PRACTICAL NO. : 04

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SECTION/BATCH : A4/B1

ROLL NO. : 06

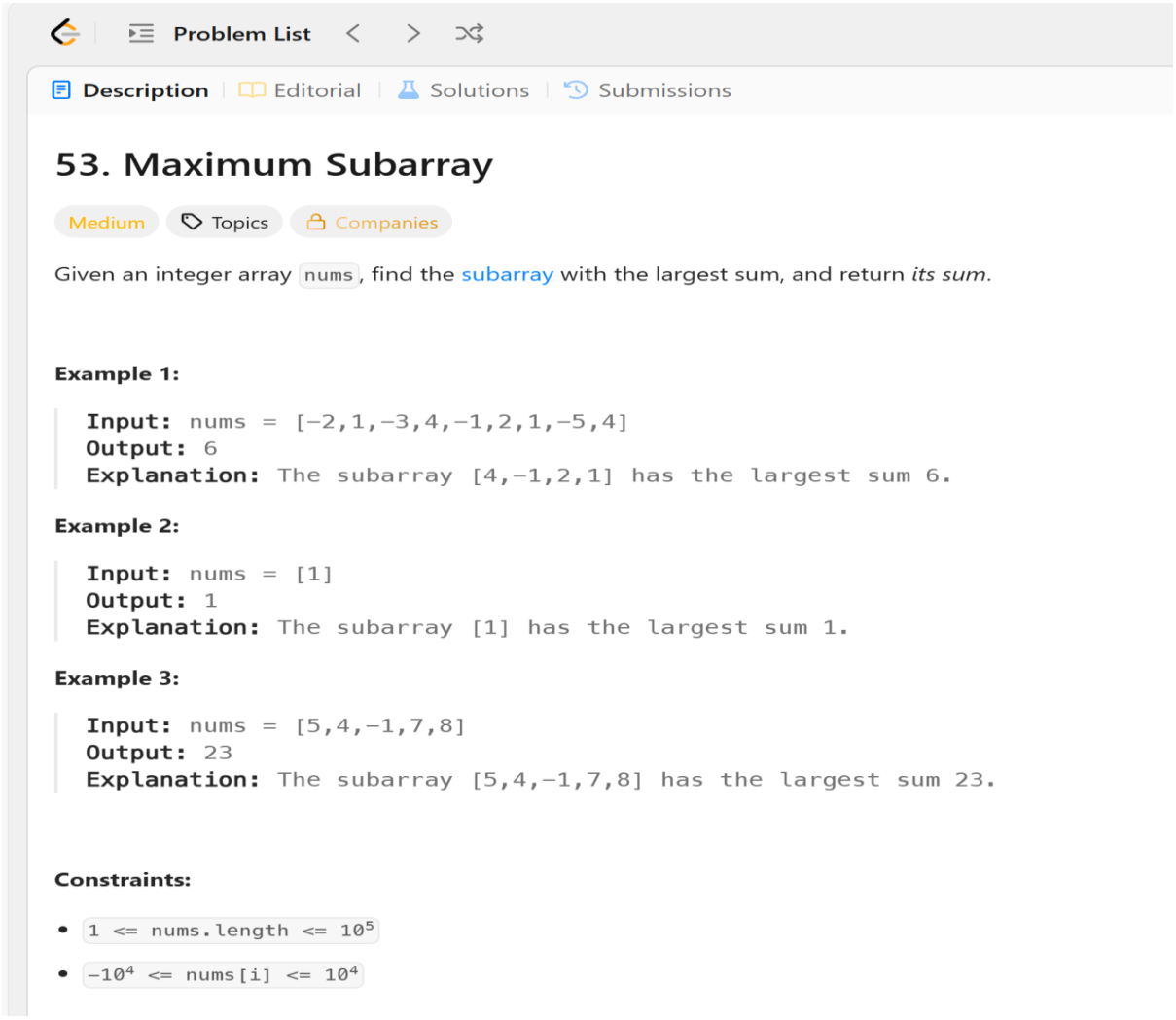
SUBJECT : DAA

LEETCODE ID : Bhortekar_Coder - LeetCode Profile

AIM : Implement maximum sum of subarray for the given scenario of resource allocation using the divide and conquer approach.

LEETCODE QUESTION ID 53. MAXIMUM SUBARRAY :

PROBLEM STATEMENT :



Problem List

Description | Editorial | Solutions | Submissions

53. Maximum Subarray

Medium | Topics | Companies

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

Example 1:

```
Input: nums = [-2,1,-3,4,-1,2,1,-5,4]
Output: 6
Explanation: The subarray [4,-1,2,1] has the largest sum 6.
```

Example 2:

```
Input: nums = [1]
Output: 1
Explanation: The subarray [1] has the largest sum 1.
```

Example 3:

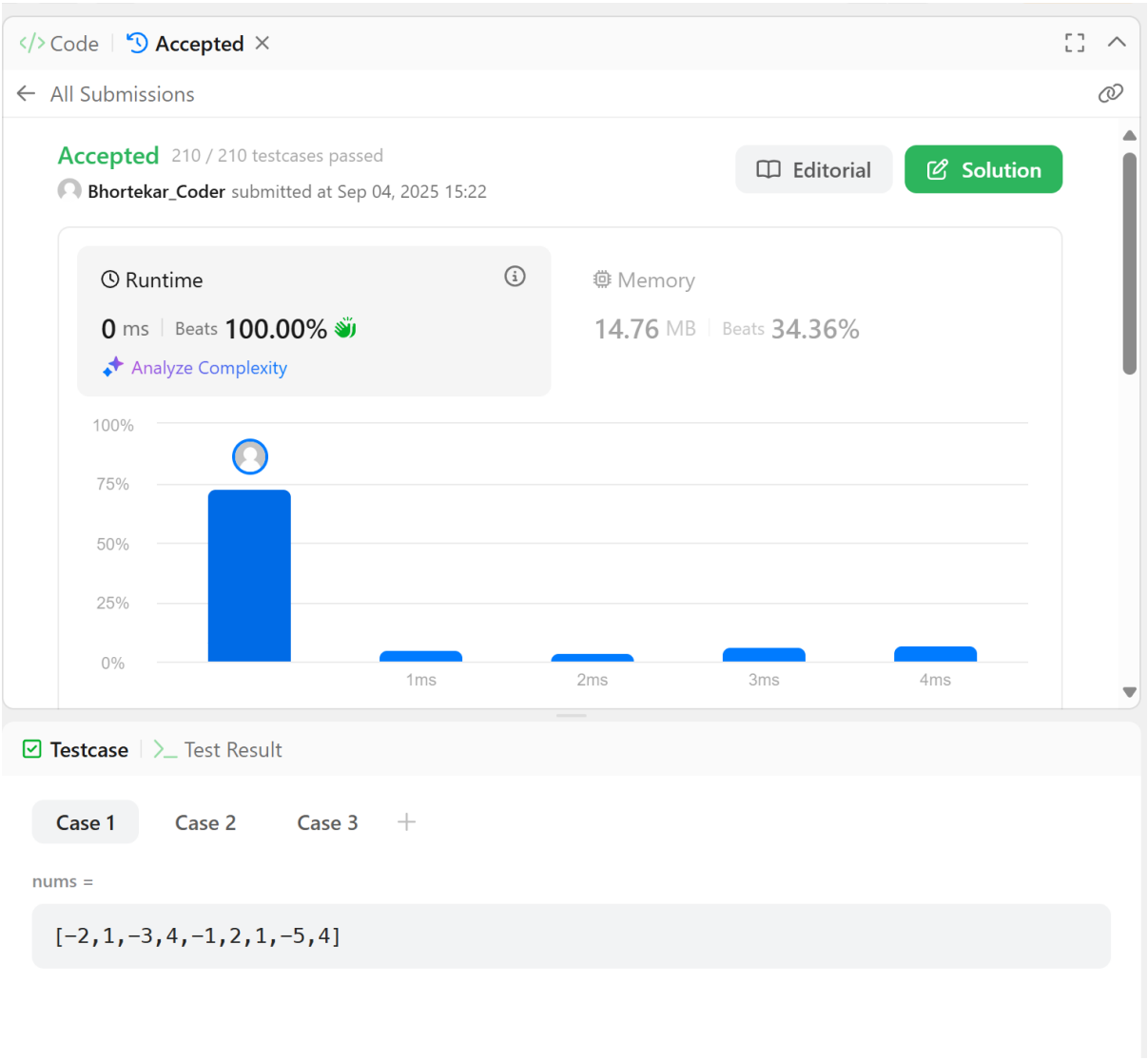
```
Input: nums = [5,4,-1,7,8]
Output: 23
Explanation: The subarray [5,4,-1,7,8] has the largest sum 23.
```

Constraints:

- `1 <= nums.length <= 10^5`
- `-10^4 <= nums[i] <= 10^4`

SUBMISSION :

CODE

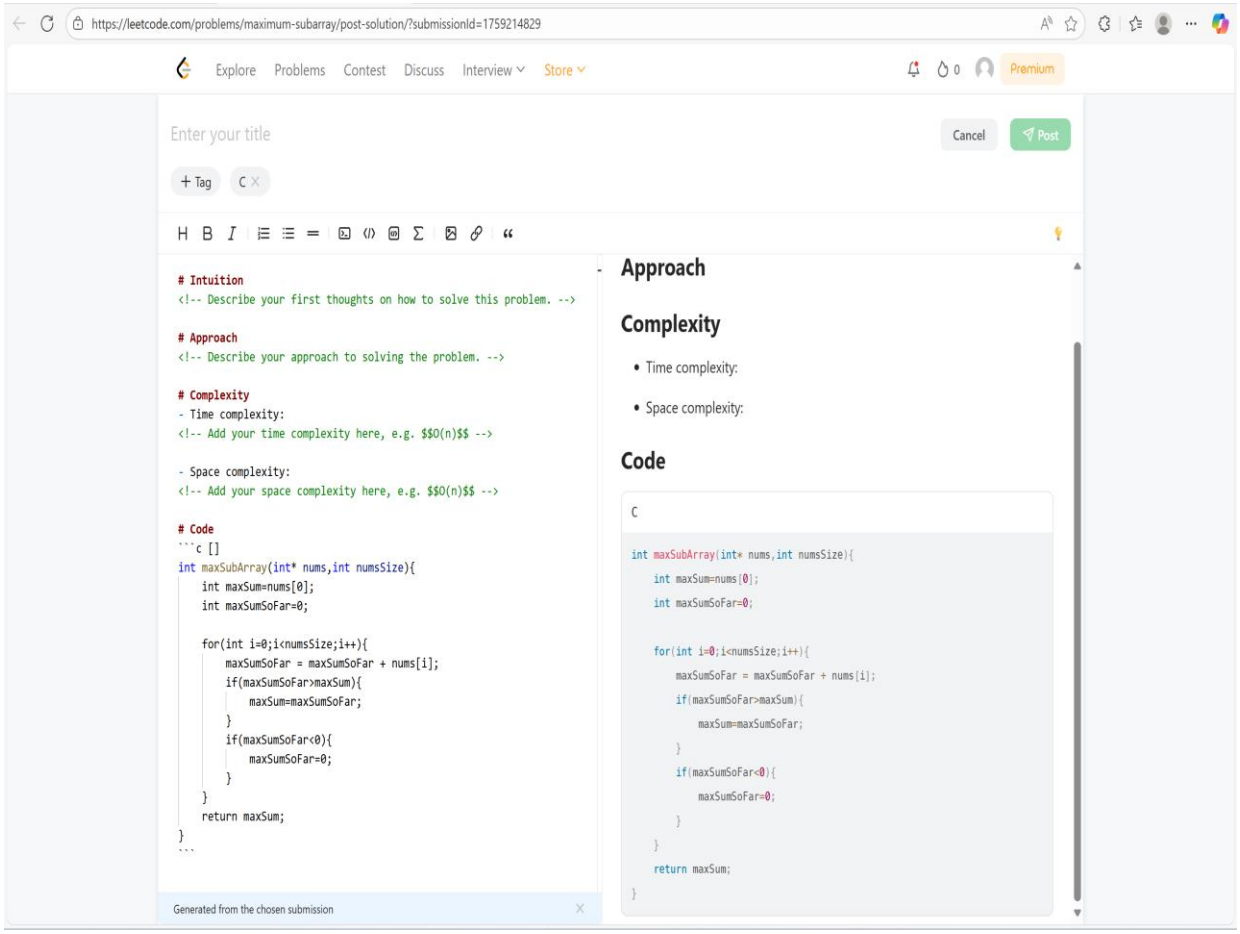


CODE IN TEXT FORMAT :

```
int maxSubArray(int* nums,int numsSize){
    int maxSum=nums[0];
    int maxSumSoFar=0;

    for(int i=0;i<numsSize;i++){
        maxSumSoFar = maxSumSoFar + nums[i];
        if(maxSumSoFar>maxSum){
            maxSum=maxSumSoFar;
```

```
        }
        if(maxSumSoFar<0){
            maxSumSoFar=0;
        }
    }
    return maxSum;
}
```

SCREENSHOT OF CODE :



PROBLEM STATEMENT :

A project requires allocating resources to various tasks over a period of time. Each task requires a certain amount of resources, and you want to maximize the overall efficiency of resource usage. You're given an array of resources where resources[i] represents the amount of resources required for the ith task. Your goal is to find the contiguous subarray of tasks that maximizes the total resources utilized without exceeding a given resource constraint. Handle cases where the total resources exceed the constraint by adjusting the subarray window accordingly. Your implementation should handle various cases, including scenarios where there's no feasible subarray given the constraint and scenarios where multiple subarrays yield the same maximum resource utilization.

CODE IN TEXT FORMAT :

```
#include <stdio.h>

int max(int a, int b) {
    return (a > b) ? a : b;
}

int maxCrossingSum(int arr[], int left, int mid, int right, int constraint) {
    int sum = 0;
    int left_sum = 0;
    for (int i = mid; i >= left; i--) {
        sum += arr[i];
        if (sum <= constraint) {
            left_sum = max(left_sum, sum);
        } else {
            break;
        }
    }
    sum = 0;
    int right_sum = 0;
    for (int i = mid + 1; i <= right; i++) {
```

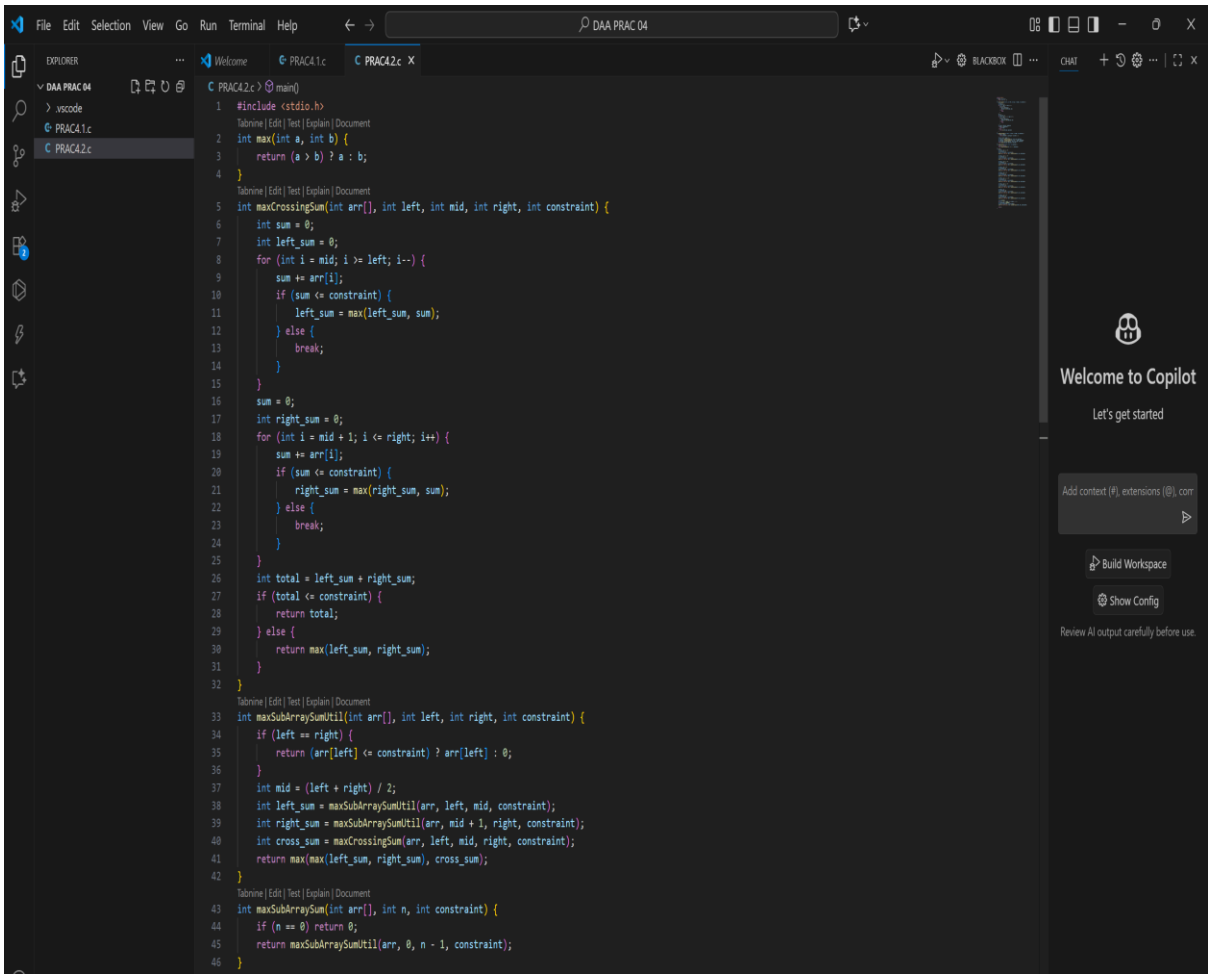
```
        sum += arr[i];
        if (sum <= constraint) {
            right_sum = max(right_sum, sum);
        } else {
            break;
        }
    }

    int total = left_sum + right_sum;
    if (total <= constraint) {
        return total;
    } else {
        return max(left_sum, right_sum);
    }
}

int maxSubArraySumUtil(int arr[], int left, int right, int constraint) {
    if (left == right) {
        return (arr[left] <= constraint) ? arr[left] : 0;
    }

    int mid = (left + right) / 2;
    int left_sum = maxSubArraySumUtil(arr, left, mid, constraint);
    int right_sum = maxSubArraySumUtil(arr, mid + 1, right, constraint);
    int cross_sum = maxCrossingSum(arr, left, mid, right, constraint);

    return max(max(left_sum, right_sum), cross_sum);
}
```

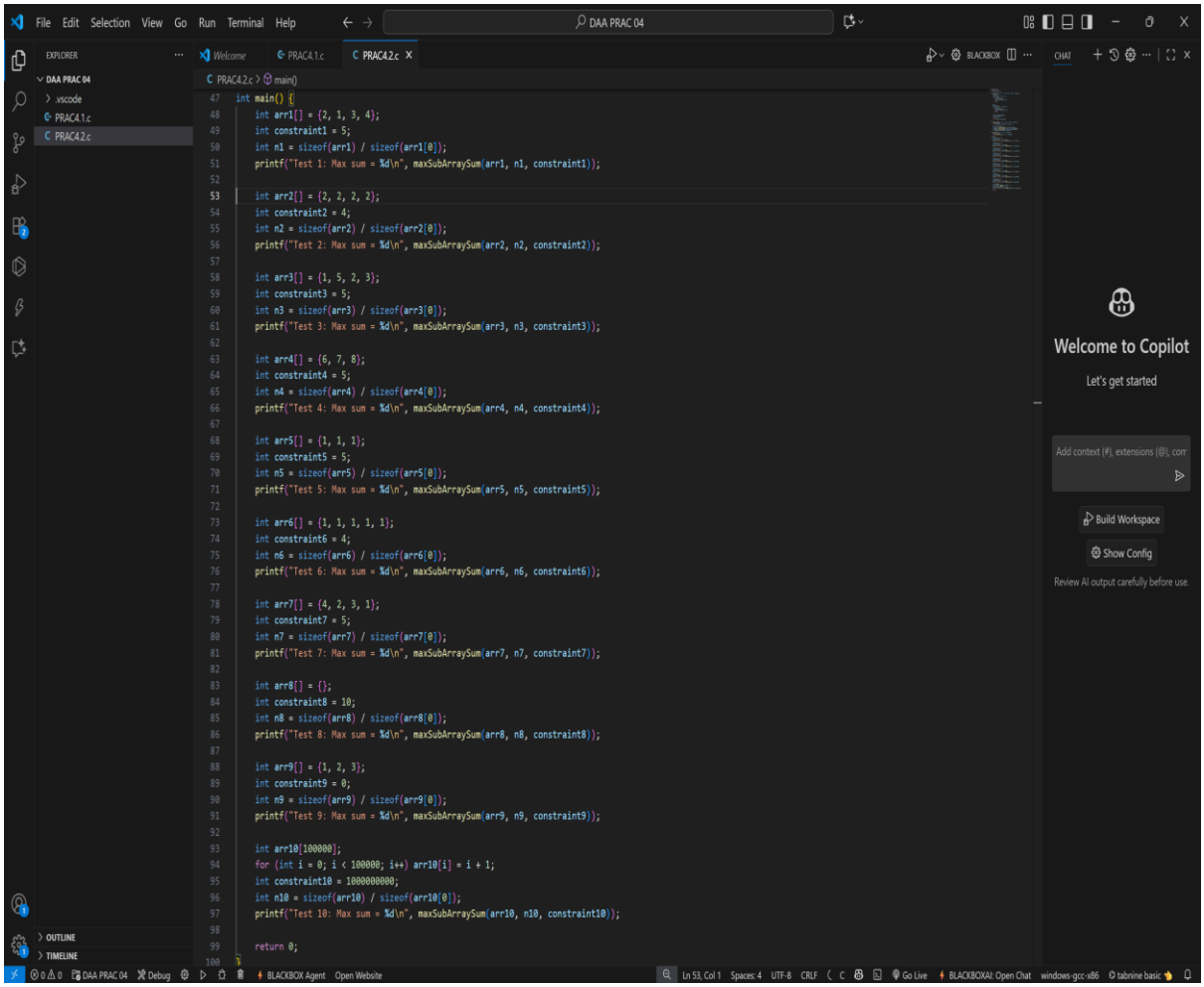
```
int maxSubArraySum(int arr[], int n, int constraint) {
    if (n == 0) return 0;
    return maxSubArraySumUtil(arr, 0, n - 1, constraint);
}

int main() {
    int arr1[] = {2, 1, 3, 4};
    int constraint1 = 5;
    int n1 = sizeof(arr1) / sizeof(arr1[0]);
    printf("Test 1: Max sum = %d\n", maxSubArraySum(arr1, n1, constraint1));

    int arr2[] = {2, 2, 2, 2};
    int constraint2 = 4;
    int n2 = sizeof(arr2) / sizeof(arr2[0]);
    printf("Test 2: Max sum = %d\n", maxSubArraySum(arr2, n2, constraint2));

    int arr3[] = {1, 5, 2, 3};
    int constraint3 = 5;
    int n3 = sizeof(arr3) / sizeof(arr3[0]);
    printf("Test 3: Max sum = %d\n", maxSubArraySum(arr3, n3, constraint3));

    int arr4[] = {6, 7, 8};
    int constraint4 = 5;
    int n4 = sizeof(arr4) / sizeof(arr4[0]);
    printf("Test 4: Max sum = %d\n", maxSubArraySum(arr4, n4, constraint4));

    int arr5[] = {1, 2, 3, 2, 1};
```

```
int constraint5 = 5;
int n5 = sizeof(arr5) / sizeof(arr5[0]);
printf("Test 5: Max sum = %d\n", maxSubArraySum(arr5, n5, constraint5));

int arr6[] = {1, 1, 1, 1, 1};
int constraint6 = 4;
int n6 = sizeof(arr6) / sizeof(arr6[0]);
printf("Test 6: Max sum = %d\n", maxSubArraySum(arr6, n6, constraint6));

int arr7[] = {4, 2, 3, 1};
int constraint7 = 5;
int n7 = sizeof(arr7) / sizeof(arr7[0]);
printf("Test 7: Max sum = %d\n", maxSubArraySum(arr7, n7, constraint7));

int arr8[] = {};
int constraint8 = 10;
int n8 = sizeof(arr8) / sizeof(arr8[0]);
printf("Test 8: Max sum = %d\n", maxSubArraySum(arr8, n8, constraint8));

int arr9[] = {1, 2, 3};
int constraint9 = 0;
int n9 = sizeof(arr9) / sizeof(arr9[0]);
printf("Test 9: Max sum = %d\n", maxSubArraySum(arr9, n9, constraint9));

int arr10[100000];
for (int i = 0; i < 100000; i++) arr10[i] = i + 1;
int constraint10 = 1000000000;
int n10 = sizeof(arr10) / sizeof(arr10[0]);
```

```
    printf("Test 10: Max sum = %d\n", maxSubArraySum(arr10, n10, constraint10));


    return 0;
}
```

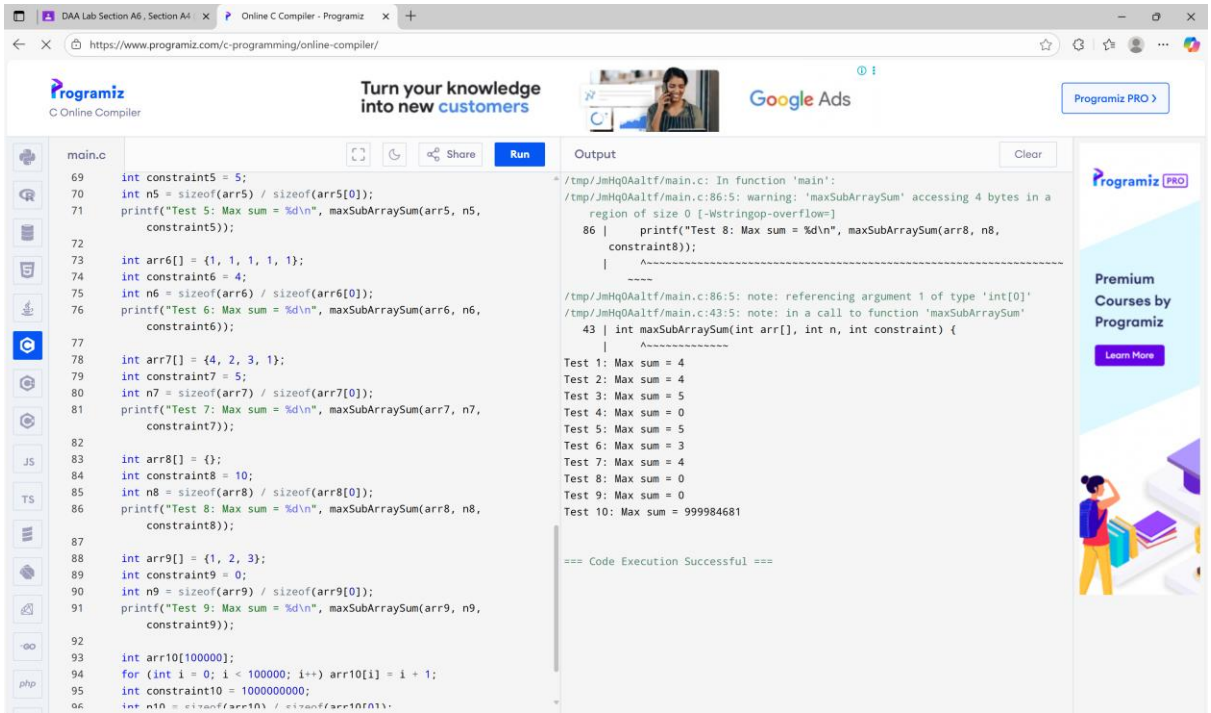
SCREENSHOT OF CODE :





```c
int main() {
    int arr1[] = {2, 1, 3, 4};
    int constraint1 = 5;
    int n1 = sizeof(arr1) / sizeof(arr1[0]);
    printf("Test 1: Max sum = %d\n", maxSubArraySum(arr1, n1, constraint1));

    int arr2[] = {2, 2, 2, 2};
    int constraint2 = 4;
    int n2 = sizeof(arr2) / sizeof(arr2[0]);
    printf("Test 2: Max sum = %d\n", maxSubArraySum(arr2, n2, constraint2));

    int arr3[] = {1, 5, 2, 3};
    int constraint3 = 5;
    int n3 = sizeof(arr3) / sizeof(arr3[0]);
    printf("Test 3: Max sum = %d\n", maxSubArraySum(arr3, n3, constraint3));

    int arr4[] = {6, 7, 8};
    int constraint4 = 5;
    int n4 = sizeof(arr4) / sizeof(arr4[0]);
    printf("Test 4: Max sum = %d\n", maxSubArraySum(arr4, n4, constraint4));

    int arr5[] = {1, 1, 1};
    int constraint5 = 5;
    int n5 = sizeof(arr5) / sizeof(arr5[0]);
    printf("Test 5: Max sum = %d\n", maxSubArraySum(arr5, n5, constraint5));

    int arr6[] = {1, 1, 1, 1, 1};
    int constraint6 = 4;
    int n6 = sizeof(arr6) / sizeof(arr6[0]);
    printf("Test 6: Max sum = %d\n", maxSubArraySum(arr6, n6, constraint6));

    int arr7[] = {4, 2, 3, 1};
    int constraint7 = 5;
    int n7 = sizeof(arr7) / sizeof(arr7[0]);
    printf("Test 7: Max sum = %d\n", maxSubArraySum(arr7, n7, constraint7));

    int arr8[] = {};
    int constraint8 = 10;
    int n8 = sizeof(arr8) / sizeof(arr8[0]);
    printf("Test 8: Max sum = %d\n", maxSubArraySum(arr8, n8, constraint8));

    int arr9[] = {1, 2, 3};
    int constraint9 = 0;
    int n9 = sizeof(arr9) / sizeof(arr9[0]);
    printf("Test 9: Max sum = %d\n", maxSubArraySum(arr9, n9, constraint9));

    int arr10[100000];
    for (int i = 0; i < 100000; i++) arr10[i] = i + 1;
    int constraint10 = 1000000000;
    int n10 = sizeof(arr10) / sizeof(arr10[0]);
    printf("Test 10: Max sum = %d\n", maxSubArraySum(arr10, n10, constraint10));

    return 0;
}
```

OUTPUT :



```
/tmp/JmHqOAaltf/main.c: In function 'main':
/tmp/JmHqOAaltf/main.c:86:5: warning: 'maxSubArraySum' accessing 4 bytes in a
    region of size 0 [-Wstringop-overflow=]
   86 |     printf("Test 8: Max sum = %d\n", maxSubArraySum(arr8, n8,
      constraint8));
      |     ^~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
      ~~~~
/tmp/JmHqOAaltf/main.c:86:5: note: referencing argument 1 of type 'int[0]'
/tmp/JmHqOAaltf/main.c:43:5: note: in a call to function 'maxSubArraySum'
   43 | int maxSubArraySum(int arr[], int n, int constraint) {
      |     ^~~~~~~~~~~~~~
Test 1: Max sum = 4
Test 2: Max sum = 4
Test 3: Max sum = 5
Test 4: Max sum = 0
Test 5: Max sum = 5
Test 6: Max sum = 3
Test 7: Max sum = 4
Test 8: Max sum = 0
Test 9: Max sum = 0
Test 10: Max sum = 999984681


=== Code Execution Successful ===
```