Experiment-5

Name: Manvi Chabbra
UID: 22BET10189
Branch: BE-IT
Section/Group: 22BET_IOT-702/A
Semester: 6th
Date of Performance:21/02/25
Subject Name: AP LAB-II
Subject Code: 22ITP-351

Problem-1

1.Aim:

You are given two integer arrays nums1 and nums2, sorted in non-decreasing order, and two integers m and n, representing the number of elements in nums1 and nums2 respectively.

2.Objective:

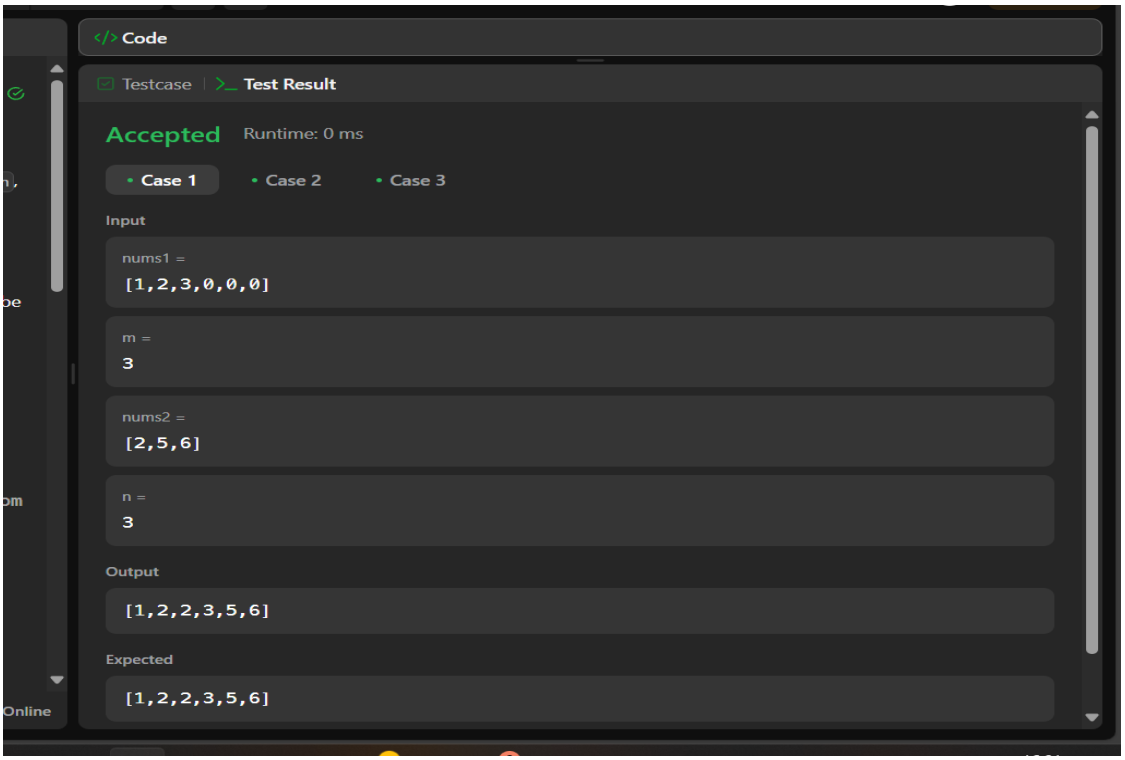
- Merge two sorted integer arrays, nums1 and nums2, into a single sorted array.
- Store the merged result in nums1, which has sufficient space (size m + n).
- Maintain non-decreasing order in the merged array.
- Perform the merge operation in-place without using extra space.
- Efficiently handle elements from both arrays while merging.

3.Code:

```
class Solution {

public:

    void merge(vector<int>& nums1, int m, vector<int>& nums2, int n) {


        int i=m-1 , j=n-1 ;

        while(i>=0 && j>=0 ){

            if(nums1[i]>=nums2[j]){

                nums1[i+j+1]=nums1[i] ;

                i-- ;

                }else{

                    nums1[i+j+1]=nums2[j];
```

```
                j-- ;
            }
        }
        while(j>=0){
                nums1[j]=nums2[j];
                j-- ;
            }
    }
};
```

4.Output:



Problem-2

1.Aim:

Given an integer array nums and an integer k, return *the* k *most frequent elements*. You may return the answer in any order.

2.Objective:

- Identify the k most frequent elements in the given integer array nums.
- Return these k elements in any order.
- Efficiently determine element frequencies and extract the top k frequent elements.
- Optimize for performance, ideally using a heap or other efficient data structures.

3.Code:

```
class Solution {

public:

   vector<int> topKFrequent(vector<int>& nums, int k) {

      unordered_map<int, int> ump;



      for(int i: nums){

         ump[i]++;

      }



      priority_queue<pair<int, int>>pq;



      for(auto i: ump){

         pq.push({i.second,i.first});

      }
```

```
        vector<int> res;


        while(k--){
            auto [elem, count] = pq.top();
            res.push_back(count);
            pq.pop();
        }


        return res;
    }
};
```

4.Output:

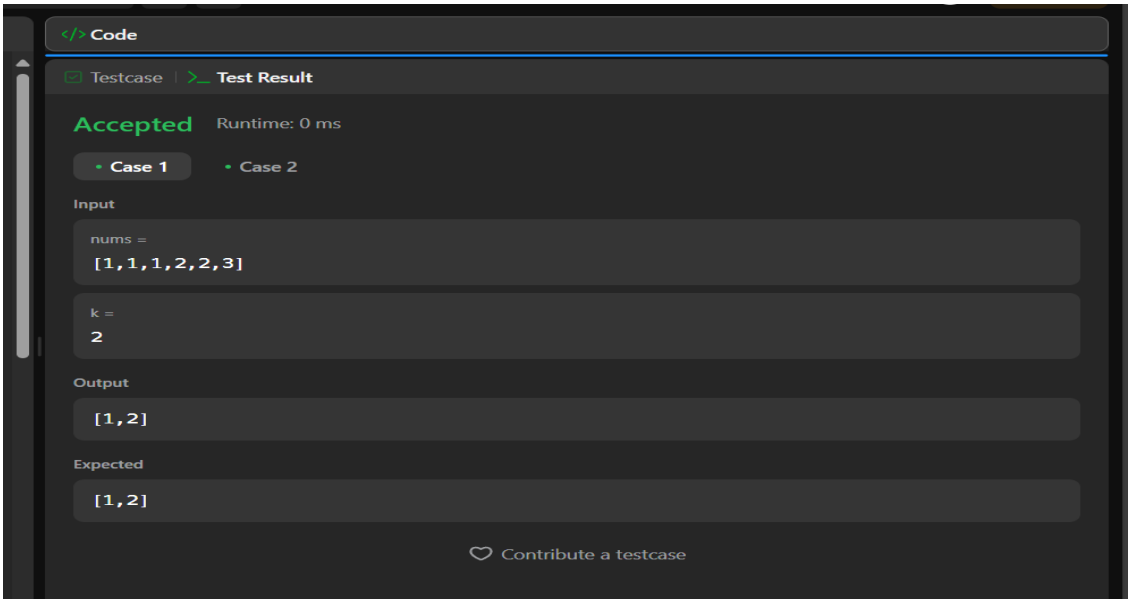


Fig.2:Top K frequent Elements

Problem-3

1.Aim:

A peak element is an element that is strictly greater than its neighbors.Given a 0-indexed integer array nums, find a peak element, and return its index. If the array contains multiple peaks, return the index to any of the peaks.

2.Objective:

- Identify a peak element in the given 0-indexed integer array nums.
- A peak element is strictly greater than its neighbors.
- If multiple peaks exist, return the index of any one of them.
- Ensure an efficient approach, ideally using binary search instead of a linear scan.

3.Code:

```
class Solution {
public:
 int findPeakElement(vector<int>& nums) {
    int n= nums.size();
    int s=0;
    int e=n-1;

    while(s<e){
       int m = s + (e-s) / 2;

       if(nums[m] > nums[m+1]){
          e = m;
       }
       else{
          s = m +1;
```

```
        }

    }

    return s;


  }

};
```

4.Output:

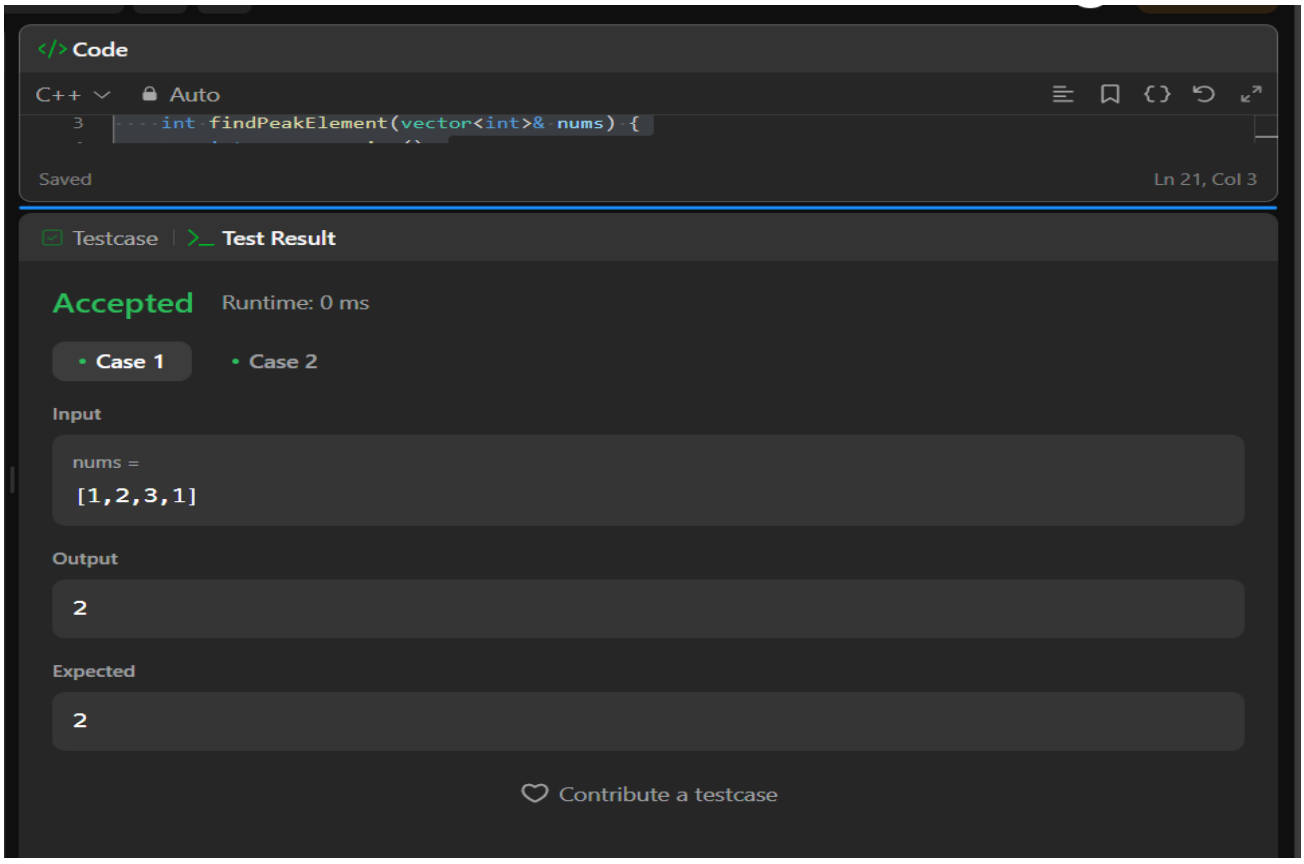


Fig.3:Find Peak Element

Problem-4

1.Aim: Given two sorted arrays nums1 and nums2 of size m and n respectively, return the median of the two sorted arrays.

2.Objective:

- To find the median of two sorted array
- The overall run time complexity should be O(log (m+n)).

3.Code:

```
class Solution {

public:

double findMedianSortedArrays(vector<int> &nums1, vector<int> &nums2) {

    int n1 = nums1.size(), n2 = nums2.size();


// Ensure nums1 is the smaller array for simplicity

if (n1 > n2)

   return findMedianSortedArrays(nums2, nums1);


int n = n1 + n2;

int left = (n1 + n2 + 1) / 2; // Calculate the left partition size

int low = 0, high = n1;


while (low <= high) {

   int mid1 = (low + high) >> 1; // Calculate mid index for nums1

   int mid2 = left - mid1; // Calculate mid index for nums2


   int l1 = INT_MIN, l2 = INT_MIN, r1 = INT_MAX, r2 = INT_MAX;
```

```
// Determine values of l1, l2, r1, and r2

if (mid1 < n1)

    r1 = nums1[mid1];

if (mid2 < n2)

    r2 = nums2[mid2];

if (mid1 - 1 >= 0)

    l1 = nums1[mid1 - 1];

if (mid2 - 1 >= 0)

    l2 = nums2[mid2 - 1];


if (l1 <= r2 && l2 <= r1) {

    // The partition is correct, we found the median

    if (n % 2 == 1)

        return max(l1, l2);

    else

        return ((double)(max(l1, l2) + min(r1, r2))) / 2.0;

}

else if (l1 > r2) {

    // Move towards the left side of nums1

    high = mid1 - 1;

}

else {

    // Move towards the right side of nums1

    low = mid1 + 1;

}
```

```
        }

        return 0; // If the code reaches here, the input arrays were not sorted.
    }
};
```

4.Output:

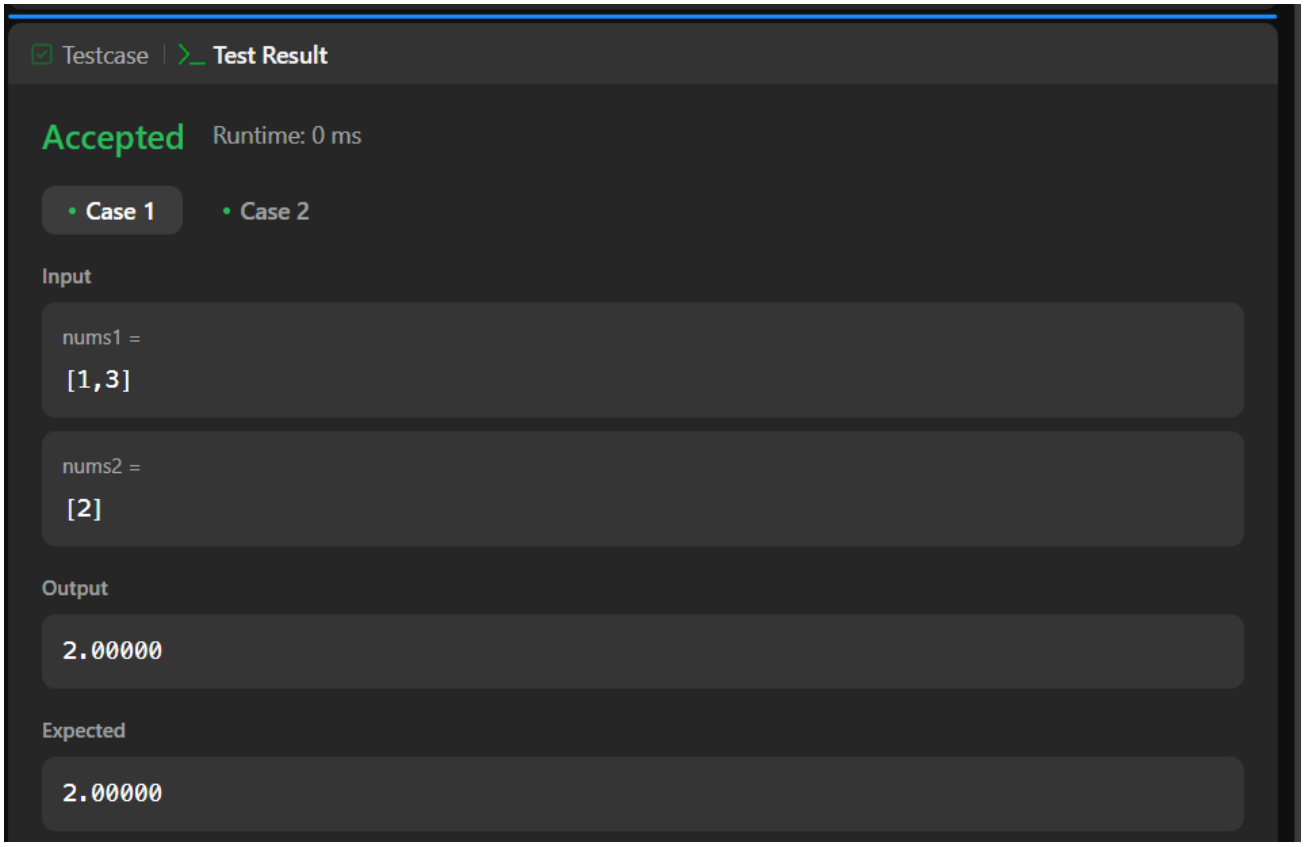


Fig.4:Median Of Two Sorted Array

Problem-5

1.Aim: Given an n x n matrix where each of the rows and columns is sorted in ascending order, return the k^{th} smallest element in the matrix.

2.Objective:

- k^{th} smallest element in the sorted order, not the k^{th} distinct element.

3.Code:

```
class Solution {

public:

   int kthSmallest(vector<vector<int>>& matrix, int z) {

      int n = matrix.size(), m = matrix[0].size();

      int a[n*m], k=0;

      for(int i=0; i<n; i++){

         for(int j=0; j<m; j++){

            a[k] = matrix[i][j];

            k++;

         }

      }

      sort(a, a+(n*m));

      return a[z-1];

   }

};
```

4.Output:

Fig.5:kth smallest element