CS19001: Programming and Data Structures Laboratory

Assignment No. 4A (One-Dimensional Arrays)

Date: 30-August-2019

Problem Statement:

The God of Wonderland decorated her garden with many wonderful Daisy flowers. Every morning, Alice walks in the Wonderland garden and collects Daisy flowers. She gradually collects/plucks the flowers having minimum number of petals, and then go on choosing (to pluck) the next set of flowers with second minimum number of petals, so on. In this way, she plucks all the Daisy flowers of the garden iteratively to make a big garland everyday. However, she always had an interesting observation while plucking the flowers and realized that God also has her own algorithm/program with these flowers. Every morning, she found N flowers initially. Then, at every iteration, when she plucks/removes all the flowers having minimum number (say M) of petals at that point, she found that immediately the remaining (not plucked) flowers also lose the same number (M) of petals.

Can you write a C-program for the procedure that God of Wonderland follows in her garden? The program takes as input the number of flowers (N) and creates an array of size $N < 10^6$ to store the number of petals for each of these N flowers (again user inputs these as integers). Note that, the number of petals for two flowers may or may not be same. For every iteration, the program outputs – (i) the iteration number, (ii) the number of flowers having minimum number (M) of petals from the remaining flowers (which is/are going to be plucked), (iii) the shrunk array expressing only the reduced sizes of petals (after the loss of M petals) for remaining flowers. From the implementation perspective, your array after every iteration must *shrink* in size – meaning that, after the removal of some flowers (depending on the minimum number of petals), those array positions/indices should be refilled by the elements appearing in the next indices of the array, thus shifting the whole array leftwards.

Example Inputs/Outputs:

Sample-1:

```
Enter Number of Daisy Flowers: 5
Enter Positive Number of Petals for Each 5 Flowers: 7 5 2 7 2
-- Iteration-1:
        Number of Flowers with Minimum Petals = 2
        Petal Numbers of Remaining Daisy Flowers =  5 3 5
-- Iteration-2:
        Number of Flowers with Minimum Petals = 1
        Petal Numbers of Remaining Daisy Flowers =  2 2
-- Iteration-3:
        Number of Flowers with Minimum Petals = 2
        Petal Numbers of Remaining Daisy Flowers =  NIL
```

Sample-2:

```
Enter Number of Daisy Flowers: 4
Enter Positive Number of Petals for Each 4 Flowers: 6 6 6 6
-- Iteration-1:
        Number of Flowers with Minimum Petals = 4
        Petal Numbers of Remaining Daisy Flowers =  NIL
```

Sample-3:

```
Enter Number of Daisy Flowers: 5
Enter Positive Number of Petals for Each 5 Flowers: 4 7 4 7 7
-- Iteration-1:
        Number of Flowers with Minimum Petals = 2
        Petal Numbers of Remaining Daisy Flowers =  3 3 3
-- Iteration-2:
        Number of Flowers with Minimum Petals = 3
        Petal Numbers of Remaining Daisy Flowers =  NIL
```

Submit a single C source file. Do not use global/static variables.

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Assignment No. 4B (One-Dimensional Arrays)

Date: 30-August-2019

Problem Statement:

The city of Wonderland has a nice 2D view from its East coastal side. The height of high-rise buildings can be represented using an elevation map (array) while considering the width of each building as 1 unit uniformly. For example, Figure 1 shows the high-rise buildings (marked in **black** color) and the elevation map is given as an array, $[0, 1, 0, 2, 1, 0, 1, 3, 2, 1, 2, 1]$, where each entry denotes the height of a building at respective positions. Now, in this monsoon season, the Wonderland city gets water-logged and the municipality wants to compute how many units of water needs to be pumped out in total. The water-logging situation is also shown in Figure 1 (water levels marked using **blue** color). Each such water-logged unit-square represents 1 unit of storage water to be pumped out. The amount of trapped water is also presented in Figure 1 (in **brown** color).

Your task is to help the municipality of Wonderland city by writing a generic C-program that computes the amount of water trapped/logged in a city, from the elevation map of the city. Note that, the elevation map (as shown in Figure 1) may not be fixed, the user inputs this as an array of integers. The size of the array will be at most 10^6 and the maximum elevation of any building is 99 floors (indicating that the range of each integer in the array is $[0, 99]$). The output will be – (a) the schematic elevation map of the city based on the user-input (refer to the example samples for illustration) and (b) the amount of trapped/logged water.

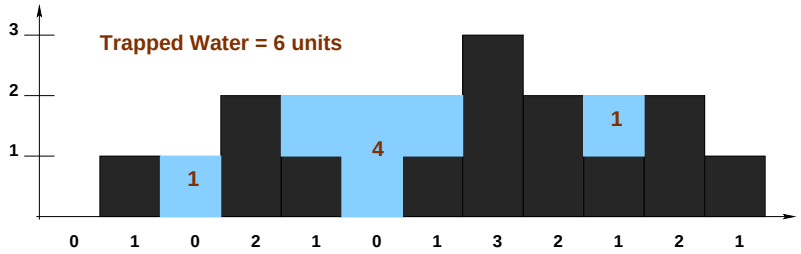

Figure 1: Cityscape of Wonderland and Water-Trapping

Example Inputs/Outputs:

Sample-1: (Refer to Figure 1)

```
Enter Total Width of the Cityscape: 12
Enter 12 Positive Height for Elevation Map: 0 1 0 2 1 0 1 3 2 1 2 1
++ The Elevation Map:
-----------------------------------
                    |H|
        |H|         |H||H|   |H|
   |H|  |H||H|  |H||H||H||H||H||H|
-----------------------------------
 0  1  0  2  1  0  1  3  2  1  2  1
-----------------------------------
Amount of Trapped Rain Water = 6 units
```

Sample-2:

```
Enter Total Width of the Cityscape: 5
Enter 5 Positive Height for Elevation Map: 0 1 2 1 1
++ The Elevation Map:
---------------
      |H|
   |H||H||H||H|
---------------
 0  1  2  1  1
---------------
Amount of Trapped Rain Water = 0 units
```

Sample-3:

```
Enter Total Width of the Cityscape: 10
Enter 10 Positive Height for Elevation Map: 3 0 0 2 0 4 1 2 0 1
++ The Elevation Map:
------------------------------
               |H|
|H|            |H|
|H|      |H|   |H|   |H|
|H|      |H|   |H||H||H|   |H|
------------------------------
 3  0  0  2  0  4  1  2  0  1
------------------------------
Amount of Trapped Rain Water = 12 units
```

Sample-4:

```
Enter Total Width of the Cityscape: 4
Enter 4 Positive Height for Elevation Map: 3 3 3 3
++ The Elevation Map:
------------
|H||H||H||H|
|H||H||H||H|
|H||H||H||H|
------------
 3  3  3  3
------------
Amount of Trapped Rain Water = 0 units
```

Sample-5:

```
Enter Total Width of the Cityscape: 26
Enter 26 Positive Height for Elevation Map: 6 2 5 6 9 4 1 4 6 1 1 2 2 10 10 1 1 2 5 6 6 1 2 1 1 1
++ The Elevation Map:
--------------------------------------------------------------------------------
                                    |H||H|
            |H|                     |H||H|
            |H|                     |H||H|
            |H|                     |H||H|
|H|      |H||H|         |H|         |H||H|            |H||H|
|H|   |H||H||H|         |H|         |H||H|         |H||H||H|
|H|   |H||H||H||H|   |H||H|         |H||H|         |H||H||H|
|H|   |H||H||H||H|   |H||H|         |H||H|         |H||H||H|
|H||H||H||H||H||H|   |H||H|      |H||H||H||H|      |H||H||H||H|   |H|
|H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H||H|
--------------------------------------------------------------------------------
 6  2  5  6  9  4  1  4  6  1  1  2  2 10 10  1  1  2  5  6  6  1  2  1  1  1
--------------------------------------------------------------------------------
Amount of Trapped Rain Water = 72 units
```

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