Search 2D Matrix

↳ Row-wise sorted from left to right
↳ first integer of each row > last integer of the previous row

$$m = 3, \quad n = 4$$

$m \to$ # rows

$n \to$ # columns

2D Matrix →

$$
\begin{array}{c}
\quad\quad 0 \quad\ 1 \quad\ 2 \quad\ 3 \\
\begin{array}{c} 0 \\ 1 \\ 2 \end{array}
\left[
\begin{array}{cccc}
1 & 3 & 5 & 7 \\
10 & 11 & 16 & 20 \\
23 & 30 & 34 & 60
\end{array}
\right]_{3 \times 4}
\end{array}
$$

target = 60

$$Left = 0$$

$$right = m \times n - 1$$

$$= 3 \times 4 - 1$$

$$= 11$$

target = 3
↳ true

target = 22
↳ false

Brute force Approach →

$$\underline{O(m * n)}$$ — m

for i=0 to m-1:   — n times

       for j=0 to n-1:

           if arr(i)(j) == target:

             return True

return false

$$mid = (0 + 1)/2 = 0$$

Row-major form → **Virtual array**

0	1	2	3	4	5	6	7	8	9	10	11
1	3	5	7	10	11	16	20	23	30	34	60

↑ mid $n = 4$

$target = 3$ (Binary search) $O(\log mn)$

$(0+4)//2 = 2$

$row = 2 // 4 = 0$

$Col = 2 \% 4 = 2$ $mid = 0 + (11-0)//2 = 5$

$row \leftarrow 5 // 4 = 1$

$column \leftarrow 5 \% 4 = 1$

$\begin{cases} left = 0 \\ right = mid - 1 \end{cases}$