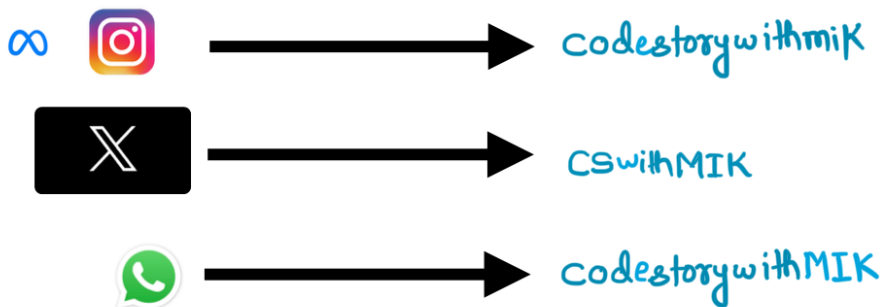


Maths : Video - 44



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Motivation -

Consistency ^{Honest?} is what transforms



MIK...

you want to stay Average ???
or achieve excellence ???

1895. Largest Magic Square

Medium

Topics

Companies

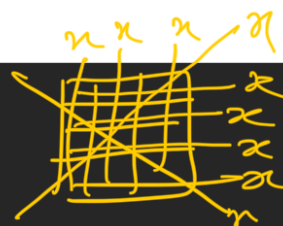
Hint

A $k \times k$ **magic square** is a $k \times k$ grid filled with integers such that every row sum, every column sum, and both diagonal sums are **all equal**. The integers in the magic square **do not have to be distinct**. Every 1×1 grid is trivially a **magic square**.

Given an $m \times n$ integer `grid`, return the **size** (i.e., the side length k) of the **largest magic square** that can be found within this grid.

Example 1:

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



Input: grid = [[7,1,4,5,6],[2,5,1,6,4],[1,5,4,3,2],[1,2,7,3,4]]

Output: 3

Explanation: The largest magic square has a size of 3.

Every row sum, column sum, and diagonal sum of this magic square is equal to 12.

- Row sums: $5+1+6 = 5+4+3 = 2+7+3 = 12$

- Column sums: $5+5+2 = 1+4+7 = 6+3+3 = 12$

- Diagonal sums: $5+4+3 = 6+4+2 = 12$

Constraints:

- `m == grid.length`
- `n == grid[i].length`
- `1 <= m, n <= 50`
- `1 <= grid[i][j] <= 106`

constraint analysis:-

Thought Process

$(j+side-1)$

side = 3 $2+3-1$
= 4

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

→₂
→₃

0	1	2	3	4
7	8	12	17	23
2	7	8	14	18
1	6	10	13	15
1	3	10	13	17

RowCumSum

↑
↑
↑
↑
↑

0	1	2	3	4
7	1	4	5	6
9	6	5	11	10
1	11	9	14	12
11	13	16	17	16

ColCumSum

`colCumSum[i+side-1][`

k=0 Grid m = 4
 $(i+2) / (j+2)$ k++ n = 5 k=0,1,2

5 + 4 + 2 =
min(m,n)

Check every possible square.

k = 1
grid[i+k][j+side-1-k]

grid[2][1+3-1-1] Square = side = 1x1
[2][2]

2x2

3x3 ←

4x4

5x5

...

ans = 1

Side = min(m,n); side >= 2

→ slight improvement

for (side = min(m,n); side >= 2; side--) {

for (i = 0; i+side-1 < m; i++) {

for (j = 0; j+side-1 < n; j++) {

// (i,j)

// side

int targetSum = rowCumSum[i][j+side-1] - (j > 0 ?
rowCumSum[i][j-1] : 0)

bool allSame = True;

// Check all remaining rows

for (int r = i+1; r < i+side; r++) {

int sum = rowCumSum[r][j+side-1] - (j > 0 ?
rowCumSum[r][j-1] : 0);

if (sum != targetSum) {

```

allSame = false;
break;

```

```

if (allSame == false)
    continue;

```

// check all columns.

```

for (c = j ; c < j+side ; c++) {

```

```

    int sum = colSum[i+side-1][c]
              - colSum[i-1][c];
              ↓ ↑
              i > 0 : 0

```

```

    if (sum != target)
        allSame = false;
}

```

```

if (!allSame) continue;

```

```

diag = 0 ; antiDi = 0;

```

```

for (int k = 0 ; k < side ; k++) {

```

```

    diag += grid[i+k][j+k];

```

```

    antiDi += grid[i+k][j+side-1-k];

```

```

}

```

```

if (diag == targetSum && antiDi == targetSum)

```

```

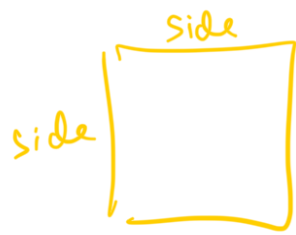
    return side;

```

```

}

```



time complexity:

```

class Solution {
public:
    int largestMagicSquare(vector<vector<int>>& grid) {
        int rows = grid.size(); //m
        int cols = grid[0].size(); //n

        //Row wise prefix sum
        vector<vector<int>> rowCumSum(rows, vector<int>(cols));
        for(int i = 0; i < rows; i++) {
            rowCumSum[i][0] = grid[i][0];
            for(int j = 1; j < cols; j++) {
                rowCumSum[i][j] = rowCumSum[i][j-1] + grid[i][j];
            }
        }

        //Column wise prefix sum
        vector<vector<int>> colCumSum(rows, vector<int>(cols));
        for(int j = 0; j < cols; j++) {
            colCumSum[0][j] = grid[0][j];
            for(int i = 1; i < rows; i++) {
                colCumSum[i][j] = colCumSum[i-1][j] + grid[i][j];
            }
        }
    }
}

```

$O(m \times n)$

$O(m \times n)$

```

//try all possible side squares from each cell
for(int side = min(rows, cols); side >= 2; side--) {

```

```

    for(int i = 0; i + side - 1 < rows; i++) {
        for(int j = 0; j + side - 1 < cols; j++) {
            int targetSum = rowCumSum[i][j+side-1] - (j > 0 ? rowCumSum[i][j-1] : 0);

            bool allSame = true;

            //check rows
            for(int r = i+1; r < i + side; r++) {
                int rowSum = rowCumSum[r][j+side-1] - (j > 0 ? rowCumSum[r][j-1] : 0);

                if(rowSum != targetSum) {
                    allSame = false;
                    break;
                }
            }

            if(!allSame)
                continue;

            //check columns
            for(int c = j; c < j + side; c++) {
                int colSum = colCumSum[i + side - 1][c] - (i > 0 ? colCumSum[i-1][c] : 0);

                if(colSum != targetSum) {
                    allSame = false;

```

side = 2 $\rightarrow m \cdot n \cdot 2$

3 $\rightarrow m \cdot n \cdot 3$

4 $\rightarrow m \cdot n \cdot 4$

5 $\rightarrow m \cdot n \cdot 5$

;

$m \cdot n (1+2+3+4+5+\dots)$

$m \cdot n \left(\frac{s(s+1)}{2} \right)$

$m \cdot n \cdot s^2$

$O(\text{side})$

$O(m \cdot n \cdot s^2)$

```

        if(!allSame)
            continue;

        //check diag and antiDiag
        int diag = 0;
        int antiDiag = 0;
        for(int k = 0; k < side; k++) {
            diag += grid[i+k][j+k];
            antiDiag += grid[i+k][j + side - 1 - k];
        }

        if(diag == targetSum && antiDiag == targetSum) {
            return side;
        }
    }
}

```

$O(\text{side})$

T.C. $O(m \cdot n \cdot (\min(m, n))^2)$

the 1990s, the number of people in the world who are undernourished has increased from 600 million to 800 million (FAO 1996).

There are a number of reasons why the world's population is becoming more undernourished. First, the world's population is growing rapidly, and the number of mouths to feed is increasing. Second, the world's food production is not keeping pace with the growing demand. Third, the world's food distribution is highly unequal, with the richest countries consuming the most food and the poorest countries consuming the least. Fourth, the world's food production is becoming increasingly dependent on fossil fuels, which are becoming increasingly scarce and expensive. Fifth, the world's food production is becoming increasingly vulnerable to climate change, which is causing more frequent and severe droughts and floods.

There are a number of ways in which the world's food production and distribution can be improved. First, the world's food production can be increased by using more efficient farming techniques and by expanding the area of land used for farming. Second, the world's food distribution can be improved by reducing the amount of food that is lost or wasted and by ensuring that food is distributed more equitably.

Third, the world's food production can be made more sustainable by using less fossil fuel and by adopting more environmentally friendly farming practices. Fourth, the world's food production can be made more resilient to climate change by developing drought-resistant crops and by improving water management practices.

There are a number of challenges that must be overcome in order to achieve these goals. First, there is a need for more investment in agricultural research and development. Second, there is a need for more international cooperation and coordination. Third, there is a need for more political will and leadership.

Fourth, there is a need for more public awareness and education. Finally, there is a need for more effective governance and management of the world's food production and distribution system.

Only by addressing these challenges can we hope to ensure that the world's population is adequately and sustainably fed in the years ahead.

References FAO (1996) *World Food Situation*. Food and Agriculture Organization of the United Nations, Rome.

Keywords Food security, Undernourishment, World population, Food production, Food distribution.

the 1990s, the number of people in the UK who are employed in the public sector has increased by 1.5 million (1990–1999) (Department of Health 2000).

There is a growing emphasis on the importance of the public sector in the provision of health care services. The public sector is seen as a key provider of health care services, and its role is expected to expand in the future. This is reflected in the fact that the public sector is the largest employer in the health care sector, and its share of total health care expenditure is expected to increase in the future.

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the 1990s, the number of people in the UK who are employed in the public sector has increased by 1.5 million, from 2.5 million in 1980 to 4 million in 1995 (Department of Health 1996).

There is a growing emphasis on the need to improve the efficiency of the public sector, and to ensure that the public sector is able to deliver the services that are required by the public. This has led to a number of initiatives, including the introduction of competition, the restructuring of public services, and the introduction of new management practices. These initiatives have led to a number of changes in the way that public services are delivered, and have led to a number of improvements in the efficiency of the public sector.

One of the main reasons for the need to improve the efficiency of the public sector is the increasing demand for public services. The population of the UK is growing, and the demand for public services is increasing. This has led to a number of challenges for the public sector, including the need to find ways to deliver services more efficiently, and the need to find ways to raise the funds that are required to pay for the services.

Another reason for the need to improve the efficiency of the public sector is the increasing pressure on public finances. The government is facing a number of challenges, including the need to reduce the budget deficit, and the need to find ways to raise the funds that are required to pay for the services. This has led to a number of initiatives, including the introduction of competition, the restructuring of public services, and the introduction of new management practices.

These initiatives have led to a number of changes in the way that public services are delivered, and have led to a number of improvements in the efficiency of the public sector. However, there is still a need to continue to improve the efficiency of the public sector, and to ensure that the public sector is able to deliver the services that are required by the public.