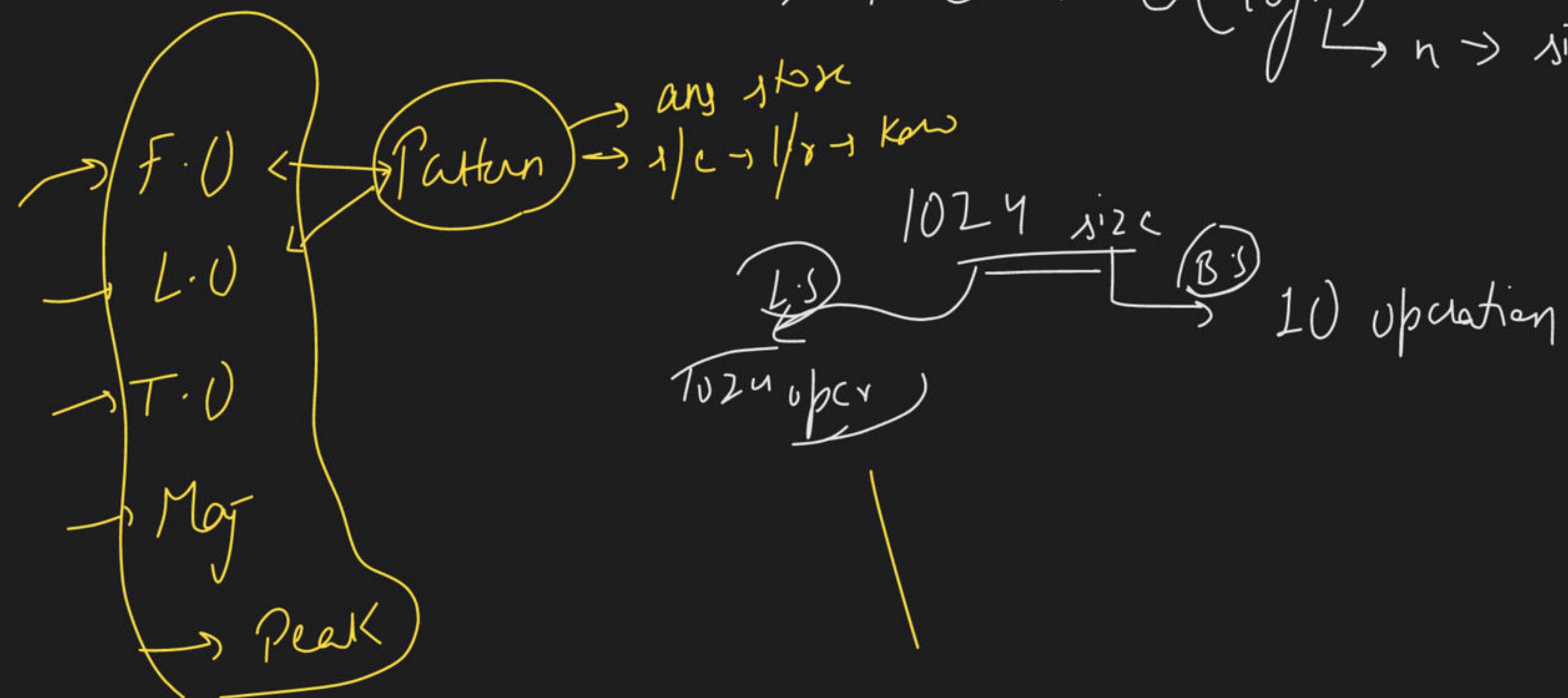


# Searching && Sorting - Level 2

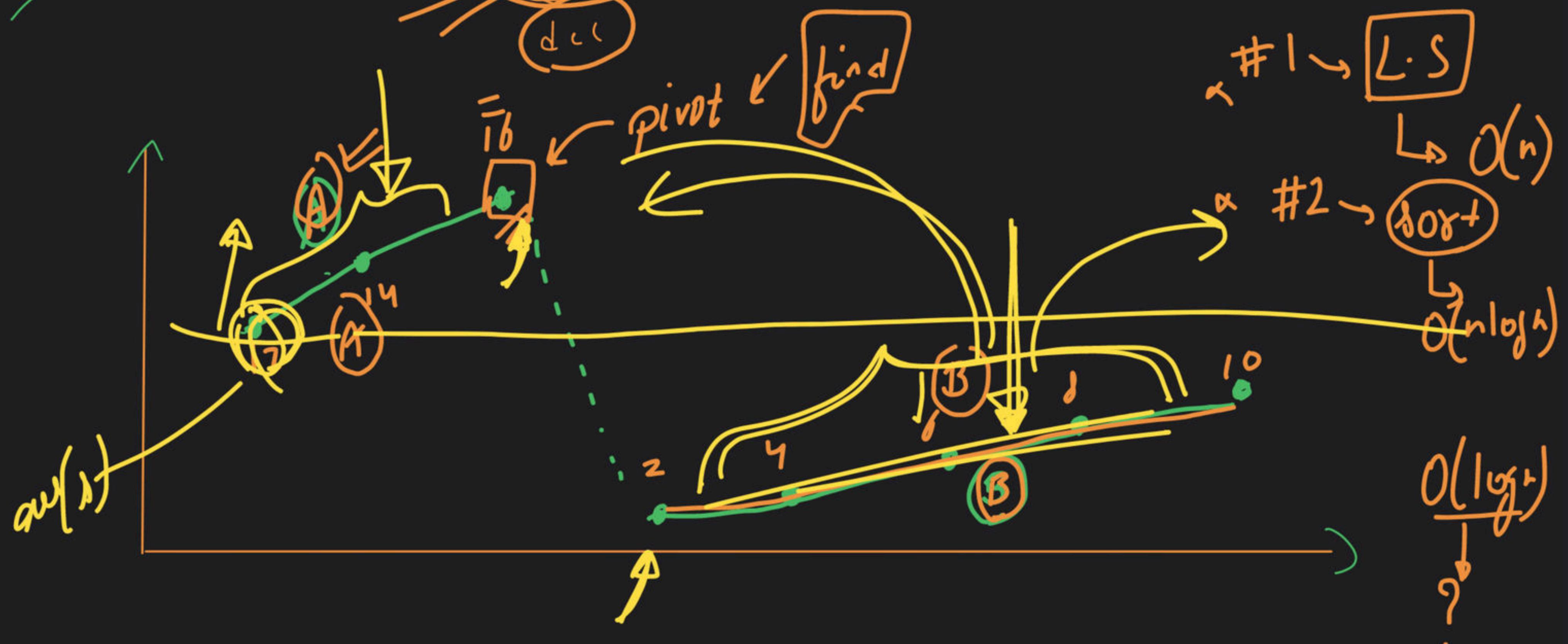
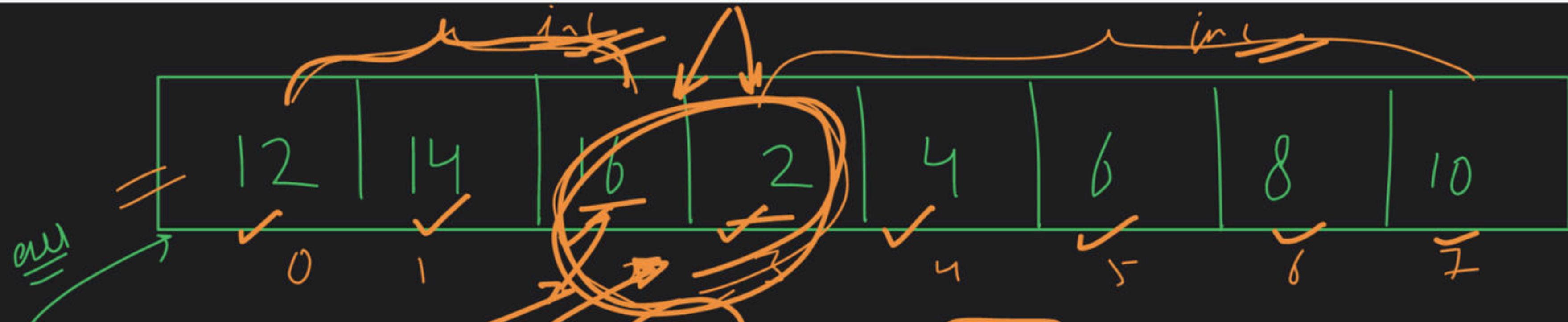
Special class

→ Binary Search  $\xrightarrow{\text{cond.}} \begin{array}{l} \text{monotonic func.} \\ \text{asc} \\ \text{desc} \end{array}$

$T.C \rightarrow O(\log n)$   $n \rightarrow \text{size of array}$







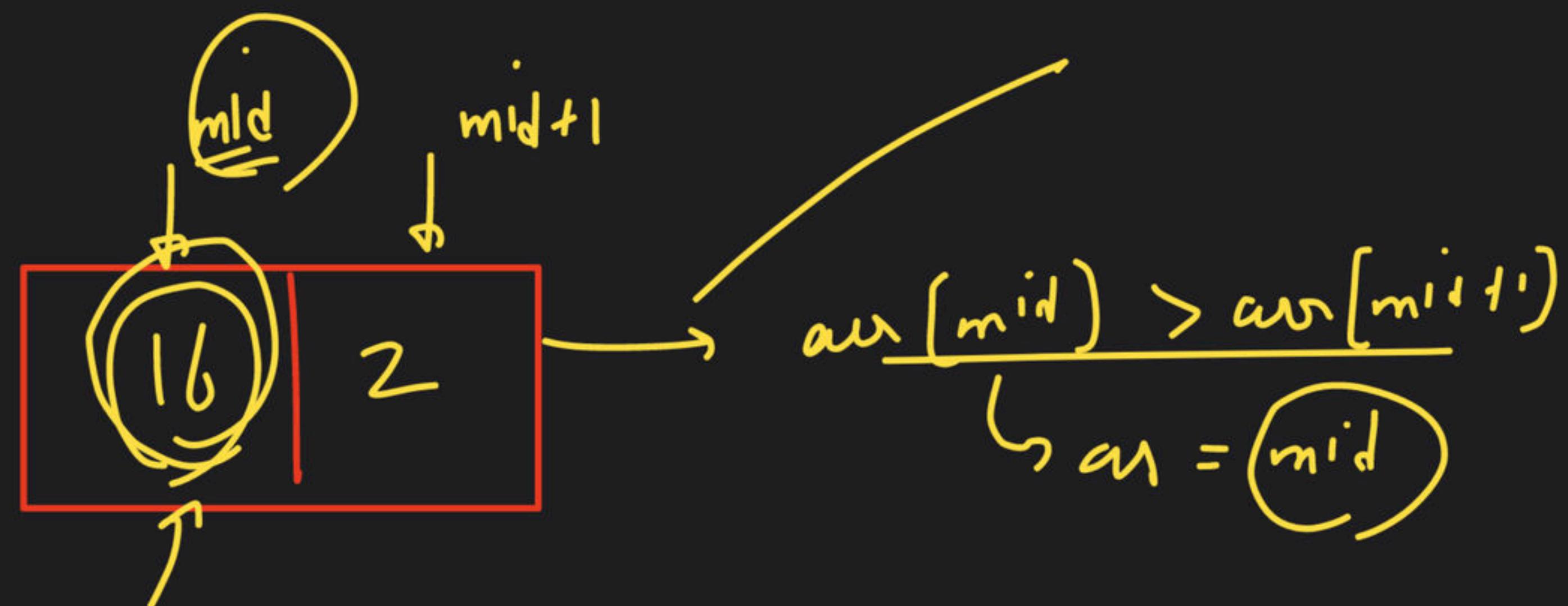
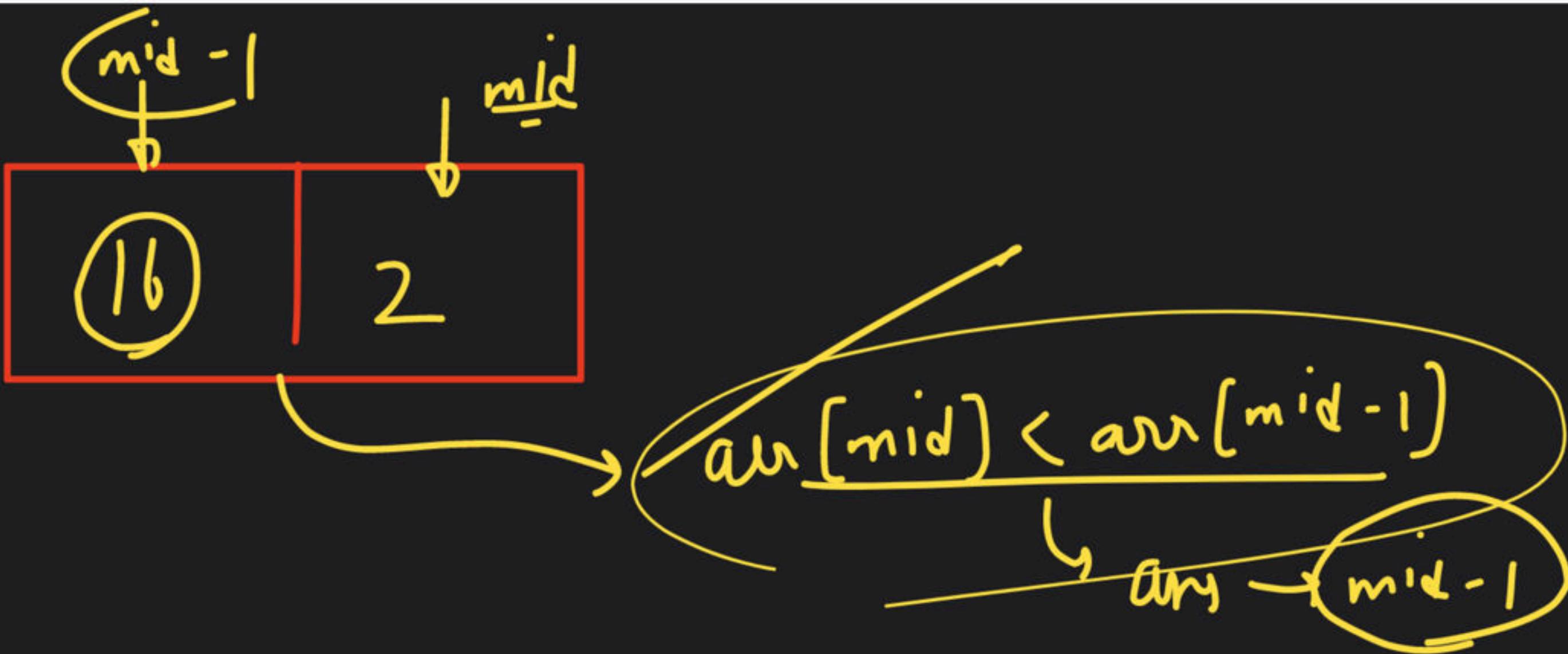


$$arr[mid] < arr[mid - 1]$$

(1)  $\Rightarrow \text{ans} = (\text{mid} - 1)$

$$\text{arr}[mid] > \text{arr}[mid + 1]$$

(2)  $\Rightarrow \text{ans} = \text{mid}$



if  $\text{arr}[s] > \text{arr}[\text{mid}] \rightarrow \textcircled{B}$

↳ left



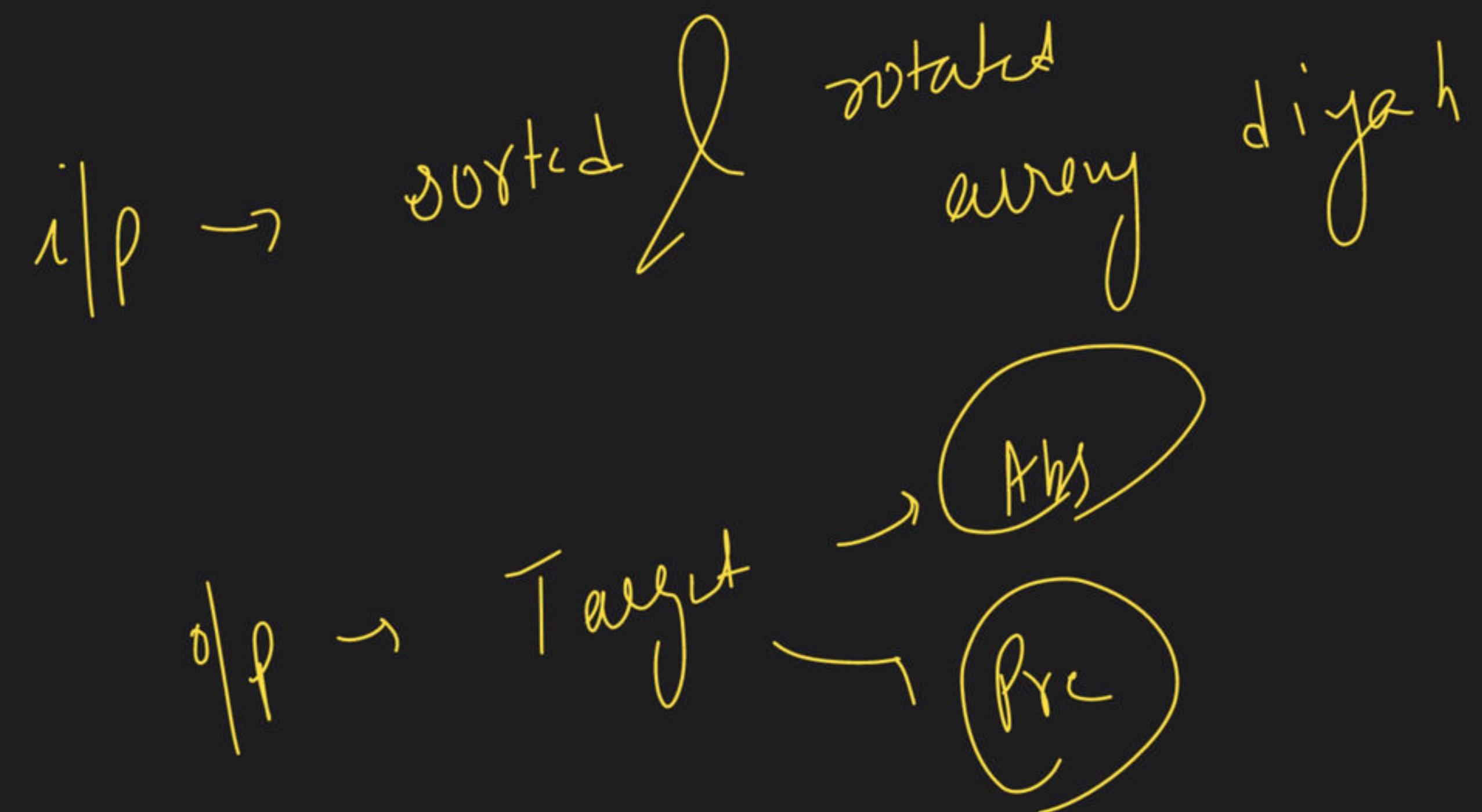
int

findPivotIndex ( arr[ ], n )

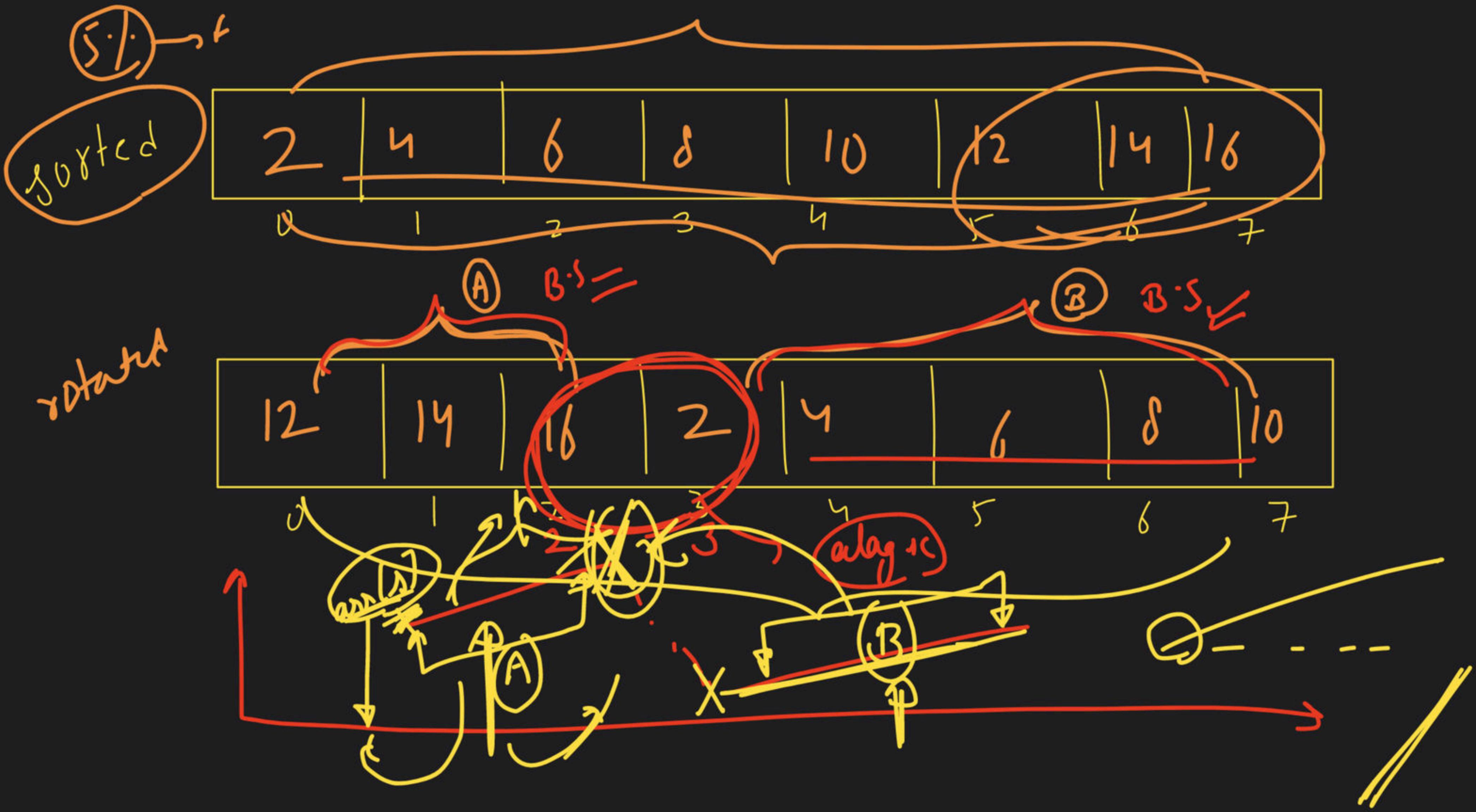
```
{ int s=0, e=n-1; int mid = (s+e)/2;  
while (s <= e) {  
    if (j == e) return s;  
    if (arr[mid] < arr[mid-1]) return mid-1;  
    else if (arr[mid] > arr[mid+1]) return mid;  
    else if (arr[s] > arr[mid]) e=mid-1;  
    else s=mid+1;  
}
```

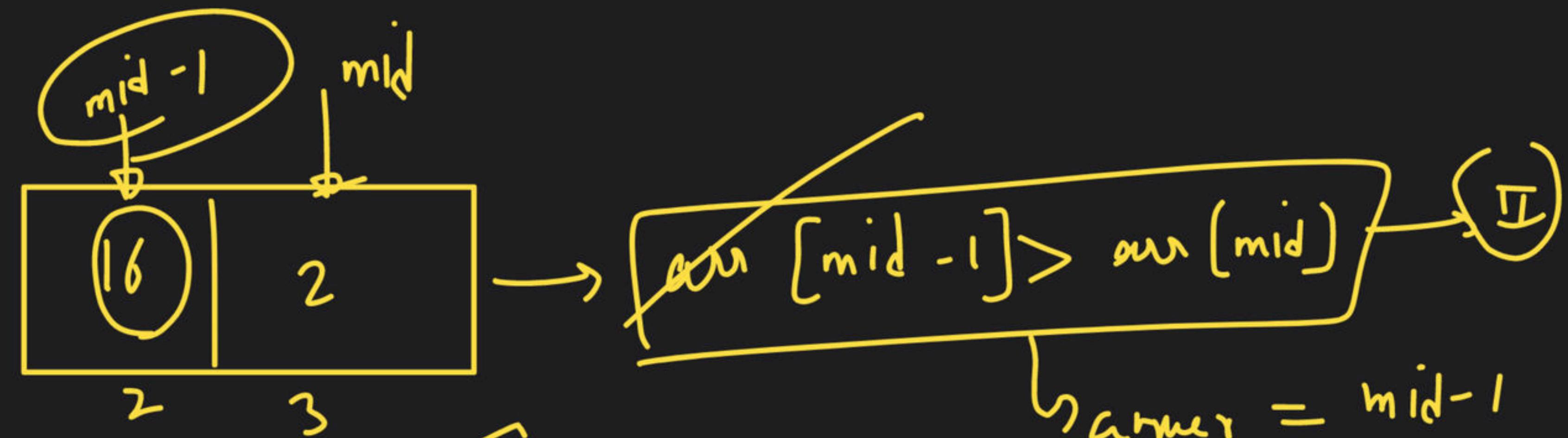
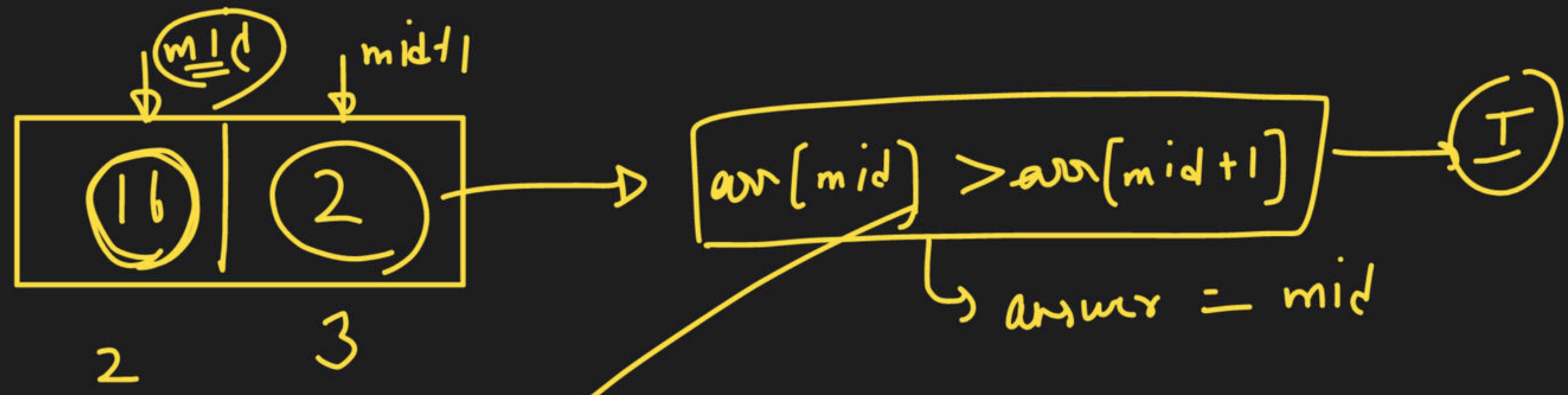


else if (arr[s] > arr[mid])  
 $e = mid - 1$ ,  
 $mid = (s + e) / 2;$   
return -1;







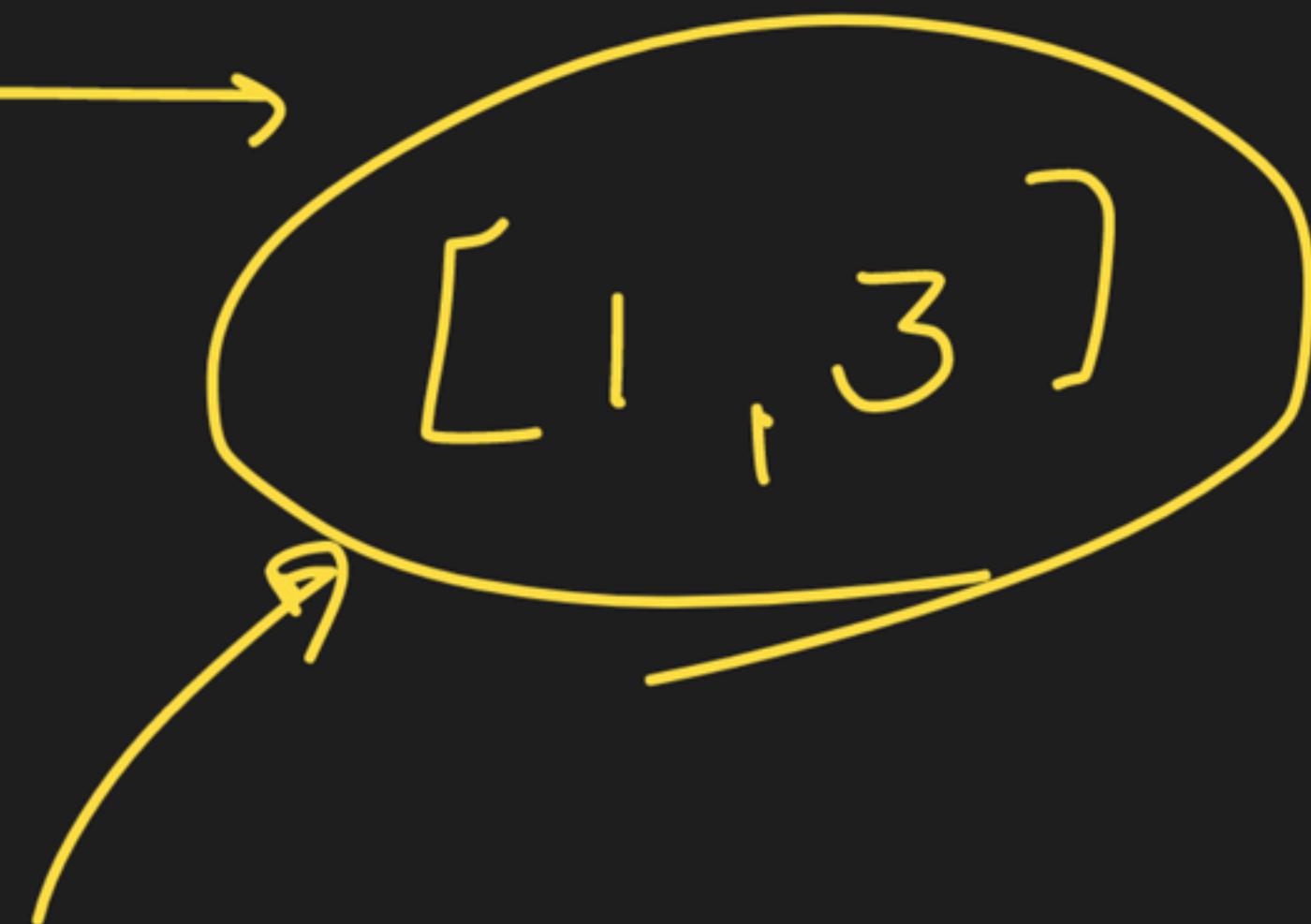


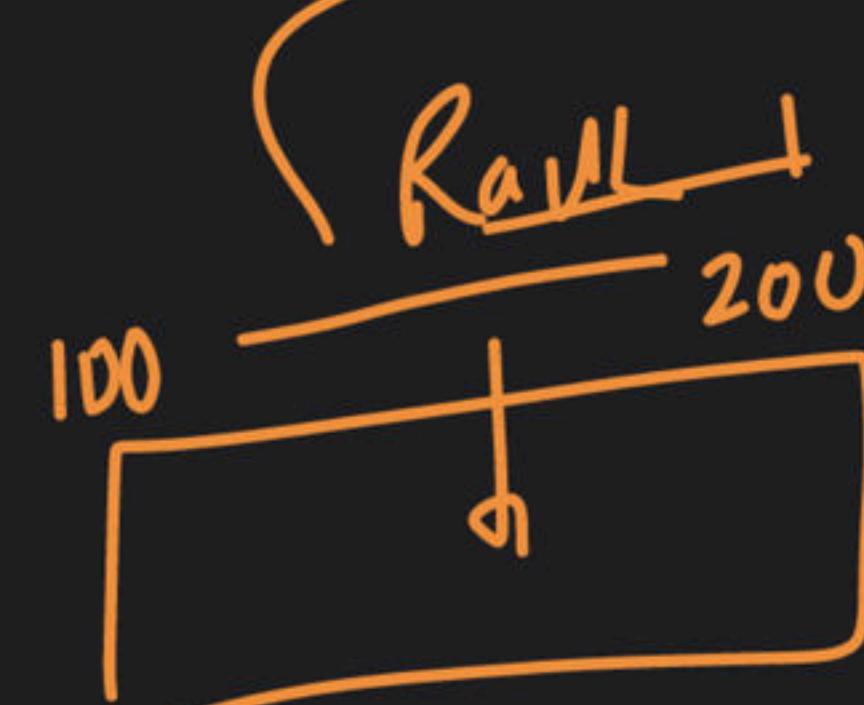
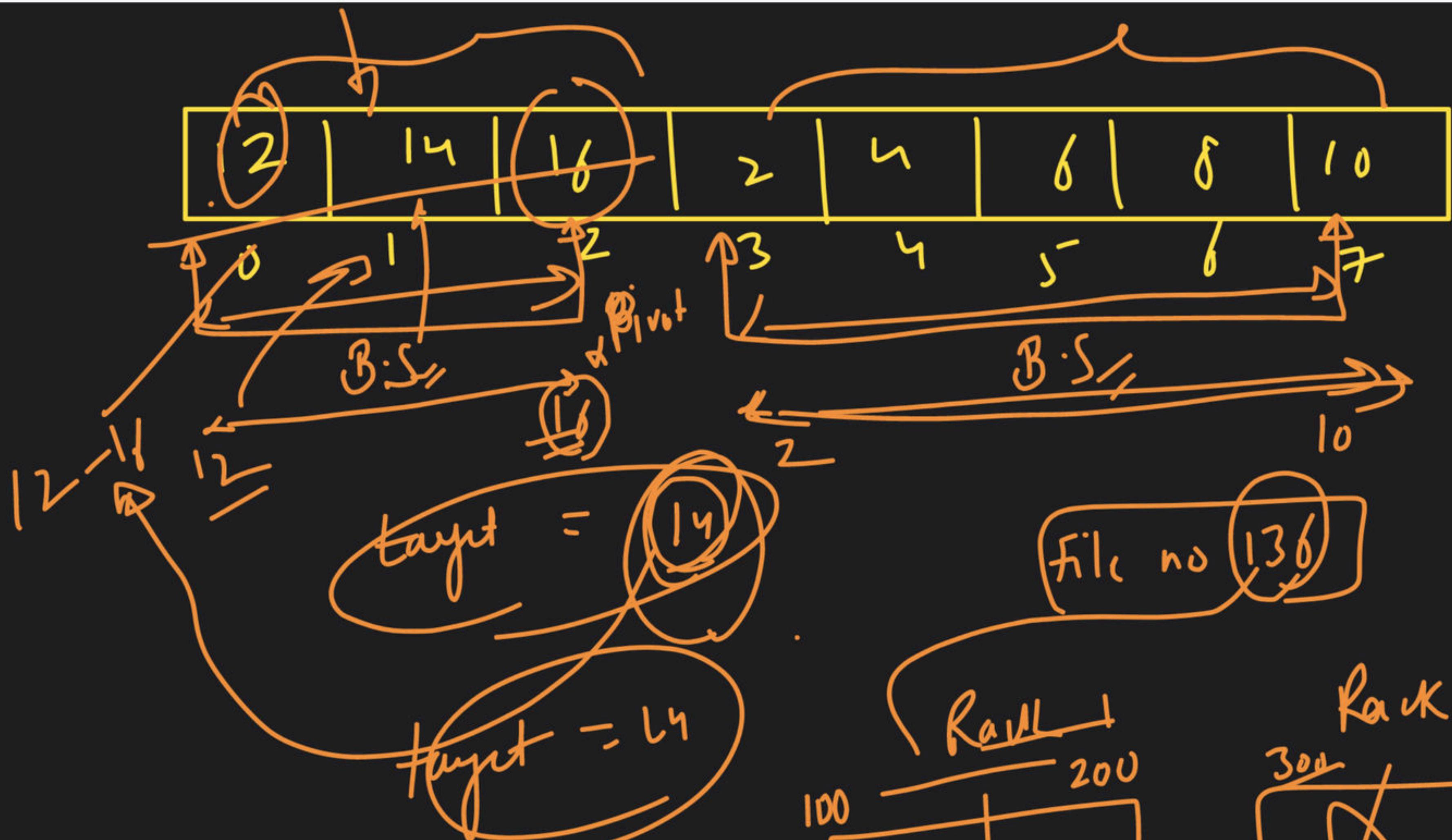
$\checkmark \text{arr}[\text{mid}] < \text{arr}[s] \rightarrow \text{B} \rightarrow \text{left}$

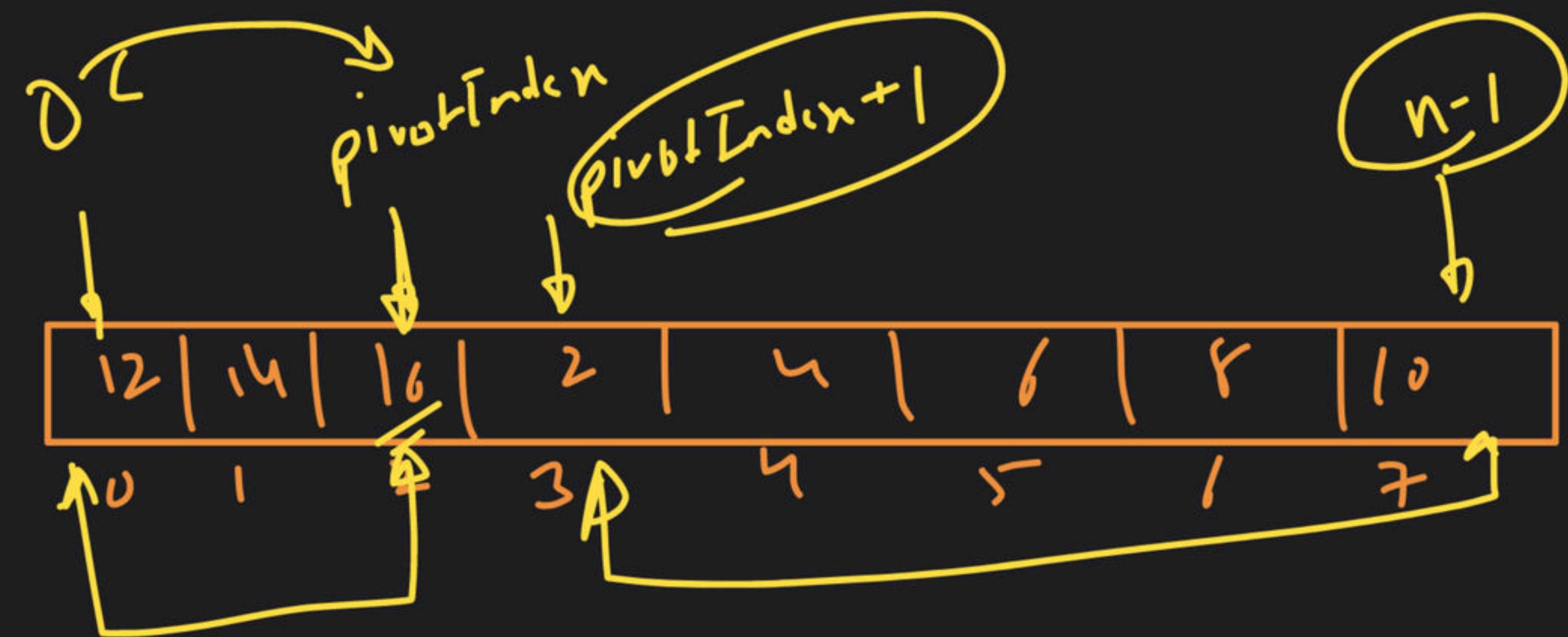
$\text{arr}[\text{mid}] > \text{arr}[\text{j}] \rightarrow (\text{A}) \rightarrow \text{right}$

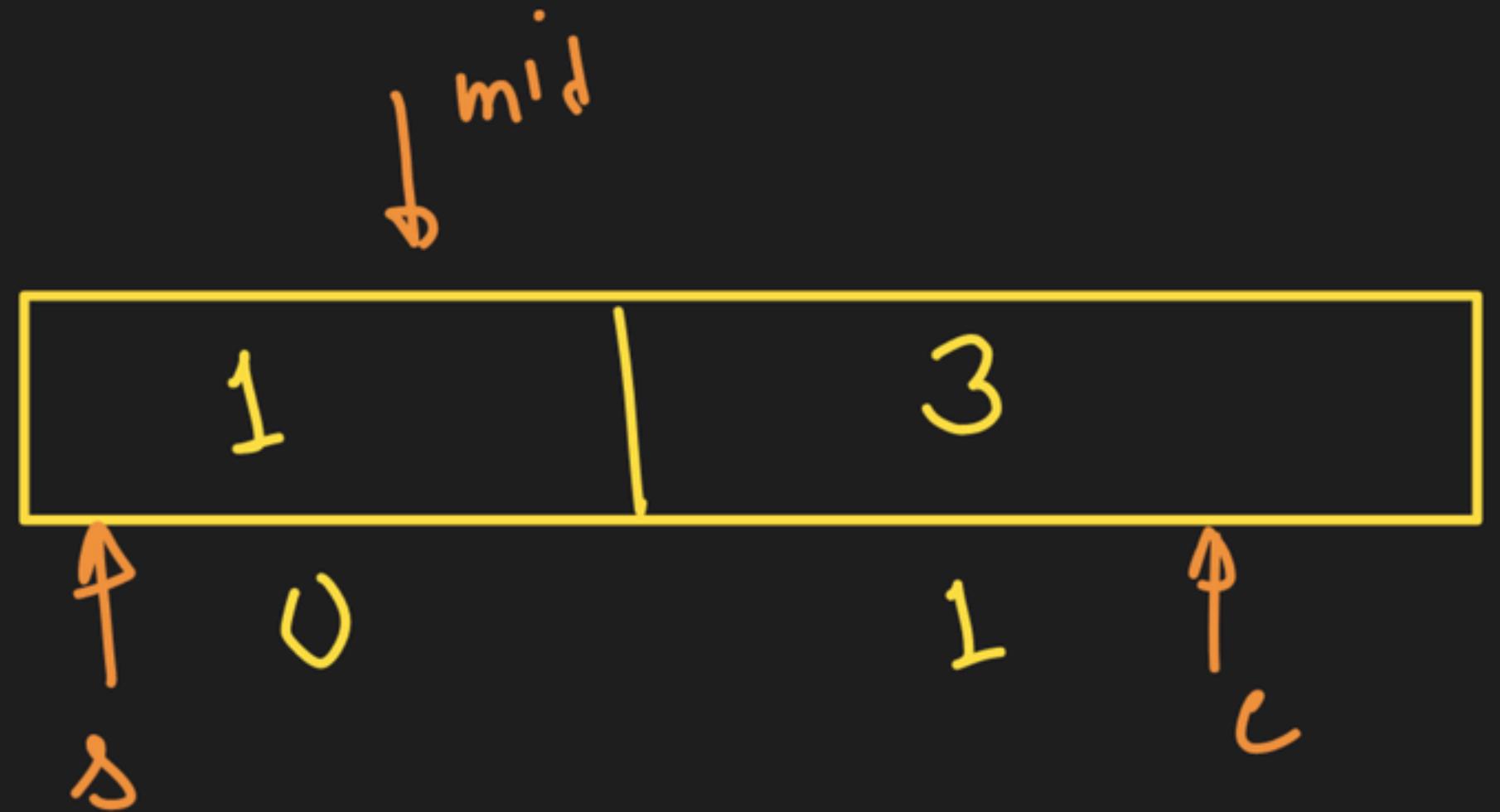
$H | W \rightarrow$

$\left( \begin{array}{l} \text{if } (\text{A} == \text{c}) \text{ return } \text{j} \\ \text{right\_elen} \end{array} \right)$



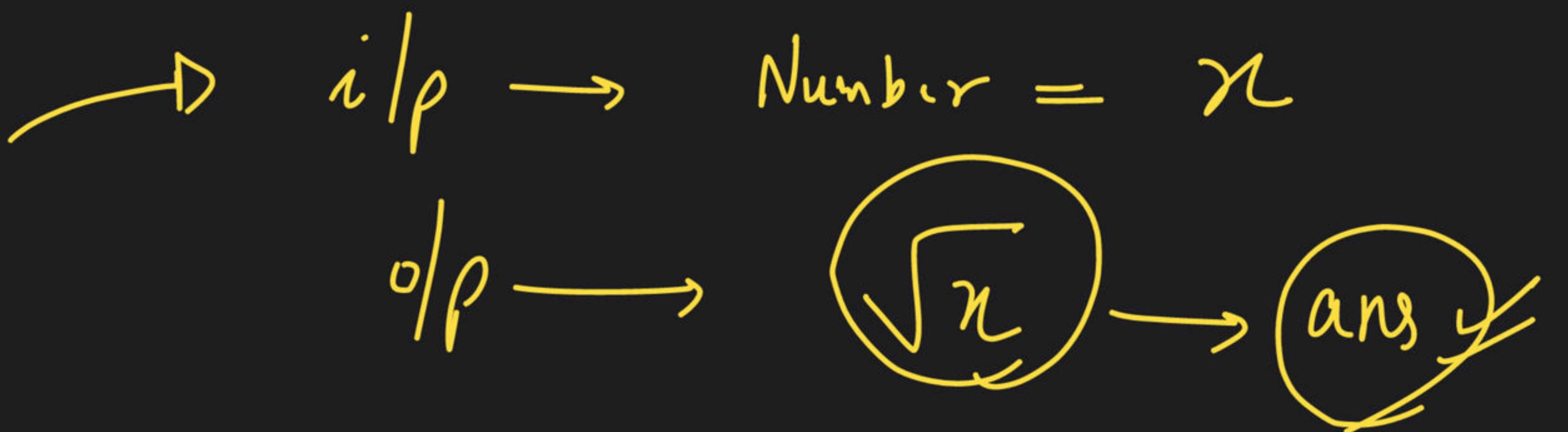




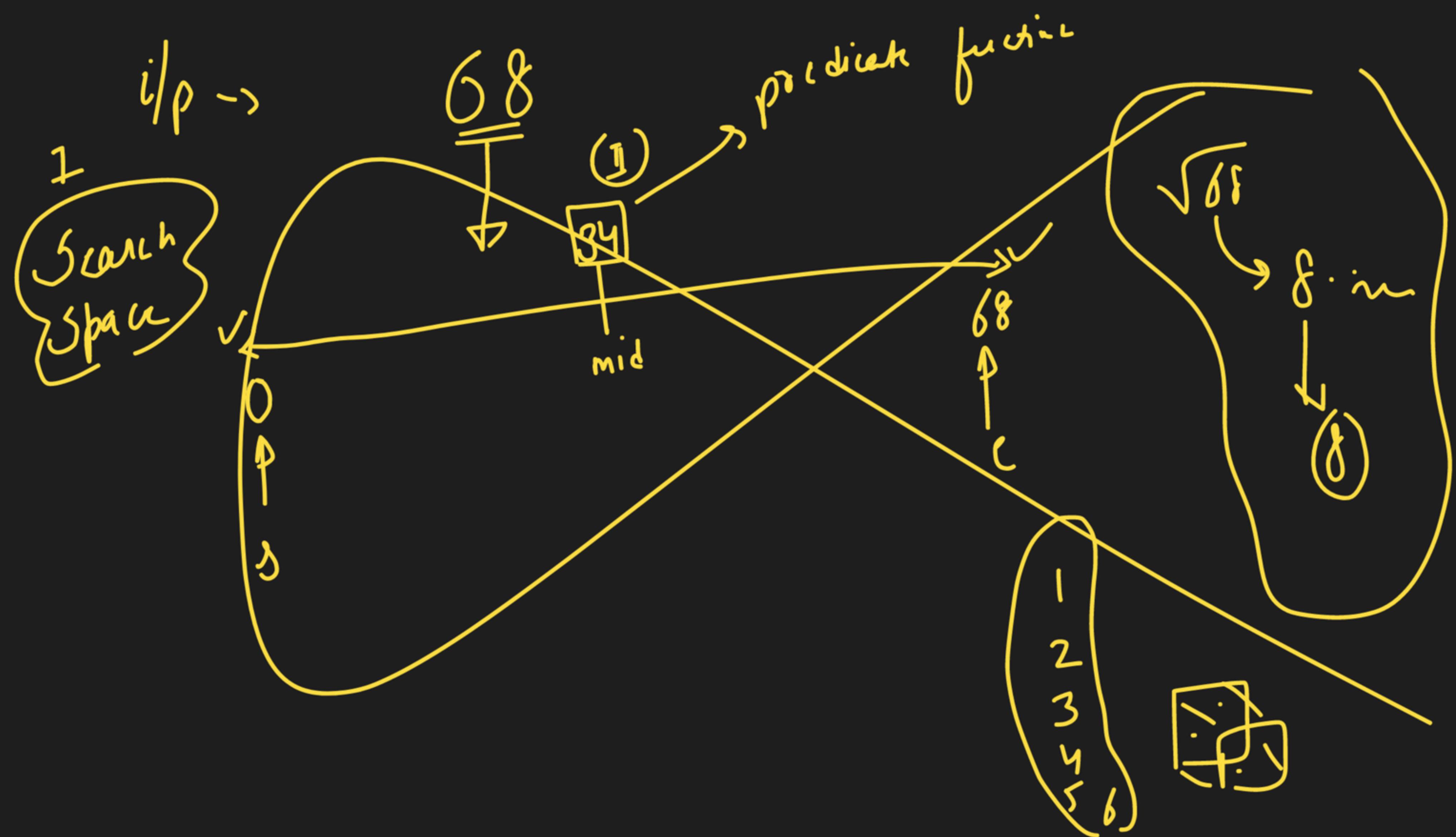


$arr[mid] > arr[mid + 1] \times$   
 $arr[mid - 1] > arr[mid]$   
 0 1  
 $[ -1 ]$   
 ↓

$\gamma_{\min}$   
Paani Break



$i/p \rightarrow 25, 36, 50$   
 $\sqrt{25} \downarrow$   
 $5$   
 $\sqrt{36} \downarrow$   
 $6$   
 $\sqrt{50} \downarrow$   
 $7\oplus$



①

$$i/p \rightarrow n$$

$$o/p \rightarrow \text{sqrt}(n) \rightarrow \sqrt{n} \rightarrow \text{ans}$$

(A) Search space

(I) predicted func

$$\boxed{n=68}$$

$$o/p \rightarrow \boxed{\sqrt{68} \rightarrow 8}$$



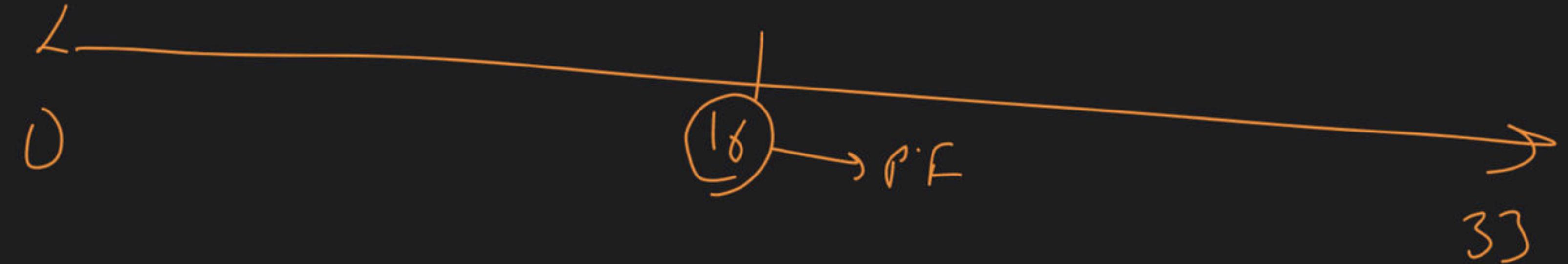
$$d = 0 \quad n \mid d = 34$$

$$e = 68$$

$$\cancel{34} \times \cancel{34} = 18$$

$$34 \times 34 > 68 \rightarrow \text{left} \rightarrow e = \text{mid} - 1$$

$$e = 34 - 1 \\ \geq 33$$



mid > 16

$$16 \times 16 \rightarrow 2^{56} = 2^{68}$$

$$2^{56} > 68 \rightarrow \text{lyt} = e^{-m,j-1}$$

$\cancel{x}$

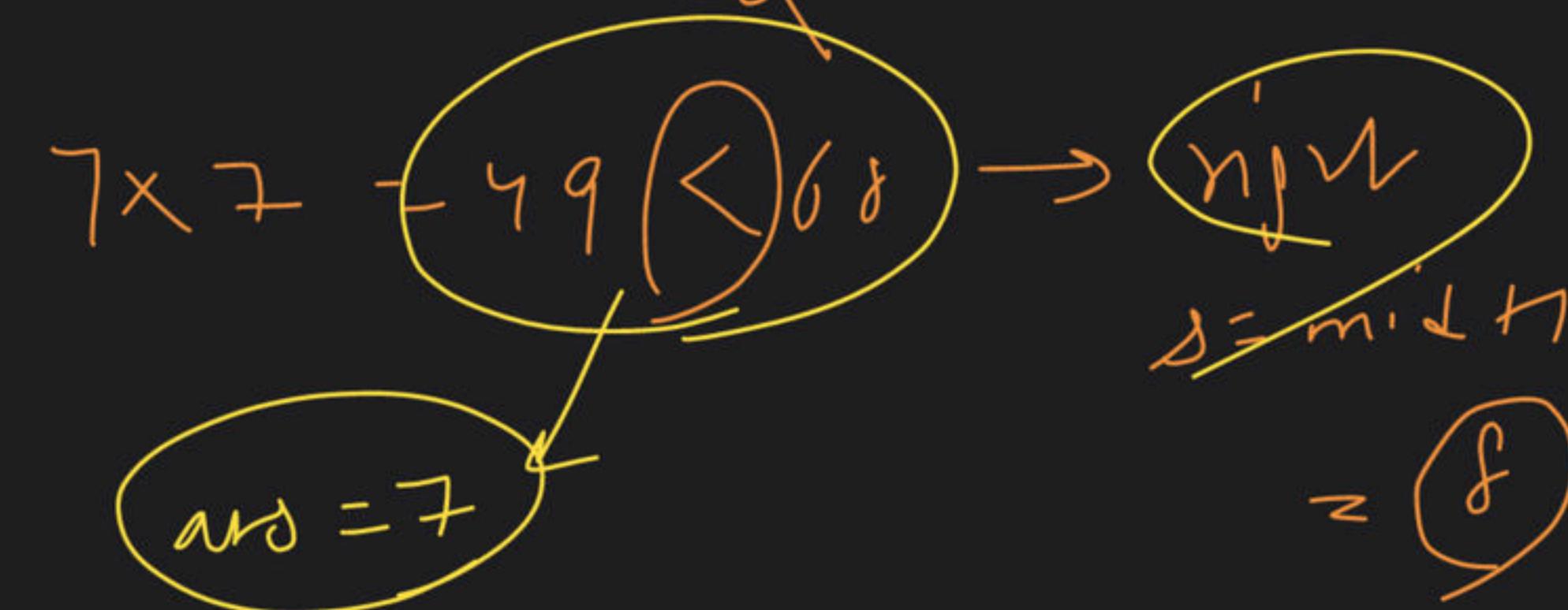
$c = 16^{-1}$

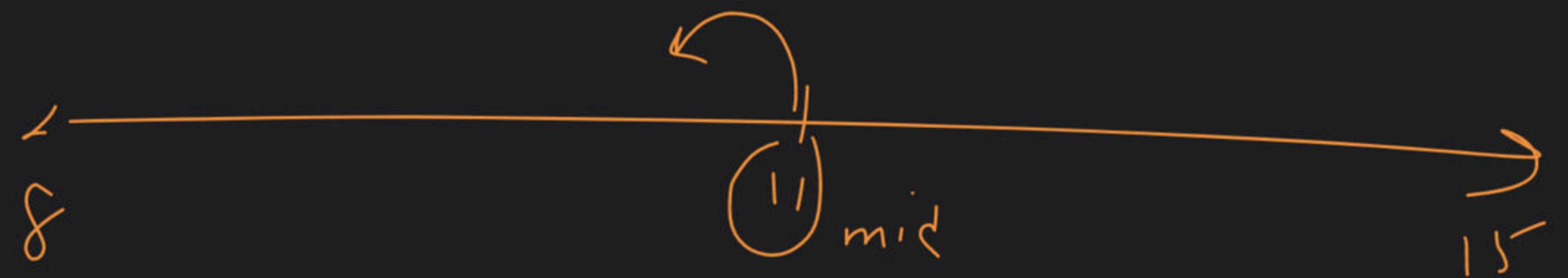
-> lr

0  $\xrightarrow{\text{7}} \rho \cdot r$  15<sup>-</sup>

$$\text{mid} = \frac{0+15}{2}$$

$$7 \times 7 = 49 = 368 \cancel{\times}$$





$$m_{12} =$$

$$11 \times 11 = -68 \cancel{\times}$$

$$11 \times 11 > f_8 \rightarrow \text{left} \quad c = 11 - 1 \\ = \textcircled{10}$$

$$8 \times 9 = 10$$

$$9 \times 9 = 10$$

$$9 \times 9 = 10$$

↓

$\approx 8$

$$\delta = \text{mid } h$$
$$\approx g$$



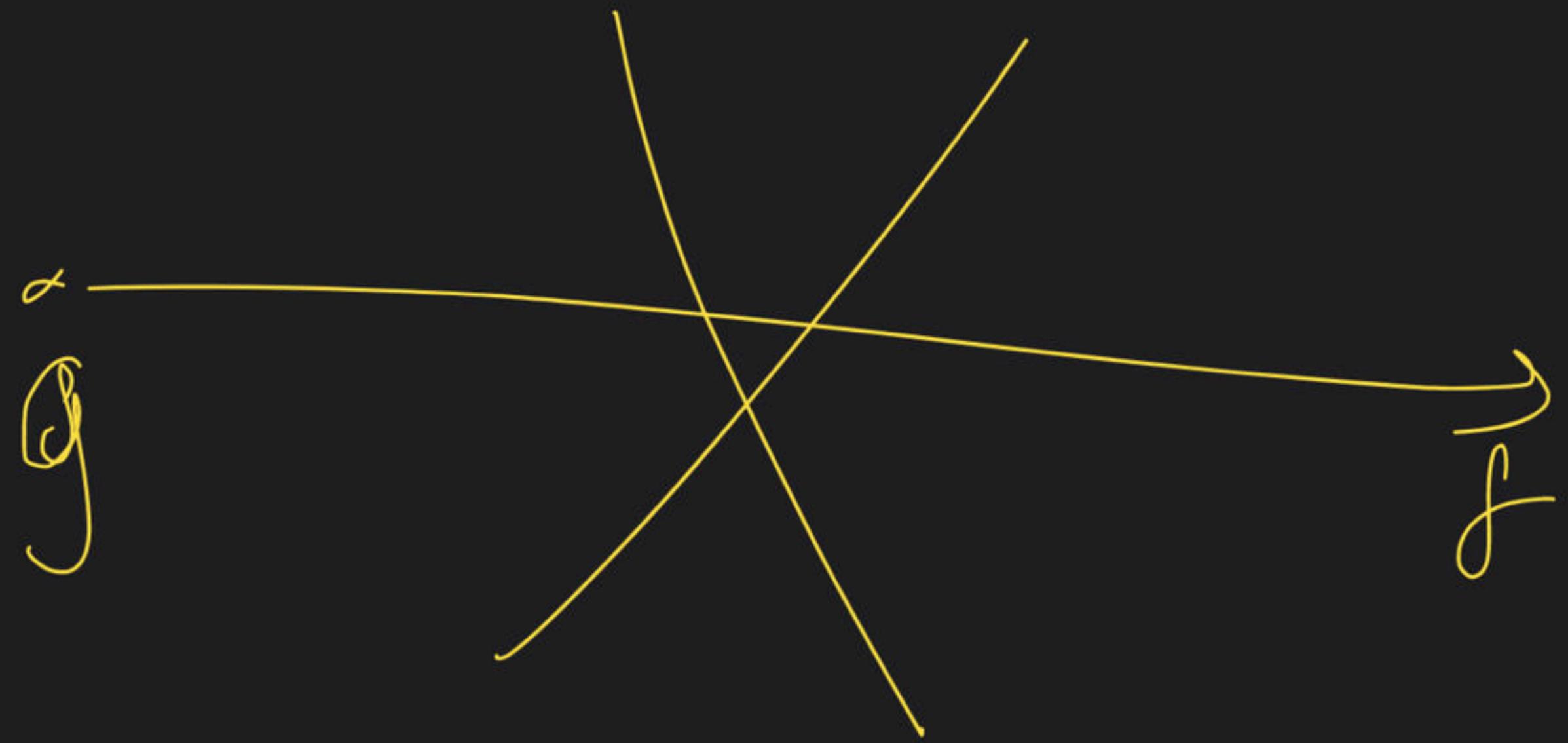
$$\delta \times \delta = f \delta \propto$$

$$\delta \times \delta > f \delta \propto$$

$\delta \times \delta \cancel{>} f \delta \propto$

ans - then

$$\text{ans} = \delta$$

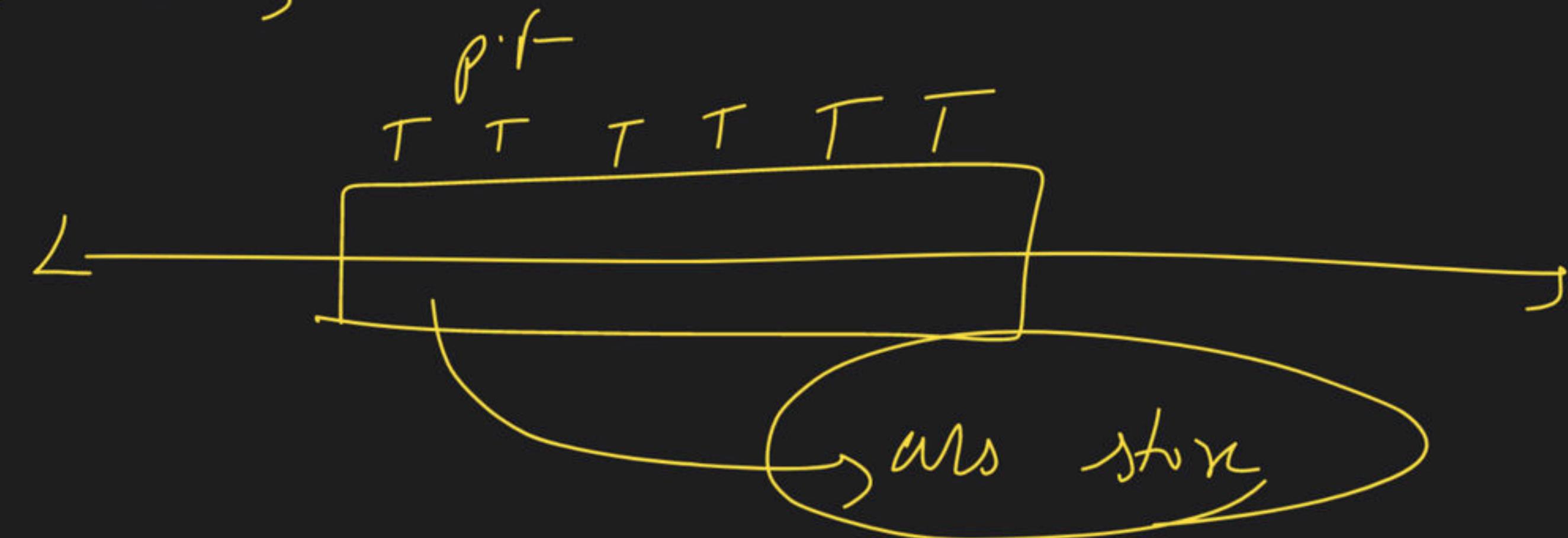


Ruekjym

(A)  $\leftarrow$  *start*  $\rightarrow$  *halt*

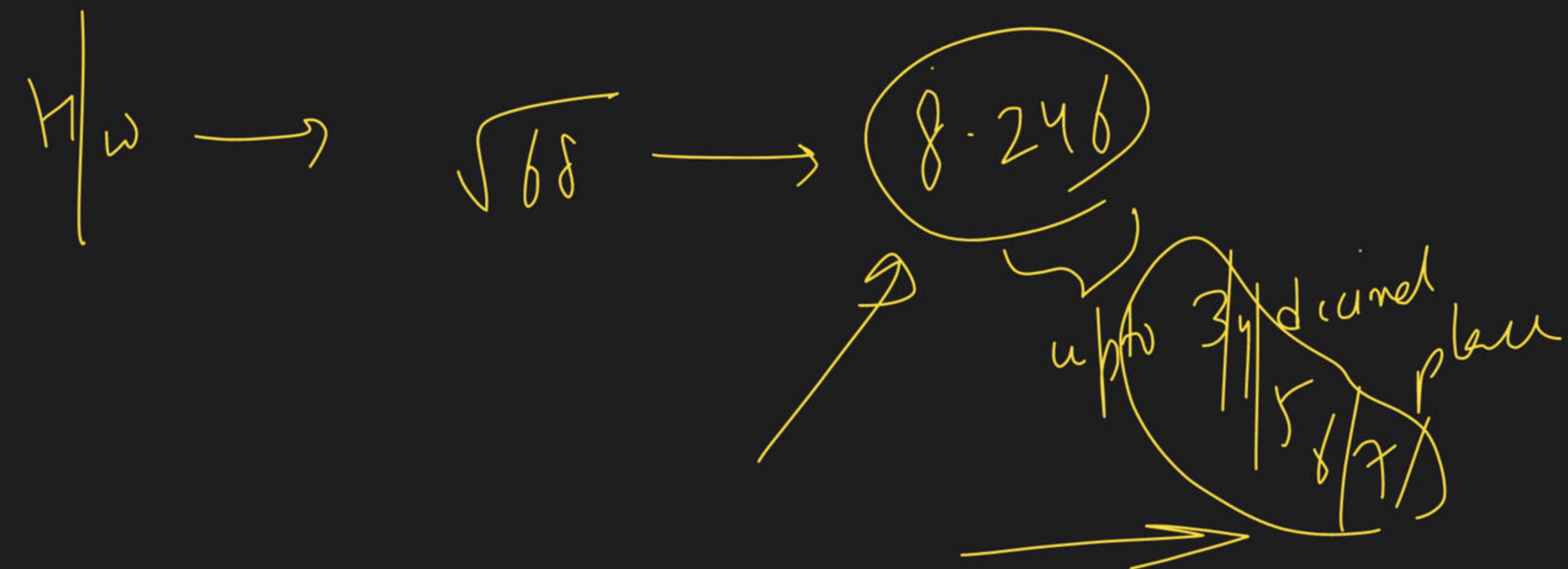
(B)  $P \cdot F \longrightarrow T/F$

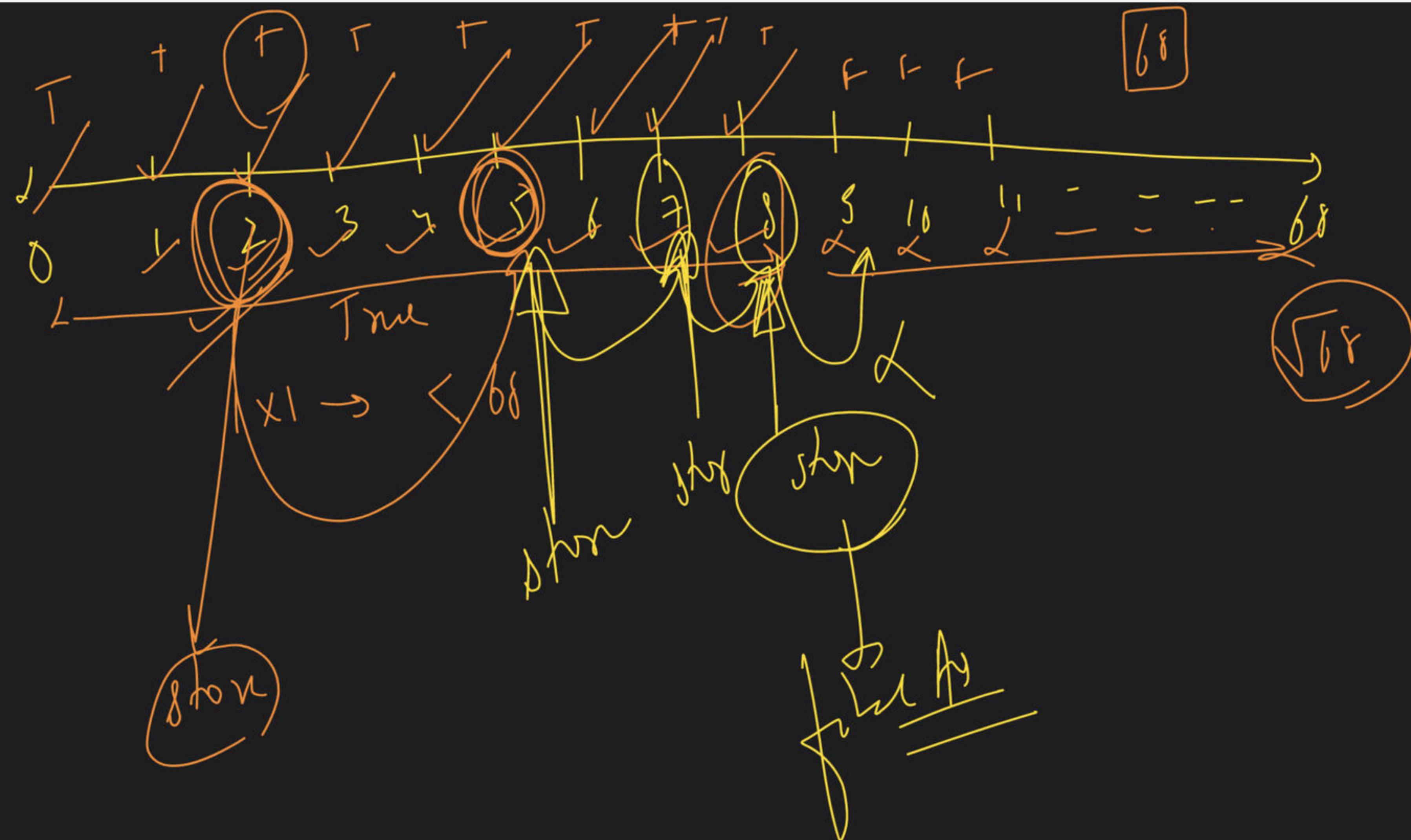
(C)  $\rightarrow$



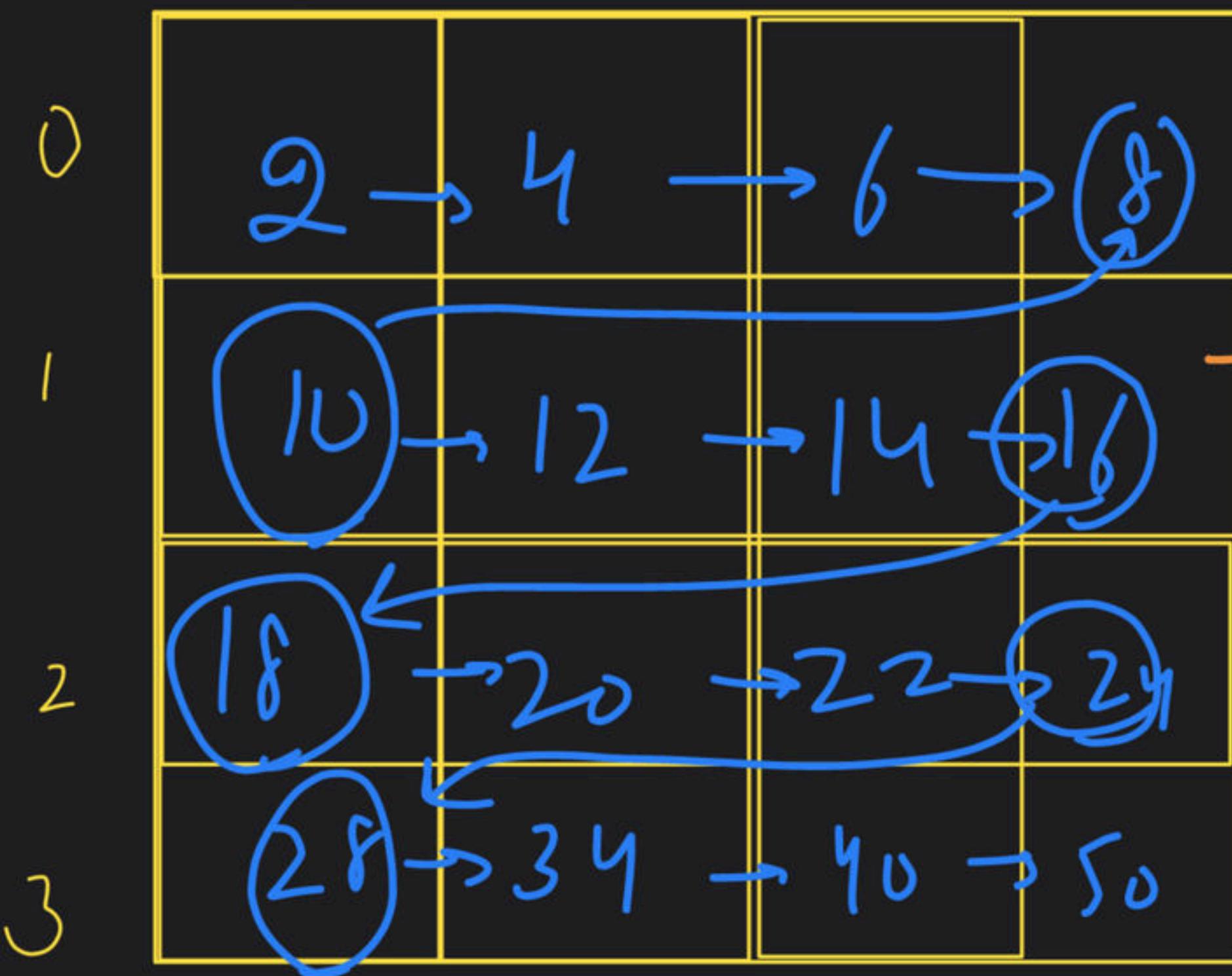


$$\begin{aligned} n &= 68 \\ \rho &= 8 \cdot 2^{n/2} \end{aligned}$$





Binary Search on



2D array

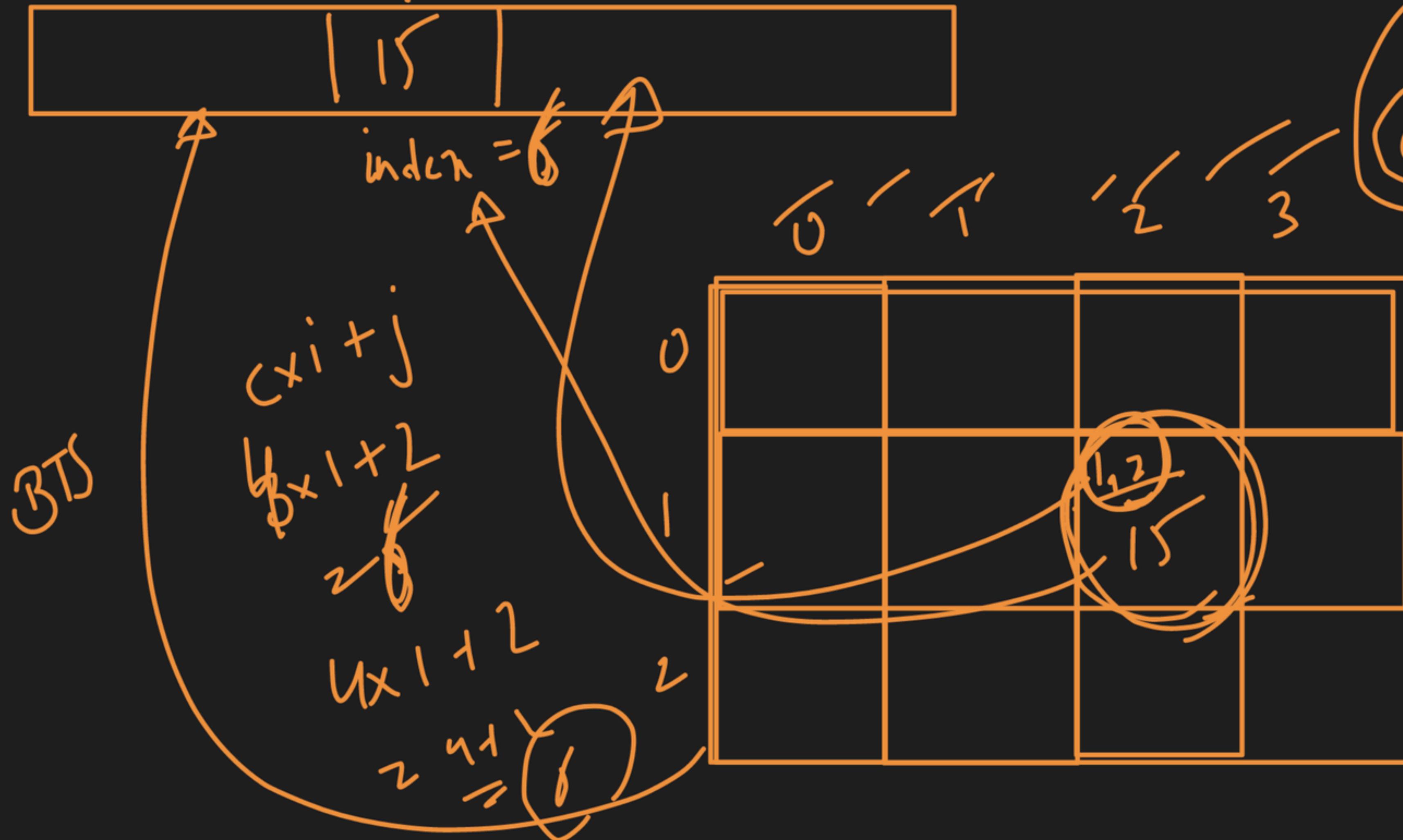
2	4	6	10	12	14	16	18	20	22	24	28
---	---	---	----	----	----	----	----	----	----	----	----

all order

$$2D \rightarrow 1D \Rightarrow f * i + j$$

$$1D \rightarrow 2D \quad p_i = \frac{m * b}{c} \quad j = \text{mid} - l$$

$20 \rightarrow 10 \rightarrow cx^i + j$





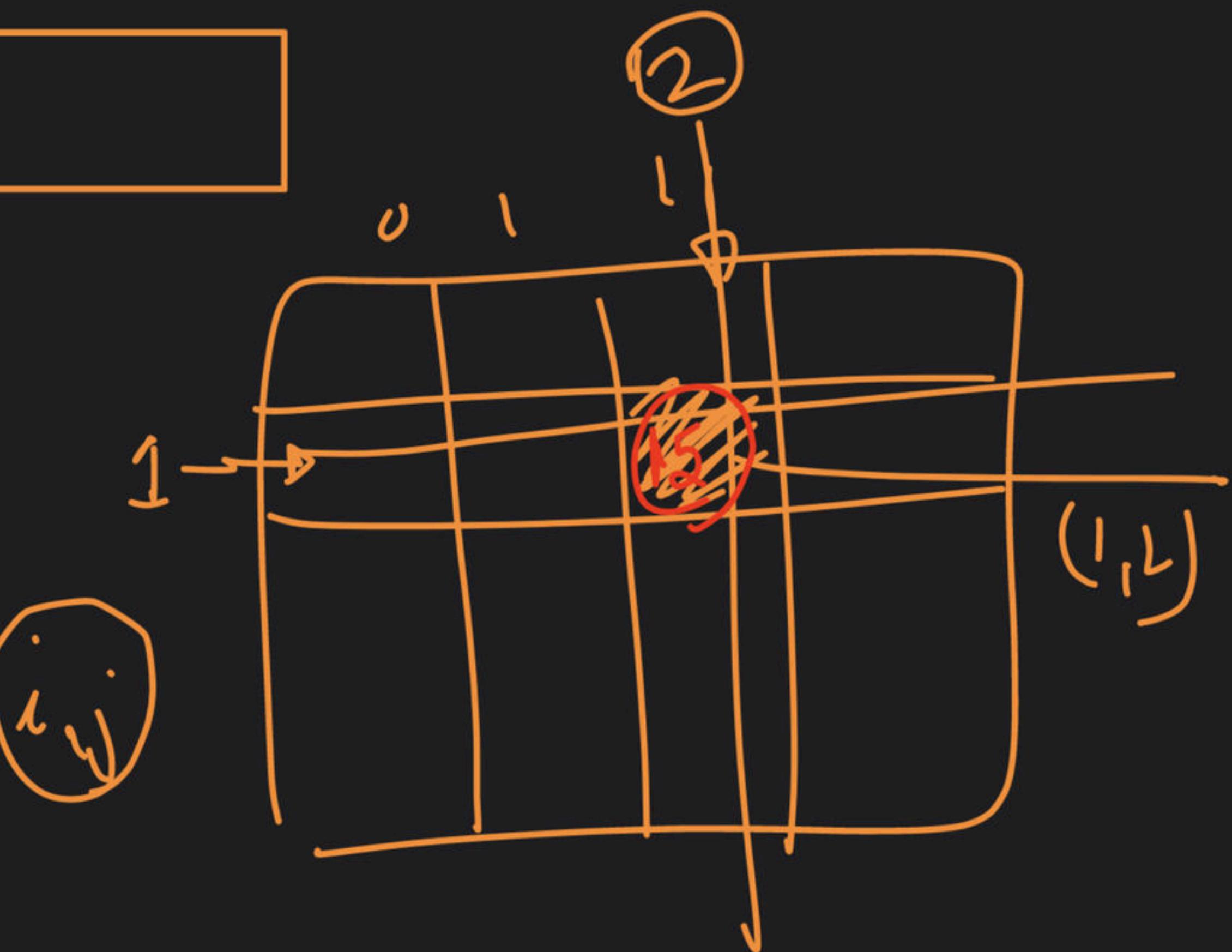
$$i = \frac{\text{index}}{\text{cols}} = \frac{6}{6} = 1$$

*index*

$$j = \text{index} \% \text{cols}$$

$$\approx 6 \% 6 = 2$$

$$c = 4$$



2D  $\rightarrow$  1D  $\rightarrow$

$(\times i + j)$

.

1D  $\rightarrow$  2D

$O(m \times n)$

$\nearrow$

$\searrow$

$O(\log(m \times n))$

$i =$

index  
col

$j =$  index  
col