Category: Very Hard

Competition: CSI KJSCE Code Wars 2017-18. Try it in a contest environment:

<https://www.hackerrank.com/contests/codewars2-round2/challenges/mumbai-floods>

Question:

Mumbai has suffered from several floods over the years. The BMC thought of taking special preventive measures and wanted to plan the rescue and precautionary measures. It thought of noting down the regions which: become **flooded** easily; which are **disconnected** from the surrounding regions because of being surrounded by floods and themselves not being flooded; the ones that are easy to reach and are **connected** to the supplies coming through ships and bridges from outside Mumbai. You are given the task of categorizing the regions in the above categories.

The city of Mumbai can be considered a square of 10X10 hence it has a total of 100 regions. It is also surrounded by the sea water on all sides which is taken as 0 level. Water always flows from a region of greater height to a region of lesser height. Regions that are adjacent (vertically, horizontally or diagonally) to a given region are its neighbours and water can move from one region to its neighbours depending on the previous condition. Regions on the coastline cannot be flooded as the water-level cannot exceed the sea level and these regions will always have a height > 0. The height to which the flood water can rise is the height of the region adjacent to the flooded group of regions that is least among all adjacent non-floodable regions. If a region has a neighbour that is flooded to height x and has a height y lesser than x then it will also become flooded to the height x. Flooded regions are represented by -1, disconnected regions are shown with 0, and the connected regions are shown with a 1. These representations are called states. A region is a part of a group of regions G if and only if it has the same state as G and is adjacent to a region belonging to this group, hence the smallest group of regions is a single region

**Input Format**

A 10x10 matrix of integers denoting heights of 100 regions

**Constraints**

-109 < h < 109

**Output Format**

A 10x10 matrix of integers -1,0,1 denoting states of all 100 regions   
flooded: -1   
disconnected: 0   
connected: 1

**Sample Input 0**

1 1 1 1 1 1 1 1 1 1

1 0 0 0 0 0 0 0 0 1

1 0 1 1 1 1 1 1 0 1

1 0 1 0 0 0 0 1 0 1

1 0 1 0 1 1 0 1 0 1

1 0 1 0 1 1 0 1 0 1

1 0 1 0 0 0 0 1 0 1

1 0 1 1 1 1 1 1 0 1

1 0 0 0 0 0 0 0 0 1

1 1 1 1 1 1 1 1 1 1

**Sample Output 0**

1 1 1 1 1 1 1 1 1 1

1 -1 -1 -1 -1 -1 -1 -1 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 0 -1 -1 -1 -1 0 -1 1

1 -1 0 -1 0 0 -1 0 -1 1

1 -1 0 -1 0 0 -1 0 -1 1

1 -1 0 -1 -1 -1 -1 0 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 -1 -1 -1 -1 -1 -1 -1 1

1 1 1 1 1 1 1 1 1 1

**Sample Input 1**

1 1 1 1 1 1 1 1 1 1

1 0 0 0 0 0 0 0 0 1

1 0 1 1 1 1 1 1 0 1

1 0 1 1 1 1 1 1 0 1

1 0 1 1 1 1 1 1 0 1

1 0 1 1 1 1 1 1 0 1

1 0 1 1 1 1 1 1 0 1

1 0 1 1 1 1 1 1 0 1

1 0 0 0 0 0 0 0 0 1

1 1 1 1 1 1 1 1 1 1

**Sample Output 1**

1 1 1 1 1 1 1 1 1 1

1 -1 -1 -1 -1 -1 -1 -1 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 0 0 0 0 0 0 -1 1

1 -1 -1 -1 -1 -1 -1 -1 -1 1

1 1 1 1 1 1 1 1 1 1

An Example with explanation:

**Example of a matrix (indexed from 0) of heights that represent the city:**

1 1 1 1 1 1 1 1 1 1

1 -1 -1 -1 -1 -2 4 5 3 6

1 0 0 4 0 0 1 8 2 5

1 2 3 0 5 0 0 4 4 4

1 0 0 0 0 0 0 0 0 1

1 0 3 5 0 0 0 0 0 1

1 0 0 0 3 0 2 6 3 1

2 3 1 0 0 0 2 2 2 2

1 0 5 1 2 3 4 0 1 2

1 1 1 1 3 3 3 3 3 3

**Example Output:**

1 1 1 1 1 1 1 1 1 1

1 -1 -1 -1 -1 -1 1 1 1 1

1 -1 -1 1 -1 -1 1 1 -1 1

1 1 1 -1 1 -1 -1 1 1 1

1 -1 -1 -1 -1 -1 -1 -1 -1 1

1 -1 0 0 -1 -1 -1 -1 -1 1

1 -1 -1 -1 0 -1 1 1 1 1

1 1 1 -1 -1 -1 1 1 1 1

1 -1 1 1 1 1 1 -1 -1 1

1 1 1 1 1 1 1 1 1 1

Explanation:

Let the input region 2D array be h:

Water levels stated here are with respect to the sea level that is 0 and not the depth of water in that region. Points along the cost are well connected with the surrounding and are not flooded so are indicated by 1. All points that are marked as 1 have an adjacent point that is 1 and is not flooded

In the flooded region h[1][8] water level is 1 as the nearest non-floodable region has height 1. Region h [8] [7] has water level 2 as the lowest non-floodable region has a height of 2. 1 is floodable hence it is not considered and it has a water level of 2  too. In the flooded group of regions which includes the elements h [1] [1], h [1] [2] …. Is having a water level of 1 as a lowest neighbour to the group (a region adjacent to a region in the group but not a part of the group) which is non-floodable has a height of 1. The group having point h [5] [3] is marked by 0 as it is not flooded but is surrounded by a group of flooded regions

Try these cases:

|  |  |
| --- | --- |
| Input | Output |
| 1 1 1 1 1 1 1 1 1 1  1 0 0 0 0 0 0 0 0 1  1 0 1 1 1 1 1 1 0 1  1 0 1 0 0 0 0 1 0 1  1 0 1 0 1 1 0 1 0 1  1 0 1 0 1 1 0 1 0 1  1 0 1 0 0 0 0 1 0 1  1 0 1 1 1 1 1 1 0 1  1 0 0 0 0 0 0 0 0 1  1 1 1 1 1 1 1 1 1 1 | 1  1 1  1 1 1  1 1 1 1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1  0 0 0  0 0 0 -1  1  1 -1  0 -1 -1 -1 -1  0 -1 1  1 -1  0 -1 0  0 -1 0 -1  1  1 -1  0 -1 0  0 -1 0 -1  1  1 -1  0 -1 -1 -1 -1  0 -1 1  1 -1  0 0 0  0 0 0 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1  1 1  1 1 1  1 1 1 1 |
| 1 1 1 1 1 1 1 1 1 1  1 0 0 0 0 0 0 0 0 1  1 0 1 1 1 1 1 1 0 1  1 0 1 1 1 1 1 1 0 1  1 0 1 1 1 1 1 1 0 1  1 0 1 1 1 1 1 1 0 1  1 0 1 1 1 1 1 1 0 1  1 0 1 1 1 1 1 1 0 1  1 0 0 0 0 0 0 0 0 1  1 1 1 1 1 1 1 1 1 1 | 1  1 1  1 1 1  1 1 1 1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1  0 0 0  0 0 0 -1  1  1 -1  0 0 0  0 0 0 -1  1  1 -1  0 0 0  0 0 0 -1  1  1 -1  0 0 0  0 0 0 -1  1  1 -1  0 0 0  0 0 0 -1  1  1 -1  0 0 0  0 0 0 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1  1 1  1 1 1  1 1 1 1 |
| 1 2 3 4 5 6 7 8 9 10  2 3 4 5 6 7 8 9 10 11  3 4 5 6 7 8 9 10 11 12  4 5 6 7 8 9 10 11 12 13  5 6 7 8 9 10 11 12 13 14  6 7 8 9 10 11 12 13 14 15  7 8 9 10 11 12 13 14 15 16  8 9 10 11 12 13 14 15 16 17  9 10 11 12 13 14 15 16 17 18  10 11 12 13 14 15 16 17 18 19 | 1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1  1  1 1  1 1 1  1 1 1 1 |
| 2 1 2 1 2 1 2 1 2 1  2 -1 -1 -1 -1 -2 1 5 3 6  2 0 0 4 0 0 1 8 2 5  2 2 3 0 5 0 0 4 5 8  2 0 0 -1 -2 -3 -2 -1 0 1  2 0 3 5 0 0 -5 0 0 1  2 0 0 0 3 0 2 6 3 1  2 3 1 0 0 0 2 3 3 2  2 0 5 1 2 3 4 0 1 2  2 1 1 1 3 2 2 3 3 3 | 1  1 1  1 1 1  1 1 1 1  1 -1 -1 -1 -1 -1  1 1 1 1  1 -1 -1  1 -1 -1 1  1 -1 1  1  1 1 -1  1 -1 -1 1  1 1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1  0 0 -1 -1 -1 -1 -1  1  1 -1 -1 -1  0 -1 1 1 1  1  1  1 1 -1 -1 -1 -1  1 1 1  1 -1  1 1 1  1 1 -1 -1  1  1  1 1  1 1 1  1 1 1 1 |
| 1 1 1 1 1 1 1 1 1 1  1 0 0 0 0 0 0 0 0 1  1 0 0 0 0 0 0 0 0 1  1 0 0 0 0 0 0 0 0 1  1 0 0 0 0 0 0 0 0 1  1 0 0 0 0 0 0 0 0 1  1 0 0 0 0 0 0 0 0 1  1 0 0 0 0 0 0 0 0 1  1 0 0 0 0 0 0 0 0 1  1 1 1 1 1 1 1 1 1 1 | 1  1 1  1 1 1  1 1 1 1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1  1 1  1 1 1  1 1 1 1 |
| 2 1 2 1 2 1 2 1 2 1  2 -1 -1 -1 -1 -2 1 5 3 6  2 0 0 4 0 1 1 8 2 5  2 2 3 0 0 0 0 4 5 8  2 0 0 -1 -2 -3 -2 -1 0 1  2 0 3 5 0 0 -5 0 0 1  2 0 0 0 3 0 2 6 3 1  2 3 1 0 0 0 2 3 3 2  2 0 5 1 2 3 4 0 1 2  2 1 1 1 3 2 2 3 3 3 | 1  1 1  1 1 1  1 1 1 1  1 -1 -1 -1 -1 -1  1 1 1 1  1 -1 -1  1 -1 1 1  1 -1 1  1  1 1 -1 -1 -1 -1  1 1 1  1 -1 -1 -1 -1 -1 -1 -1 -1  1  1 -1  0 0 -1 -1 -1 -1 -1  1  1 -1 -1 -1  0 -1 1 1 1  1  1  1 1 -1 -1 -1 -1  1 1 1  1 -1  1 1 1  1 1 -1 -1  1  1  1 1  1 1 1  1 1 1 1 |