Page No.:
Date:

LC-1277

Count all submatrices with all ones (square)

☆ The approach followed here will be similar to LC221 - Maximal Square, wherein we had to find the area of maximal square of 1's in the matrix.

In that question, we used Tabulation DP approach. At every index (i, j) of the DP matrix, we stored the maximum side length of square that can be formed to the top left of it.

5 ← denotes that upto this cell, a max. of square side of 5 units can be formed.

In this question, our approach will be similar.

$$\begin{matrix} 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{matrix}$$

→ All the 1's at boundary, will obviously make a square of size 1 each. So result += 1 for each such 1 at boundary.

→ We will skip all 0s.

→ For every 1, we will ~~see the~~ do

top, left

result += 1 + min(grid[i-1][j], grid[i][j-1], grid[i-1][j-1])

topleft

→ The idea is that since we know that

$1 + \min(grid[i-1][j], grid[i][j-1], grid[i-1][j-1])$

is the max. length of square that can also be formed using the current 1.

say,

1 1

1 1 → $1 + \min(1,1,1)$

$= 1 + 1$

$= 2$

Denotes that 1 square is made alone by this 1.

and 1 square of side 2 units is made with the previous 1s.

so in total $1 + 1 = 2$ squares can be made from this current 1.

say,

0 1

1 1 → $1 + \min(1,0,1)$

$= 1 + 0$

$= 1$

There's no way of expanding the previous square of 1's using this current square, since a 0 exists. So only 1 square made using the current '1' is considered.

→ CODE:-

```
int squares=0;
for(int i=0; i< grid.size(); i++)
   for (int j=0; j<grid[0].size; j++)
   { if(grid[i][j]==0) continue;
     else squares += (grid[i][j] = 1 + min({grid[i-1][j],
                                grid[i][j-1], grid[i-1][j-1]}));
   }
return squares;
```

→ example :

Here, ← old value

1_2 ← updated value

$\Rightarrow 1 + \min(\text{top}, \text{left}, \text{top-left})$

$$\begin{matrix} 1_1 & 1_1 & 1_1 \\ 1_1 & 1_2 & 1_2 \\ 1_1 & 1_2 & 1 \end{matrix}$$

$1+2=3$

Here 2 is being added because this 1 would also be a part of 2×2 square and also a part of the newly discovered 3×3 square.