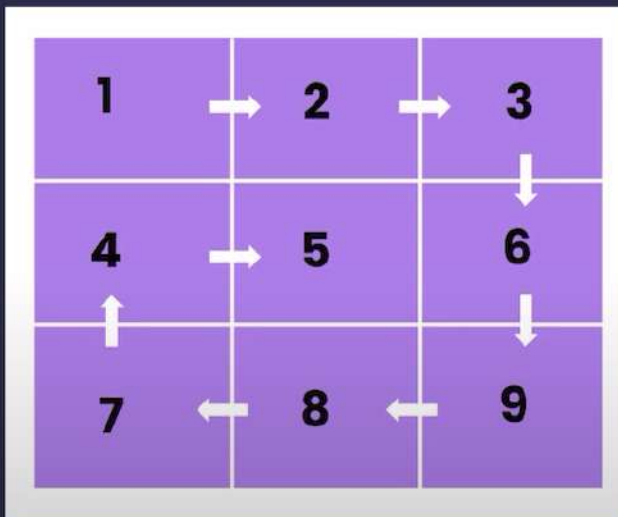


# Pattern: Spiral Matrix

Given an  $n \times m$  matrix 'a', return all elements of the matrix in spiral order.



1 2 3 6 9 8 7 4 5



506

row

col

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

LC

RC

while ( ) {

① topRow

② rightCol

③ bottomRow

④ leftCol



## Try this :

Given a positive integer  $n$ , generate an  $n \times n$  matrix filled with elements from 1 to  $n^2$  in spiral order.

$n=5$

1	→	2	→	3
8	→	9		↓
↑				↓
7	←	6	←	5

$n=3$

	0	1	2	3	4
0					
1					
2					
3					
4					





## Method 1: Brute Force

$$l_1 = 3, u_1 = 2$$

$$l_2 = 5, u_2 = 4$$

	0	1	2	3	4	5	6
0							
1							
2		(3, 1)					
3							
4							
5						(5, 4)	
6							



## Method 2: Pre-Calculating the horizontal sum for each row in the Matrix

q queries  
[l, r]

pref[i] -

a =

2	1	3	4	1
0	1	2	3	4

a =

2	3	6	10	11
---	---	---	----	----



	0	1	2	3	4	5	6
0	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
2	1	(3,1)	1	1	1	1	1
3	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1
5	1	1	1	1	1	(5,4)	1
6	1	1	1	1	1	1	1

x	0	1	2	3	4	5	6
0	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7
2	1	(3,1) 2	3	4	5	6	7
3	1	2	3	4	5	6	7
4	1	2	3	4	5	6	7
5	1	2	3	4	5	6	7
6	1	2	3	4	5	6	7





	0	1	2	3	4	5	6
0	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
2	1	(3,1)	1	1	1	1	1
3	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1
5	1	1	1	1	1	(5,4)	1
6	1	1	1	1	1	1	1

a

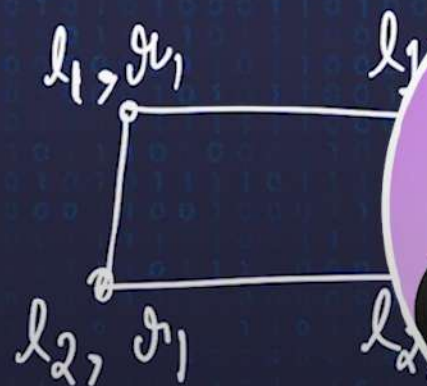
	0	1	2	3	4	5	6
0	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7
2	1	(3,1) 2	3	4	5	6	7
3	1	2	3	4	5	6	7
4	1	2	3	4	5	6	7
5	1	2	3	4	5	6	7
6	1	2	3	4	5	6	7

a p



	0	1	2	3	4	5	6
0	1	2	3	4	5	6	7
1	2	4	6	8	10	12	14
2	3	6	9	12	15	18	21
3	4	0	12	16	20	24	28
4	5	10	15	20	25	30	35
5	6	12	18	24	30	36	42
6	7	14	21	28	35	42	49

$(aA)_c$





*(Left)* *Left* *Up*

	0	1	2	3	4	5	6
0	1	2	3	4	5	6	7
1	2	4	6	8	10	12	14
2	3	6	9	12	15	18	21
3	4	8	12	16	20	24	28
4	5	11	15	20	25	30	35
5	6	14	19	24	30	36	42
6	7	17	22	28	35	42	49

$$\text{sum} = a[l_2][r_2]$$

$$\text{Ans} = \text{sum} - \text{up} - \text{left} + \text{leftUp}$$

$$\text{sum} = a[l_2][r_2]$$

$$\text{up} = a[l_1 - 1][r_2]$$

$$\text{left} = a[l_2][r_1 - 1]$$

$$\text{leftUp} = a[l_1 - 1][r_1 - 1]$$

