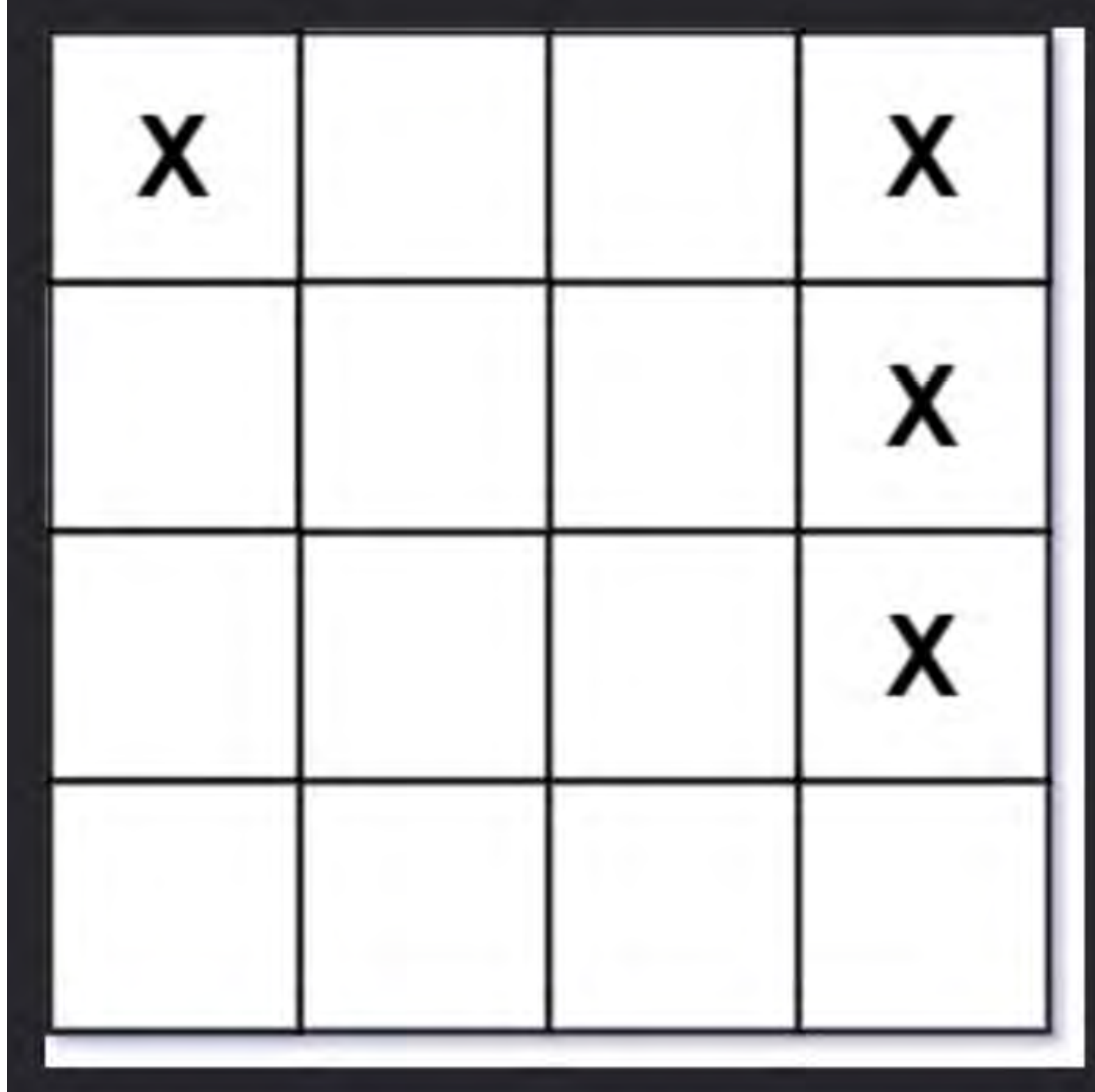
419. Battleships in a Board

Leetcode Link

Given an `m x n` matrix `board` where each cell is a battleship `'X'` or empty `'.'`, return the number of the **battleships** on `board`.

Battleships can only be placed horizontally or vertically on `board`. In other words, they can only be made of the shape `1 x k` (`1` row, `k` columns) or `k x 1` (`k` rows, `1` column), where `k` can be of any size. At least one horizontal or vertical cell separates between two battleships (i.e., there are no adjacent battleships).

Example 1:



X			X
			X
			X

Input: `board = [["X",".",".","X"],[".",".",".","X"],[".",".",".","X"]]` **Output:** 2

Example 2:

Input: `board = [["."]]`
Output: 0

Constraints:

- `m == board.length`
- `n == board[i].length`
- $1 \leq m, n \leq 200$
- `board[i][j]` is either `'.'` or `'X'`.

Solution

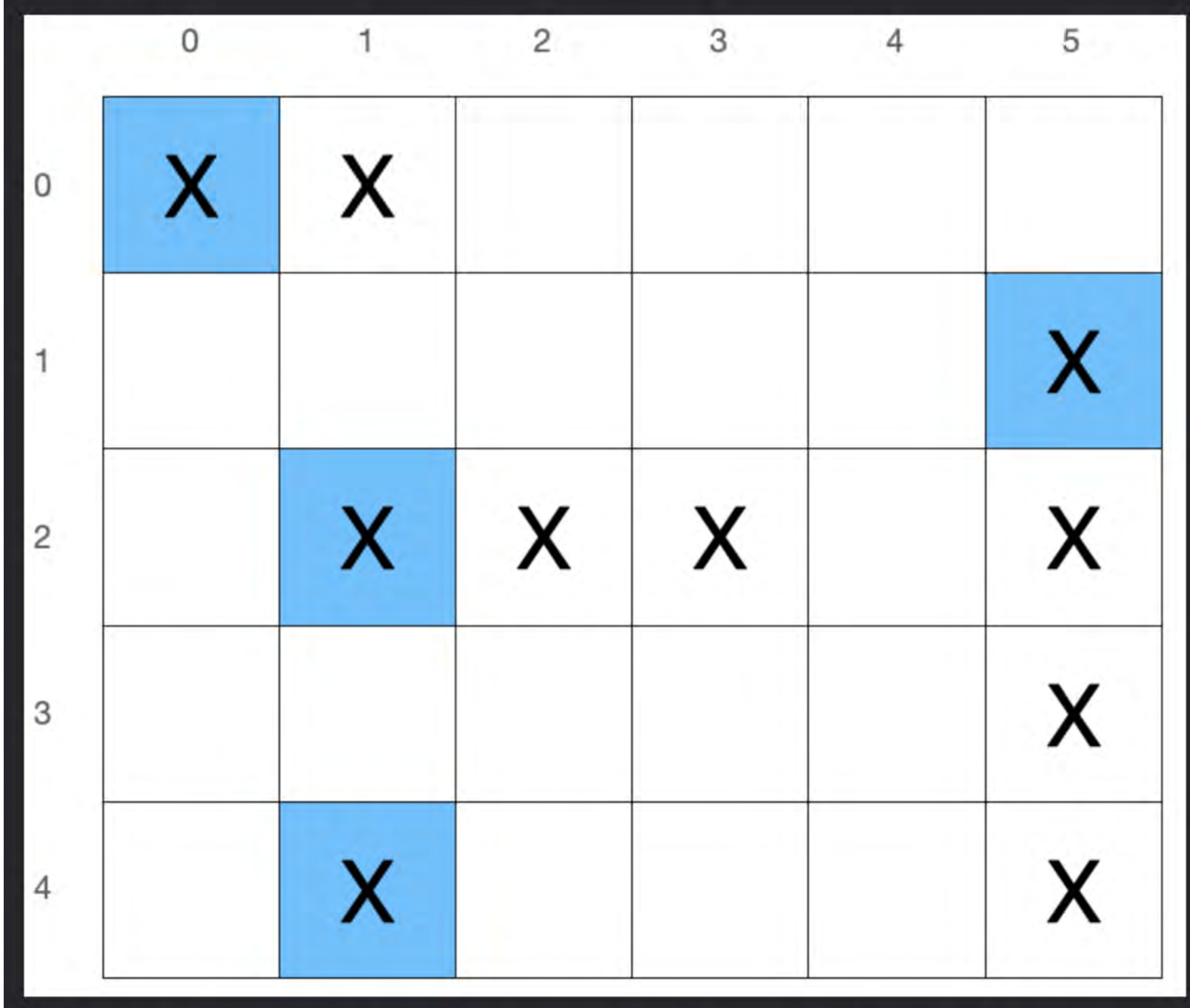
Full Solution

To count the number of battleships, we can first observe that each battleship acts the same as an island described in this problem. We can run the solution to this same problem however it's unnecessary and a much more elegant solution exists.

The problem statement mentions that each battleship will be a `1 x k` or `k x 1` rectangle and no battleships are adjacent. Instead of counting battleships, we can pick a cell in each battleship that defines it. Let's call this the **leader** of the ship. To solve the problem, we can simply count the number of **leaders**. The total number of **leaders** we count will be the same as the number of battleships.

For each battleship, we will let the **leader** be the leftmost and upmost cell out of all cells in that battleship.

Example



	0	1	2	3	4	5
0	X	X				
1						X
2		X	X	X		X
3						X
4		X				X

In this specific example, there are four battleships with **leaders** (indicated with blue) located at `(0,0)`, `(2,1)`, `(4,1)`, and `(1,5)`.

How can we determine efficiently if a cell is a **leader**?

Since the **leader** is located in the top-left cell of a battleship and no two battleships are adjacent, we can observe that a cell with an `'X'` is a **leader** if the cells to the left (`board[i][j-1]`) and above (`board[i-1][j]`) it (if they exist) are not `'X'` cells. In addition, cells that are not **leaders** will always have an `'X'` cell to the left or above it so they will never be counted. To count the total number of **leaders**, we'll iterate through all cells and count the number of cells that satisfy the condition mentioned above.

Time Complexity

We can check if a cell is a leader in $\mathcal{O}(1)$ and since there are $\mathcal{O}(MN)$ cells, our time complexity is $\mathcal{O}(MN)$.

Time Complexity: $\mathcal{O}(MN)$

Space Complexity

Since we only maintain a counter for the number of leaders, our space complexity is $\mathcal{O}(1)$.

Space Complexity: $\mathcal{O}(1)$

C++ Solution

```cpp
class Solution {
   public:
    int countBattleships(vector<vector<char>>& board) {
        int ans = 0;
        int m = board.size();
        int n = board[0].size();  // dimensions for board
        for (int i = 0; i < m; i++) {
            for (int j = 0; j < n; j++) {
                if (board[i][j] == 'X') {
                    if ((i == 0 || board[i - 1][j] == '.') && (j == 0 || board[i][j - 1] == '.')) {
                        // check if cell is a leader
                        ans++;
                    }
                }
            }
        }
        return ans;
    }
};
```

Java Solution

```java
class Solution {
    public int countBattleships(char[][] board) {
        int ans = 0;
        int m = board.length;
        int n = board[0].length; // dimensions for board
        for (int i = 0; i < m; i++) {
            for (int j = 0; j < n; j++) {
                if (board[i][j] == 'X') {
                    if ((i == 0 || board[i - 1][j] == '.') && (j == 0 || board[i][j - 1] == '.')) {
                        // check if cell is a leader
                        ans++;
                    }
                }
            }
        }
        return ans;
    }
}
```

Python Solution

```python
class Solution:
    def countBattleships(self, board: List[List[str]]) -> int:
        ans = 0
        m = len(board)
        n = len(board[0])  # dimensions for board
        for i in range(m):
            for j in range(n):
                if board[i][j] == "X":
                    if (i == 0 or board[i - 1][j] == ".") and (
                            j == 0 or board[i][j - 1] == "."):
                        # check if cell is a leader
                        ans += 1
        return ans

```

Got a question? Ask the Teaching Assistant anything you don't understand.