

Experiment 4

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Subject Name: Advanced Programming Lab-2

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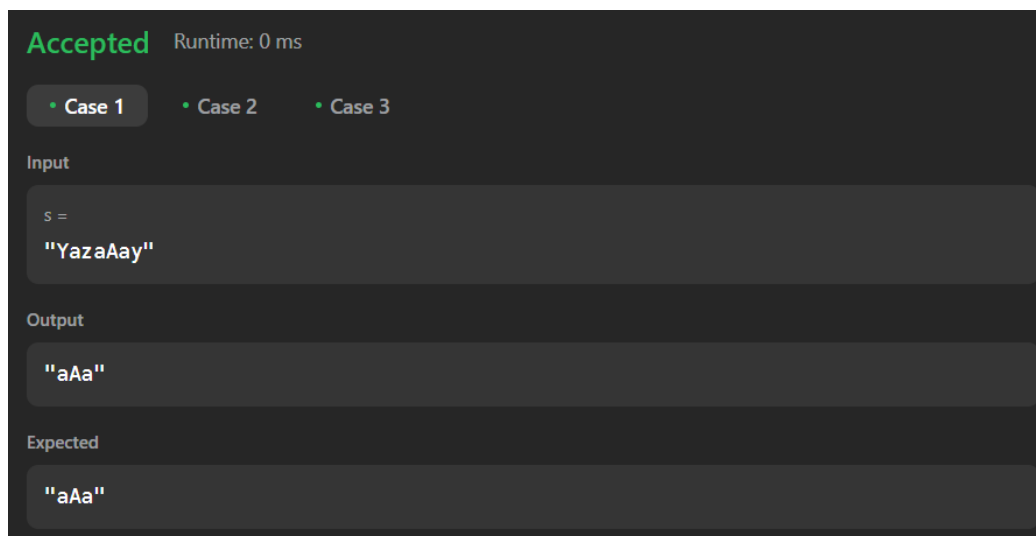
Subject Code: 22ITP-351

Problem 1. Longest Nice Substring - A string s is nice if, for every letter of the alphabet that s contains, it appears both in uppercase and lowercase. For example, "abABB" is nice because 'A' and 'a' appear, and 'B' and 'b' appear. However, "abA" is not because 'b' appears, but 'B' does not.

Code:

```
class Solution
{
public:
    string longestNiceSubstring(string s) {
        if (s.size() < 2) return "";
        unordered_set<char> st(begin(s), end(s));
        for (int i = 0; i < s.size(); i++) {
            if (st.find((char) toupper(s[i])) == end(st) || st.find((char) tolower(s[i])) == end(st)) {
                string s1 = longestNiceSubstring(s.substr(0, i));
                string s2 = longestNiceSubstring(s.substr(i + 1));
                return s1.size() >= s2.size() ? s1 : s2;
            }
        }
        return s;
    }
};
```

Output:



Problem 2. Reverse Bits - Reverse bits of a given 32 bits unsigned integer

Code:

```
class Solution {
public:
    uint32_t reverseBits(uint32_t n) {
        uint32_t result = 0;
        for (int i = 0; i < 32; i++) {
            int bit = n & 1;    // Extract the least significant bit
            result = (result << 1) | bit; // Append the bit to the result
            n = n >> 1;        // Right-shift n to process the next bit
        }
        return result;
    }
};
```

Output:

Accepted Runtime: 0 ms

• Case 1

• Case 2

Input

n =
00000010100101000001111010011100

Output

964176192 (00111001011110000010100101000000)

Expected

964176192 (00111001011110000010100101000000)

Problem 3. Number of 1 bits. - 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(int n) {
        int count = 0;
        while(n > 0){
            if(n%2 == 1){
                count++;
                n = n/2;
            }
            else{
                n = n/2;
            }
        }
        return count;
    }
};
```

Output:

Accepted Runtime: 0 ms

• Case 1

• Case 2

• Case 3

Input

n =
11

Output

3

Expected

3

Problem 4. Max Subarray - 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 n = size(nums), ans = INT_MIN;  
        for(int i = 0; i < n; i++)  
            for(int j = i, curSum = 0; j < n ; j++)  
                curSum += nums[j],  
                ans = max(ans, curSum);  
        return ans;  
    }  
};
```

Output:

Accepted Runtime: 0 ms

• Case 1

• Case 2

• Case 3

Input

nums =
[-2,1,-3,4,-1,2,1,-5,4]

Output

6

Expected

6

Problem 5. Search 2d matrix 2 - Write an efficient algorithm that searches for a value target in an m x n integer matrix matrix. This matrix has the following properties:

Code:

```
class Solution {
private:
    bool search(vector<int>& arr, int target) {
        int low = 0, high = arr.size() - 1;
        while (low <= high) {
            int mid = low + (high - low) / 2;
            if (arr[mid] == target) return true;
            else if (arr[mid] < target) low = mid + 1;
            else high = mid - 1;
        }
        return false;
    }
public:
    bool searchMatrix(vector<vector<int>>& matrix, int target) {
        int n = matrix.size(), m = matrix[0].size();
        for (int i = 0; i < n; i++) {
            if (search(matrix[i], target)) {
                return true;
            }
        }
        return false;
    }
};
```

Output:

Accepted Runtime: 3 ms

• Case 1

• Case 2

Input

matrix =
[[1,4,7,11,15], [2,5,8,12,19], [3,6,9,16,22], [10,13,14,17,24], [18,21,23,26,30]]

target =
5

Output

true

Problem 6. Super Pow-Your task is to calculate $ab \bmod 1337$ where a is a positive integer and b is an extremely large positive integer given in the form of an array.

Code:

```
class Solution {
    const int base = 1337;
    int powmod(int a, int k) //a^k mod 1337 where 0 <= k <= 10
    {
        a %= base;
        int result = 1;
        for (int i = 0; i < k; ++i)
            result = (result * a) % base;
        return result;
    }
public:
    int superPow(int a, vector<int>& b) {
        if (b.empty()) return 1;
        int last_digit = b.back();
        b.pop_back();
        return powmod(superPow(a, b), 10) * powmod(a, last_digit) % base;
    }
};
```

Output:

Accepted Runtime: 0 ms

• Case 1

• Case 2

• Case 3

Input

a =
2

b =
[3]

Output

8

Problem 7. Beautiful Array- An array nums of length n is beautiful if:

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

Code:

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

Output:

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

n =
4

Output

[1,3,2,4]

Expected

[2,1,4,3]

Problem 8. The Skyline Problem-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<vector<int>> ans;
        multiset<int> pq{0};
        vector<pair<int, int>> points;
        for(auto b: buildings){
            points.push_back({b[0], -b[2]});
            points.push_back({b[1], b[2]});
        }
        sort(points.begin(), points.end());
        int ongoingHeight = 0;
        for(int i = 0; i < points.size(); i++){
            int currentPoint = points[i].first;
            int heightAtCurrentPoint = points[i].second;
            if(heightAtCurrentPoint < 0){
                pq.insert(-heightAtCurrentPoint);
            } else {
                pq.erase(pq.find(heightAtCurrentPoint));
            }
            auto pqTop = *pq.rbegin();
            if(ongoingHeight != pqTop){
                ongoingHeight = pqTop;
                ans.push_back({currentPoint, ongoingHeight});
            }
        }
        return ans;
    }
};
```

Output:

Accepted
Runtime: 0 ms

• Case 1
• Case 2

Input

buildings =
[[2,9,10],[3,7,15],[5,12,12],[15,20,10],[19,24,8]]

Output

[[2,10],[3,15],[7,12],[12,0],[15,10],[20,8],[24,0]]

Problem 9. Reverse Pairs- Given an integer array nums, return the number of reverse pairs in the array.

Code:

```
class Solution {
public:
    int reversePairs(vector<int>& nums) {
        int n = nums.size();
        long long reversePairsCount = 0;
        for(int i=0; i<n-1; i++){
            for(int j=i+1; j<n; j++){
                if(nums[i] > 2*(long long)nums[j]){
                    reversePairsCount++;
                }
            }
        }
        return reversePairsCount;
    }
};
```

Output:

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

nums =
[1,3,2,3,1]

Output

2

Expected

2

Problem 10. Longest increasing subsequence 2- You are given an integer array nums and an integer k. Find the longest subsequence of nums that meets the following requirements:

Code:

```
class MaxSegmentTree {
public:
    int n;
    vector<int> tree;
    MaxSegmentTree(int n_) : n(n_) {
        int size = (int)(ceil(log2(n)));
        size = (2 * pow(2, size)) - 1;
        tree = vector<int>(size);
    }
    int max_value() { return tree[0]; }
    int query(int l, int r) { return query_util(0, l, r, 0, n - 1); }
    int query_util(int i, int qL, int qR, int l, int r) {
        if (l >= qL && r <= qR) return tree[i];
        if (l > qR || r < qL) return INT_MIN;

        int m = (l + r) / 2;
        return max(query_util(2 * i + 1, qL, qR, l, m), query_util(2 * i + 2, qL, qR, m + 1, r));
    }
    void update(int i, int val) { update_util(0, 0, n - 1, i, val); }
    void update_util(int i, int l, int r, int pos, int val) {
        if (pos < l || pos > r) return;
        if (l == r) {
            tree[i] = max(val, tree[i]);
            return;
        }
        int m = (l + r) / 2;
        update_util(2 * i + 1, l, m, pos, val);
        update_util(2 * i + 2, m + 1, r, pos, val);
        tree[i] = max(tree[2 * i + 1], tree[2 * i + 2]);
    }
};

class Solution {
public:
    int lengthOfLIS(vector<int>& nums, int k) {
        MaxSegmentTree tree(1e5 + 1);
        for (int i : nums) {
            int lower = max(0, i - k);
            int cur = 1 + tree.query(lower, i - 1);
            tree.update(i, cur);
        }
        return tree.max_value();
    }
};
```



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```
}  
};
```

Output:

Accepted Runtime: 0 ms

• Case 1

• Case 2

• Case 3

Input

nums =
[4,2,1,4,3,4,5,8,15]

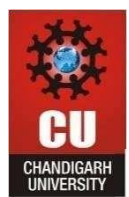
k =
3

Output

5

Expected

5



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