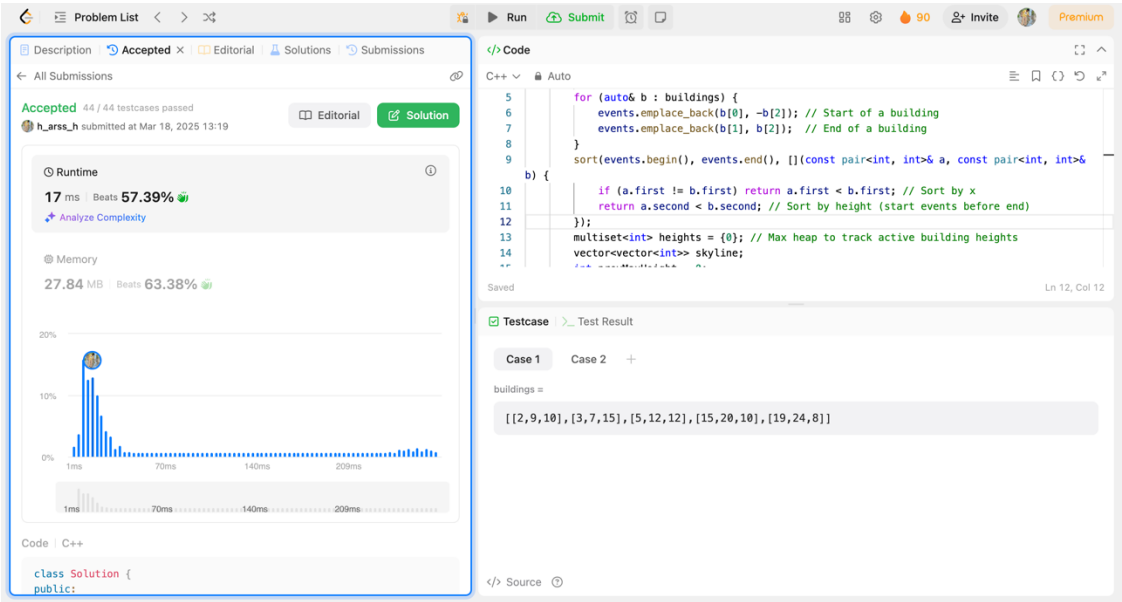


8. **The Skyline Problem:**

CODE:

```
class Solution {
public:
  vector<vector<int>> getSkyline(vector<vector<int>>& buildings) {
     vector<pair<int, int>> events; // Store (x, height)
    for (auto& b : buildings) {
      events.emplace_back(b[0], -b[2]); // Start of a building
      events.emplace_back(b[1], b[2]);  // End of a building
    }
    sort(events.begin(), events.end(), [](const pair<int, int>& a, const pair<int,
int>& b) {
      if (a.first != b.first) return a.first < b.first; // Sort by x
      return a.second < b.second; // Sort by height (start events before end)
    });
    multiset<int> heights = {0}; // Max heap to track active building heights
    vector<vector<int>> skyline;
    int prevMaxHeight = 0;
    for (auto& e : events) {
      int x = e.first, h = e.second;
      if (h < 0) heights.insert(-h); // Building starts: add height
      else heights.erase(heights.find(h)); // Building ends: remove height
      int currMaxHeight = *heights.rbegin(); // Get max height
      if (currMaxHeight != prevMaxHeight) { // If height changes, record key point
        skyline.push_back({x, currMaxHeight});
        prevMaxHeight = currMaxHeight;
```

```
        }
      }
      return skyline;
    }
};
```

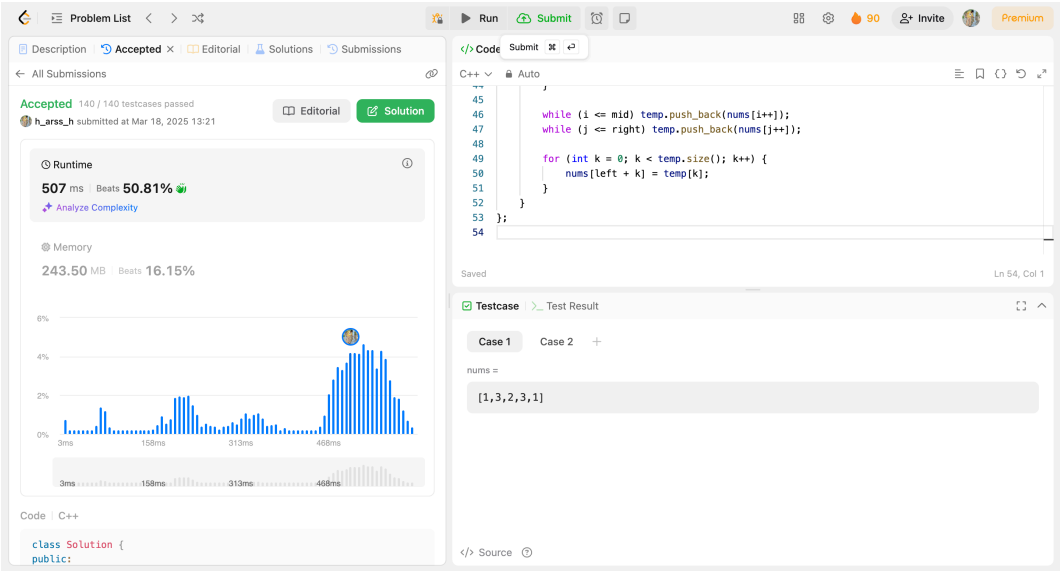


9. **Reverse Pairs:**

CODE:

```
class Solution {
public:
  int reversePairs(vector<int>& nums) {
    return mergeSort(nums, 0, nums.size() - 1);
  }

private:
  int mergeSort(vector<int>& nums, int left, int right) {
    if (left >= right) return 0;

    int mid = left + (right - left) / 2;
    int count = mergeSort(nums, left, mid) + mergeSort(nums, mid + 1, right);

    // Count valid reverse pairs
    count += countPairs(nums, left, mid, right);

    // Merge the sorted halves
    merge(nums, left, mid, right);
```

```
        return count;
    }

    int countPairs(vector<int>& nums, int left, int mid, int right) {
        int count = 0;
        int j = mid + 1;

        for (int i = left; i <= mid; i++) {
            while (j <= right && nums[i] > 2LL * nums[j]) {
                j++;
            }
            count += (j - (mid + 1));
        }

        return count;
    }

    void merge(vector<int>& nums, int left, int mid, int right) {
        vector<int> temp;
        int i = left, j = mid + 1;

        while (i <= mid && j <= right) {
            if (nums[i] <= nums[j]) temp.push_back(nums[i++]);
            else temp.push_back(nums[j++]);
        }

        while (i <= mid) temp.push_back(nums[i++]);
        while (j <= right) temp.push_back(nums[j++]);

        for (int k = 0; k < temp.size(); k++) {
            nums[left + k] = temp[k];
        }
    }
};
```



10. **Longest Increasing Subsequence II:**

CODE:

```
class SegmentTree{
  public:
  int leftIndex;
  int rightIndex;
  SegmentTree* left;
  SegmentTree* right;
  int maxNum;
    SegmentTree(int leftI,int rightI,int val){
      leftIndex=leftI;
      rightIndex=rightI;
      maxNum=val;
      left=NULL;
      right=NULL;
    }

    void updateTree(int index,int val,SegmentTree* root){
      if(root->leftIndex==root->rightIndex){
        root->maxNum=val;
        return;
      }

      int midIndex=(root->leftIndex+root->rightIndex)/2;
      if(midIndex>=index){
        updateTree(index,val,root->left);
      } else {
```

```
            updateTree(index,val,root->right);
        }
        root->maxNum=max(root->left->maxNum,root->right->maxNum);
        return;
    }


    int query(int leftI,int rightI,SegmentTree* root){
        if(root->rightIndex==rightI && root->leftIndex==leftI)
            return root->maxNum;

        if(leftI>rightI){
            return -1;
        }

        int midIndex=(root->leftIndex+root->rightIndex)/2;
        int ans=0;
        if(leftI<=midIndex && midIndex<=rightI){
            ans=max(ans,max(query(leftI,midIndex,root-
>left),query(midIndex+1,rightI,root->right)));
        } else if(midIndex<leftI) {
            ans=max(ans,query(leftI,rightI,root->right));
        } else {
            ans=max(ans,query(leftI,rightI,root->left));
        }
        return ans;
    }
};

SegmentTree* construct(int leftI,int rightI){
  if(leftI==rightI){
    return new SegmentTree(leftI,rightI,-1);
  }

  int midIndex=(leftI+rightI)/2;
  SegmentTree* root=new SegmentTree(leftI,rightI,0);
  SegmentTree* leftTree=construct(leftI,midIndex);
  SegmentTree* rightTree=construct(midIndex+1,rightI);
  root->left=leftTree;
  root->right=rightTree;
  root->maxNum=max(leftTree->maxNum,rightTree->maxNum);
```

```
    return root;
}

class Solution {
public:
    int lengthOfLIS(vector<int>& nums, int k) {
        int maxN=-1;
        for(auto n:nums){
            maxN=max(maxN,n);
        }
        stack<int> st;
        SegmentTree* root;
        root=construct(0,maxN+k);
        int ans=1;
        for(int i=nums.size()-1;i>=0;i--){
            int n=nums[i];
            while(!st.empty() && (st.top()<=n || st.top()>n+k)){
                st.pop();
            }
            st.push(n);
            int l=root->query(n+1,n+k,root)+1;
            ans=max(ans,l);
            root->updateTree(n,l,root);
        }
        return ans;
    }
};
```