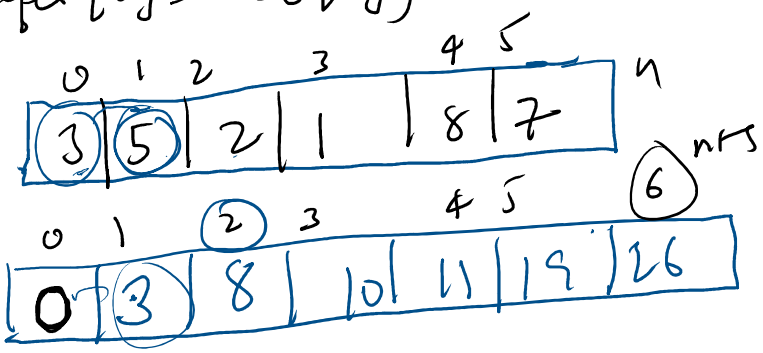
4.4 - Prefix Sum and Kadanes

Sunday, August 31, 2025 10:48 AM

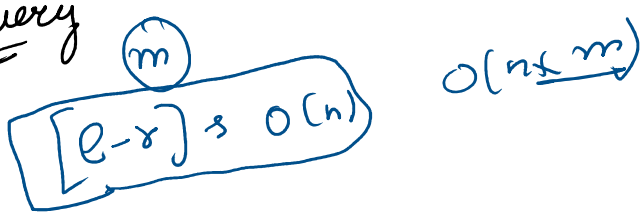
#

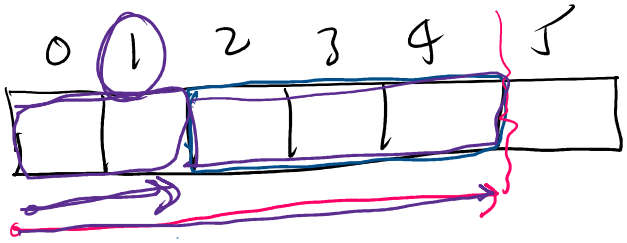
prefix[0] = arr[0];



for (int i=1; i<n+1; i++) {
prefix[i] = prefix[i-1] + arr[i-1];
}

Range Sum Query



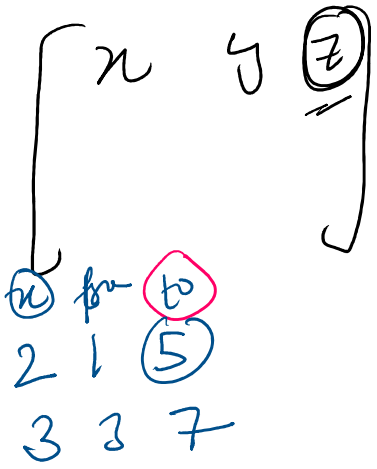


p[r] - p[l-1]

l = 2

r = 4

Car Pooling



XOR

↳ Exclusive OR

x	y	x^y
1	1	0
1	0	1
0	1	1
0	0	0

⇒ Properties of XOR

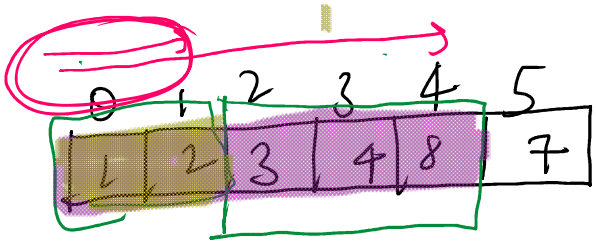
$$\varepsilon \wedge \varepsilon = 0$$

$$0 \wedge \varepsilon = \varepsilon$$

XOR queries of Sub array

XOR queries of Sub array

Brute force $O(N+Q)$

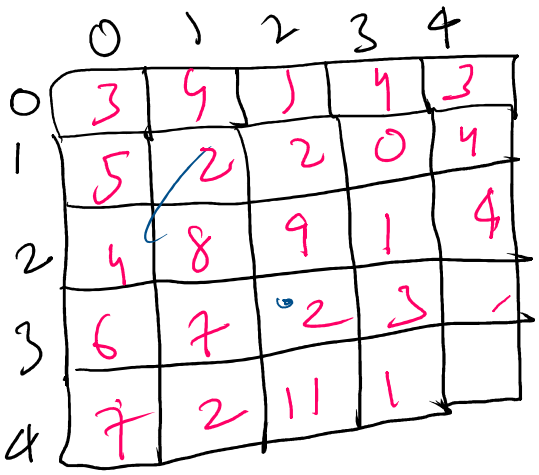


$3 \wedge 4 \wedge 8$

$1 \wedge 2 \wedge 3 \wedge 4 \wedge 8 \wedge 1 \wedge 2$

Range Sum 2D

$O(Q \times m \times n)$



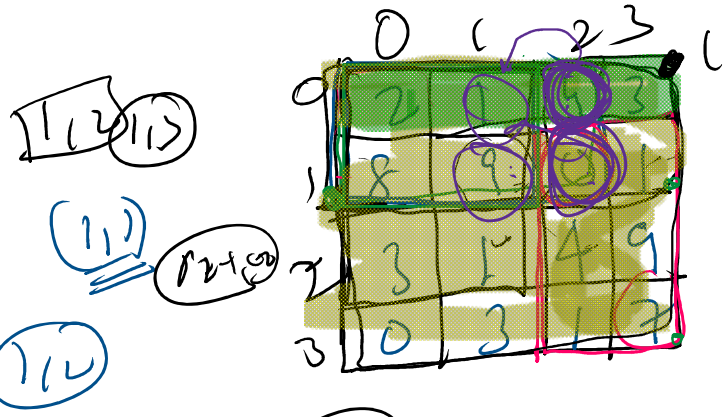
r1 c1
r2 c2

r1 = 1
c1 = 2

r2 = 3
c2 = 4

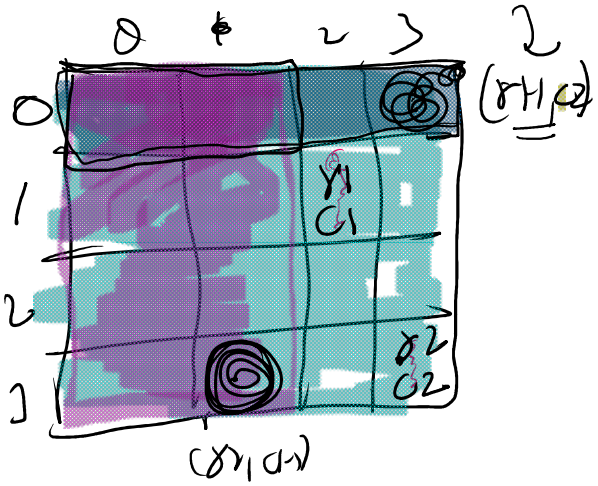
⇒ Meaning of prefix sum in 2D matrix

[i, j] → sum of the rectangle / sub array formed [0, 0] - [i, j]

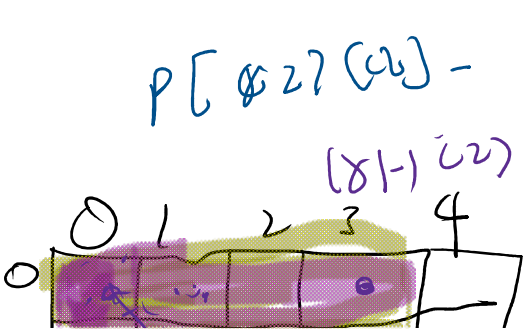


2	3	7	10
10	20	24	28
13	24	32	45
13	27	36	56

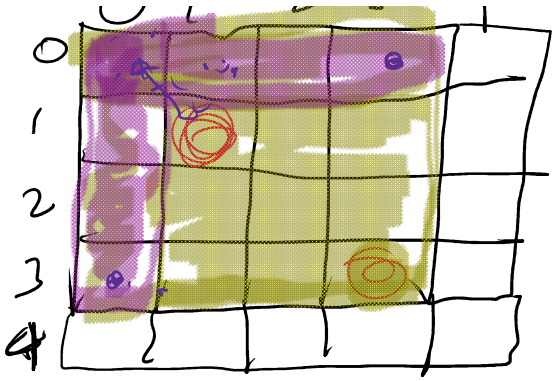
$p[i][j] = p[i-1][j] + p[i][j-1] - p[i-1][j-1] + a[i][j]$



$p[x_2][y_2] - p[x_1-1][y_2] - p[x_2][y_1-1] + p[x_1-1][y_1-1]$

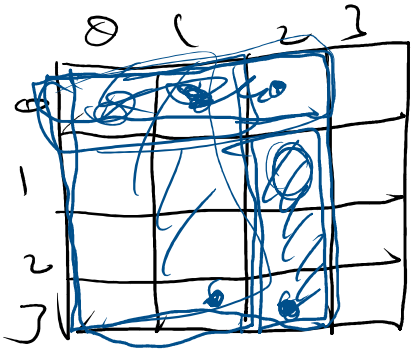


$x_1 = 1,\ y_1 = 1$



r1 = 1, c1 = 1

r2 = 3, c2 = 3



r1 = 1, c1 = 2

r2 = 3, c2 = 2

P[r2][c2] − P[r1−1][c2] − P[r2][c1−1] + P[r1−1][c1−1]

O(n × m + Q)

build prefix sum

queries