

ARRAYS 2

"Goals Begin Behaviors –
Consequences Maintain Behavior"



Good
Morning

Agenda

01. Find in row wise & colwise sorted matrix
02. Row with maximum no. of 1s
03. Spiral matrix
04. Sum of all submatrices sum .

Q1. Given a row wise & column wise sorted matrix.

Search for an ele K.

$A =$

-5	-2	1	13
-4	0	3	14
-3	2	6	18

num

$K = 13 \rightarrow \text{True}$

$K = 2 \rightarrow \text{True}$

$K = 7 \rightarrow \text{False}$

Brute force \rightarrow Iterate on each row & each column
& look for K

TC: $O(n*m)$

SC: $O(1)$

$A =$

-5	-2	1	13
-4	0	3	14
-3	2	6	18

$K = 0 \rightarrow \text{True}$

$A =$

-5	-2	1	13
-4	0	3	14
-3	2	6	18

$K = -3 \rightarrow \text{True}$

-5	-2	1	13
-4	0	3	14
-3	2	6	18

↓
Stop

$k = -1 \rightarrow \text{false}$

$n+m$

* $i = 0, j = m-1$

while ($i < n \&& j \geq 0$)

```

if ( $A[i][j] == k$ ). return true;
else if ( $A[i][j] > k$ ).  $j--$ ;
else if ( $A[i][j] < k$ ).  $i++$ ;
```

3

return false

TC: $O(n+m)$
SC: $O(1)$

Q2 Given a row wise sorted binary matrix. Find the row with maximum no. of 1s.

Note → If two rows have same no. of 1s, we have to return the row with smaller index
 → Assume each row to be sorted by values.

Example 1:

A = [[0, 1, 1]	Ans = 0 th row
	[0, 0, 1]	
	[0, 1, 1]	

Output 1: 0th row**Example 2:**

A = [[0, 0, 0, 0]	
	[0, 0, 0, 1]	
	[0, 0, 1, 1]	
	[0, 1, 1, 1]	Ans = 3 rd row

Brute force → Iterate on each & every row & count the no. of 1s.

TC: $O(n \times m)$ SC: $O(1)$

	0	1	2	3
0	0	0	1	1
1	0	0	0	1
2	0	1	1	1
3	0	1	1	1
4	0	0	0	1

⇒ Ans = 2nd row

	0	1	2	3
0	0	0	1	1
1	1	1	1	1
2	0	1	1	1
3	0	1	1	1
4	0	0	0	1

Ans = \emptyset 1

N = rows

M = columns

$i=0, j=m-1$

```

while (i < n && j ≥ 0)
    while (j ≥ 0 && A[i][j] == 1) {
        j--;
        ans = i;
    }
    i++;
return ans;

```

Tc: $O(n+m)$
Sc: $O(1)$

Q → Given a mat [N][N], print boundary in clockwise direction.

	0	1	2
0	1	2	3
1	4	5	6
2	7	8	9

3*3

Ans = 1 2 3 6 9 8 7 4

0	1	2	3	4
0	1	2	3	4
1	16	17	18	19
2	15	24	25	20
3	14	23	22	21
4	13	12	11	10

5*5

Ans = 1 2 3 4 5 6 7 8 9 10 11
12 13 14 15 16

N=3
2 ele →

2 ele ↓

2 ele ←

2 ele ↑

N=5
4 ele →

4 ele ↓

4 ele ←

4 ele ↑

```
void printboundary (int [][] A)
```

$i=0, j=0$

```
// (n-1) ele →  
for (k=1 ; k ≤ n-1 ; k++) {  
    print (A[i][j]);  
    j++;
```

TC: O(n)
SC: O(1)

// i=0, j=2 = print (n-1) ele ↓

```
for (k=1 ; k ≤ n-1 ; k++) {  
    print (A[i][j]);  
    i++;
```

// i=2, j=2 = print (n-1) ele ←

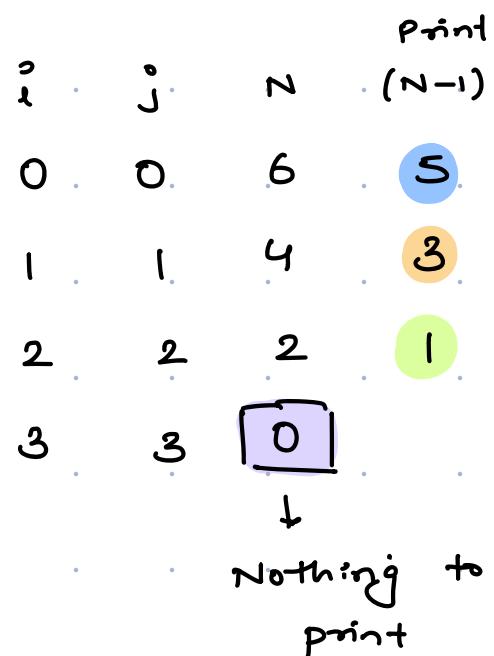
```
for (k=1 ; k ≤ n-1 ; k++) {  
    print (A[i][j]);  
    j--;
```

// i=2, j=0 = print (n-1) ele ↑

```
for (k=1 ; k ≤ n-1 ; k++) {  
    print (A[i][j]);  
    i--;
```

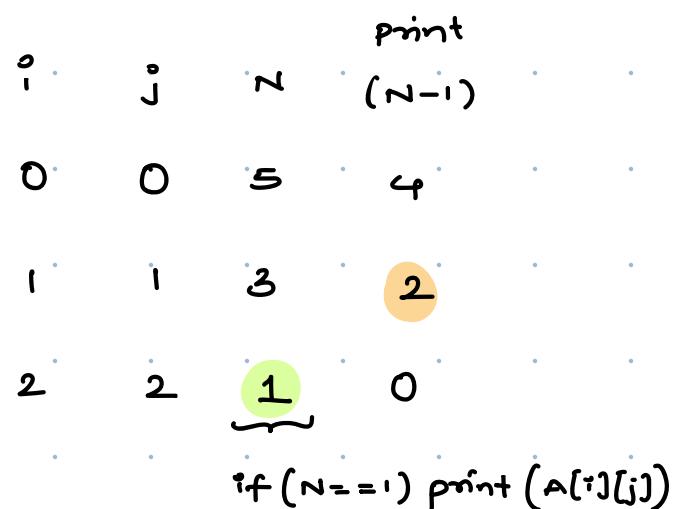
* Spiral matrix

	0	1	2	3	4	5
0	1	2	3	4	5	6
1	20	21	22	23	24	7
2	19	32	33	34	25	8
3	18	31	36	35	26	9
4	17	20	29	28	27	10
5	16	15	14	13	12	11



	0	1	2	3	4
0	1	2	3	4	5
1	16	17	18	19	6
2	15	24	25	20	7
3	14	23	22	21	8
4	13	12	11	10	9

n * n



$N = A.length$

```
void spiral matrix ( ) { A }
```

```
i=0 j=0
```

```
while ( N > 1 ) {
```



```
i = i+1, j = j+1, N = N-2
```

3

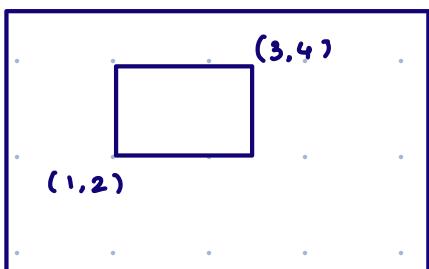
```
if ( N == 1 ) print ( A[i][j] ).
```

3

TC: $O(A \cdot \text{length}^2)$

SC: $O(1)$

* Submatrix : part of the matrix



01 Single cell is a submatrix

02 Entire matrix is also a submatrix

To represent a submatrix

↳ TL & BR is needed

↳ TR & BL is needed

Sum of all submatrices sum

Q Given a matrix of size $N \times M$. Determine the sum of all submatrices sum.

$$\begin{bmatrix} 3 & 1 & -1 \\ -1 & -2 & 4 \\ 2 & 4 \end{bmatrix} = \left\{ \begin{array}{cccccc} [3] & [3, 1] & \begin{bmatrix} 3 & 1 \\ -1 & -2 \end{bmatrix} & \begin{bmatrix} 3 & 1 \\ -1 & -2 \\ 4 \end{bmatrix} & \begin{bmatrix} 3 \\ -1 \end{bmatrix} & \begin{bmatrix} 3 \\ -1 \\ 2 \end{bmatrix} \\ [1] & [-2] & \begin{bmatrix} 1 \\ -2 \\ 4 \end{bmatrix} & [-1] & \begin{bmatrix} -1 \\ -2 \end{bmatrix} & \begin{bmatrix} -1 \\ 2 \\ 4 \end{bmatrix} \\ [-1] & [-2] & \begin{bmatrix} -2 \\ 4 \end{bmatrix} & [2] & \begin{bmatrix} 2 \\ 4 \end{bmatrix} & [4] \end{array} \right\}$$

$$\text{Ans} = 3 + 4 + 1 + 1 + 2 + 4 + 1 + (-1) + 3 + (-1) + (-3) \\ + 3 + 1 + (-2) + 2 + 2 + 2 + 6 + 4$$

Ans = 36

Brute force \rightarrow Generate all submatrices,

\rightarrow For one matrix \downarrow

Iterate & get the sum.

\rightarrow Totalsum += sum

$$\approx \frac{m+n*(n+1)*(m+1)}{4} \text{ no. of submatrices}$$

* Contribution Technique \rightarrow Look for contribution of each ele in all submatrices

$$\text{contribution} = A[i][j] * \text{count}$$

$$\begin{array}{r}
 3 * 6 = 18 \\
 1 * 6 = 6 \\
 -1 * 8 = -8 \\
 -2 * 8 = -16 \\
 2 * 6 = 12 \\
 4 * 6 = 24 \\
 \hline
 36
 \end{array}$$

* How many no. of times is (1,3) going to contribute?

	0	1	2	3	4
0	✓	✓	✓	✓	
1	✓	✓	✓	✓	✓
2				✓	✓

$$TL * BR$$

$$8 * 4 = \underline{\underline{32}}$$

$$3 * 5$$

	0	1
0	✓	
1	✓	✓
2	✓	✓

How many times (1,0) is going to contribute in submatrices?

$$TL * BR$$

$$2 * 4 = \underline{\underline{8}}$$

$$3 * 2$$

In how many submatrices, (1,2) will be present?

	0	1	2	3	4
0	✓	✓	✓		
1	✓	✓	✓	✓	✓
2			✓	✓	✓
3			✓	✓	✓

4 * 5

$$\begin{array}{l} \underline{\text{TL}} * \underline{\text{BR}} \\ 6 * 9 = \underline{\underline{54}} \end{array}$$

$$\underline{\text{TL}} = (i+1) * (j+1)$$

$$\text{BR} = (n-i) * (m-j)$$

ans = 0

```
for ( i=0 ; i<n; i++ ) {
```

```
    for ( j=0; j<m; j++ ) {
```

$$\text{cont} = (i+1) * (j+1) * (n-i) * (m-j)$$

```
    ans = ans + A[i][j] * cont;
```

3

3

Tc : O(n*m)

Sc : O(1)

Genetic Sequence

Problem Description

You are a software engineer working on a program that analyzes genetic sequences. You are given a sequence of nucleotides represented as a string **A** of size **N**, where each nucleotide is represented by a lowercase English letter [a - z]. Your task is to count the number of substrings in **A** that begin and end with the same nucleotide.

For example: if A = "abcbba", The substrings of length 1 that start and end with the same letters are "a", "b", "c", "b", and "a". The substring of length 3 that starts and ends with the same letter is "bcb". The substring of length 5 that starts and ends with the same letter is "abcb".

Problem Constraints

$1 \leq N \leq 10^5$

A consists of lowercase english letters.