Experiment 5

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Subject Name: Advanced Programming Lab **Subject Code: 22CSP-351**

1. Aim:

Problem-1: Sort Colors

2. Objective:

Given an array nums with n objects colored red, white, or blue, sort them in-place so that objects of the same color are adjacent, with the colors in the order red, white, and blue. We will use the integers 0, 1, and 2 to represent the color red, white, and blue, respectively. You must solve this problem without using the library's sort function.

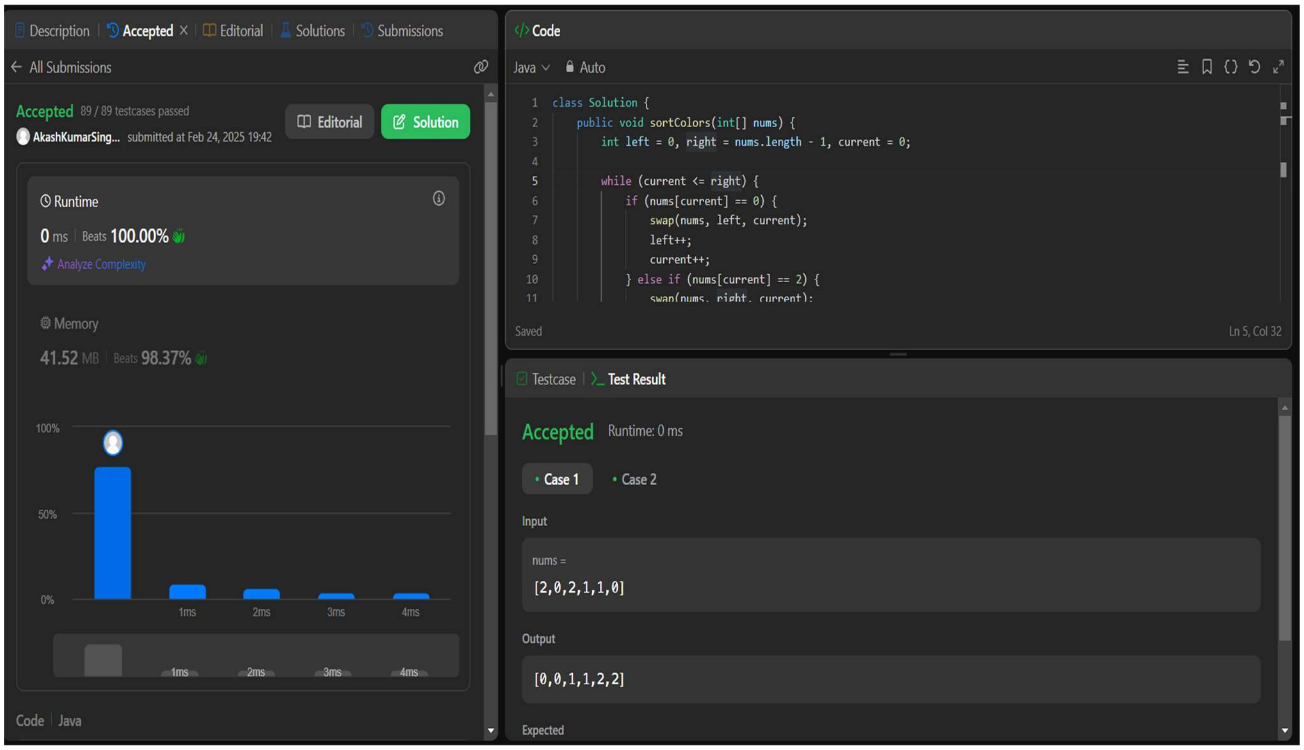
3. Implementation/Code:

```
class Solution {
    public void sortColors(int[] nums) {
        int left = 0, right = nums.length - 1, current = 0;

        while (current <= right) {
            if (nums[current] == 0) {
                swap(nums, left, current);
                left++;
                current++;
            } else if (nums[current] == 2) {
                swap(nums, right, current);
                right--;
            } else {
                current++;
            }
        }
    }

    private void swap(int[] nums, int i, int j) {
        int temp = nums[i];
        nums[i] = nums[j];
        nums[j] = temp;
    }
}
```

4. Output



Accepted 89 / 89 testcases passed
AkashKumarSing... submitted at Feb 24, 2025 19:42

0 ms | Beats 100.00%

41.52 MB | Beats 98.37%

```
class Solution {
    public void sortColors(int[] nums) {
        int left = 0, right = nums.length - 1, current = 0;

        while (current <= right) {
            if (nums[current] == 0) {
                swap(nums, left, current);
                left++;
                current++;
            } else if (nums[current] == 2) {
                swap(nums, right, current);
```

Saved Ln 5, Col 32

Accepted Runtime: 0 ms

Input
```
nums =
[2,0,2,1,1,0]
```

Output
```
[0,0,1,1,2,2]
```

Problem-2: Kth Largest Element in an Array

1. Objective:

Given an integer array nums and an integer k, return the kth largest element in the array. Note that it is the kth largest element in the sorted order, not the kth distinct element.

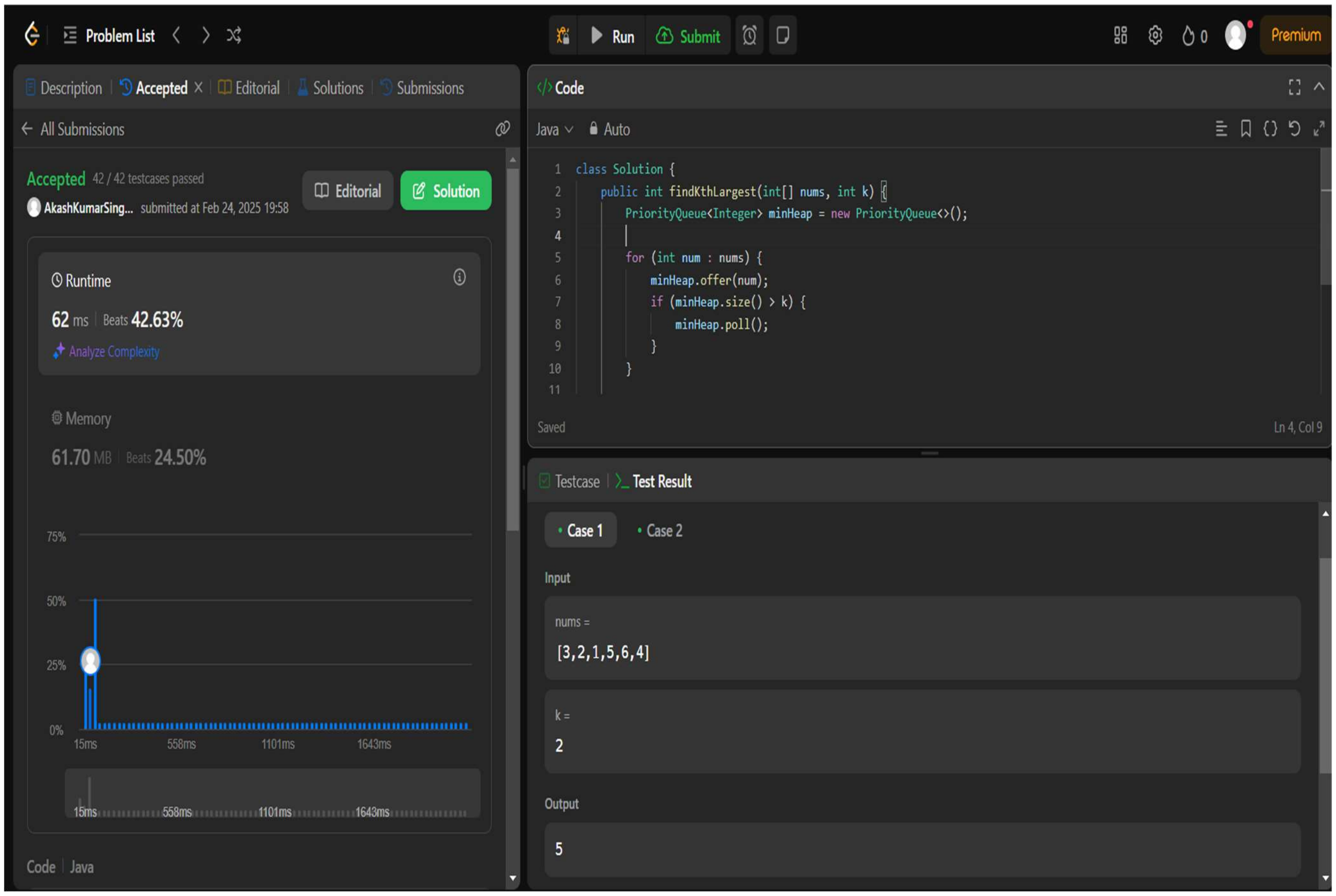
2. Implementation/Code:

```
class Solution {
    public int findKthLargest(int[] nums, int k) {
        PriorityQueue<Integer> minHeap = new PriorityQueue<>();

        for (int num : nums) {
            minHeap.offer(num);
            if (minHeap.size() > k) {
                minHeap.poll();
            }
        }

        return minHeap.peek();
    }
}
```

3. Output:



Accepted 42 / 42 testcases passed
AkashKumarSing... submitted at Feb 24, 2025 19:58

Runtime
62 ms | Beats 42.63%

Memory
61.70 MB | Beats 24.50%

```java
class Solution {
    public int findKthLargest(int[] nums, int k) {
        PriorityQueue<Integer> minHeap = new PriorityQueue<>();
        
        for (int num : nums) {
            minHeap.offer(num);
            if (minHeap.size() > k) {
                minHeap.poll();
            }
        }

```

Saved   Ln 4, Col 9

Input

nums =
[3,2,1,5,6,4]

k =
2

Output

5

4. Learning Outcomes:

1. Understand and implement in-place sorting algorithms like the **Dutch National Flag Algorithm** for efficiently sorting a three-color array.
2. Learn how to find the **Kth largest element** using optimized approaches like **QuickSelect** or **Min-Heap**, avoiding full sorting.
3. Analyze and compare **time and space complexity** of different sorting and selection algorithms for better optimization.
4. Develop problem-solving skills in **array manipulation and partitioning techniques** for constrained problems.
5. Gain experience in handling **edge cases and constraints** while ensuring algorithm correctness and efficiency.