

# Arrays - III



traverse in all  
of the subarrays

Find if there is a subarray with 0 sum

$$a = [2, 3, 1, \underbrace{-4, 3, -2}]$$

$O(N^2)$ .

```
for ( i → ) {  
    int start = i;  
    sum = a[i];  
    for ( j = i+1; - - )  
        sum += a[j]
```

Brute-force,

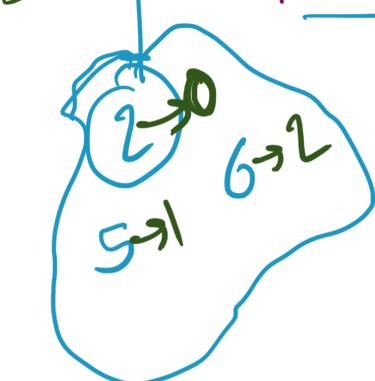
$O(N^3)$        $\frac{2^N}{O(N^2)}$

) optimize  
→ Space  
→ Sort  
...  
logic

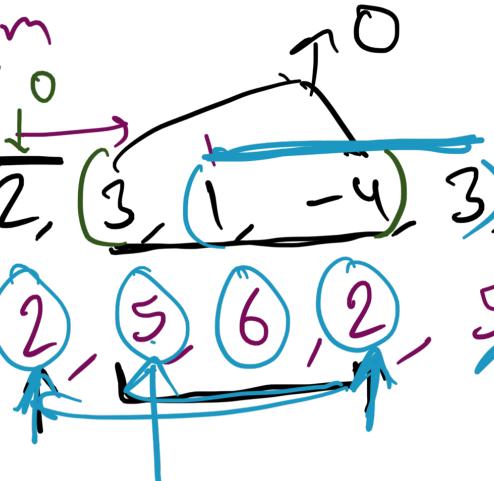
: Prefix sum

$(0+1, 3)$

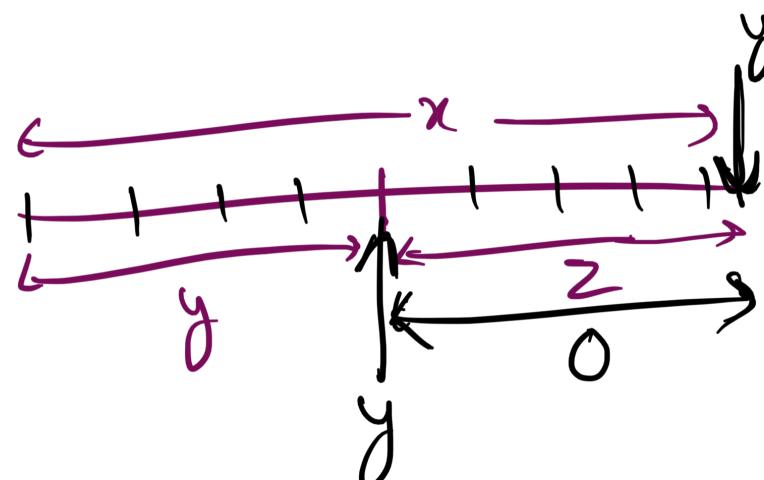
PrefixSum[] =



$a = [ \underline{2}, \underline{3}, \underline{1}, \underline{-4}, \underline{3}, -2 ]$



$\text{Set } O(1)$



$$x = y + z$$

$$x = y + 0$$

$$x = y$$

$\text{for } (i \rightarrow)$

$\text{for } (j \rightarrow)$

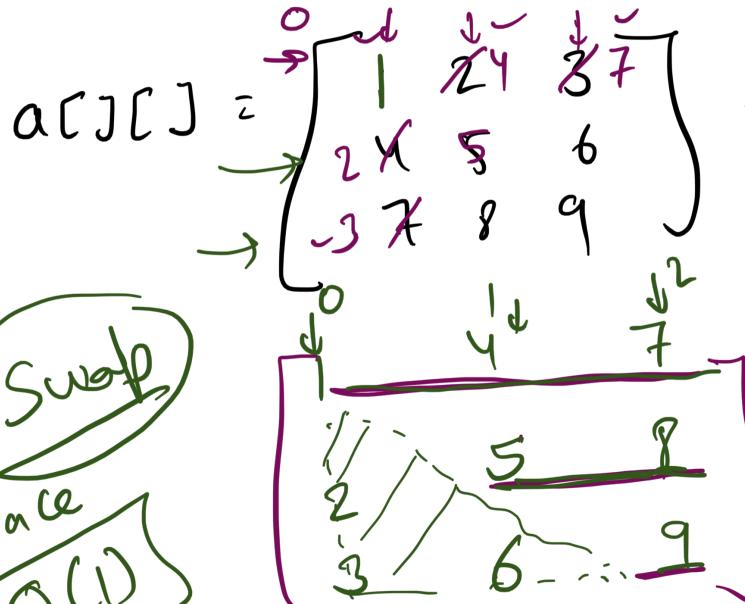
$a[i][j]$

Square

temp =

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

## Transpose of a Matrix



~~Swap~~  
In place  
 $O(1)$

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

Brute-force

$\text{temp}[j][j] =$

The diagram illustrates the transpose of a 3x3 matrix using a temporary array. The original matrix is shown with indices  $i$  and  $j$ . The transpose is shown with swapped indices. A purple box highlights the  $O(N^2)$  complexity.

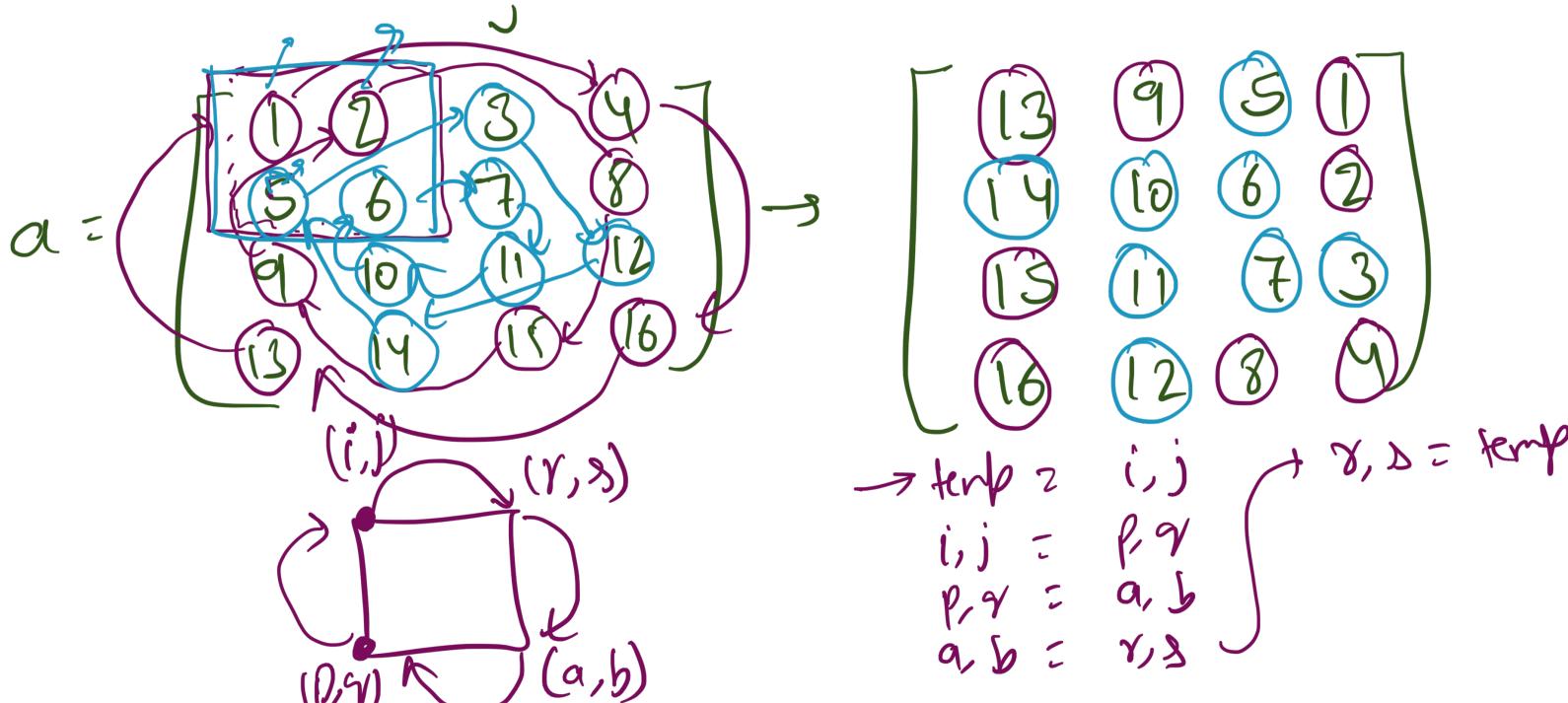
$(i, j)$

$$a = \begin{bmatrix} (0, 0) & \overset{i}{(0, 1)} & (0, 2) \\ (\overset{j}{1, 0}) & (1, 1) & (1, 2) \\ (2, 0) & (2, 1) & (2, 2) \end{bmatrix}$$

$$2 \times 3 \longrightarrow 3 \times 2$$

Square

## Rotate a Matrix 90° clockwise



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

Transpose ↓

$$(i, j) \leftarrow \begin{bmatrix} 1 & 5 & 9 & 13 \\ 2 & 6 & 10 & 14 \\ 3 & 7 & 11 & 15 \\ 4 & 8 & 12 & 16 \end{bmatrix} \xrightarrow{(i, n-j-1)} \begin{bmatrix} 1 & 2 & 3 & 7 & 4 & 1 \\ 4 & 5 & 6 & 8 & 5 & 2 \\ 7 & 8 & 9 & 9 & 6 & 3 \\ 10 & 11 & 12 & 13 & 14 & 15 \end{bmatrix}$$

Reverse every row.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \xrightarrow{90^\circ} \begin{bmatrix} 7 & 4 & 1 \\ 8 & 5 & 2 \\ 9 & 6 & 3 \end{bmatrix}$$

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

$$a = \begin{bmatrix} i & j \rightarrow 0 & 1 & 2 & 3 \\ 0 & (0,0) & (0,1) & (0,2) & (0,3) \\ 1 & (i,j) & & & \\ 2 & & & & \\ 3 & & & & \end{bmatrix} \quad l, n-j-1 \quad j, n-j-1$$

$n = 4 \quad n/2 \quad n$

$(0, 0)$

$j=0$

$(0, 1)$

$j=1$

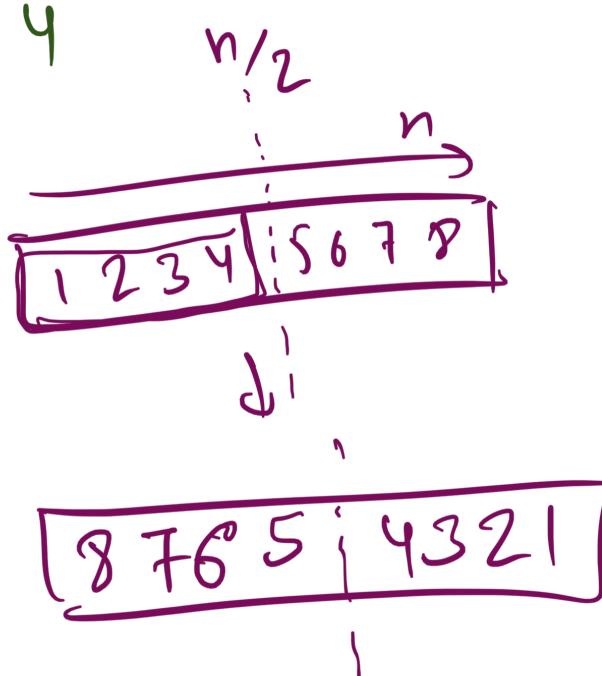
$(0, 3)$

$n-j-1$

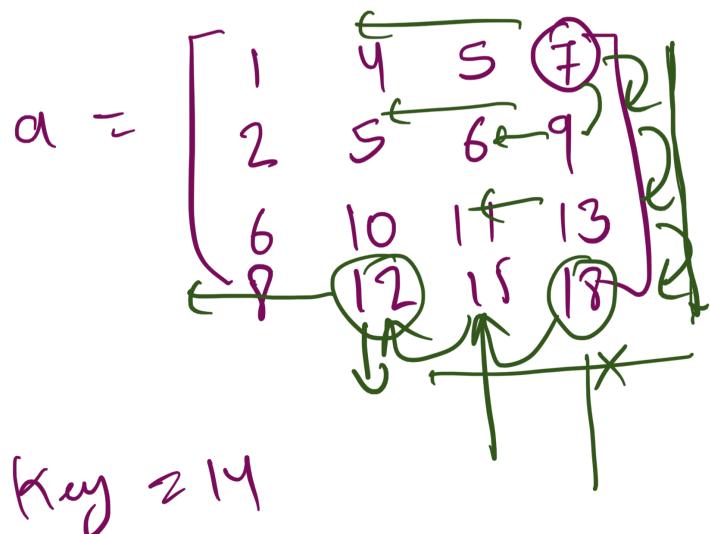
$(0, 2)$

$n-j-1$

$4-1-1 = \underline{2}$



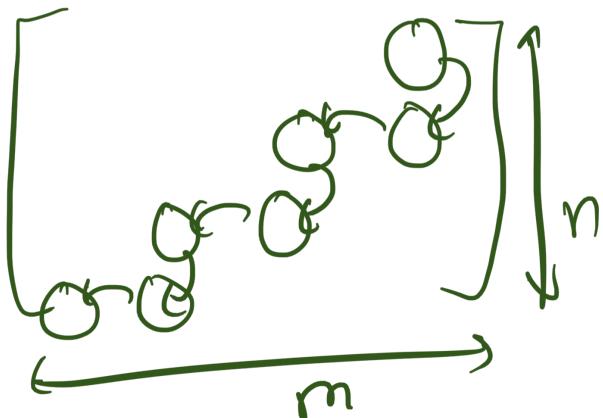
## Search Element in Row-wise and Column-wise Sorted Matrix



$O(N \times m)$

$\cancel{O(N + m)}$

14





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## Practice Problems

1. Split array in three equal sum subarrays.
2. Find the largest subarray with equal numbers of 0s and 1s
3. Majority Element Problem - Find the element that repeats more than  $n/2$  times.
4. Left Rotate an Array by 1 step.
5. Left Rotate an Array by k steps.
6. *afa → Arrays Practice*