



## **Introduction to Algorithms**

### **Module 04: Assignment 01 (Theory)**

**Deadline 100 marks:** 11:59pm, 5 August 2023

**Deadline 90 marks:** 11:59pm, 7 August 2023

**Deadline 80 marks:** Anytime after that.

**What you need to submit :** Just your answer DOC

## Question No 1

**Question:** Write a C++ program that takes N integer numbers and sorts them in non-increasing order using **Merge Sort**.

**You can't use any built-in function for sorting.**

**Marks:** 20

| Sample Input       | Sample Output |
|--------------------|---------------|
| 7<br>1 2 9 4 0 2 5 | 9 5 4 2 2 1 0 |
| 6<br>5 3 -1 3 3 8  | 8 5 3 3 3 -1  |

## Question No 2

**Question:** Write a C++ program that takes N integer numbers that are sorted and distinct. The next line will contain an integer k. You need to tell whether K exists in that array or not. If it exists, print its index otherwise print “Not Found”.

**You must solve this in  $O(\log n)$  complexity.**

**Marks: 20**

| Sample Input                    | Sample Output |
|---------------------------------|---------------|
| 8<br>-4 0 2 6 9 10 29 54<br>29  | 6             |
| 10<br>0 1 2 3 4 5 6 7 8 9<br>-3 | Not Found     |

## Question No 3

**Question:** You are given an array of N positive integers. The next line will contain an integer K. You need to tell whether there exists more than one occurrence of K in that array or not. If there exists more than one occurrence of K print YES, Otherwise print NO.

See the sample input-output for more clarification.

The given array will be sorted in increasing order. And it is guaranteed that at least one occurrence of K will exist. **You must solve this in  $O(\log n)$  complexity.**

**Marks: 20**

| Sample Input                   | Sample Output |
|--------------------------------|---------------|
| 7<br>1 3 4 6 6 9 17<br>6       | YES           |
| 10<br>0 1 2 3 4 5 6 7 8 9<br>3 | NO            |

## Question No 4

Calculate the time complexity of the following code snippets.

**Marks: 20**

(a)

```
int count = 0;
for (int i = n; i > 0; i /= 2)
{
    for (int j = 0; j < n; j += 5)
    {
        count += 1;
    }
}
```

(b)

```
for(int i=1; i*i<n; i++)
{
    cout << "hello";
}
```

(c)

```
for(int i =1; i<n; i=i*2)
{
    for(int j=1; j*j<n; j+=2)
    {
        cout << "hello";
    }
}
```

(d)

```
int m = 1;
for(int i=0; m<=n; i++)
{
    m+=i;
}
```

## Question No 5

**Question:** You are given two sorted arrays arr1 and arr2 in descending order. Your task is to merge these two arrays into a new array result using the merge sort technique, but Instead of merging the arrays in ascending order, you need to merge them in descending order to create the result array.

**You cannot use stl sort function here**

**Marks: 20**

| Sample Input                 | Sample Output   |
|------------------------------|-----------------|
| 4<br>8 6 4 2<br>4<br>7 5 3 1 | 8 7 6 5 4 3 2 1 |

