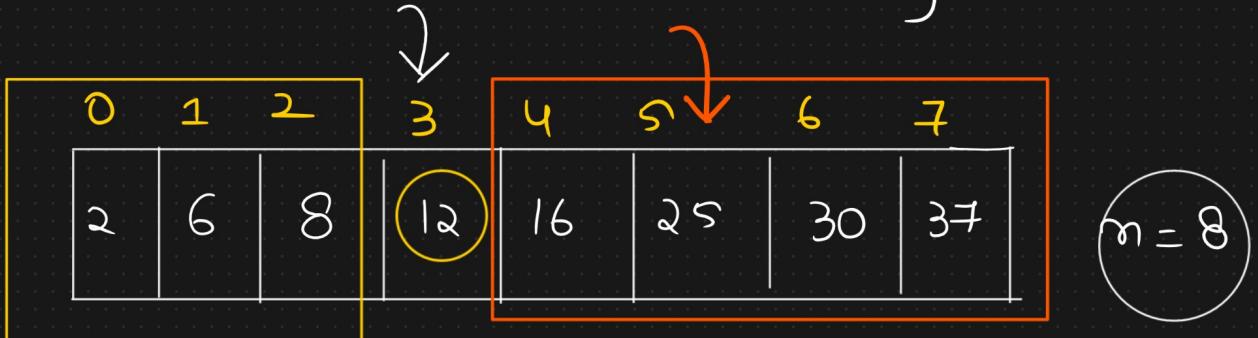


Binary Search

→ Sorted array



$$x = 25$$

$$\underline{\text{low} = 0, \text{high} = 7}$$

$$\text{mid} = \text{low} + (\text{high} - \text{low}) / 2 - ①$$

$$= \underline{(\text{low} + \text{high}) / 2} - ②$$

$$\underline{\text{mid} = 3}$$

while ($\text{low} < \text{high}$) α

$$\text{mid} = \text{low} + (\text{high} - \text{low}) / 2;$$

if ($\text{arr}(\text{mid}) == x$) α

①

return mid ; 5

12 < 25

if ($\text{arr}(\text{mid}) < x$) α

②

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

③

if($\text{arr}(\text{mid}) \geq x$)

high = mid - 1;

low = 4, high = 7

mid = 5

Sqrt(x)

→ $x = 16$

→ result = 4

Binary Search

if ($x < 2$)

return x ;

$$\begin{array}{c|c}
 x=0 & x=1 \\
 \downarrow & \downarrow \\
 0 & 1
 \end{array}
 \quad
 \textcircled{x=16}
 \quad
 \frac{x/2}{\underline{\underline{\quad}}}$$

$$\underline{\underline{\quad}}
 \quad
 \underline{\underline{\text{high} = x/2 = 16/2 = 8}}$$

2	3	4	5	6	7	8	

$$\underline{\underline{\text{mid} = 5}}$$

$$\begin{aligned}
 \text{num} &= \text{mid} * \text{mid} \\
 &= 5 * 5 = 25
 \end{aligned}$$

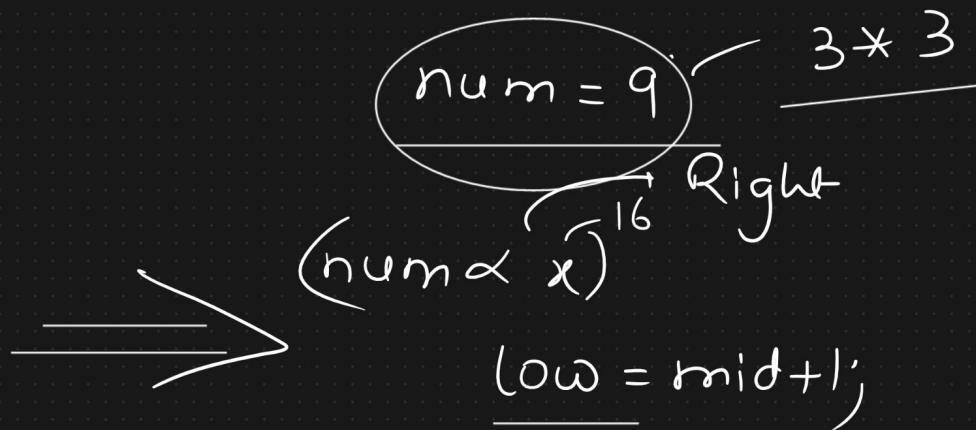
if $(\text{num} < x)$ → right side
 $\underline{\underline{\text{low} = \text{mid} + 1}}$

if $(\underline{\underline{\text{num}}} > \underline{\underline{x}})$ → left side
 $\underline{\underline{\text{high} = \text{mid} - 1}}$

if ($\text{num} == x$)
 $\quad \quad \quad \text{return mid;}$

$\text{low} = 2$, $\text{high} = 4$

$\text{mid} = 3$



$\text{low} = 3$, $\text{high} = 4$

$\text{mid} = 3$

$\text{num} = 9 < x$

$\text{low} = 4$ $\text{high} = 4$

$\text{mid} = 4$

$\text{num} = 16 = x$



$$x = 8$$

low / high

$$\text{low} = 2$$

$$\text{high} = 8 / 2 = 4$$

$$\text{mid} = 3$$

2		3		4
---	--	---	--	---

↑

$$\text{mid}$$

$$\left\{ \begin{array}{l} \text{mid} * \text{mid} \\ x \end{array} \right.$$

$$\text{num} = 9 \geq 8$$



$$\text{low} = 2, \text{high} = 2$$

$$\text{mid} = 2$$

↙ 8

$$\text{num} = 4 < 8$$

while
 $(\text{low} \leq \text{right})$

↳ Right

$$\text{low} = 3,$$

$$\text{high} = 2$$

right

return high;

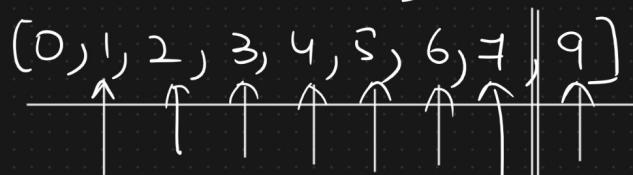
↳

Missing Number

Range $\rightarrow [0, n]$

① Approach 1

Sort the array



Missing Number $\leftarrow \frac{\text{Return}}{8}$

② Gauss' formula

$[0, n]$

Sum of
 n

$$\cancel{n=9}$$

$$\left[9, 6, 4, 2, 3, 5, 7, 0, 1 \right)$$

$$\text{actualSum} = 37$$

natural
numbers

$$\text{ExpectedSum} = \frac{n(n+1)}{2} = c$$

$$= \frac{9 \times 10}{2} = 45$$

$$\text{missingNum} = \text{ExpectedSum} - \text{actualSum}$$

$$= 45 - 37 = 8$$

3 XOR Operation

A	B	O/P
0	0	0
0	1	1
1	0	1
1	1	0

Property of XOR

$$\boxed{A \text{ XOR } 0} = A \quad \text{Operation}$$

$$n = 9$$

$$\text{arr} \leftarrow [9, 6, 4, 2, 3, 5, 7, 0, 1]$$

$$\underline{\underline{\text{missingEle}} = 9 \text{ (size of array)}}$$

$$\underline{\underline{\text{for}(i=0 \text{ to } n) \&}}$$

$$\underline{\underline{\text{missingEle}} = i \wedge \text{nums}(i) \wedge 9}$$



return missingEle

0 \wedge 9 \wedge 6 \wedge 1 \wedge 4 \wedge 2 \wedge 3 \wedge 2 \wedge 4 \wedge 3 \wedge 5 \wedge 5 \wedge 7 \wedge 6

$\overbrace{10 \wedge 7 \wedge 1 \wedge 8 \wedge 9}$

$$0 \wedge A = A$$

$$\underline{0 \wedge 8} = 8 - \underline{\text{MissingEle}}$$