

Today's Content

1. Make term

Make Zero

Problem 3 Row to Column zero.

You are given a 2D integer matrix A.

if $A[i][j] = 0$: Make all the elements in a i^{th} row & j^{th} column zero

Constraints: $0 \leq A[i][j] \leq 10^9$

Ex1:

Input mat[3][4]

→ Output

$$\begin{matrix} 0 & 1 & 2 & 3 \\ 0 & \begin{bmatrix} 5 & 3 & 2 & 9 \end{bmatrix} & \text{Rows: } 1 \ 2 \\ 1 & \begin{bmatrix} 2 & 1 & 2 & 0 \end{bmatrix} & \text{Cols: } 3 \ 2 \\ 2 & \begin{bmatrix} 9 & 2 & 0 & 4 \end{bmatrix} & \end{matrix}$$

$$\begin{matrix} 0 & 1 & 2 & 3 \\ 0 & \begin{bmatrix} 5 & 3 & 0 & 0 \end{bmatrix} & \\ 1 & \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} & \\ 2 & \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} & \end{matrix}$$

Ex2:

Input mat[3][4]

→ Output

$$\begin{matrix} 0 & 1 & 2 & 3 \\ 0 & \begin{bmatrix} 5 & 0 & 2 & 9 \end{bmatrix} & \text{Rows: } 0 \ 2 \\ 1 & \begin{bmatrix} 3 & 2 & 2 & 1 \end{bmatrix} & \text{Cols: } 1 \ 2 \\ 2 & \begin{bmatrix} 9 & 2 & 0 & 4 \end{bmatrix} & \end{matrix}$$

$$\begin{matrix} 0 & 1 & 2 & 3 \\ 0 & \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} & \\ 1 & \begin{bmatrix} 3 & 0 & 0 & 1 \end{bmatrix} & \\ 2 & \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} & \end{matrix}$$

Ideal: Iterate in mat[0][0] *

if $\text{mat}[i][j] == 0$:

 Iterate in i^{th} row & make all elements 0

 Iterate in j^{th} col & make all elements 0

Issue: We cannot differentiate between input 0 & updated 0,

Dry Run: because of that every element becomes = 0.

$$\begin{matrix} 0 & 1 & 2 & 3 \\ 0 & \begin{bmatrix} 5 & 0 & 2 & 9 \end{bmatrix} & \\ 1 & \begin{bmatrix} 3 & 2 & 2 & 1 \end{bmatrix} & \\ 2 & \begin{bmatrix} 9 & 2 & 0 & 4 \end{bmatrix} & \end{matrix}$$

After Modifying →

$$\begin{matrix} 0 & 1 & 2 & 3 \\ 0 & \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} & \\ 1 & \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} & \\ 2 & \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} & \end{matrix}$$

Idea:

1. Iterate m mat[i][j] $T(n) \Theta(\underline{N}^2 \underline{N} (\underline{N} + \underline{N})) = N^2 N + N N^2$

if $\text{mat}[i][j] == 0$:

N Iterate m ith row & make all elements -1; } We can diff between

N Iterate m jth col & make all elements -1; } update 0 & ignore 0.

Note: while updating elements by -1, if $\text{mat}[i][j]$ is already 0
skip it.

2. Iterate m mat[i][j] all -1, make it 0

Matrix 0:

$$\begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 \\ 5 & 0 & 2 & 9 & 0 & 3 \end{bmatrix}$$

Matrix 1:

$$\begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 \\ -1 & 0 & -1 & -1 & 0 & -1 \\ 3 & -1 & -1 & 1 & -1 & 2 \end{bmatrix}$$

Matrix 2:

$$\begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 \\ -1 & -1 & 0 & -1 & -1 & -1 \\ -1 & -1 & -1 & -1 & 0 & -1 \end{bmatrix}$$

Matrix 3:

$$\begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Matrix 4:

$$\begin{bmatrix} 0 & 1 & 2 & 3 & 4 & 5 \\ 3 & 0 & 0 & 1 & 0 & 2 \end{bmatrix}$$

vector<vector<int>> mul (vector<vector<int>> v1, vector<vector<int>> v2, A); { TODO }

Update Constraints;

Constraints: $-10^9 \leq A[i][j] \leq 10^9$

{smu; Mat[3]T[3]}

$$\begin{array}{c} 0 \begin{bmatrix} -1 & 6 & 3 \\ 2 & 0 & 4 \\ 3 & 9 & -1 \end{bmatrix} \xrightarrow{\text{Abre apros}} 1 \begin{bmatrix} -1 & -1 & 3 \\ -1 & 0 & -1 \\ 3 & -1 & -1 \end{bmatrix} \xrightarrow{\text{Mlt -1}} 0 \begin{bmatrix} 0 & 0 & 3 \\ 0 & 0 & 0 \\ 3 & 0 & 0 \end{bmatrix} \\ \hline 1 & & & \\ 2 & & & \end{array}$$

Wing

Ideas:

$$w_1 \left[\begin{array}{cccccc} 0 & 1 & 2 & 3 & 4 & 5 \\ 1 & 0 & 0 & 1 & 0 & 1 \end{array} \right]$$

<u>r0l</u>	0	1	2	3	4	5
0	0	5 ↗	0 ↗	2 ↗	9 ↗	7 ↗
1	1	3 ↗	2 ↗	2 ↗	1 ↗	b ↗
2	0	2 ↗	9 ↗	2 ↗	0 ↗	4 ↗
3	0	3 ↗	7 ↗	3 ↗	2 ↗	0 ↗
4	1	4 ↗	7 ↗	8 ↗	10 ↗	11 ↗

	0	1	2	3	4	5
0	0	0	0	0	0	0
1	3	0	0	1	0	2
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	4	0	0	10	0	9

Idea:

int mat[N][N];

TC: $\Theta(N^2M)$ SC: $O(N+M)$

Step: 0 { vector<int> row(N, 1);
 vector<int> col(N, 1);

Step: 1 Iterate in mat[0][]

```
if (mat[i][j] == 0) {  
    row[i] = 0  
    col[j] = 0  
}
```

Step 2: Insert in `match()`

```

if( row[i] == 0 || col[j] == 0 ){
    mat[i][j] = 0;
}

```

Update Constraints: No Entra Espan

Idea:

Step1:

Trace1:

	0	1	2	3	4		0	1	2	3	4	
0	5	2	9	0	2	0	5	2	0	2	0	
1	0	2	0	1	b		0	2	0	1	b	
2	0	2	2	4	0		0	2	2	4	0	
3	6	3	2	9	2		6	3	2	9	2	

$$\text{mat}[0][j] = 0 \Rightarrow j^{\text{th}} \text{ col} = 0$$

$$\text{mat}[i][0] = 0 \Rightarrow i^{\text{th}} \text{ row} = 0$$

Trace2:

	5	2	9	8	7	3
0	0	1	2	3	4	5
0	0	2	9	8	7	3
1	3	2	2	1	b	2
2	0	2	0	4	2	7
3	10	3	2	9	0	b
4	6	7	8	10	11	9

Issue: Not sure $\text{mat}[0][0]$ representing 0th row or 0th col.

	0	1	2	3	4	5	0 th row or 0 th col.
0	0	2	9	8	7	3	
1	3	2	2	1	b	2	
2	0	2	0	4	2	7	
3	10	3	2	9	0	b	
4	6	7	8	10	11	9	

To avoid above issue:

Assume $\text{mat}[0][0]$: Is representing 0th row.

We will take flag variable: To indicate if 0th col = 0

Trace3:

flag = 1 \rightarrow 0: 0th col.

	0	1	2	3	4	5
0	0	2	9	8	7	3
1	3	2	2	1	b	2
2	0	2	0	4	2	7
3	0	3	2	9	0	b
4	6	7	8	10	11	9

flag = 0 = 0th col

	0	1	2	3	4	5
0	0	2	9	8	7	3
1	3	2	2	2	b	2
2	0	2	0	4	2	7
3	0	3	2	9	0	b
4	6	7	8	10	11	9

Step 2:

Trace 1: Skip other row & other col & update everything else

$$\text{flag} = 0 = 0^{\text{th}} \text{Col}$$

	0	1	2	3	4	5
0	0	2	0	0	7	3
1	3	2	2	1	b	d
2	0	2	0	4	2	f
3	0	3	2	9	0	b
4	6	f	8	10	11	9

	0	1	2	3	4	5
0	0	2	0	0	7	3
1	3	2	0	b	d	
2	0	2	0	0	0	0
3	0	0	0	0	0	0
4	6	f	0	0	11	9

Step 3: Update other row & other col. in that row

0^{th} Row: If $\text{matrix}[0][j] == 0$: Iterate in 0^{th} Row

0^{th} Col: If $\text{flag} == 0$: Iterate in 0^{th} Col

	0	1	2	3	4	5
0	0	2	0	0	7	3
1	3	2	0	0	b	d
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	6	f	0	0	11	9

vector<vector<int>> mul (vector<vector<int>> A) { TC: $O(N^2n)$ SC: $O(1)$

int N = A.size(), n = A[0].size();
int flag = 1; # 0th col representation.

for (int i=0; i < N; i++) {

 for (int j=0; j < n; j++) {

 if (mat[i][j] == 0) {

 if (j == 0) {

 mat[i][0] = 0;

 flag = 0;

 } else {

 mat[i][0] = 0;

 mat[0][j] = 0;

 }

 for (int i=1; i < N; i++) {

 for (int j=1; j < n; j++) {

 # mat[i][j] = 0

 if (mat[i][0] == 0 || mat[0][j] == 0) {

 mat[i][j] = 0;

 if (mat[0][0] == 0) { # iterate in 0th row q mat = 0 }

 if (flag == 0) { # iterate in 0th col q mat = 0 }