Arrays 2

Friday, 22 October 2021 8:58 PM

Q→ Given a integer array with 0s & 1s. We have to maximize the no. of 1's in atmost one operation of flipping any one subarray. → contiguous part of array

A→ [1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 1] Ans = 10

1 1 0 1 1

Bruteforce → Try all subarrays.

→ # subarrays in array of size N = $\boxed{\frac{N*(N+1)}{2}}$ $= O(N^2)$

_ _ _ _ _
$*$ $*$ $*$ $*$ 1

$5+4+3+2+1 = \Sigma 5 = \frac{5*6}{2} = 15$

$\Sigma N = \frac{N*(N+1)}{2}$

O(N) to flip & count.

$TC = O(N^3)$ → $O(N^2)$

```
→ cnt = 0;
  for(i=0; i<N; i++) {
      cnt += A[i];
  }

→ ans = cnt;   // Initial no. of 1's
  for (i = 0; i < N; i++) {
      count0 = 0;  count1 = 0;
      for ( j = i ; j < N ; j++) {
          if(A[j] == 1) count1++;
          else count0++;
          ans = max( ans, cnt + (count0 - count1));
      }
  }
  return ans;
```

// i → start
j → end of subarray

$TC = O(N^2)$

N=6

0	1	2	3	4	5
1	0	0	1	0	0

cnt = 2
ans = ~~2~~ ~~3~~ ~~4~~ $\boxed{5}$

i	j	count0	count1	newans
~~0~~	~~0~~	~~0~~	~~0~~ 1	2+(0−1) = 1
	~~1~~	~~1~~		2+(1−1) = 2
	~~2~~	~~2~~		2+(2−1) = 3
	~~3~~		2	2+(2−2) = 2
	~~4~~	~~3~~		2+(3−2) = 3
	5	4		2+(4−2) = 4
1	~~1~~	~~0~~	~~0~~	2+(1−0) = 3
	~~2~~	~~1~~		2+(2−0) = 4
	~~3~~	~~2~~	1	2+(2−1) = 3
	~~4~~	~~3~~		2+(3−1) = 4
	5	4		2+(4−1) = 5

0 0 0 1 0 0 0 1 0 0 0 1 1 0 0 0 0   4+4 = 8

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observations → 1) Flip a 0 → +1
2) Flip a 1 → −1
3) subarray will start & end at 0.
(Empty subarray is also possible).

1 1 [0 1 0] 1

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

1

updating the elements based on what they are contributing to the answer.

Find max sum subarray.

max sum

≥0

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Ans = # 1's in original array + Max sum subarray in new array.

cnt + ?

> max sum

max sum

<0
−2

if prefix >0 include it
else exclude it

Max Subarray Sum

[−1, 1, 1, −1, 1, 1, −1, −1, −1, −1, 1, −1]
→ [0, 1, 2, 1, 2, 3, 2, 1, 0, 0, 1, 0]

Ans

Kadane's Algo

$TC = O(N)$

$P[i] = P[i-1] + A[i]$

P[i] = A[i] + P[i−1];
if(P[i] < 0) P[i] = 0;

(A[i]==0 ? 1 : −1)

SC = ~~O(N)~~ → O(1)

Final Ans = 3 + original no. of 1's

```
p = A[i] + p;
if(p < 0) p = 0;
max Sum = max(max Sum, p);
```

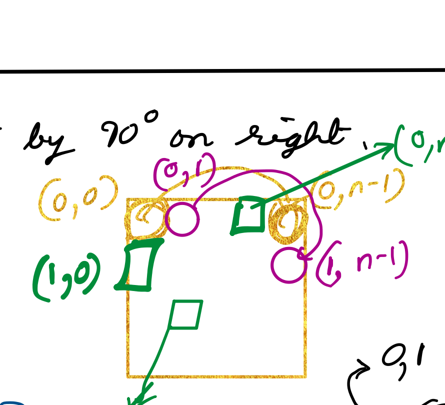
excluded start

	0	1	2	3	4	5	6
	3	−5	2	8	−4	6	−3
p →	3	0	2	10	6	12	9

Ans

Q→ Given a 2D square Matrix, rotate it by 90° on right.

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



0,1 → (1, n−1)
n−1, (n−1)−1

(2,1) → (1, n−3)

$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \rightarrow \begin{bmatrix} 7 & 4 & 1 \\ 8 & 5 & 2 \\ 9 & 6 & 3 \end{bmatrix}$

N*N

$\boxed{(i,j) \rightarrow (j, (n-1)-i)}$

Ans[j, n−1−i] = A[i][j]

$\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix} \rightarrow$ Transpose $\begin{bmatrix} 1 & 5 & 9 & 13 \\ 2 & 6 & 10 & 14 \\ 3 & 7 & 11 & 15 \\ 4 & 8 & 12 & 16 \end{bmatrix}$

$TC = O(N^2)$
$SC = O(1)$

Transpose
$A[i][j] \rightarrow A[j][i]$
$\forall i < j$

Ans
$\begin{bmatrix} 13 & 9 & 5 & 1 \\ 14 & 10 & 6 & 2 \\ 15 & 11 & 7 & 3 \\ 16 & 12 & 8 & 4 \end{bmatrix}$

```
∀i
for (j = 0; j < n/2; j++)
    swap[j, n-1-j];
```

i, j → j, (n−1)−i
i, j → j, i

i, j → j, (n−1)−i → (n−1)−i, (n−1)−j → (n−1)−j, ~~(n−1)−((n−1)−i)~~ i

Q→ Find sum of all submatrix of a given matrix.

A→ $\begin{bmatrix} 9 & 6 \\ 5 & 4 \end{bmatrix}$ 2*2 → [9] 9, [6] 6, [5] 5, [4] 4, [9 6] 15, [5 4] 9, $\begin{bmatrix} 9 \\ 5 \end{bmatrix}$ 14, $\begin{bmatrix} 6 \\ 4 \end{bmatrix}$ 10, $\begin{bmatrix} 9 & 6 \\ 5 & 4 \end{bmatrix}$ 24

4*6 = 24

4*9 = 36

Total = 96

Brute →

submatrix of a matrix of size N*M = $\boxed{\frac{N*(N+1)}{2} * \frac{M*(M+1)}{2}}$ $= O(N^4)$

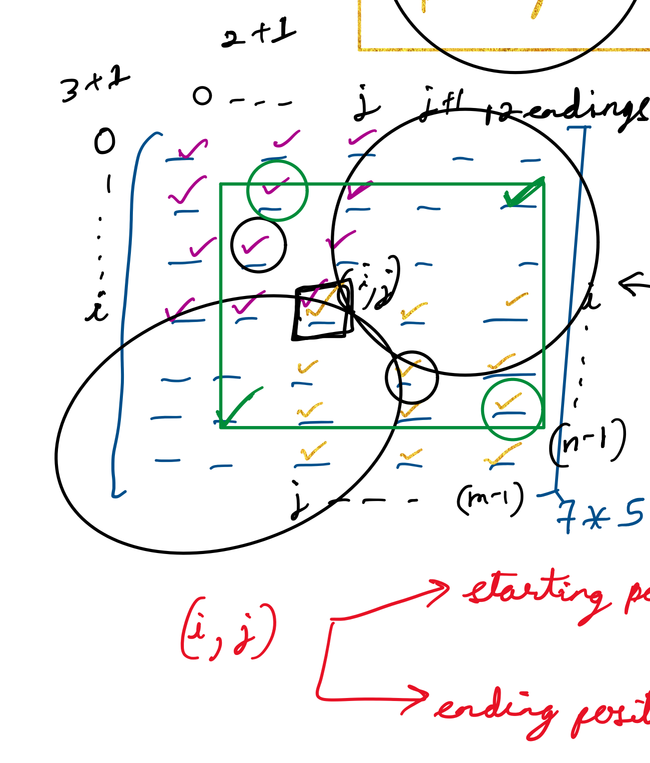
(i, j)
i — N
j — M

Ans = Σ contribution of each element

submatrix element is part of * A[i][j]

Top Right
Bottom left

Top left
Bottom Right



(3+1)*(2+1) → starting positions
4 * 3 → ending positions
(7−3) (5−2)

(i, j) → starting positions → (i+1)*(j+1)
*
→ ending positions → (n−i)*(m−j)

contribution of (i, j) → (i+1)*(j+1)*(n−i)*(m−j) * A[i][j]

$\boxed{Ans = \sum_{\forall i,j} (i+1)*(j+1)*(n-i)*(m-j)*A[i][j]}$

$TC = O(N*M)$
$SC = O(1)$

n=2 m=2

$\begin{array}{c|cc} & 0 & 1 \\ \hline 0 & 1 & 3 \\ 1 & 5 & 10 \end{array}$ N*M

Ans = 1*(1*1*2*2) → 4
+ 3*(1*2*2*1) → 12
+ 5*(2*1*1*2) → 20
+ 10*(2*2*1*1) → 40
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[1] 1, [3] 3, [5] 5, [10] 10, [1 3] 4, [5 10] 15, $\begin{bmatrix} 1 \\ 5 \end{bmatrix}$ 6, $\begin{bmatrix} 3 \\ 10 \end{bmatrix}$ 13, $\begin{bmatrix} 1 & 3 \\ 5 & 10 \end{bmatrix}$ 19 = 19 + 19 + 19 + 19 = 76

$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$

submatrix = 9

submatrix = (2*2) * (2*2) = 16