Magic Wand

Problem Code: MAGIC

Design Challenge

Task Description

In image editing software, there is typically a handy tool called "magic wand". The magic wand will select a connected set of pixels starting from a user selected pixel (the starting pixel), so that all the selected pixels are similar to the stating pixel based on a tolerance difference k. In other words, the value difference between any pixel selected from the starting pixel shall not be larger than k.

Two pixels are considered directly connected if they share a square side, and are considered indirectly connected if they can be connected via some other pixels.

In the illustration, the user selects the red "7" pixel (highlighted in dark gray) and set $k = 4$. All the pixels that are directly or in directly connected to this starting pixel, with a different no larger than 4 are thus selected (highlighted in gray).

0	0	0	1	1	1	0	1
0	1	3	1	5	0	1	0
0	1	7	7	7	6	1	0
0	1	5	6	6	6	5	2
1	0	1	2	2	4	3	3
1	1	0	1	2	3	3	2

You now have an image. You are to perform the magic wand from a given starting pixel with tolerance k. How many pixels would be selected?

The image is given as an $n \times m$ matrix with n rows and m columns of integers. The starting pixel is specified by a $(row, column)$ pair.

Constraints

$n, m \geq 1, k \geq 0$.

Examples

Case 1: $n = 6, m = 8, k = 4$. Starting pixel is (3, 4).

Image: $\begin{bmatrix} 0 & 0 & 0 & 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 3 & 1 & 5 & 0 & 1 & 0 \\ 0 & 1 & 7 & 7 & 7 & 6 & 1 & 0 \\ 0 & 1 & 5 & 6 & 6 & 6 & 5 & 2 \\ 1 & 0 & 1 & 2 & 2 & 4 & 3 & 3 \\ 1 & 1 & 0 & 1 & 2 & 3 & 3 & 2 \end{bmatrix}$

Answer: 16

As illustrated above.

Case 1: $n = 3, m = 3, k = 2$. Starting pixel is (2, 2).

Image: $\begin{bmatrix} 1 & 5 & 3 \\ 4 & 1 & 2 \\ 1 & 3 & 1 \end{bmatrix}$

Answer: 6

Selected pixels are (1, 3), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3).

Requirements

Time: $O(nm)$ **Space:** $O(nm)$