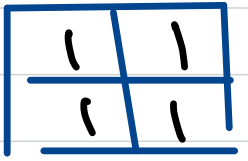
Q) Given a matrix of integers, find the sum of all possible submatrices.

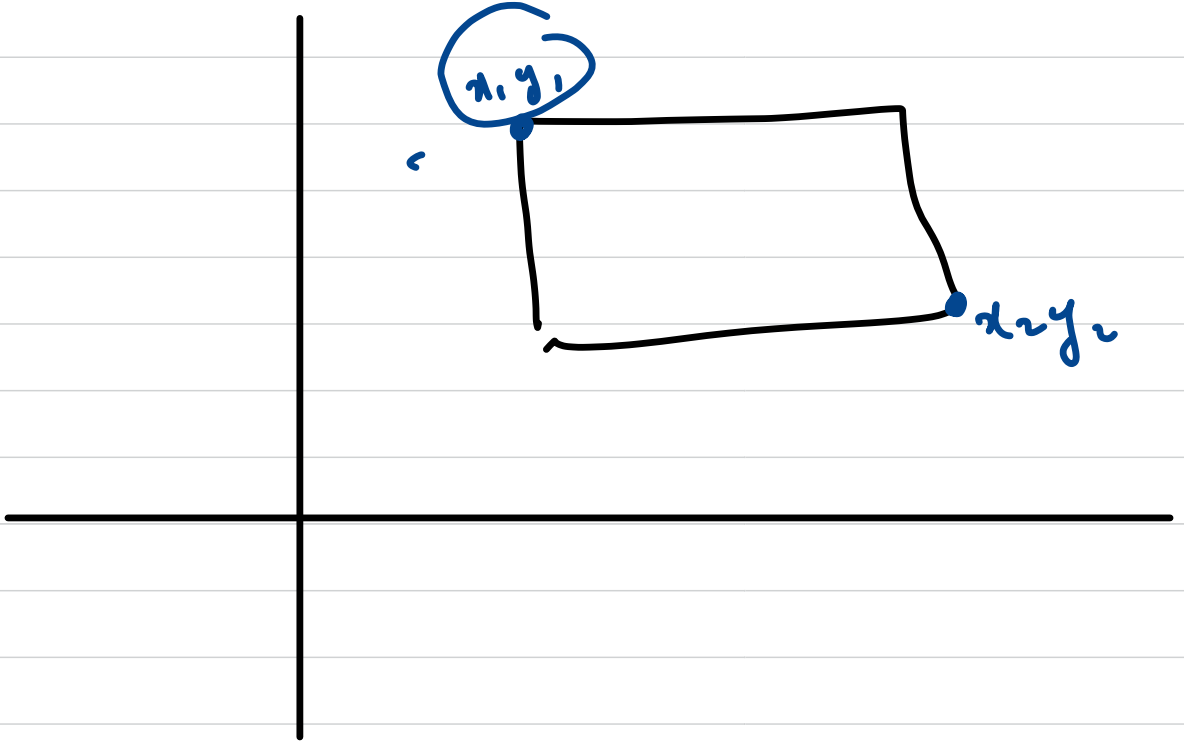


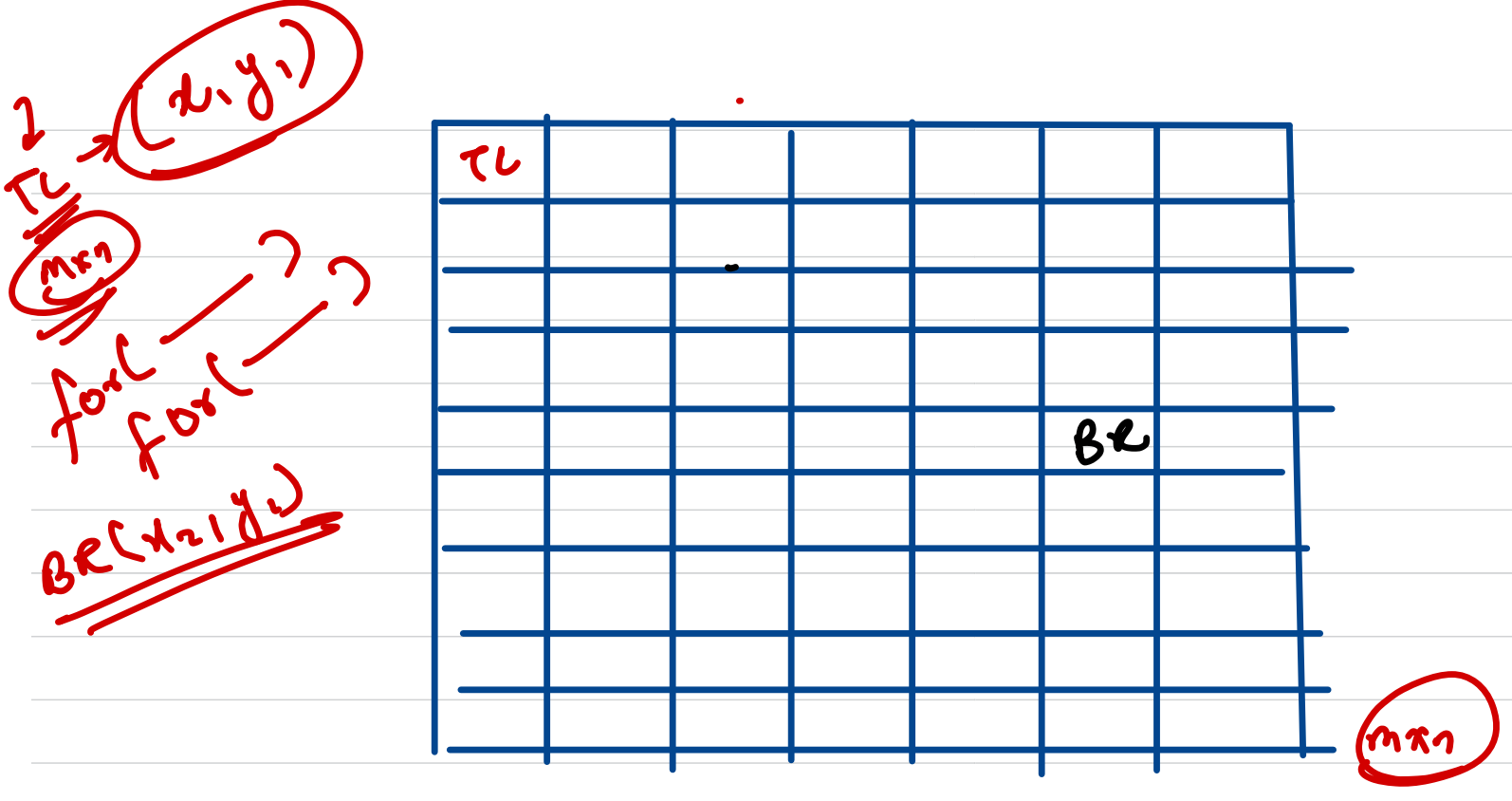
2×2

1×1 1×2 2×1 2×2

1 + 1 + 1 + 1 + 2 + 2 + 2 + 2 + 4

ans → 16


x1 y1
x2 y2

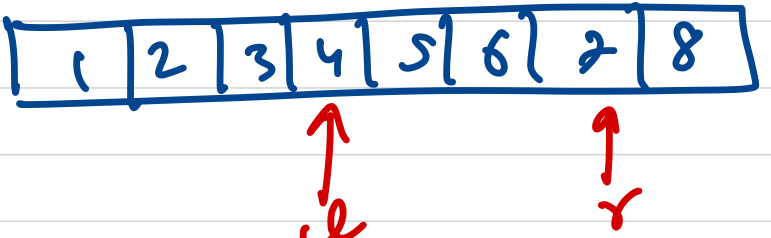

TL
BR
TL
(x1, y1)
mxn
for(—)
for(—)
BR(x2, y2)
mxn

```
for(x1=0; x1<n; x1++){
    for(y1=0; y1<n; y1++){
        for(x2=x1; x2<n; x2++){
            for(y2=y1; y2<n; y2++){
                for(i=x1; i<=x2; i++){
                    for(j=y1; j<=y2; j++){
                        sum+=mat[i][j];
```

Brute force

$n^6 \rightarrow n^4$

Prefix Sum



Queries
l, r

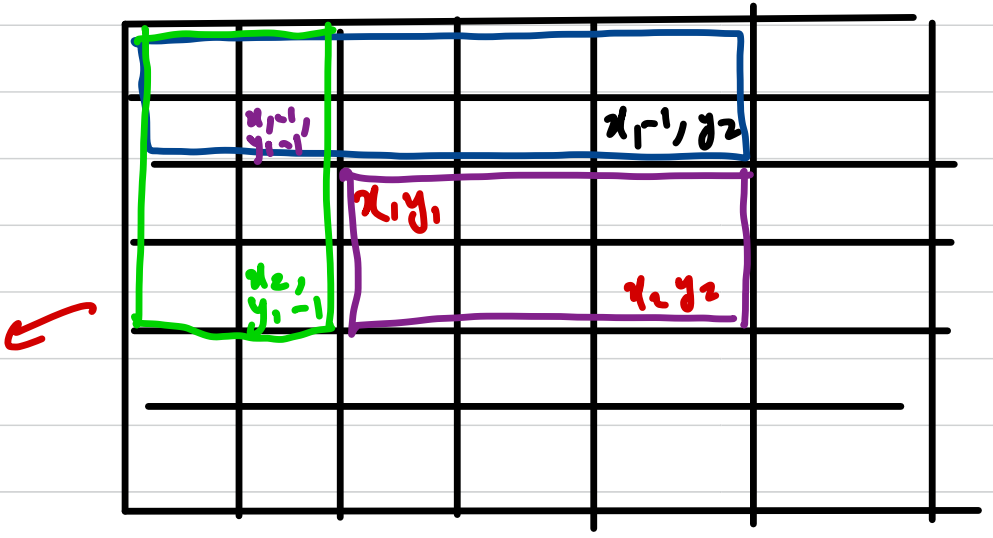
O(n) 1, 3, 6, 10, 15, 21, 28, 36

2	5
1	4
0	2
2	3
4	4

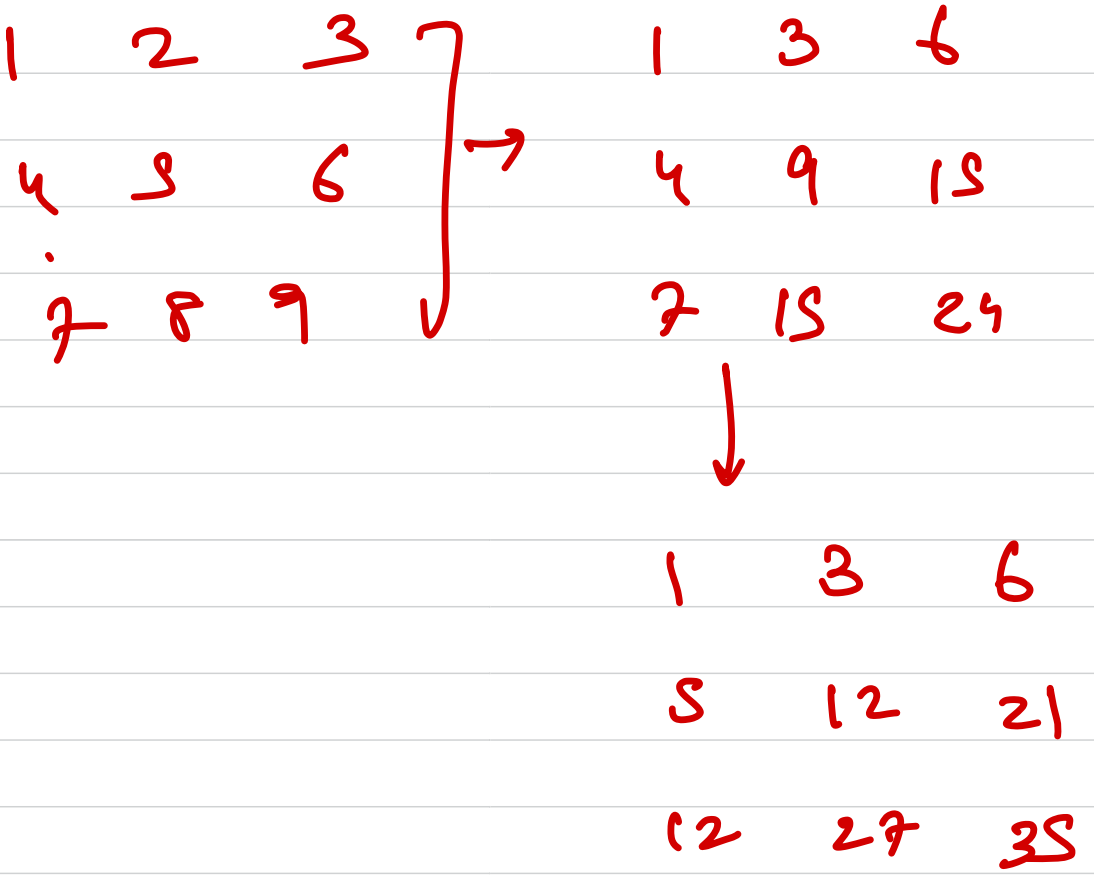
$$Sum(l,r) = Sum(0,r) - Sum(0,l-1)$$

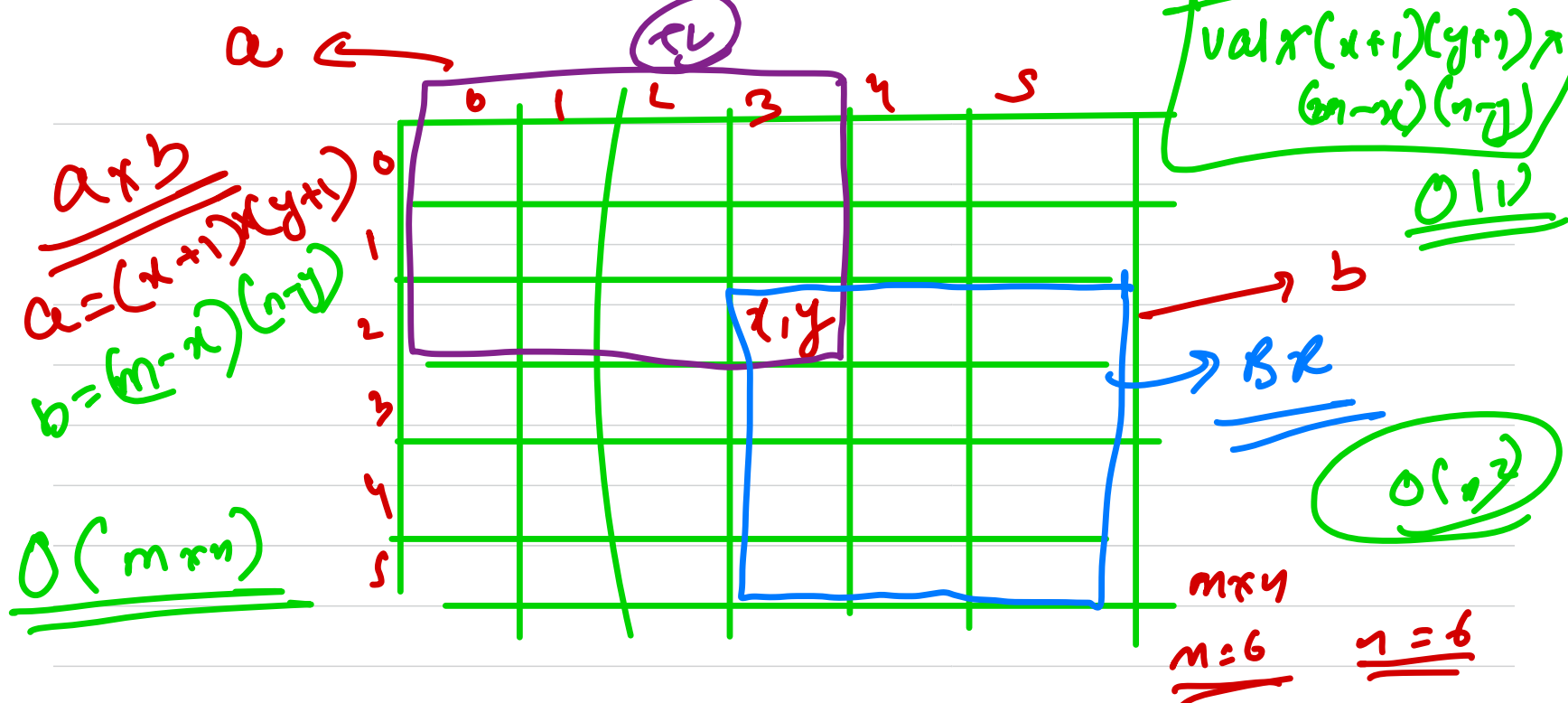
$$prefix[r] - prefix[l-1]$$

Sum of all Submatrix



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


1 2 3
4 5 6
7 8 9
1 3 6
4 9 15
7 15 24
1 3 6
5 12 21
12 27 35



if I can calc contribution of each cell in the final sum.

Contri → val of x,y × (# of possible submatrices)

Q» Given an array, Calc the maximum Sum Subarray.

Kadane's

-2, -3, 4, -1, -2, 1, 5, -3

result = ~~-∞~~ ~~4~~ ~~7~~ ~~8~~ 16

-2, 6, 2, -1, 9

Sum = 16