14/06/2022

Data Structures and Algorithms (CSE102) - Section B
Mid-Semester Lab Examination - Group 1, Summer Semester, 2022
Indraprastha Institute of Information Technology, Delhi

Duration: 2 Hrs **Full Marks: 30**

Answer all questions.

1. **Cartoon World:** (Time Limit = 1 second, Memory Limit = 256 MB) (5 Marks)

   In Cartoon World, Nobita studied hard for her exam. Everyone is now awaiting for their marks. But they are more excited to know the marks Nobita got and Nobita does not want others to know her marks. Her teacher supports her and instead of declaring Nobita's marks to the class, the teacher gives a hint about her marks. The teacher says that "the marks Nobita got is equal to the number of students who scored higher marks than Nobita". As no one knows Nobita's marks, so she is flexing in front of the class that she has got good marks. Suneo and Gian does not like this. So they start figuring out marks Nobita got. But they don't know how to do it. Help Suneo and Gian to find out Nobita's marks and stop Nobita from flexing in front of the class.

   Input:
   The first line contains an integer N which is the number of students in the class.
   The second line contains N space-separated integers which indicates the marks of all the students.

   Output:
   Print Nobita's marks.

   Constraints:
   $1 \leq N \leq 10^5$
   $-10^8 \leq Marks \leq 10^8$

   Examples:

   - **Input 1:**
     5
     2 4 5 3 6

     Output 1:
     3

     Explanation 1: For 3, there are 3 students whose marks are greater than 3 so Nobita's marks is 3.
   - **Input 2:**
     4
     0 -5 -2 -3

     Output 2:
     0

     Explanation 2: For 0, there are 0 students whose marks are greater than 0 so Nobita's mark is 0 and he is the topper in the class.

- **Input 3:**
  4
  3 2 1 3

  Output 3:
  2

2. **Monsters' Delight:** (Time Limit = 1 sec, Memory Limit = 256 MB) (10 Marks)

   You are given an array A (starting index being 0) of size 'n' containing the size of monsters. In one step, every monster eats the monster to its right if the size of the monster in the right is smaller, i.e, delete index i from array if $A[i-1] > A[i]$ for $i > 0$ and $i < n$. Then, how many steps are required such that the size of all the remaining monsters are in non decreasing order?

   Note: In one step only one monster can eat another monster.

   (Expected time complexity - $\mathcal{O}(n)$)

   Constraints: $1 \leq n \leq 10^6$

   Input:
   First line of the input contains the size of the array, n.
   Second line contains 'n' space separated integers.

   Output: Print the number of steps that are required to make the size of monsters in non-decreasing order.

   Example:

   - **Input 1:**
     5
     9 10 4 7 17

     Output 1:
     2

     Explanation: Size of the monster at index 2 is smaller than the size of monster at index 1 so it will eat the monster of index 2 (i.e., $A[1] = 10 > A[2]$). Now the remaining monsters are: 9 10 7 17

     At index 2, $A[1] = 10 > A[2] = 7$ so the $A[i-1]$th monster will eat the $A[i]$th monster. Now the remaining monsters are: 9 10 17.

     The final remaining monsters, i.e., 9 10 17, are in non decreasing order.
   - **Input 2:**
     10
     1 2 6 4 4 6 3 8 5 10

     Output 2:
     4
   - **Input 3:**
     7
     7 6 5 4 3 2 1

     Output 3:
     6

- **Input 4:**
  10
  3 47 59 77 18 27 6 28 79 41

  Output 4:
  5
- **Input 5:**
  8
  2284 5473 5594 6270 8238 8497 9317 9363

  Output 5:
  0

3. **Go in Circles:** (Time Limit = 1 sec, Memory Limit = 256 MB) (15 Marks)

   There are a group of n friends playing the "Go in Circles" game. The rules of the game are simple:

   (a) All the friends sit in a pre-decided ordering in a circle. Then, the first person counts 1, the second person counts 2 and they do so on in the circle.

   (b) The person that gets to count the number k loses the round and is removed from the circle.

   (c) For the next round, the counting starts going around in the opposite direction and again the person that gets to count k loses the round. In each alternative round, the direction of counting reverses.

   (d) The last person to stand after $n-1$ rounds win the game.

   For the next game, the ordering in which the friends sit in the circle would be the order the players lost in the previous game.

   For example, say, we have 4 friends sitting for the first game in the order [2,4,1,3] and say k=5. For the first round, 2 is the loser, for the second round, 1 is the loser (the direction of counting reverses), 3 is the loser of round 3 (the direction of counting reverses again) and so 4 is the winner. For the next game, the order in which they sit in the circle becomes [2,1,3,4] and the game goes on.

   Find the winner of the t^{th} game.

   Constraints:
   $1 \leq n, k, t \leq 10^3$

   Input: The first line of the input contains n k t.
   The second line of the input contains the ordering in which the friends will sit in a circle.

   Output: The output should contain the number of the winner of the t^{th} game.

   Examples:

   - **Input 1:**
     4 5 3
     2 4 1 3

     Output 1:
     3
   - **Input 2:**
     6 3 8
     1 6 2 5 3 4

     Output 2:
     4

- **Input 3:**
  8 10 1
  8 7 6 5 4 3 2 1

  Output 3:
  8
- **Input 4:**
  5 20 20
  3 1 2 4 5

  Output 4:
  3
- **Input 5:**
  10 7 9
  9 4 2 7 1 10 3 6 5 8

  Output 5:
  10

- - End - -