Problem 2088: Count Fertile Pyramids in a Land

Problem Information

Difficulty: Hard
Acceptance Rate: 66.17%
Paid Only: No
Tags: Array, Dynamic Programming, Matrix

Problem Description

A farmer has a **rectangular grid** of land with `m` rows and `n` columns that can be divided into unit cells. Each cell is either **fertile** (represented by a `1`) or **barren** (represented by a `0`). All cells outside the grid are considered barren.

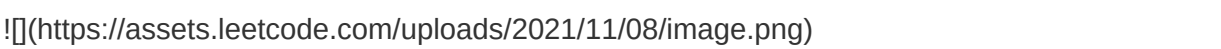
A **pyramidal plot** of land can be defined as a set of cells with the following criteria:

1. The number of cells in the set has to be **greater than**`1` and all cells must be **fertile**.
2. The **apex** of a pyramid is the **topmost** cell of the pyramid. The **height** of a pyramid is the number of rows it covers. Let `(r, c)` be the apex of the pyramid, and its height be `h`. Then, the plot comprises of cells `(i, j)` where `r <= i <= r + h - 1` **and** `c - (i - r) <= j <= c + (i - r)`.

An **inverse pyramidal plot** of land can be defined as a set of cells with similar criteria:

1. The number of cells in the set has to be **greater than**`1` and all cells must be **fertile**.
2. The **apex** of an inverse pyramid is the **bottommost** cell of the inverse pyramid. The **height** of an inverse pyramid is the number of rows it covers. Let `(r, c)` be the apex of the pyramid, and its height be `h`. Then, the plot comprises of cells `(i, j)` where `r - h + 1 <= i <= r` **and** `c - (r - i) <= j <= c + (r - i)`.

Some examples of valid and invalid pyramidal (and inverse pyramidal) plots are shown below. Black cells indicate fertile cells.



Given a **0-indexed** `m x n` binary matrix `grid` representing the farmland, return _the**total number** of pyramidal and inverse pyramidal plots that can be found in_ `grid`.

Example 1:

Input: grid = [[0,1,1,0],[1,1,1,1]] **Output:** 2 **Explanation:** The 2 possible pyramidal plots are shown in blue and red respectively. There are no inverse pyramidal plots in this grid. Hence total number of pyramidal and inverse pyramidal plots is 2 + 0 = 2.

Example 2:

Input: grid = [[1,1,1],[1,1,1]] **Output:** 2 **Explanation:** The pyramidal plot is shown in blue, and the inverse pyramidal plot is shown in red. Hence the total number of plots is 1 + 1 = 2.

Example 3:

Input: grid = [[1,1,1,1,0],[1,1,1,1,1],[1,1,1,1,1],[0,1,0,0,1]] **Output:** 13 **Explanation:** There are 7 pyramidal plots, 3 of which are shown in the 2nd and 3rd figures. There are 6 inverse pyramidal plots, 2 of which are shown in the last figure. The total number of plots is 7 + 6 = 13.

Constraints:

* `m == grid.length` * `n == grid[i].length` * `1 <= m, n <= 1000` * `1 <= m * n <= 105` * `grid[i][j]` is either `0` or `1`.

Code Snippets

C++:

```
class Solution {
public:
```

```
int countPyramids(vector<vector<int>>& grid) {

}
};
```

Java:

```
class Solution {
public int countPyramids(int[][] grid) {

}
}
```

Python3:

```
class Solution:
def countPyramids(self, grid: List[List[int]]) -> int:
```