Course: Data Structures

Student Name

Roll Number

Submission Date:

Exercise-1

Array Manipulation (Crush Problem) -

Problem Statement

Starting with a 1-indexed array of zeros and a list of operations, for each operation add a value to each array element between two given indices, inclusive. Once all operations have been performed, return the maximum value in the array.

Input and Output

Input:
- n: Integer, size of the array (1-indexed)
- m: Integer, number of operations
- queries: A list of m queries, each with three integers (a, b, k)

Output:
- A single integer: the maximum value after performing all operations.

Algorithm

1. Initialize the difference array:
   - Create an array diff of size n + 2 (to handle boundaries).
   - Set all elements of diff to 0.

2. Process each query efficiently:
   - For each query (a, b, k) in queries:
     - Increment diff[a] by k.
     - Decrement diff[b + 1] by k.

3. Compute prefix sums and track the maximum:
   - Initialize maxVal = 0 and currentSum = 0.
   - For i from 1 to n:
     - Update currentSum = currentSum + diff[i].
     - If currentSum > maxVal, then set maxVal = currentSum.

4. Return the result:
   - Output maxVal as the maximum value in the array after all operations.

Exercise-2

Algorithm: Count Valid Array Pairs

Problem Description

Given an array arr of size n, count pairs (i, j) where i < j and arr[i] * arr[j] ≤ max(arr).

Algorithm Steps

Step 1: Read Input
- Input n → size of array
- Input array elements → arr[n]

Step 2: Find Maximum Value
- Initialize maxVal = arr[0]
- For each element x in arr:
  - If x > maxVal, then maxVal = x

Step 3: Sort the Array
- Sort arr in ascending order (Sorting helps us break early when condition fails and optimize searching.)

Step 4: Initialize Counter
- Set count = 0

Step 5: Iterate through Pairs
- For i = 0 to n-2:
  - For j = i + 1 to n-1:
    - If arr[i] * arr[j] ≤ maxVal:
      - Increment count
    - Else:
      - Break the inner loop (because further values will only be larger)

Step 6: Output Result
- Print count