

Binary Search a 2D Matrix

Corresponding row

| | | | |
|----|----|----|----|
| 1 | 3 | 5 | 7 |
| 10 | 11 | 16 | 20 |
| 23 | 30 | 34 | 60 |

row = 3, col = 4

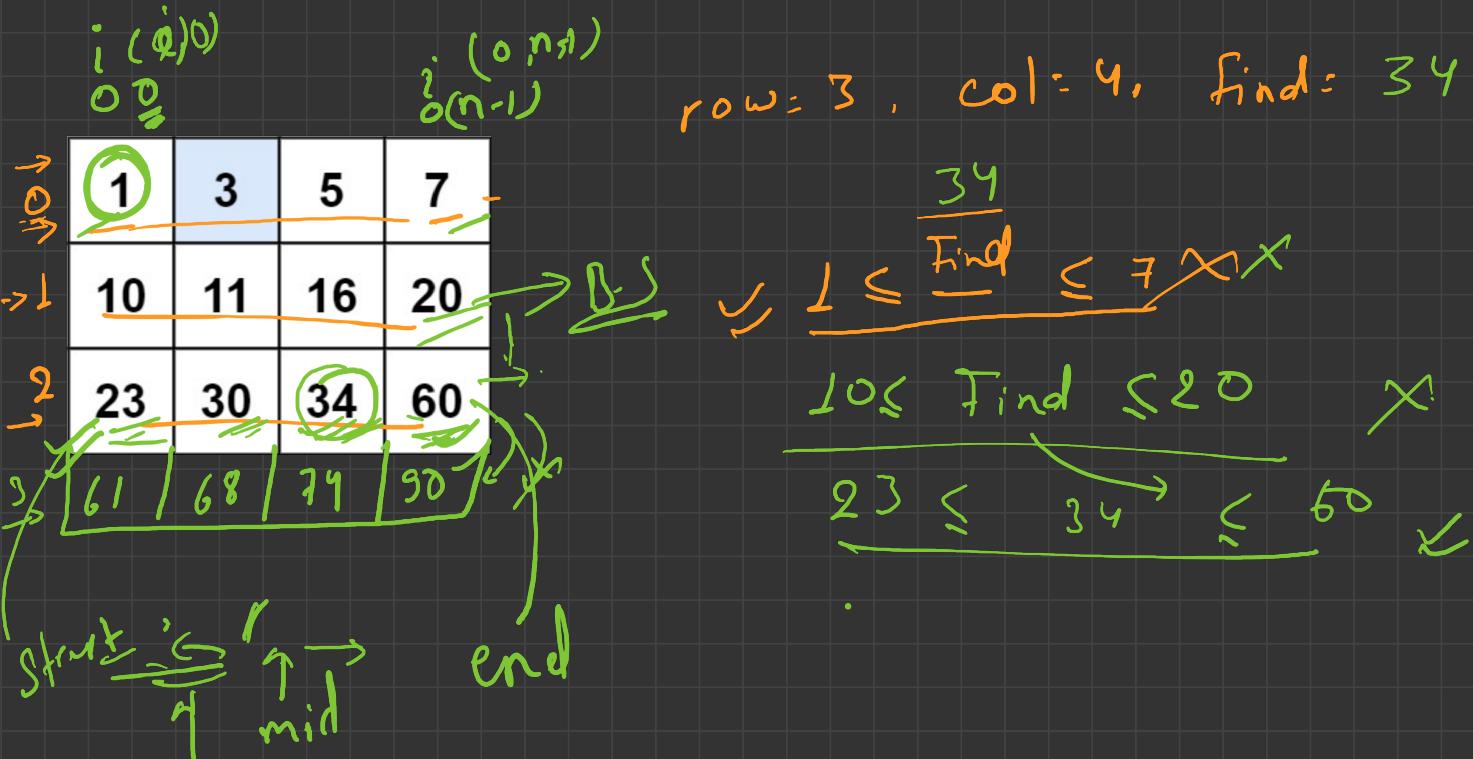
Find = 16

Brute force

```
- for(i=0; i<row; i++) {  
    - for(j=0; j<col; j++) {  
        if(matrix[i][j] == find)  
            } } return 1  
        } } return 0
```

matrix

T.C. = $O(n^2)$
S.C. = $O(1)$



```
for (i=0 ; i < row; i++) {  
    if (matrix[i][0] <= find &&  
        matrix[i][n-1] >= find) {
```

row - 2

{

start = 0 , end = col - 1

while(start < end) {

mid = $\frac{\text{start} + \text{end}}{2}$;

if (matrix[i][mid] == find)

return 1;

else if (matrix[i][mid] < find)
 start = mid + 1;

else

end = mid - 1;

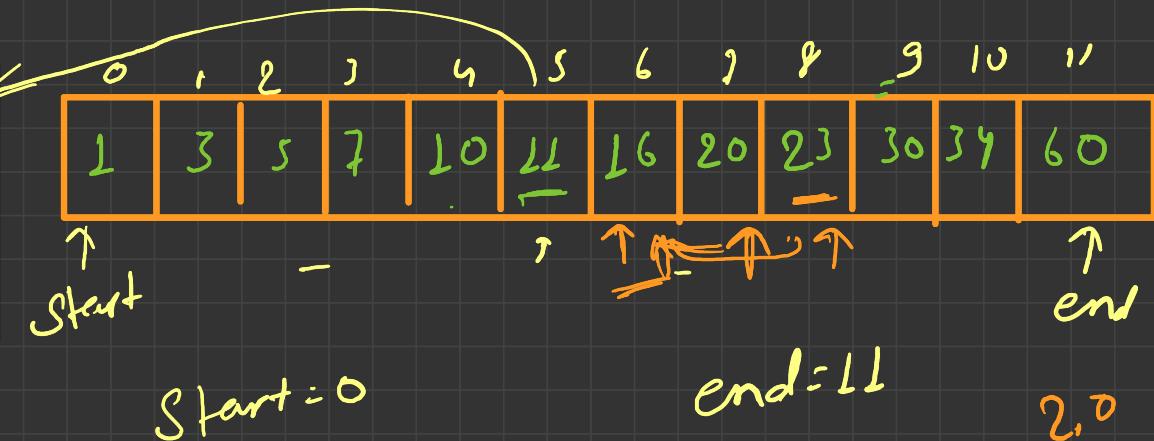
T.C =

$O(\text{row} + \log(\text{col}))$

S.C = $O(1)$
return 0;

$$r=3, c=4, F=16$$

| | | | |
|----|----|----|----|
| 1 | 3 | 5 | 7 |
| 10 | 11 | 16 | 20 |
| 23 | 30 | 34 | 60 |



$$\text{row index} = \frac{\text{Index}}{\text{col}}$$

$$\text{col index} = \text{Index} \% \text{ col}$$

$$\text{mid} = \frac{LL + 0}{2} = 5$$

$$r \cdot I = \frac{5}{4} = 1$$

$$5 \% 4 = 1$$

$$2, 0$$

$$\frac{8}{4} = 2$$

$$8 \% 4 = 0$$

start = 0 end = row * (col - 1) find = 16
 while (start < end) {
 mid = $\frac{(start + end)}{2}$;
 (r-i) row-index = mid / col;
 (c-i) col-index = mid % col;
 if (matrix[r-i][c-i] == find) {
 return 1;
 } else if (matrix[r-i][c-i] < find) {
 start = mid + 1;
 } else {
 end = mid - 1;
 }
 }
 return 0;

T.C ($\log (row \cdot col)$)
 S.C ($O(1)$)

Search in a sorted Matrix

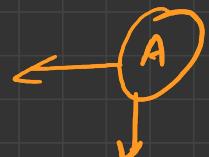
$x < 16$

| | | | | |
|----|----|----|----|----|
| 1 | 4 | 7 | 11 | 15 |
| 2 | 5 | 8 | 12 | 19 |
| 3 | 6 | 9 | 16 | 22 |
| 10 | 13 | 14 | 17 | 24 |
| 18 | 21 | 23 | 26 | 30 |

$i=2$ $j=2$ $j++$
 ~~$i=3$~~ $j=3$

$row = 5$

$col = 5$



(16)

$x = 16$

if ($A == x$)
 return 2
else if ($A < x$)
 $i++$
else ($A > x$)
 $j--$

i, j
 \uparrow
 $row \leftarrow col$
 $i = 0, j = n - 1$

$i = 0, j = \text{col} - 1$

$\text{row} = 5$

$\text{col} = 5$

$x = 16$

while ($i < \text{row}$ && $j \geq 0$) {

 if ($\text{matrix}[i][j] == x$) {

 return 1

 else if ($\text{matrix}[i][j] < x$)

$i++$

 else

$j++$

}

return 0;

 if ($A == x$)
 return 1

 else if ($A < x$)

$i++$

 else
 $j--$

