

# ARRAY : Video -

171



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Something important you'll learn

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## Motivation -

The most powerful thing we have is that we have the ability to change our future in present by working hard. Failures in present are building blocks to a good future.



MIK..

### 1292. Maximum Side Length of a Square with Sum Less than or Equal to Threshold

Medium

Topics

Companies

Hint

Given a  $m \times n$  matrix `mat` and an integer `threshold`, return the maximum side-length of a square with a sum less than or equal to `threshold` or return `0` if there is no such square.

Example:  $mat =$

1	1	3	2	4	3	2
1	1	3	2	4	3	2
1	1	3	2	4	3	2

, threshold  
= 4  
 $2 \leq 4$

square side =  $\sqrt{2}$

Output:  $2 \leftarrow$

Constraints  
analysis:

- Constraints:**
- $m == \text{mat.length}$  ✓ rows
  - $n == \text{mat}[i].length$  ✓ cols
  - $1 \leq m, n \leq 300 \rightarrow n^2, n^3$
  - $0 \leq \text{mat}[i][j] \leq 10^4$
  - $0 \leq \text{threshold} \leq 10^5$

# Thought Process

0	1	2	3	4
0				
1				
2				
3				
4				
5				

$$\text{rows} = 6$$

$$\text{cols} = 5$$

$\leq \text{threshold}$

$(i+0, i+0)$

off = 1

$$\min(w, h)$$

$$w = 5 - i = 5 - 2 = 3$$

$$h = 6 - i = 6 - 2 = 4$$

$$\min(w, h) = 3$$

Offset = 0

$$\text{Side} = 0 + 1 = 1$$

best Sq. Side = 0;

```
for(i = 0; i < m; i++) {
    for(j = 0; j < n; j++) {
        // (i, j)
    }
}
```

$(i, j)$

$O(m * n * \min(m, n) * m * n)$

$O(m^2 n^2 * \min(m, n))$

T.L.E.

```
for( int K = 0; K < min(rows-i, cols-j); K++) {
```

$i_2 = i + K$  ; loop diag. cell.  
 $c_2 = j + K$  ;

```
val = findSum(i, j, i_2, c_2);
```

```
if(val <= threshold) {  

    bestSide = K+1;  

} else {  

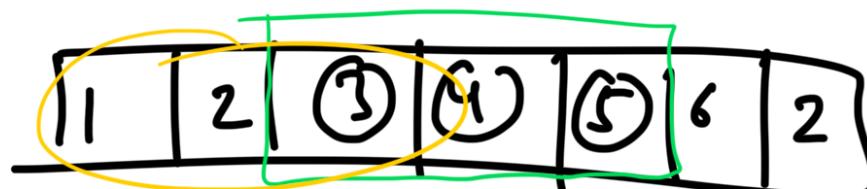
    break;  

}
```

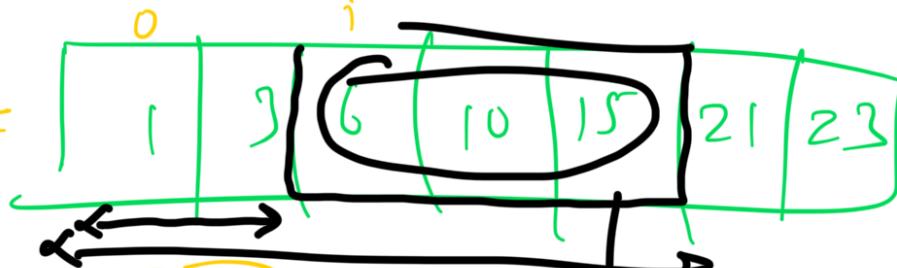
Optimally finding

elements sum of  
a sub-matrix

1-D  $\rightarrow$



Prefix =



Prefix[i]

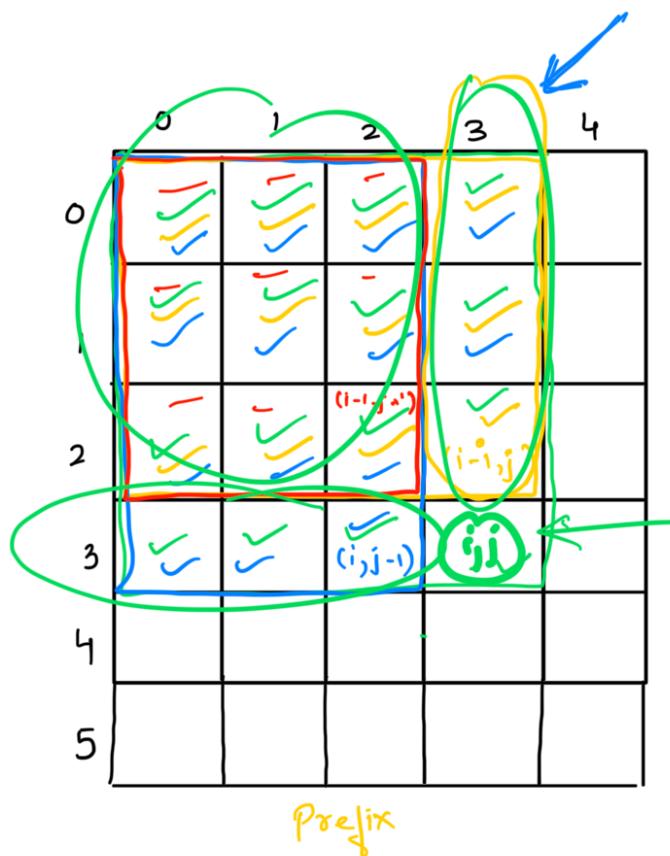
$$15 - 3 = 12$$

1D Array  $\rightarrow$  Sub-array  $\rightarrow O(1)$

2D Array  $\rightarrow$  Sub-matrix  $= O(1)$ .  $\leftarrow$

mat

prefix



$$\text{Prefix}[i][j] =$$

$$\text{Prefix}[i-1][j] =$$

$$\text{Prefix}[i][j-1] =$$

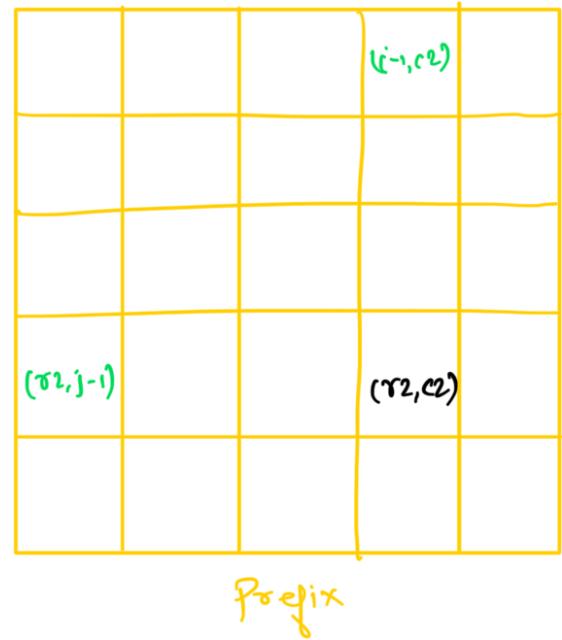
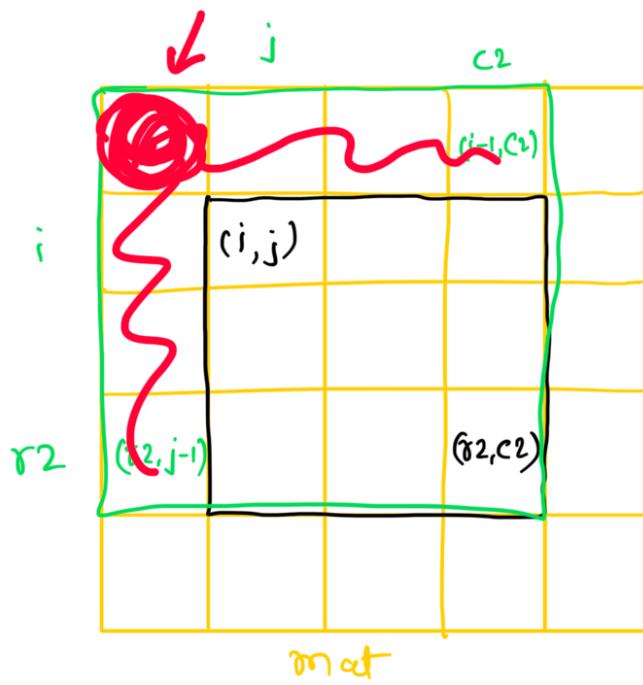
$$\text{Prefix}[i-1][j-1] =$$

$\text{Prefix}[0][0] =$  total sum of elements of mat from top-left to  $(0,0)$

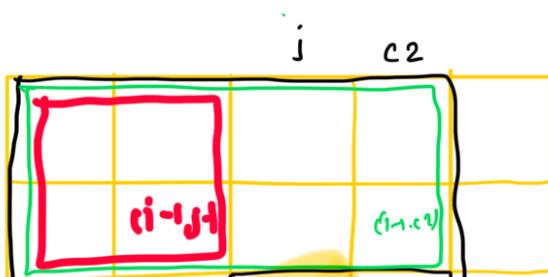
$\text{Prefix}[0][1] =$  total sum of elements of mat from top-left to  $(0,1)$

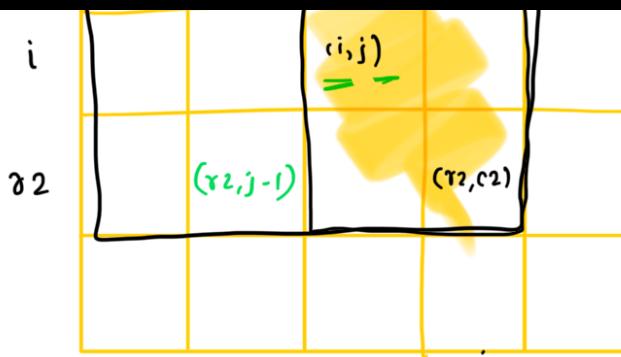
$\text{Prefix}[i][j]$  = total sum of elements of mat from top-left to  $(i, j)$   
 $(0,0)$

$$\text{Prefix}[i][j] = \text{Prefix}[i-1][j] + \text{Prefix}[i][j-1] \\ - \text{Prefix}[i-1][j-1] + \text{mat}[i][j];$$

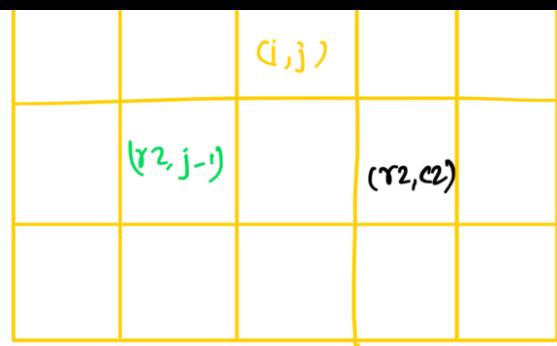


$$\text{Prefix}[r2][c2] \\ - \text{prefix}[i-1][c2] \\ - \text{prefix}[r2][j-1]$$

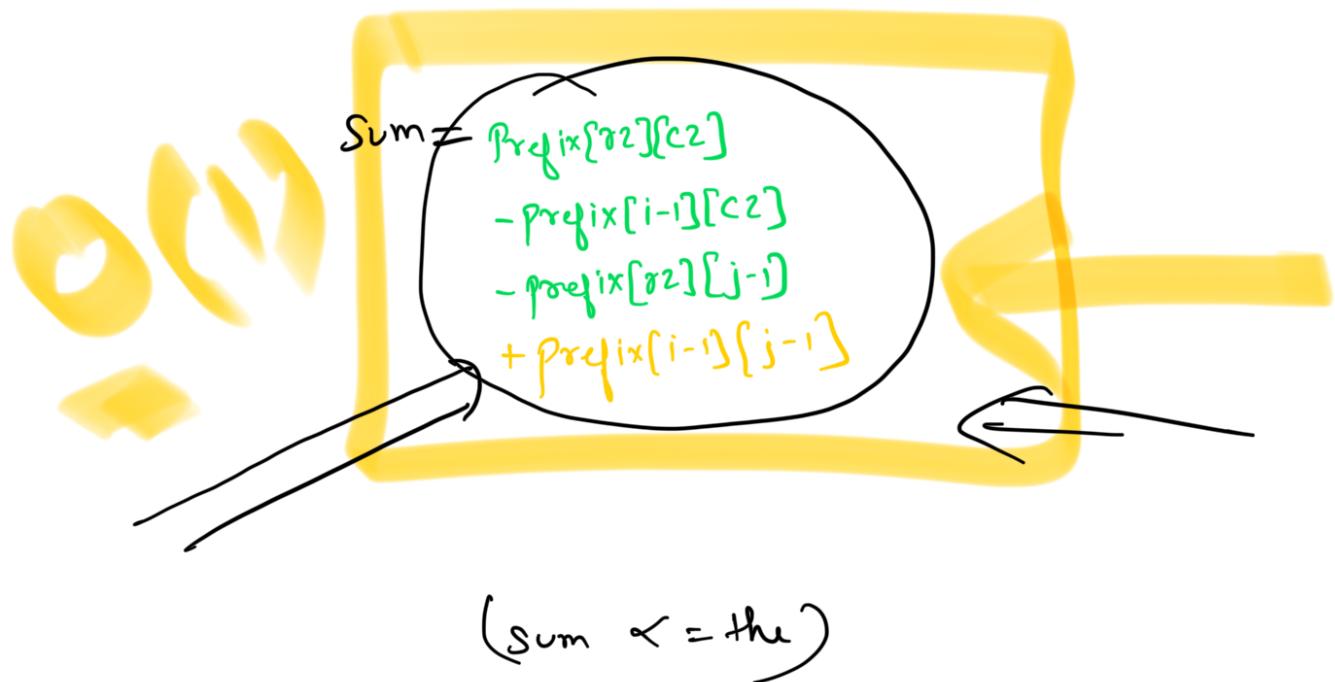




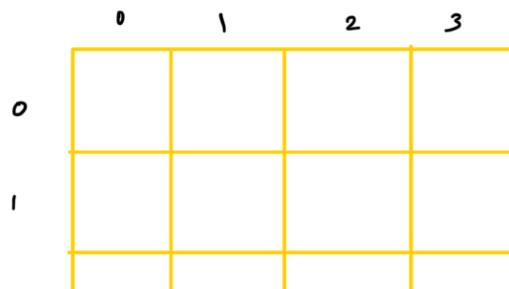
mat



Prefix



## Approach - 2



rows = 5  
cols = 4

side = 4


②  $\rightarrow r_2:i + \text{side} - 1 \quad r = 2 \quad (0,0)$

$c_2:j + \text{side} - 1$

$0 + 4 - 1 = 3$

$0 + 4 - 1 = 3$

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$(i, j, r_2, c_2)$

Binary Search on side:

$\text{low} = 1, \quad \text{high} = \min(\text{row}, \text{col})$

$\text{while}(l \leq h) \{$

$\quad \text{mid} = l + (h-l)/2;$

$\quad \text{if} (\text{check}(\text{mid}))$

$\quad \quad \text{resul} = \text{mid};$

$\quad \quad \text{low} = \text{mid} + 1;$

$\quad \quad \text{else} \quad \text{high} = \text{mid} - 1;$

$l <= h$

}

return result;

## Constraints:

- $m == \text{mat.length}$
- $n == \text{mat[i].length}$
- $1 \leq m, n \leq 300$
- $0 \leq \text{mat}[i][j] \leq 10^4$
- $0 \leq \text{threshold} \leq 10^5$