Hill Descent

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1 Problem Description

John is an Olympic Skier. In order to maximize his fun on a given slope, he wants to find the longest path down the slope. has decided to maximize his distance down the hill. Help John find the longest decreasing path from the mountain down the hill.

Input: You are given $n, m (1 \leq n, m \leq 5000)$ and then you are given n rows and m columns of numbers.

Output: The length of the longest path.

2 Solutions

There are several ways to solve this problem, ranging to naive to slightly more difficult. For example,

- Naively perform dfs on every spot and record the furthest distance reached. Time complexity is $O((nm)^2)$.
- Use dynamic programming to consider a cell up to i, j and whether or not taking a step in any valid direction would add to the distance. So the state would be current distance, i, j. $O(mn)$
- Find a topological sort and find the length of the longest sub-length. $O(mn)$

3 Anti-Solutions

Some common pitfalls are:

- One may think that the length of the longest path may simply be the furthest DFS traversal from the highest point, that may not be true because it may be surrounded by barriers (values larger than it).

4 Test Case Design

Ideas for test case generation.

- Three cases are generated randomly
- One case contains only negative numbers
- One case contains only zeroes
- One case with one peak and valleys
- Randomly generated 2D Perlin noise

A total of 7 secret cases will be generated.