Experiment - 3

Student Name: Mandeep Kaur **UID:** 23BCS10854
Branch: BE-CSE **Section/Group:** KRG-2B
Semester: 5th **Date of Performance:** 7/8/25
Subject Name: Design and Analysis of Algorithms
Subject Code: 23CSH-301

1. **Aim:** To find frequency of an element in a given array in $O(1)$ time complexity.

2. **Objective:** The main objective is to efficiently determine the frequency of each element in an array using **HashMap** (hashing technique) to reduce time complexity compared to nested loops.

3. **Input/ Apparatus Used:**

A HashMap(or dictionary) is used to store array elements as keys and their frequencies as values.

4. **Algorithm:**

Naive Algorithm (using array traversal – $O(N^2)$):

1. Input the number of elements in the array and then array elements.
2. For each element, traverse the array to count its frequency.
3. Print each element with its frequency.

This takes $O(N^2)$ in the worst case.

Optimized Approach(using Hashing-$O(N)$ -

1. Input the number of elements in an array.
2. Input the array elements.
3. Create a HashMap(key=element, value= frequency).
4. Traverse the array:
   - For each element, increase its count in the HashMap.
5. Traverse the HashMap and print each element with its frequency.

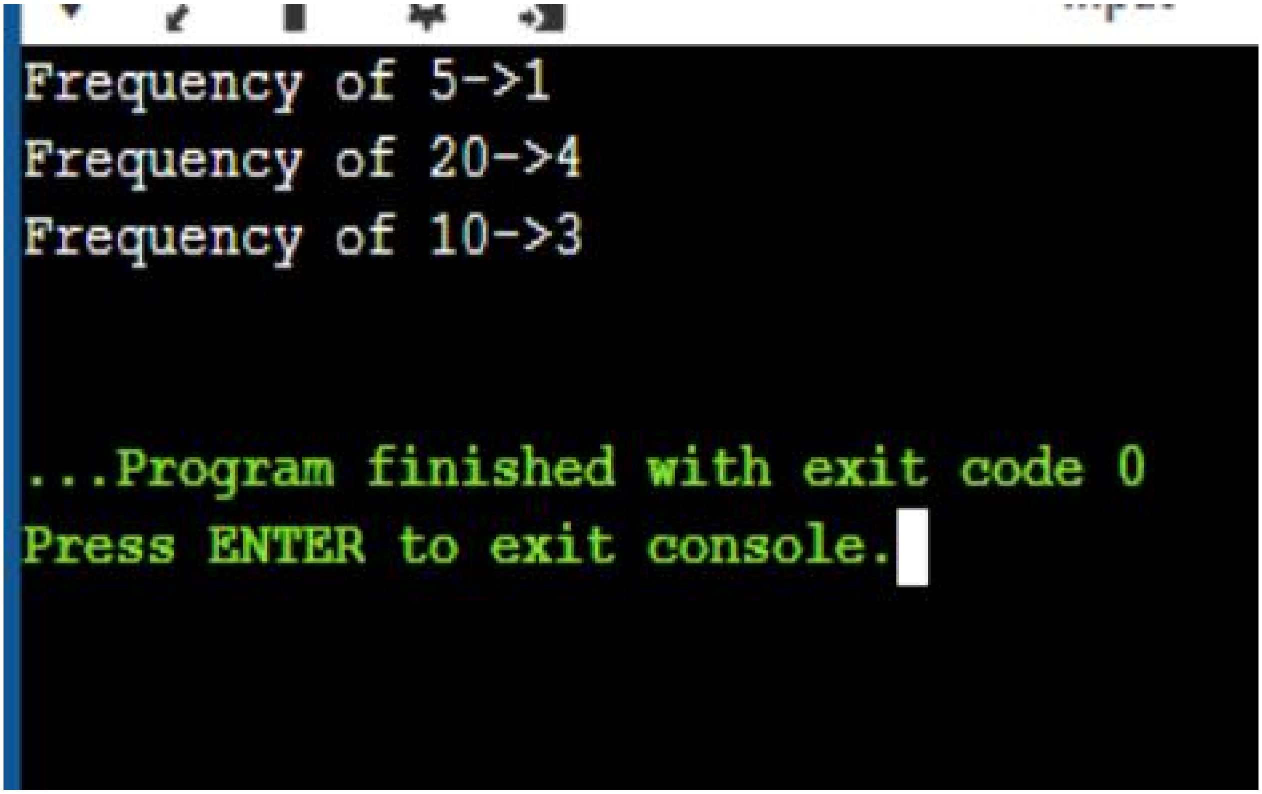
5. Step- wise Pseudocode/Algorithm used-

```
function findFrequency(arr, n):
    create empty HashMap hm

    for i = 0 to n-1:
        if arr[i] exists in hm:
            hm[arr[i]] = hm[arr[i]] + 1
        else:
            hm[arr[i]] = 1

    for each key in hm:
        print key, hm[key]
```

6. Code and output:

```
#include <bits/stdc++.h>
using namespace std;

void findFrequency(int arr[], int n) {
    unordered_map<int, int> freq; // element -> frequency

    // Count frequencies (O(n))
    for (int i = 0; i < n; i++) {
        freq[arr[i]]++;
    }

    // Print result (O(n))
    for (auto it : freq) {
        cout << it.first << "->" << it.second << endl;
    }
}
```

```
int main() {
    int arr[] = {10, 20, 20, 10, 10, 20, 5, 20};
    int n = sizeof(arr) / sizeof(arr[0]);

    findFrequency(arr, n);
    return 0;
}
```



```
Frequency of 5->1
Frequency of 20->4
Frequency of 10->3


...Program finished with exit code 0
Press ENTER to exit console.
```