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Assignment-04

Advanced Programming Lab - 2 (22CSP-351)

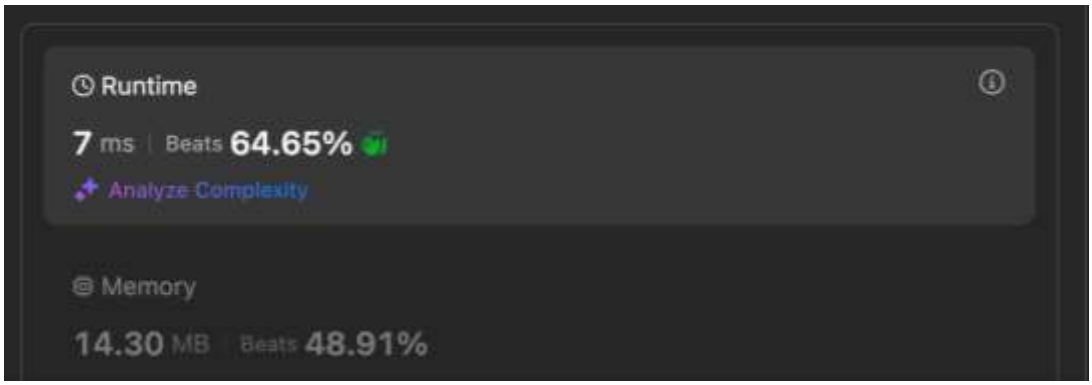
Divide and Conquer

Question 1: Longest Nice Substring

Code:

```
class Solution {
public:
    string longestNiceSubstring(string s) {
        int n = s.length();
        if (n < 2) return "";

        unordered_set<char> st(s.begin(), s.end());

        for (int i = 0; i < n; i++) {
            if (st.count(tolower(s[i])) && st.count(toupper(s[i]))) continue;
            string left = longestNiceSubstring(s.substr(0, i));
            string right = longestNiceSubstring(s.substr(i + 1));
            return left.length() >= right.length() ? left : right;
        }
        return s;
    }
};
```

Question 2: Reverse Bits



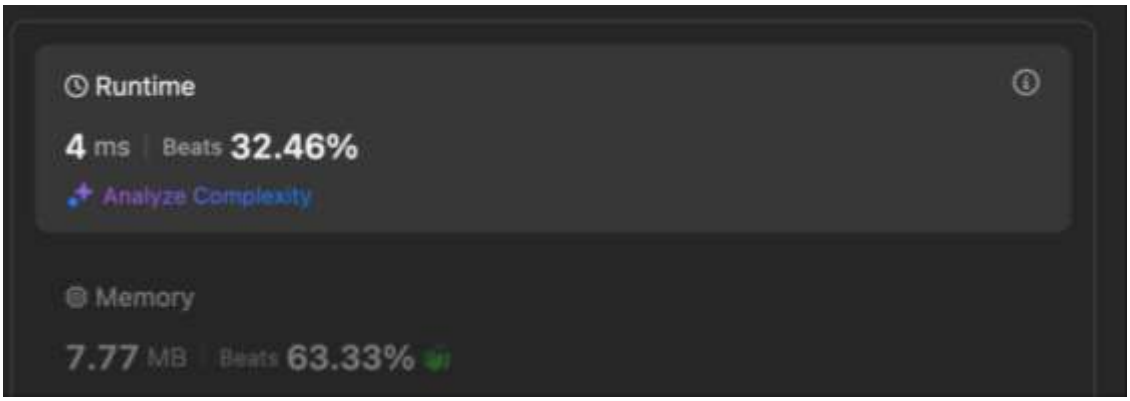
Code:

```
class Solution {
public:
    uint32_t reverseBits(uint32_t n) {
        uint32_t res = 0;
        for (int i = 0; i < 32; i++) {
```

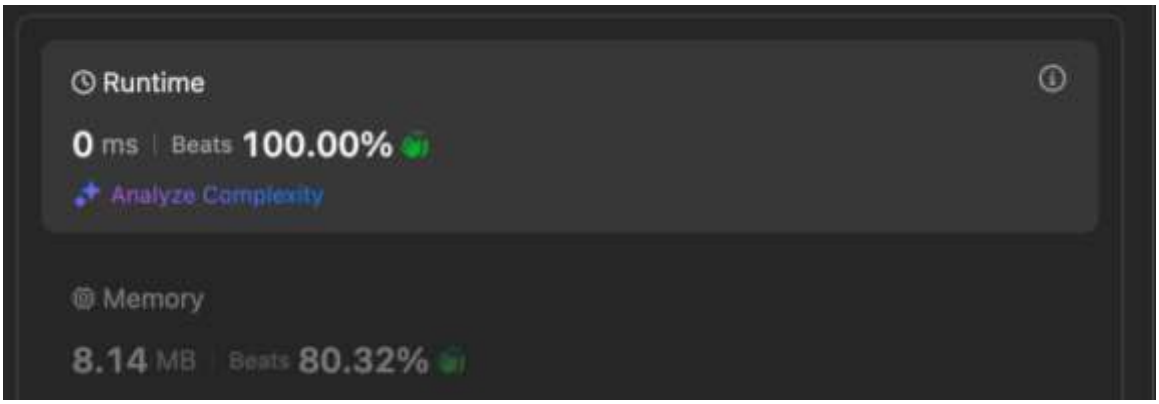
```
            res = (res << 1) | (n & 1);
            n >>= 1;
        }
        return res;
    }
};
```

Question 3: Number of 1 Bits

Code:




```
class Solution {
public:
    int hammingWeight(int n) {
        int count = 0;
        while (n) {
            count += (n & 1);
            n >>= 1;
        }
        return count;
    }
};
```



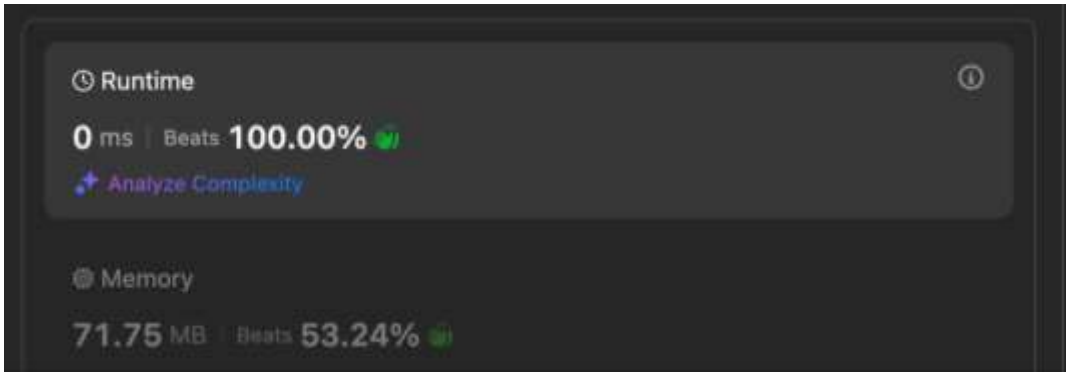
Question 4: Maximum Subarray

Code:

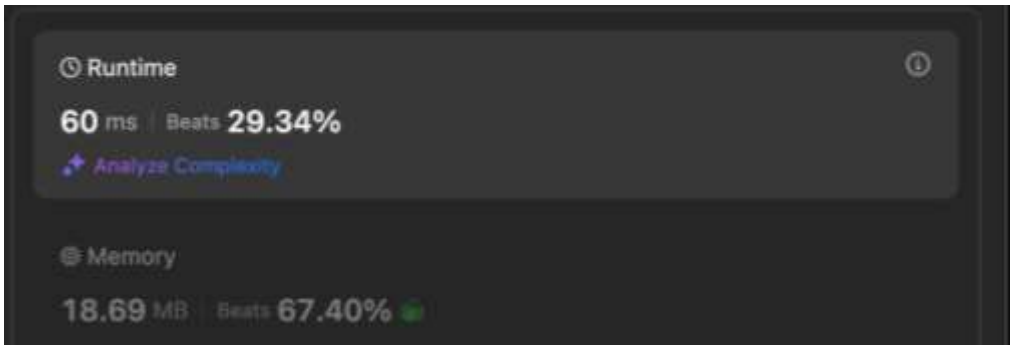
```
class Solution {
public:
    int maxSubArray(vector<int>& nums) {
        int maxSum = nums[0], curSum = 0;
        for (int num : nums) {
            curSum = max(num, curSum + num);
            maxSum = max(maxSum, curSum);
        }
        return maxSum;
    }
};
```

Question 5: Search a 2D Matrix II

Code:



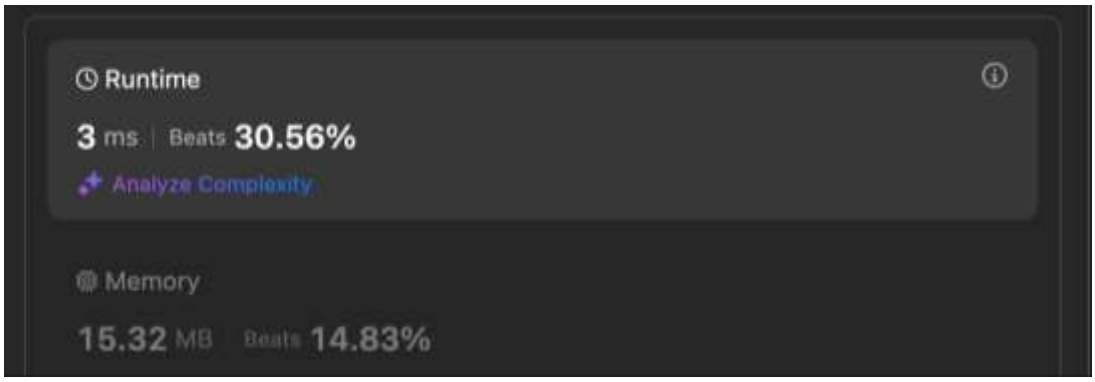

```
class Solution {
public:
    bool searchMatrix(vector<vector<int>>& matrix, int target) {
        int rows = matrix.size(), cols = matrix[0].size();
        int r = 0, c = cols - 1;

        while (r < rows && c >= 0) {
            if (matrix[r][c] == target) return true;
            else if (matrix[r][c] > target) c--;
            else r++;
        }

        return false;
    }
};
```



Question 6: Super Pow

Code:

```
class Solution {
public:
    const int MOD = 1337;
    int modPow(int x, int n) {
        int res = 1;
        x %= MOD;
        while (n) {
            if (n % 2) res = (res * x) % MOD;
            x = (x * x) % MOD;
            n /= 2;
        }
        return res;
    }
    int superPow(int a, vector<int>& b) {
        int res = 1;
        for (int digit : b) {
            res = modPow(res, 10) * modPow(a, digit) % MOD;
        }
        return res;
    }
};
```



Question 7: Beautiful Array

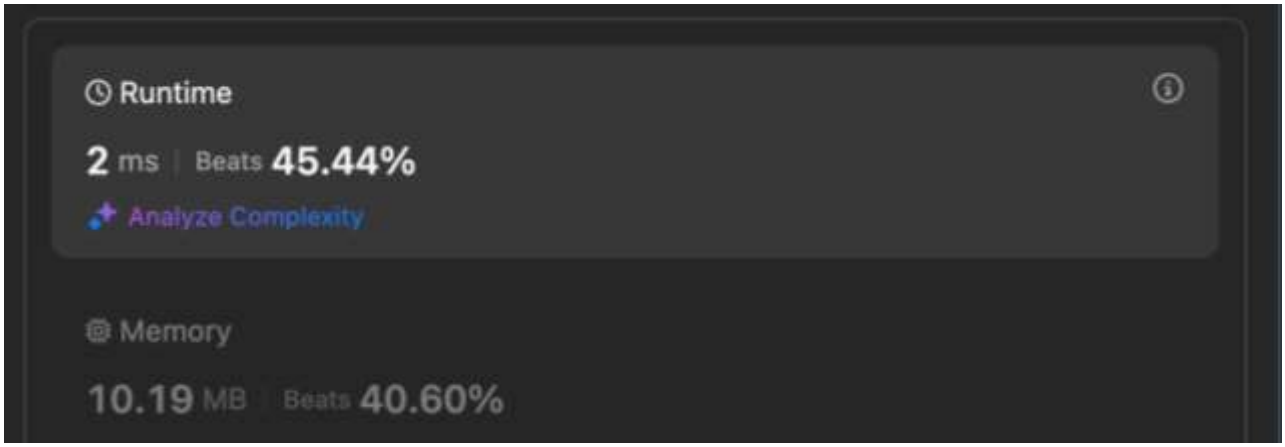
Code:

```
class Solution {
public:
    vector<int> beautifulArray(int n) {
        vector<int> res = {1};
        while (res.size() < n) {
            vector<int> temp;
            for (int num : res) if (num * 2 - 1 <= n) temp.push_back(num * 2 - 1);
            for (int num : res) if (num * 2 <= n) temp.push_back(num * 2);
            res = temp;
        }
        return res;
    }
};
```

Question 8: The Skyline Problem

Code:

```
class Solution {
```



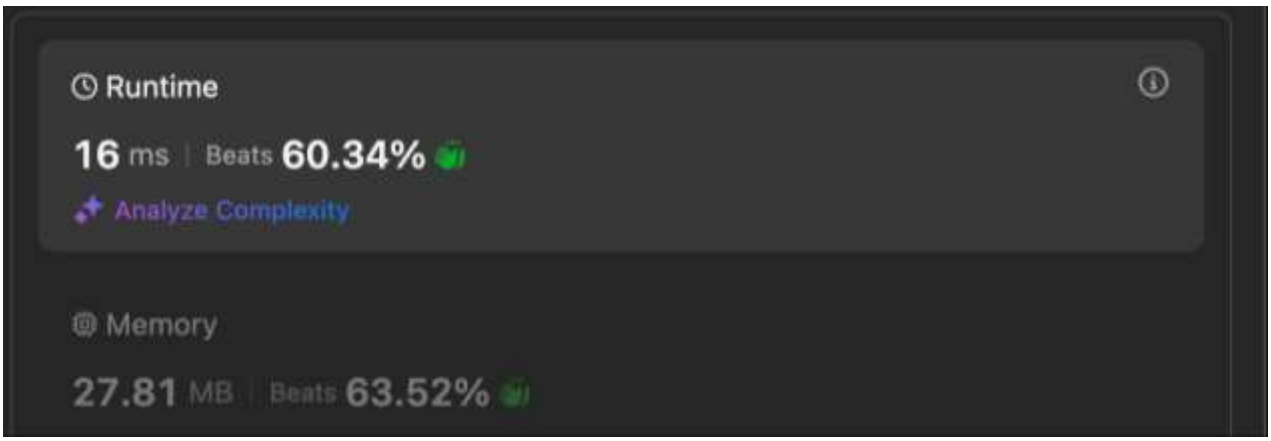

```
public:
    vector<vector<int>> getSkyline(vector<vector<int>>& buildings) {
        vector<pair<int, int>> events;
        for (auto& b : buildings) {
            events.emplace_back(b[0], -b[2]); // Start of building
            events.emplace_back(b[1], b[2]);  // End of building
        }
        sort(events.begin(), events.end());

        multiset<int> heights = {0};
        vector<vector<int>> res;
        int prevMax = 0;

        for (auto& [x, h] : events) {
            if (h < 0) heights.insert(-h); // Insert height for start
            else heights.erase(heights.find(h)); // Remove height for end
```

```
            int curMax = *heights.rbegin();
            if (curMax != prevMax) {
                res.push_back({x, curMax});
                prevMax = curMax;
            }
        }
        return res;
    }
};
```

Question 9: Reverse Pairs

Code:

```
class Solution {
```



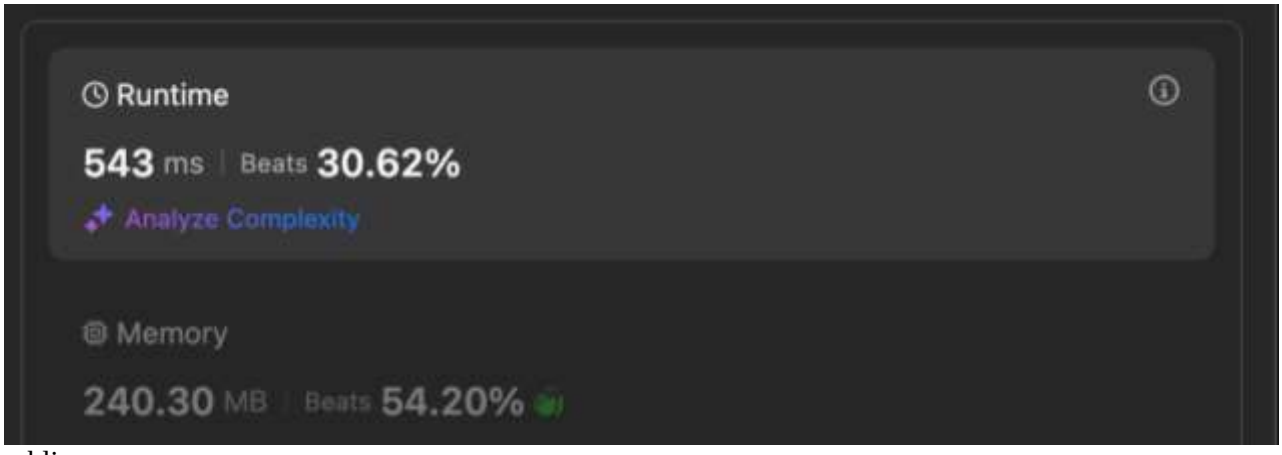

```
public:
    int mergeSort(vector<int>& nums, int left, int right) {
        if (left >= right) return 0;
        int mid = left + (right - left) / 2;
        int count = mergeSort(nums, left, mid) + mergeSort(nums, mid + 1, right);

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

        vector<int> sorted;
        int i = left, k = mid + 1;
        while (i <= mid && k <= right) {
            if (nums[i] <= nums[k]) sorted.push_back(nums[i++]);
            else sorted.push_back(nums[k++]);
        }
        while (i <= mid) sorted.push_back(nums[i++]);
        while (k <= right) sorted.push_back(nums[k++]);

        for (int i = left; i <= right; i++) nums[i] = sorted[i - left];
```

```
        return count;
    }

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

Question 10: Longest Increasing Subsequence II

Code:

```
class Solution {
```




```
public:
    class SegmentTree {
    public:
        vector<int> tree;
        int size;

        SegmentTree(int n) {
            size = n;
            tree.resize(4 * n, 0);
        }

        void update(int index, int value, int node, int start, int end) {
            if (start == end) {
                tree[node] = value;
                return;
            }
            int mid = (start + end) / 2;
            if (index <= mid) update(index, value, 2 * node, start, mid);
            else update(index, value, 2 * node + 1, mid + 1, end);
            tree[node] = max(tree[2 * node], tree[2 * node + 1]);
        }

        int query(int left, int right, int node, int start, int end) {
            if (left > end || right < start) return 0;
            if (left <= start && end <= right) return tree[node];
```

```
        int mid = (start + end) / 2;
        return max(query(left, right, 2 * node, start, mid), query(left, right, 2 * node + 1, mid + 1, end));
    }

    void update(int index, int value) {
        update(index, value, 1, 1, size);
    }

    int query(int left, int right) {
        return query(left, right, 1, 1, size);
    }
};

int lengthOfLIS(vector<int>& nums, int k) {
    int maxVal = *max_element(nums.begin(), nums.end());
    SegmentTree segTree(maxVal);
    int maxLength = 0;

    for (int num : nums) {
        int bestPrev = segTree.query(max(1, num - k), num - 1);
        int newLength = bestPrev + 1;
        segTree.update(num, newLength);
        maxLength = max(maxLength, newLength);
    }

    return maxLength;
}
};
```