

$$\begin{bmatrix} 1 & 3 & 5 \\ 2 & 6 & 9 \\ 3 & 6 & 9 \end{bmatrix} \quad m=3 \quad n=3$$

V=9
Median = $9/2 = 4.5 = 5^{\text{th}}$ element

How?
 0 1 2 3 4 5 6 7 8
 1 2 3 3 5 6 6 9 9

↳ Median

» Let's check for each Number, How many Numbers are less than or equal to current number?

arr: 1 2 3 3 5 6 6 9 9
 1 2 3 4 5 6 7 8 9

with No duplicated

arr: 1 2 3 5 6 9
 1 2 4 5 7 9

of
number

\leq

from 1 - 9

1 2 3 4 5 6 7 8 9
 1 2 4 4 5 7 7 7 9

» From this, we get an important relation.

Median is the 5th element

of numbers says how many elements are less than or equal to current number

∴ If we find the first occurrence of 5th Number, we found median

so first numbers whose count is greater than $[5-1] = 4$ is our Median.

Counting how many numbers are \leq cur Number

1	3	5
2	6	9
3	6	9

Eq. Count how many no are less than
Equal to 7

We go row by row & perform binary search to find
first occurrence of 7 in that row

$$i=0 [1 \ 3 \ 5] = 3$$

$$i=1 [2 \ 6 \ 9] = 2$$

$$i=3 [3 \ 6 \ 9] = 2 \longrightarrow [3 \ \textcircled{6} \ 9]$$

6 > 7? \rightarrow NO

Similarly for $[1 \ \textcircled{3} \ 5]$

mid



$$[1 \ 3 \ \textcircled{5}]$$



$$[1 \ 3 \ 5]$$

l

$$[3 \ 6 \ \textcircled{9}]$$



9 > 7 \rightarrow Yes

$$[3 \ 6 \ 9]$$



l=2 \rightarrow that is the
no of element less
than 7

l=3 \rightarrow return 3

$$\left[\begin{array}{cccccc} 1 & 5 & 7 & 9 & 11 \\ 2 & 3 & 4 & 5 & 10 \\ 9 & 10 & 12 & 14 & 16 \end{array} \right] \quad m=3 \quad n=5$$

$$V = m * n = 15$$

Median = 8th number

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

↓

$$\left[\begin{array}{ccccccccc} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 1 & 2 & 3 & 4 & 5 & 5 & 7 & 9 & 9 \end{array} \begin{array}{ccccccccc} 9 & 10 & 10 & 11 & 12 & 13 & 14 \\ 9 & 10 & 10 & 11 & 12 & 14 & 16 \end{array} \right]$$

median = 9

Left = 1 right = 16

mid = 8

how many number $\leq 8 \rightarrow 7$

threshold or median = 8

so there are 7 numbers with us, we need 8, so move right

Left = 9, Right = 16

mid = 12

how many $\leq 12 \rightarrow 13$

we may find 8th number to the left

Left = 9, Right = 11

mid = 10

how many $\leq 10 \rightarrow 11$, move left

Left = 9, Right = 9

mid = 9

how many $\leq 9 \rightarrow 9$, move left

Now right < left \rightarrow that means we have found our Median \rightarrow ie 9.

How?

* There are 9 numbers which is greater than or equal to 9

* There are 7 numbers which is greater than or equal to 8

$\gg 1 \ 2 \ 3 \ 4 \ 5 \ 5 \ 7 \rightarrow$ These are Numbers ≤ 8

Our Median is 8th element but there are Only 7 Available

\gg But with 9

1 2 3 4 5 5 7 9 9 \rightarrow There are 9 numbers & we for sure know that 9 has repeated twice.

How \rightarrow Count of numbers Until 8 was 7, 8 at 9 it became 9, meaning 9 got repeated twice