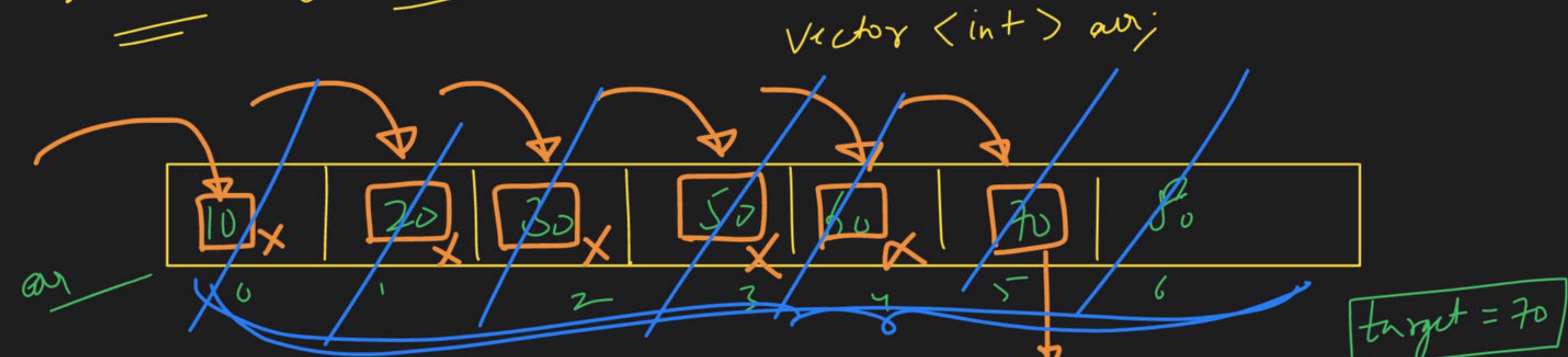


# Searching & Sorting - Level 1

Special class

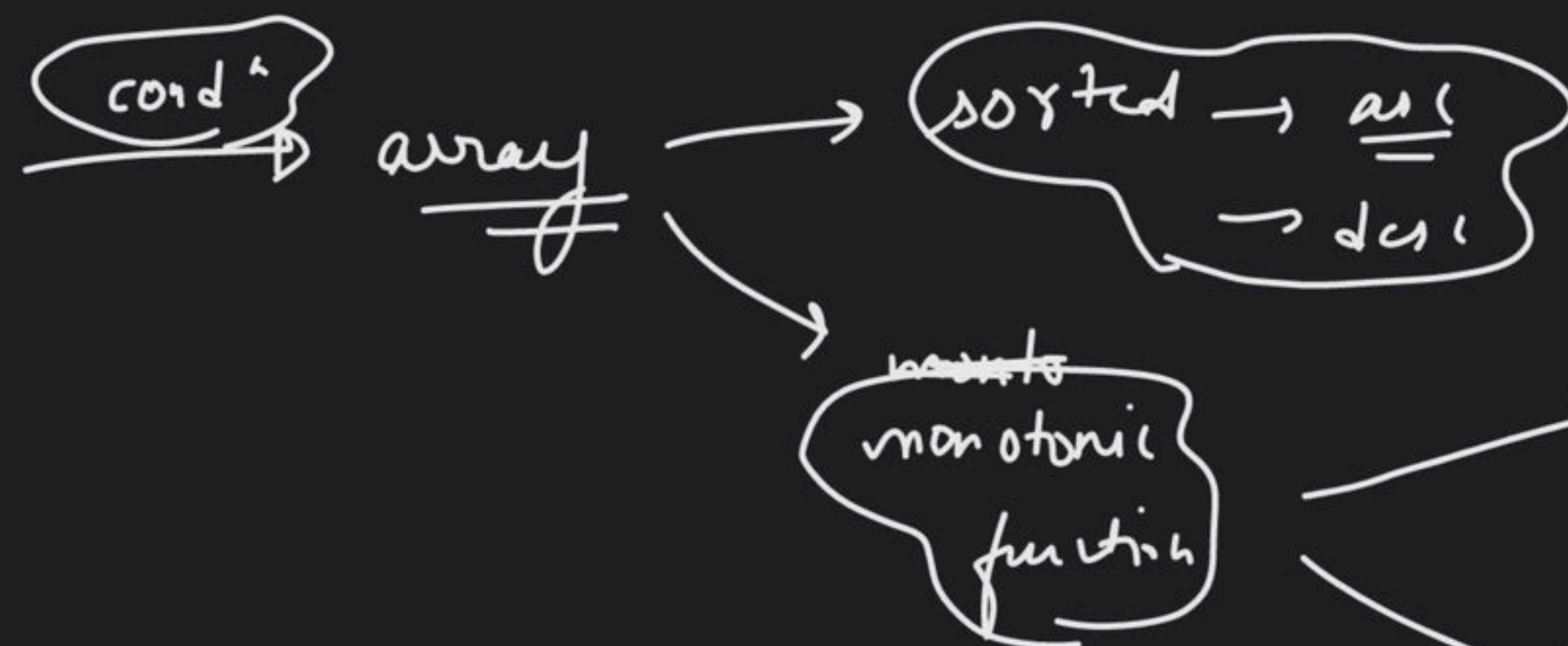
1. Linear Search → 1-1 Kiske sabko check krdungi



```
for (int i=0; i<n; i++)  
{    if (arr[i] == target)  
        return true;  
}  
return false;
```

L.S → T.S → O(n)  
size of array

$\Rightarrow$  Binary Search



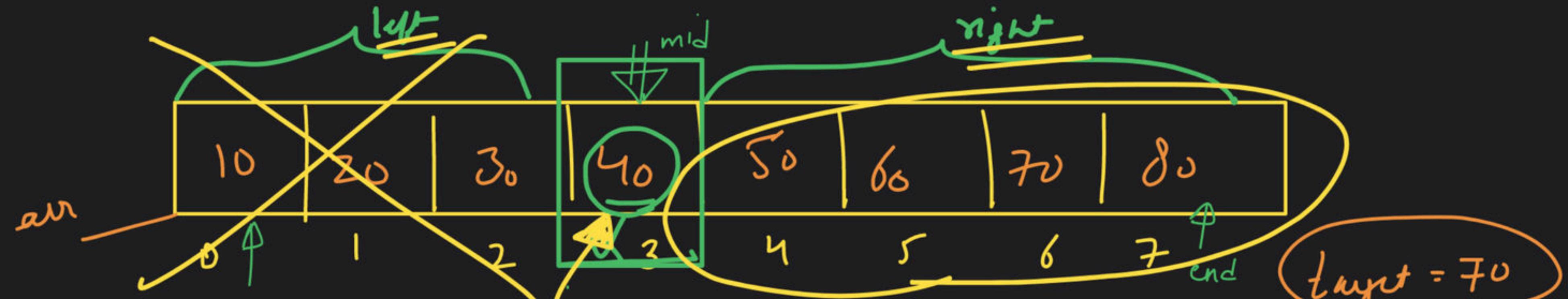
ascending



descending



Reload if  
no ans



(A) ✓ ✓

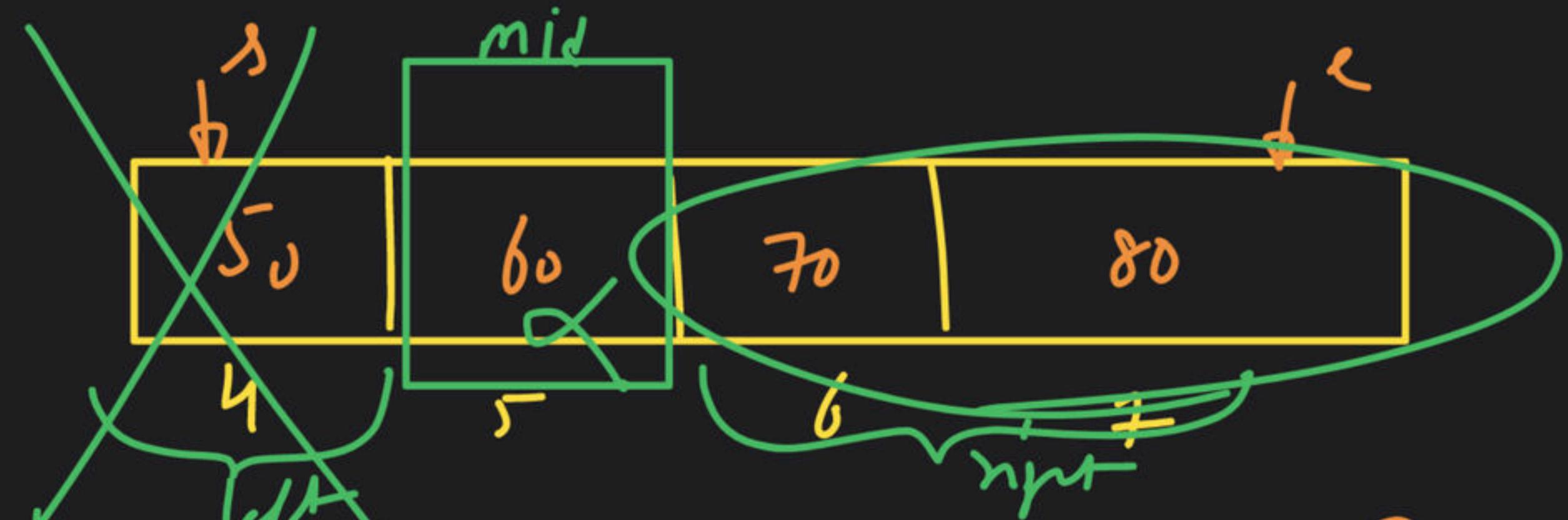
$$\text{③ } \text{mid} = \lfloor \frac{\text{start} + \text{end}}{2} \rfloor$$

$$\boxed{\text{start} = 0}, \quad \boxed{\text{end} = 7} \quad \boxed{\left( \frac{\text{start} + \text{end}}{2} \right)}$$

$$\text{mid} = \frac{0+7}{2} = \frac{7}{2} = 3$$

$$40 == 70 \rightarrow F$$

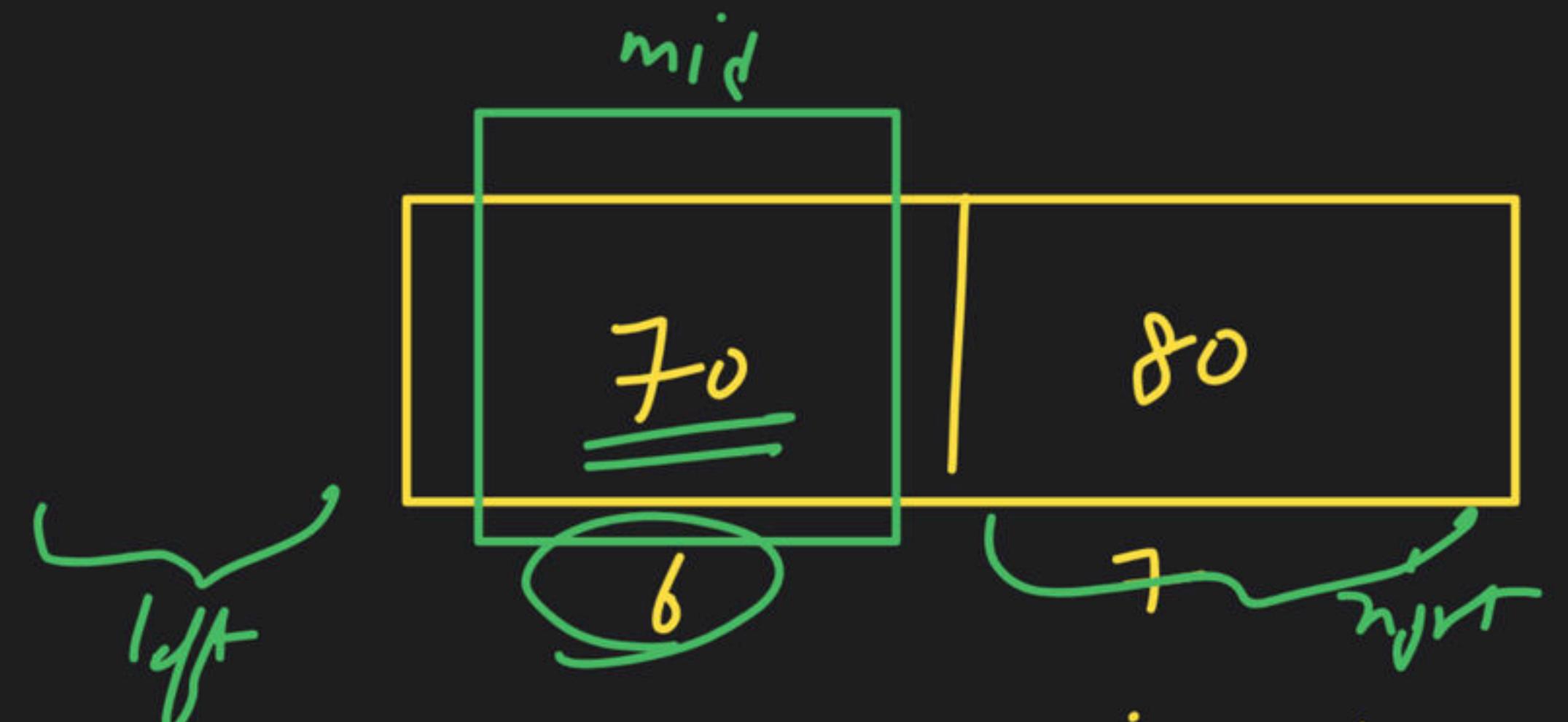
$$70 > 40 \rightarrow \text{right}$$



A)  $\underline{\underline{\text{start} = 1}}, \underline{\underline{\text{end} = 7}}, \text{mid} = \frac{1+7}{2} = 5$

$b_0 = \boxed{70} \rightarrow f$

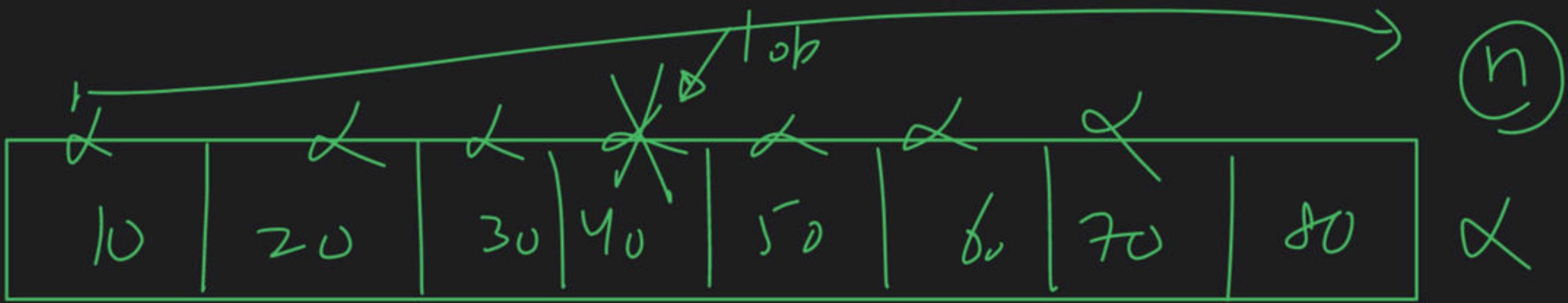
$70 > b_0 \rightarrow \text{right} \rightarrow$



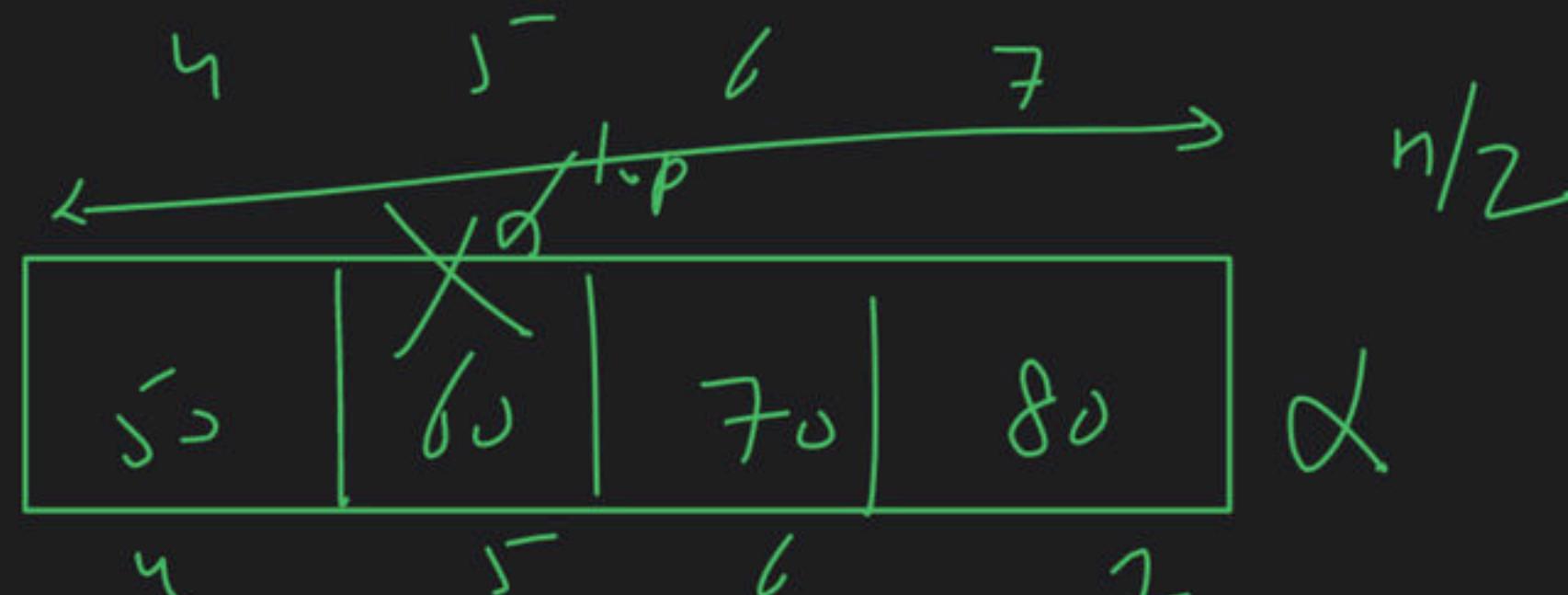
(A)       $start = 6$ ,  $end = 7$ ,  $mid = \frac{6+7}{2} = \frac{13}{2} = 6$

$70 == 70 \rightarrow \text{Yes} \rightarrow \text{True}$

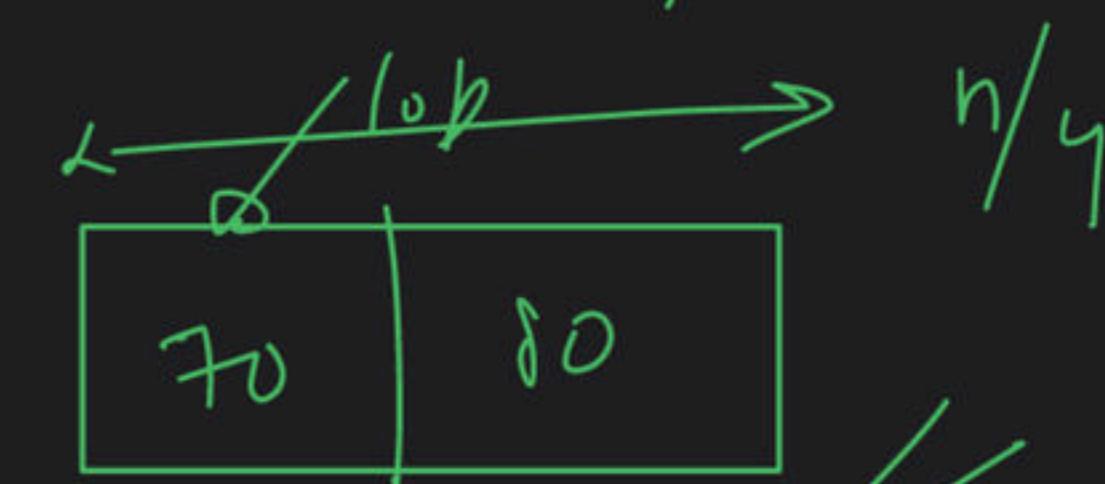
return iack  
return 6



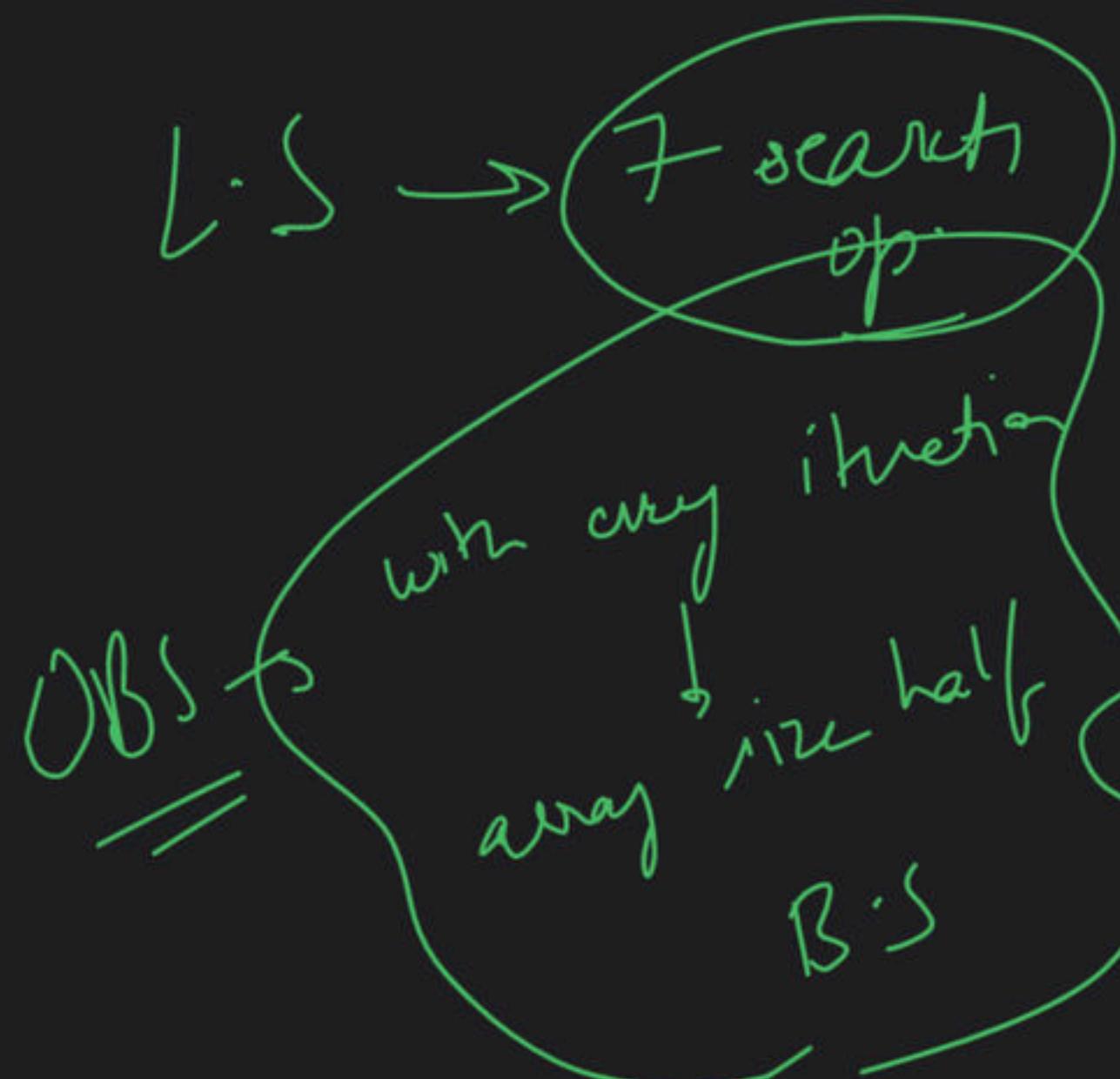
0 1 2 3 4 5 6 7



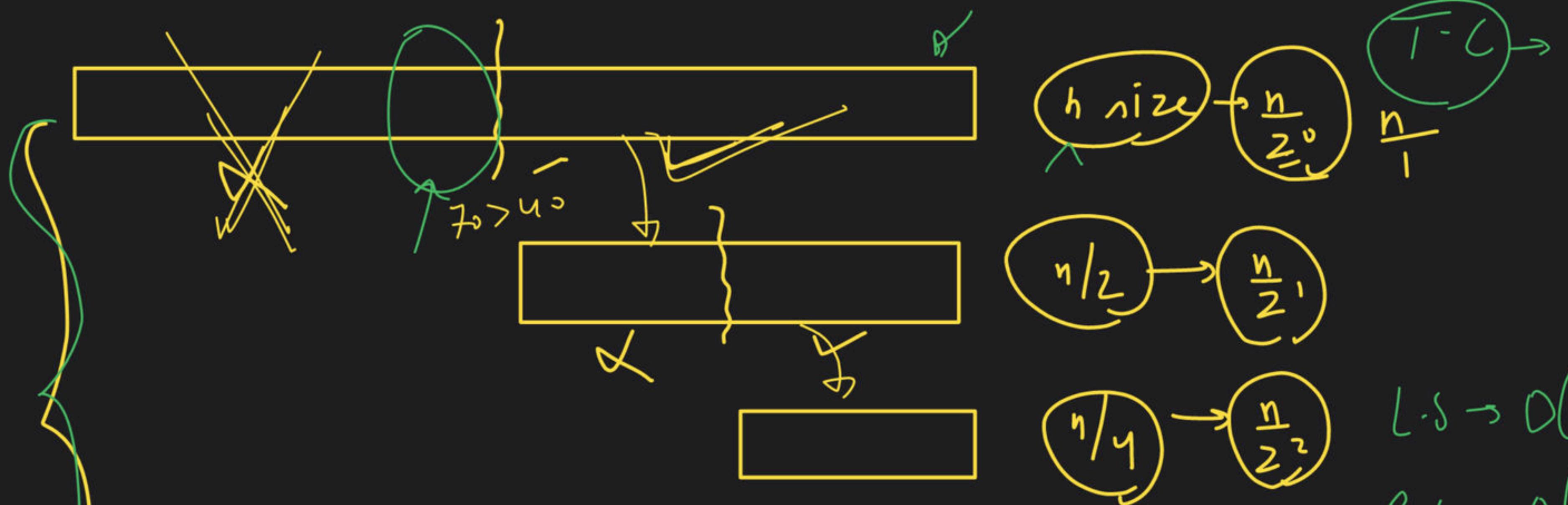
4 5 6 7



7







$L \cdot S \rightarrow D(n)$

$$\beta \cdot \varsigma \sim O(\log^{\omega})$$

$$h = z^k$$

$$\sum_{k=1}^n k = \frac{n(n+1)}{2}$$

$$n = \frac{z}{k}$$

$$\log_2 n = T \cdot C$$

## K iteration

$$\sum_{k=1}^n k = \frac{n(n+1)}{2}$$

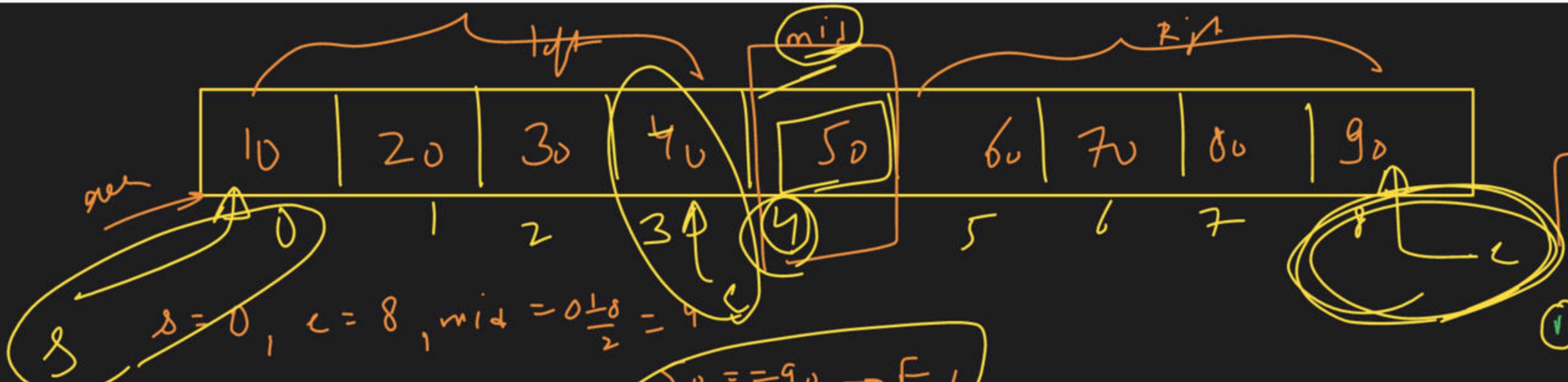
$$n = \frac{z}{k}$$

$$\log_2 n = T \cdot C$$

18:12

0 gr

11



$\text{target} = 90$

0 found

if ( $\text{arr}[\text{mid}] == \text{target}$ )  
return mid

$$s = 5, e = 8, \text{mid} = \frac{5+8}{2} = 6$$

$70 == 50 \rightarrow \text{false}$

~~$90 > 70 \rightarrow \text{right}$~~

$$s = 7, e = 8, \text{mid} = \frac{7+8}{2} = 7$$

$80 == 50 \rightarrow \text{false}$

$90 > 80 \rightarrow \text{right}$

$$s = 8, e = 8, \text{mid} = \frac{8+8}{2} = 8, 90 == 90$$

return 8

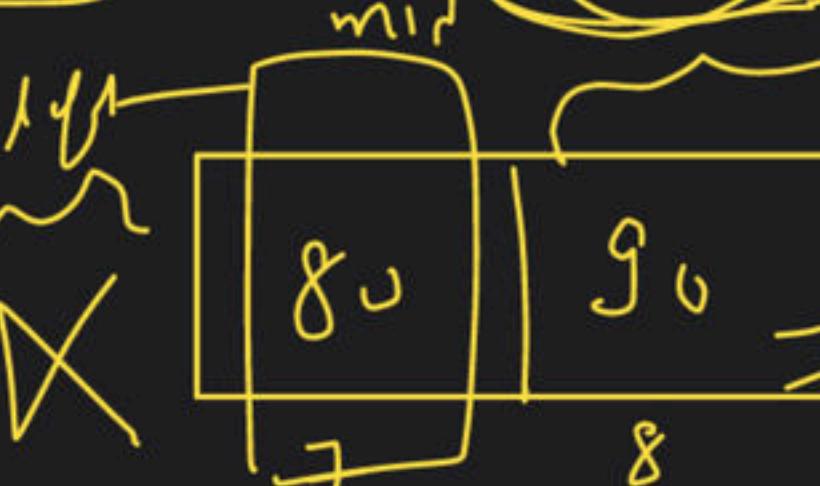
$50 == 90 \rightarrow \text{false}$

$50 > 90 \rightarrow \text{right}$

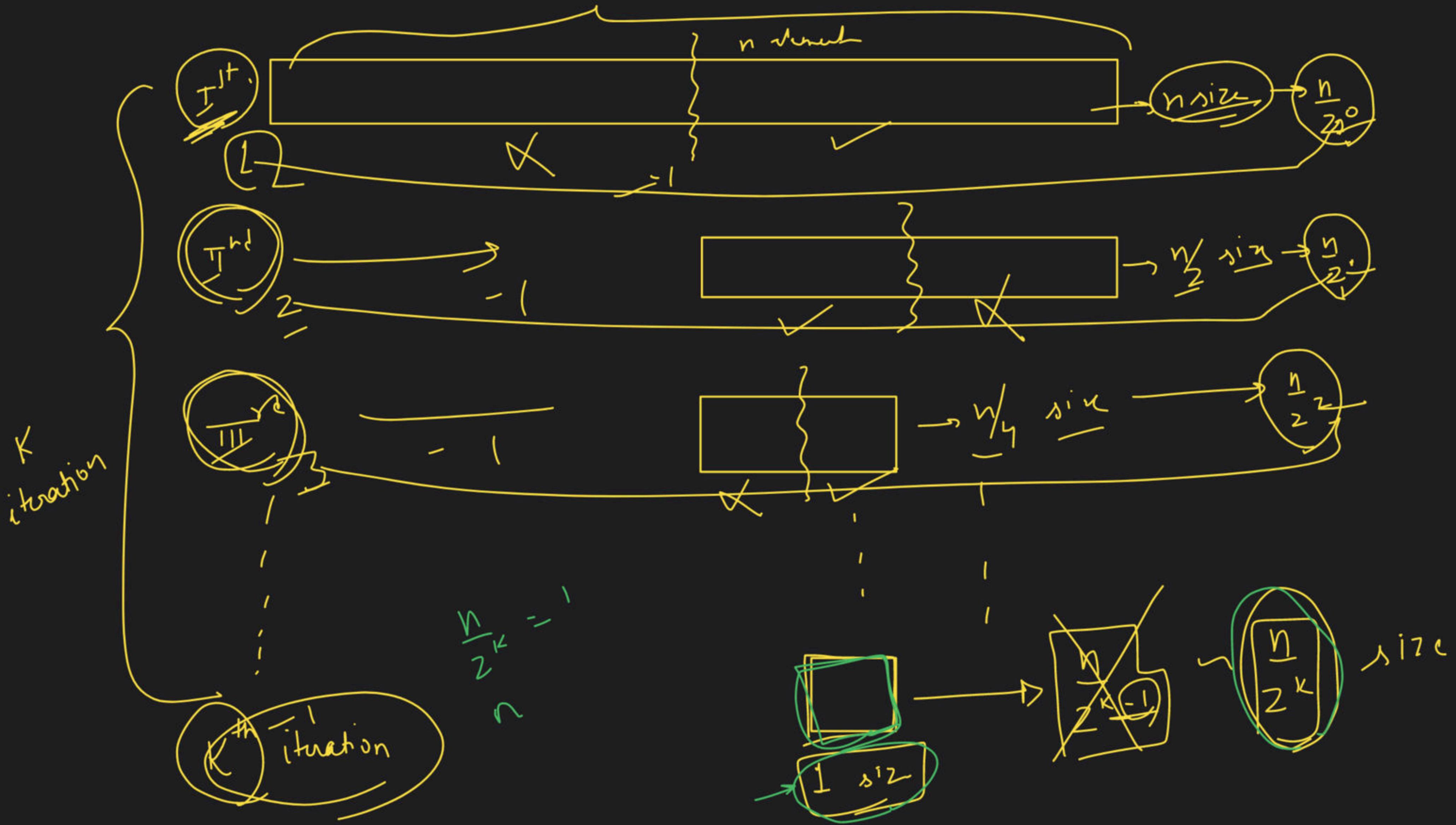


$s = \text{mid} + 1$

if ( $\text{target} < \text{arr}[\text{mid}]$ )  
 $e = \text{mid} - 1$



while ( $s < e$ )



$$\frac{n}{2^k} = 1$$

$$\frac{a}{b} = 1$$

~~$$n = 1 \times 2^k$$~~

$$a = c \times b$$

$$n = 2^k$$

$\cancel{k-1}$

$$1 \times a \rightarrow \boxed{a}$$

apply

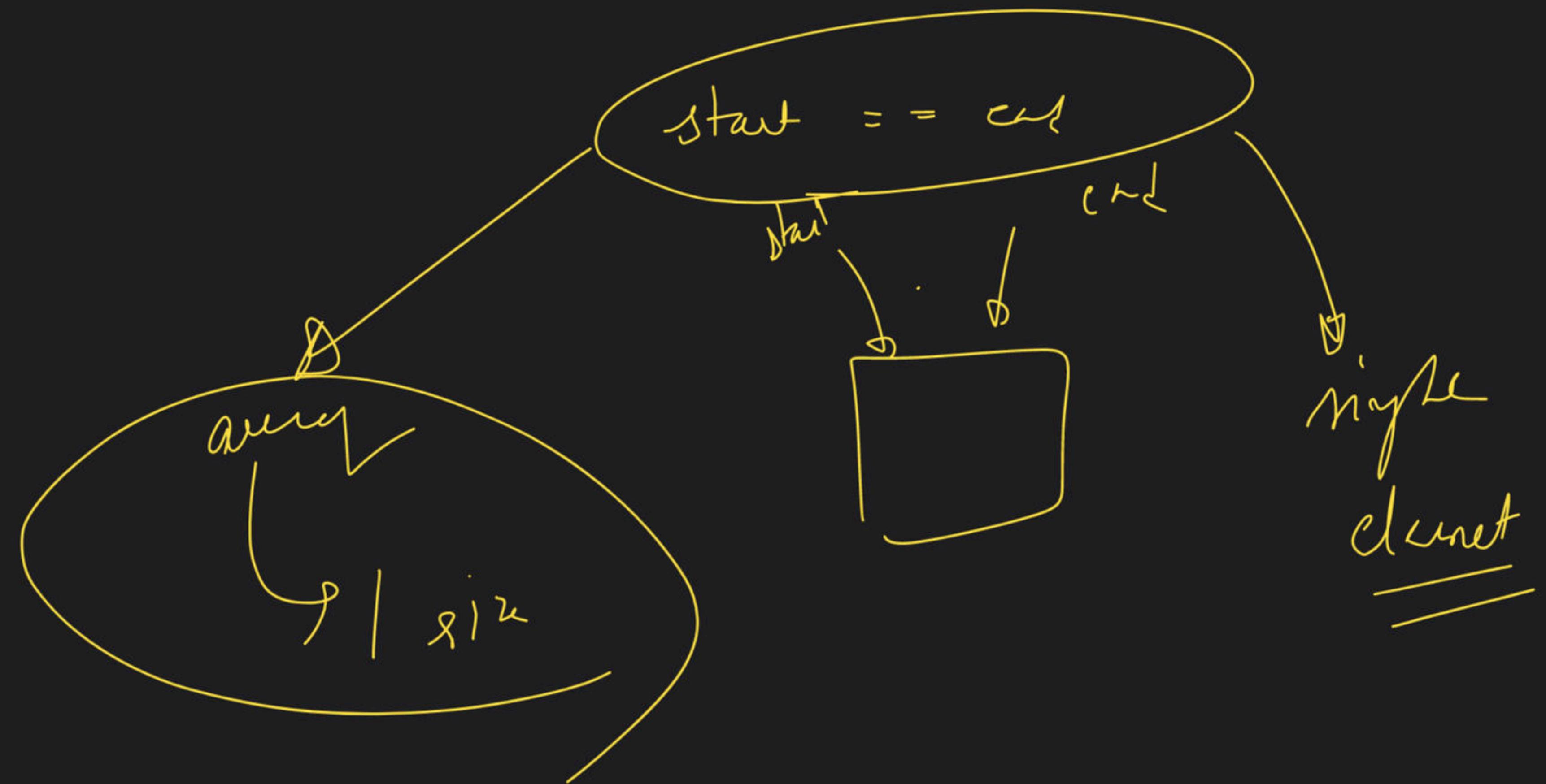
$$\text{both sides} \rightarrow \log_2$$

$$\log_2 n = \log_2 (2^k)$$

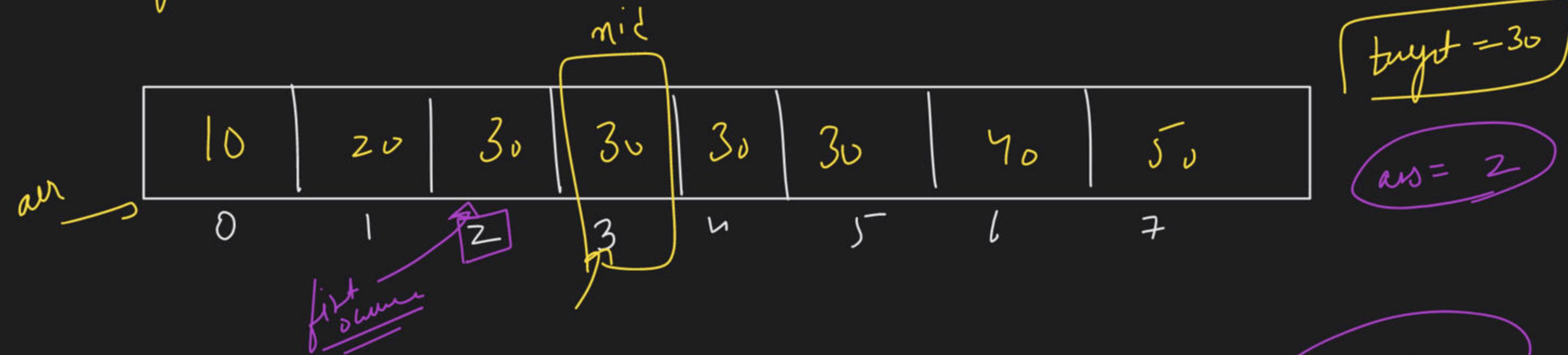
$$\log_2 n = k$$

$$T.C \rightarrow O(k)$$

$$O(\log_2 n)$$



→ find first occurrence of a number in array



$$\rightarrow s=0, e=7, \text{mid} = 3$$



$$\rightarrow s=0, e=3-1, e=2 \rightarrow \text{mid } 2$$

$$\text{arr[mid]} == \text{target}$$

$$30 == 30 \rightarrow \text{true} \rightarrow \text{found}$$

$$\text{ans} = 3$$

$$\text{left} \rightarrow e = \text{mid} - 1$$

$$20 == 30 \rightarrow \times$$

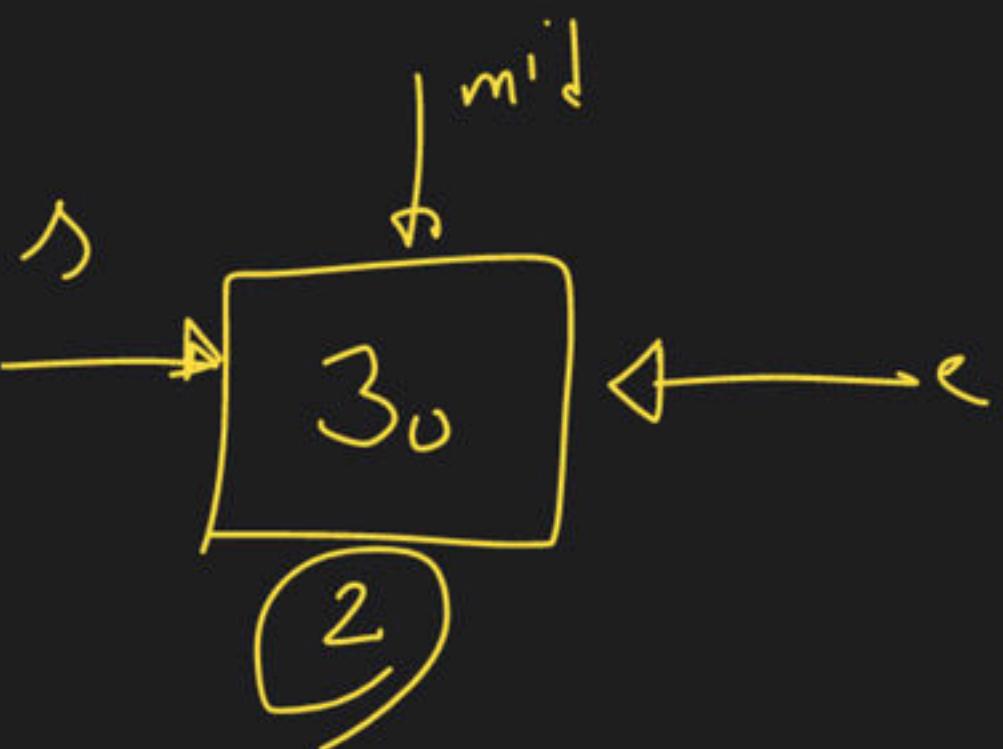
$$30 > 20 \rightarrow \checkmark \rightarrow \text{right} \rightarrow s = \text{mid} + 1 = 1 + 2 = 3$$

2 min

Soln

found → ans store

→ left not false



$$s = 2, e = 2, \text{ mid} = \frac{s+e}{2} \rightarrow 2$$

int mid =

$$s + \frac{(e-s)}{2}$$

$\text{arr}[\text{mid}] = 2$  found

$30 = 30$

found  $\rightarrow \text{ans} = 2$

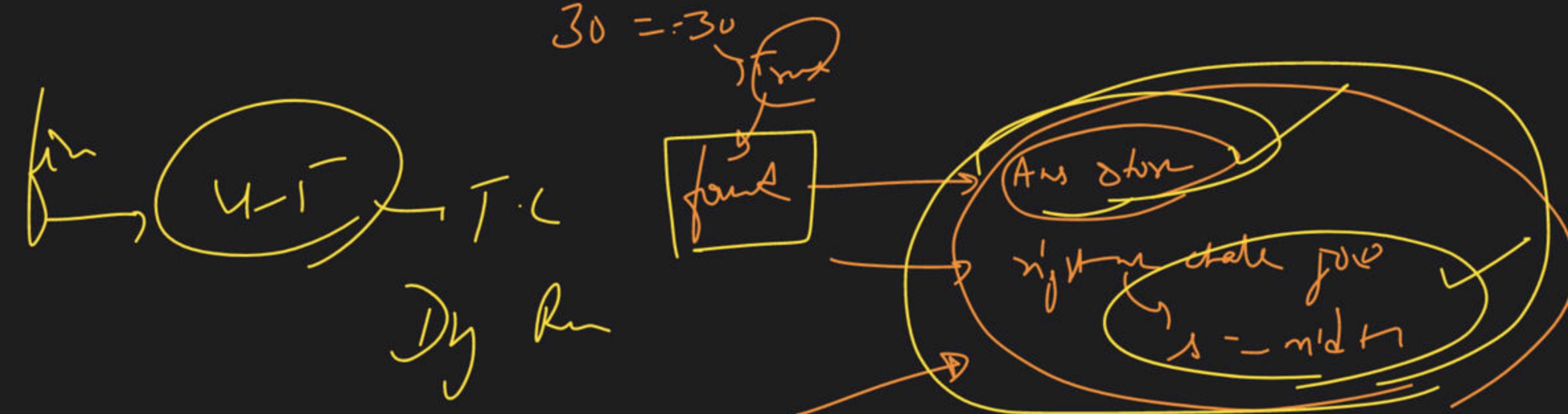
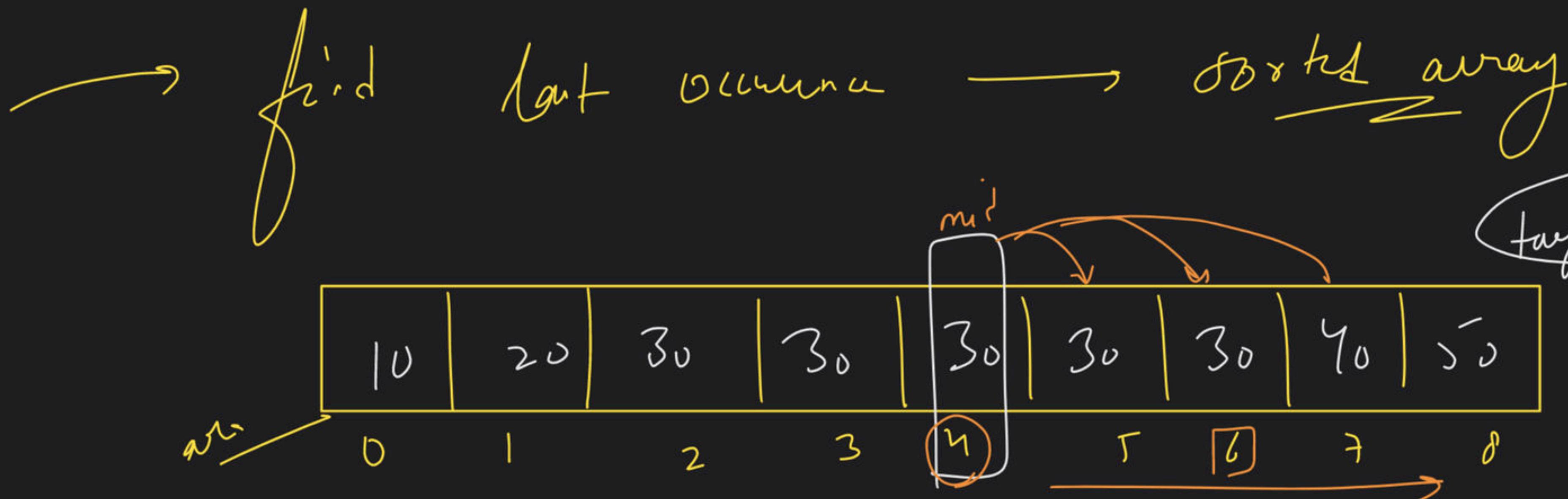
$\rightarrow$  left in find

$$e = \text{mid} - 1$$

$$e = 2 - 1$$

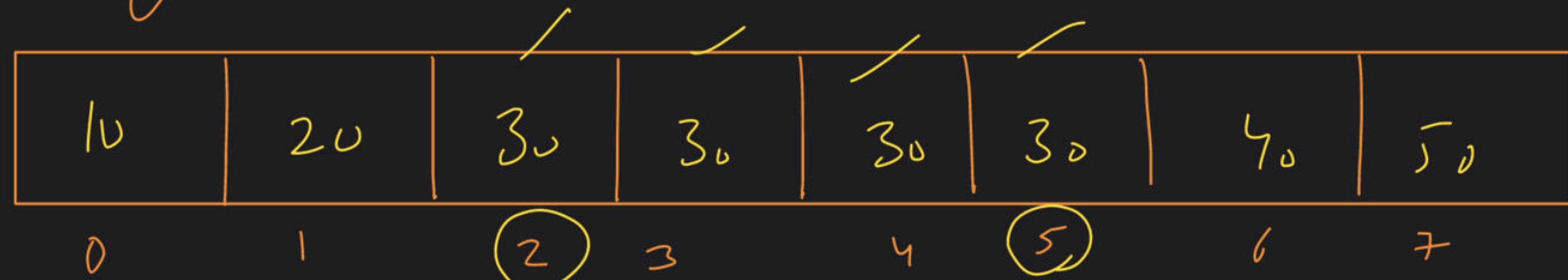
$$e = 1$$

$\rightarrow s = 2, e = 1 \rightarrow 2 > 1 \rightarrow \text{left find}$



~~Find total occurrence~~

target = 3  $\sigma$



Total Occ  $\rightarrow$  4

first occ = 2

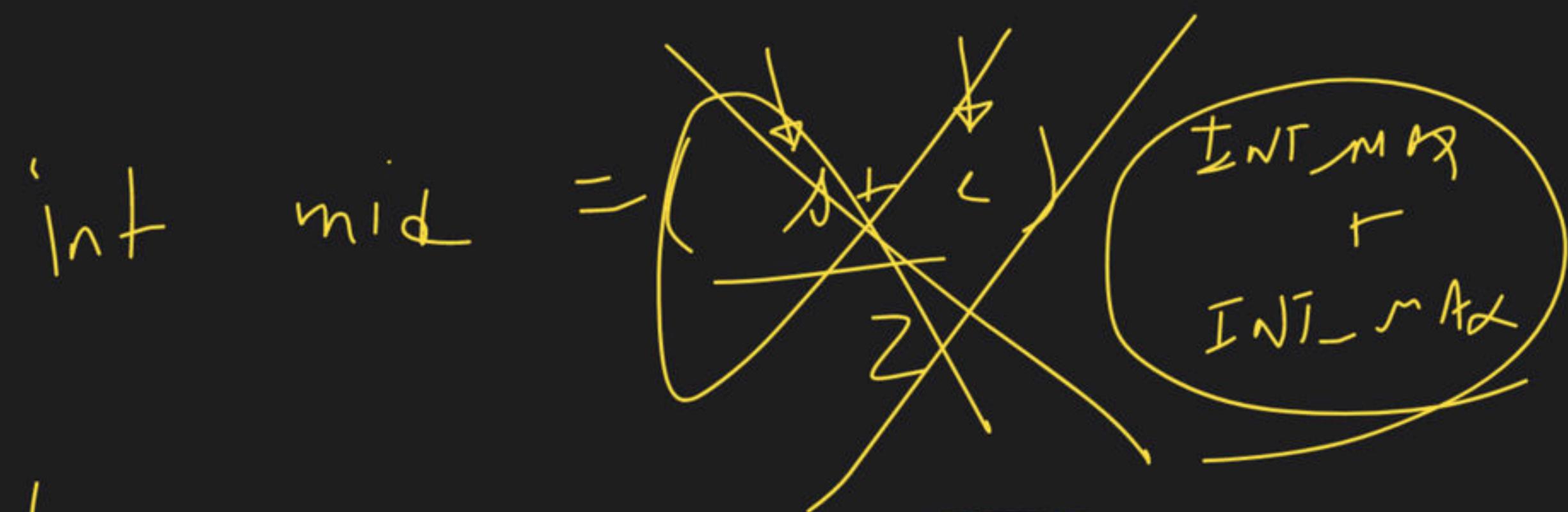
last occ = 5

Total Occ =

last occ - first occ + 1

B.S → Advanced Question

2 min → Raai  
Break



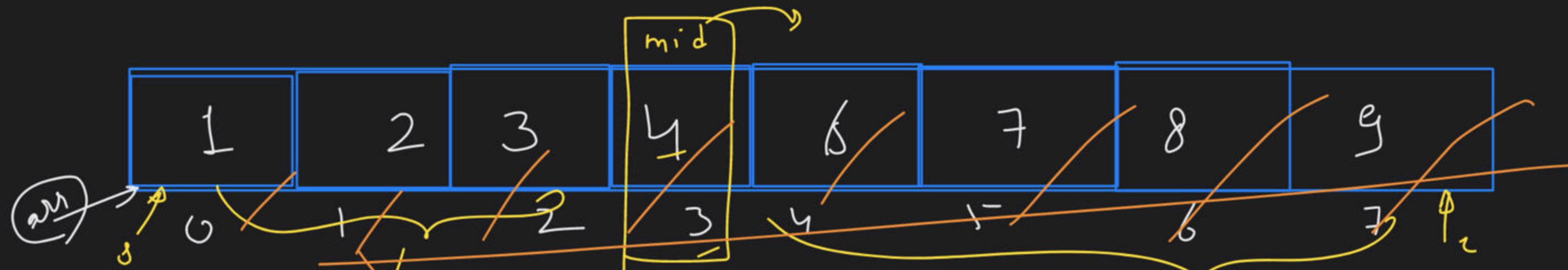
$s + c \backslash$   
2  
 $\lambda \vdash (c \dashv)$



$$s + \frac{(e-s)}{2} \rightarrow s + \frac{e}{2} - \frac{s}{2}$$

$$\rightarrow s + \frac{e}{2} - \frac{1+c}{2}$$





$$\begin{aligned} s &= 0 \\ e &= 7 \end{aligned}$$

$\text{mid} = \frac{0+7}{2} = 3$

$$\begin{aligned} \text{diff} &= \text{arr}[\text{mid}] - \text{arr}[\text{mid}] \\ &= 4 - 3 \\ \text{diff} &= 1 \end{aligned}$$

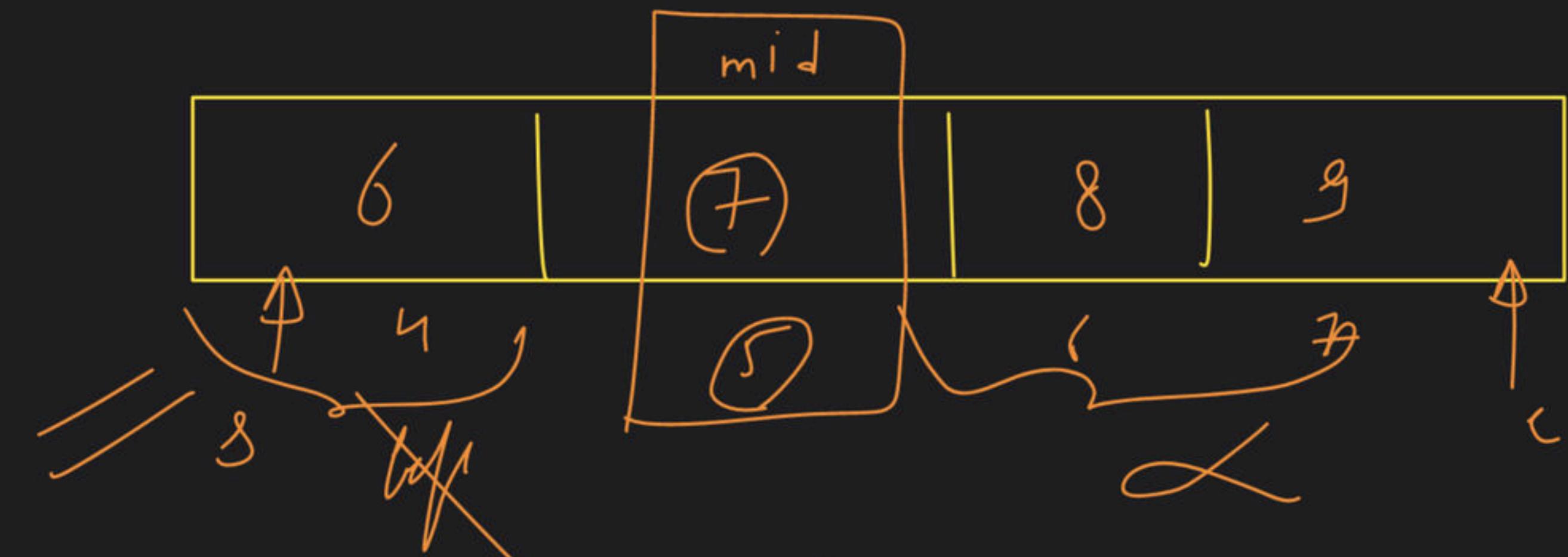
$$\boxed{\text{diff} = 1} \rightarrow \text{right} \rightarrow s = \text{mid} + 1$$

$\downarrow \downarrow \rightarrow (n-1)$  iteration  
of inner

$1 \rightarrow y$

$1 \rightarrow v$

$1 - y$



$$s = 4 \quad \rightarrow \quad mid = \frac{4+7}{2} = 5$$

$$e = 7$$

$$\begin{aligned} diff &= arr[mid] - mid \\ &= 7 - 5 \end{aligned}$$

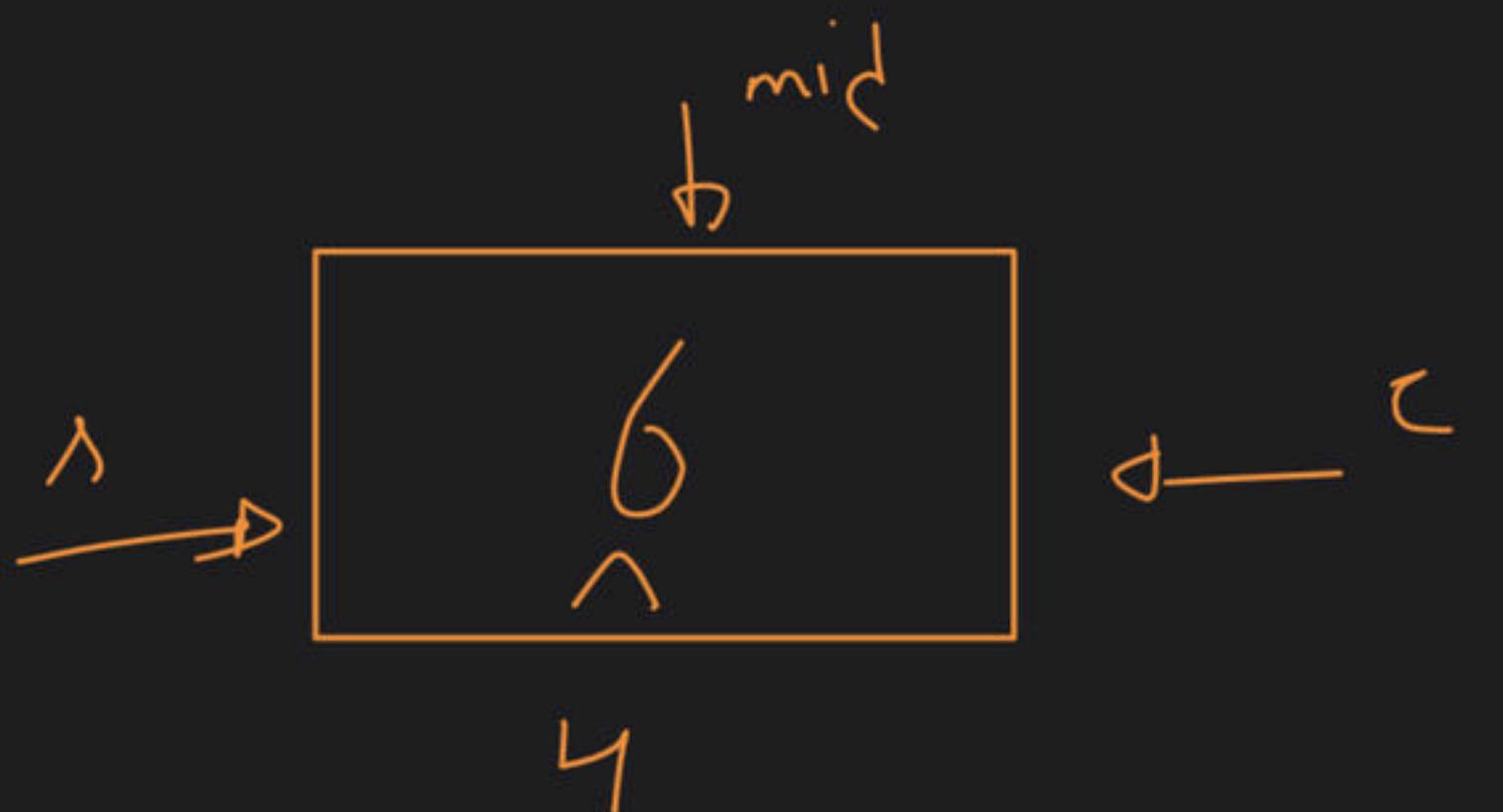
$$diff = 2$$

$$diff = -1 \rightarrow \text{false} \rightarrow \text{ans\_notn}$$

$$ans = 7$$

$$\rightarrow \text{left on go}$$

$$e = mid - 1$$



$$s = 4 \quad l = 1 \quad \text{mid} = \frac{4+1}{2} = 2.5 \rightarrow 3$$

$$\text{diff} = \text{ans}[\text{mid}] - \text{ans}[l]$$

$$\text{diff} = 6 - 4$$

$$\text{diff} = 1 \rightarrow \text{No} \rightarrow \text{ans} = 4$$

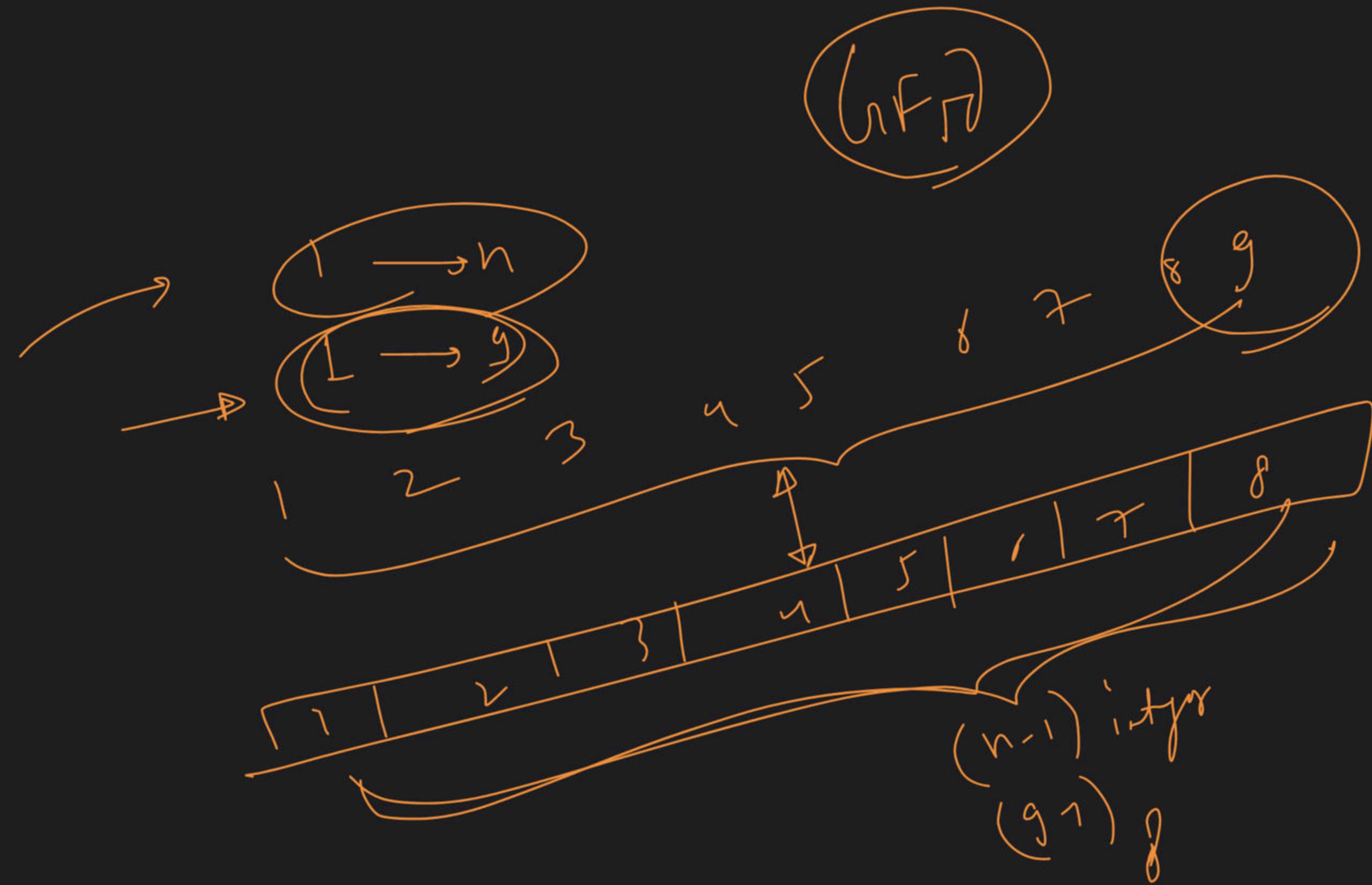
$$\text{left} \rightarrow r = \text{mid} - 1$$

$$s = 4, \quad l = 3$$

$l > r \rightarrow \text{break}$

$$\text{final} > \text{ans} + 1$$



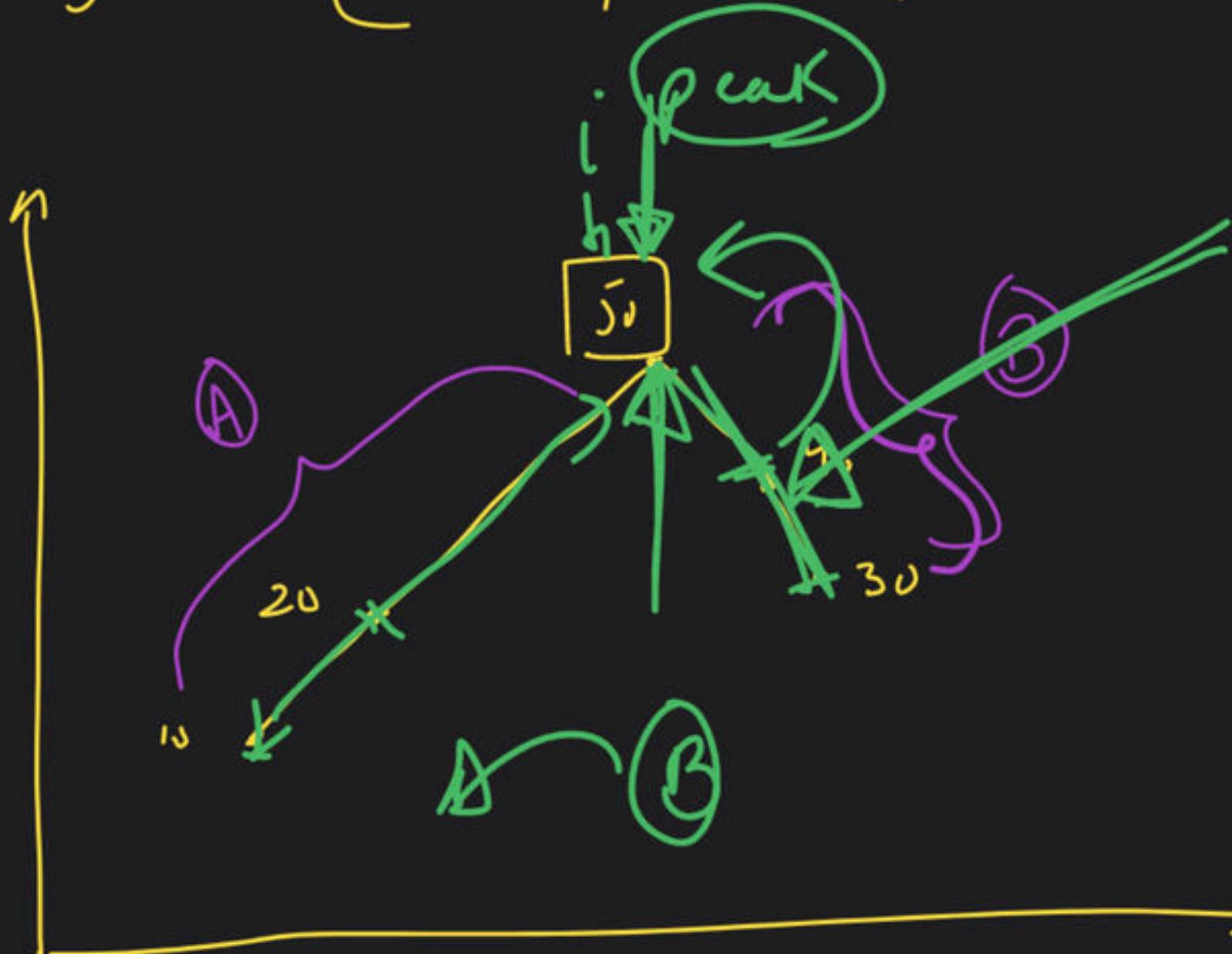


Peak element in a Mountain Array

$i/p \rightarrow \text{array}() = \{ 10, 20, 50, 40, 30 \}$

(A)  $\text{arr}[i] < \text{arr}[i+1]$

(B)  $\text{arr}[i] > \text{arr}[i+1]$

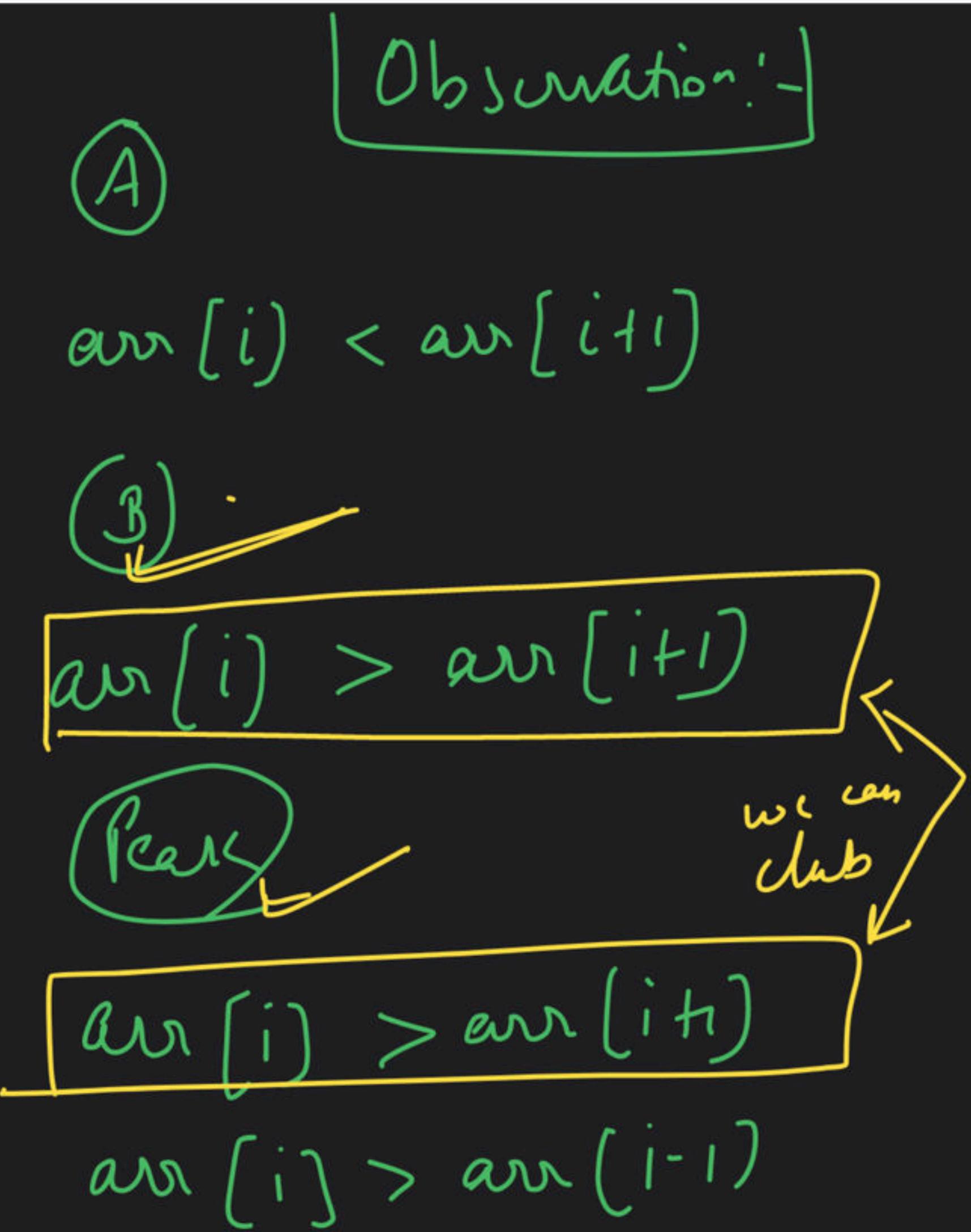
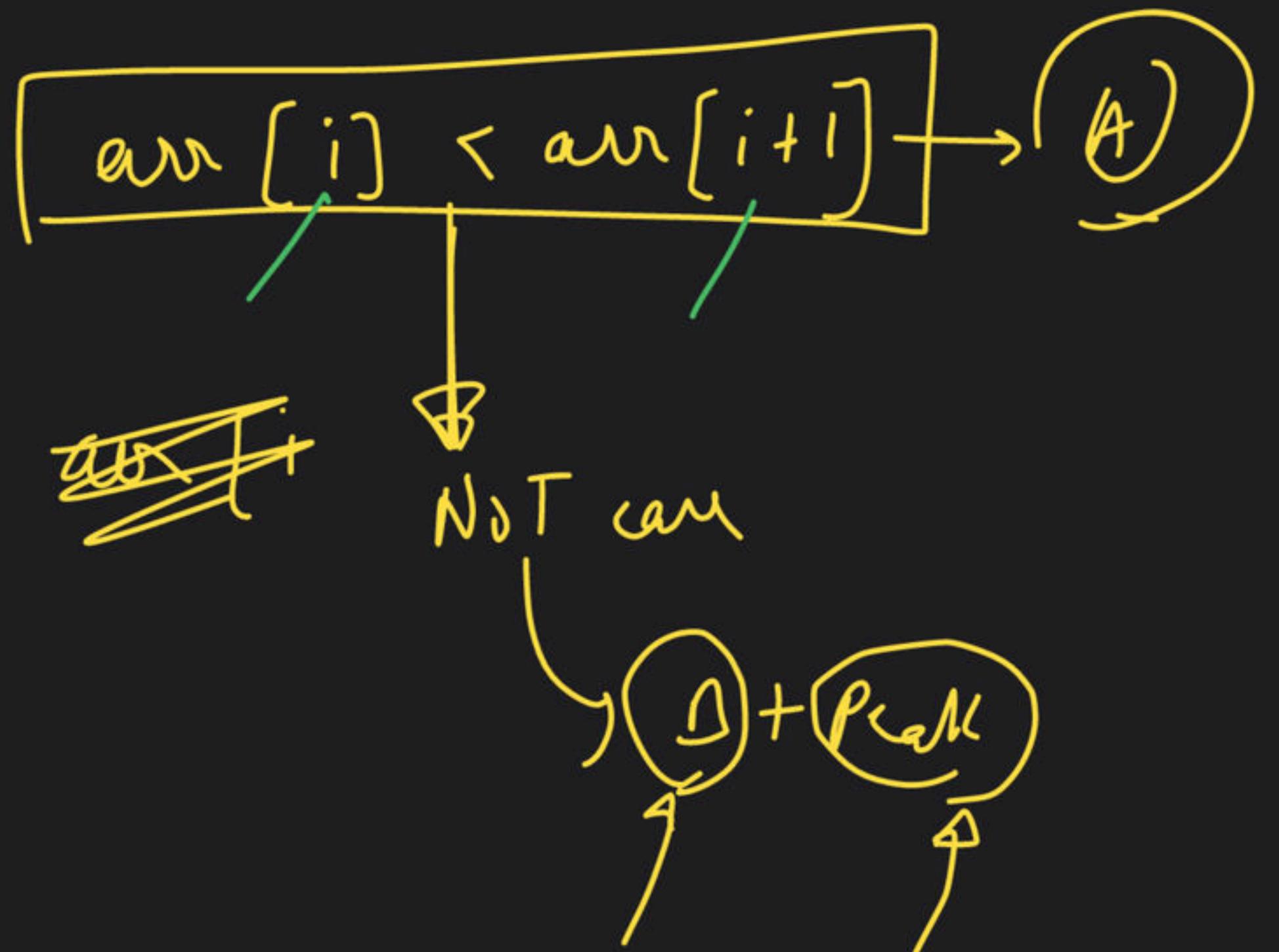


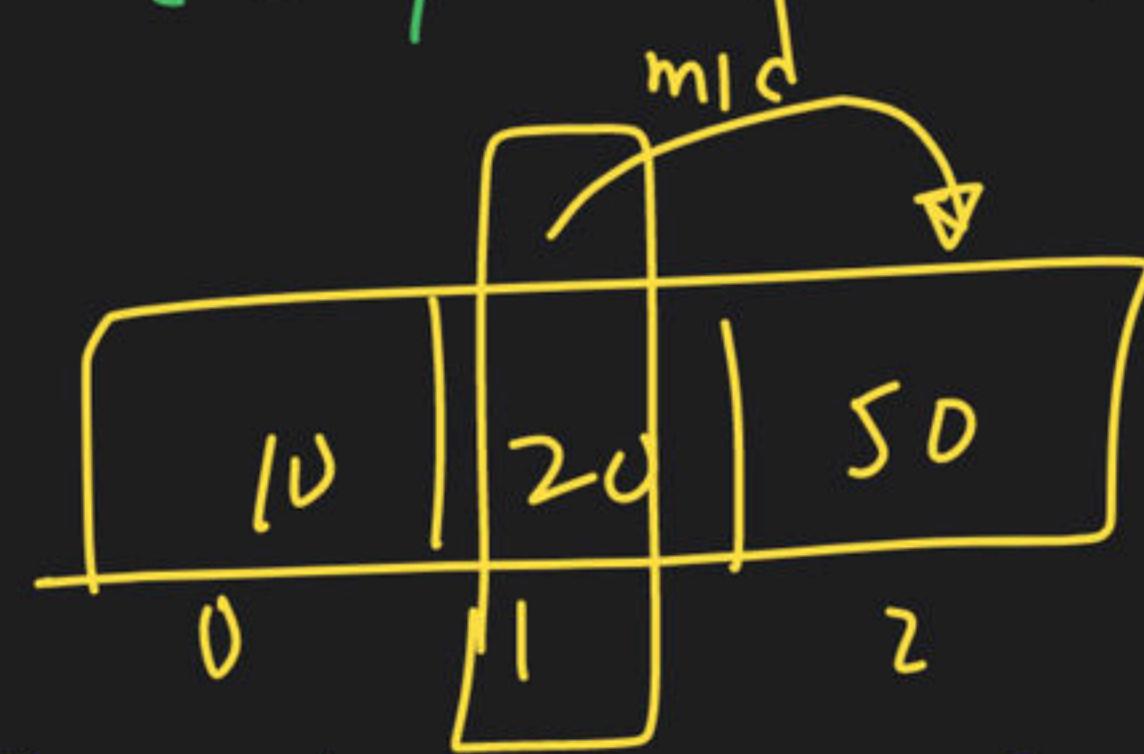
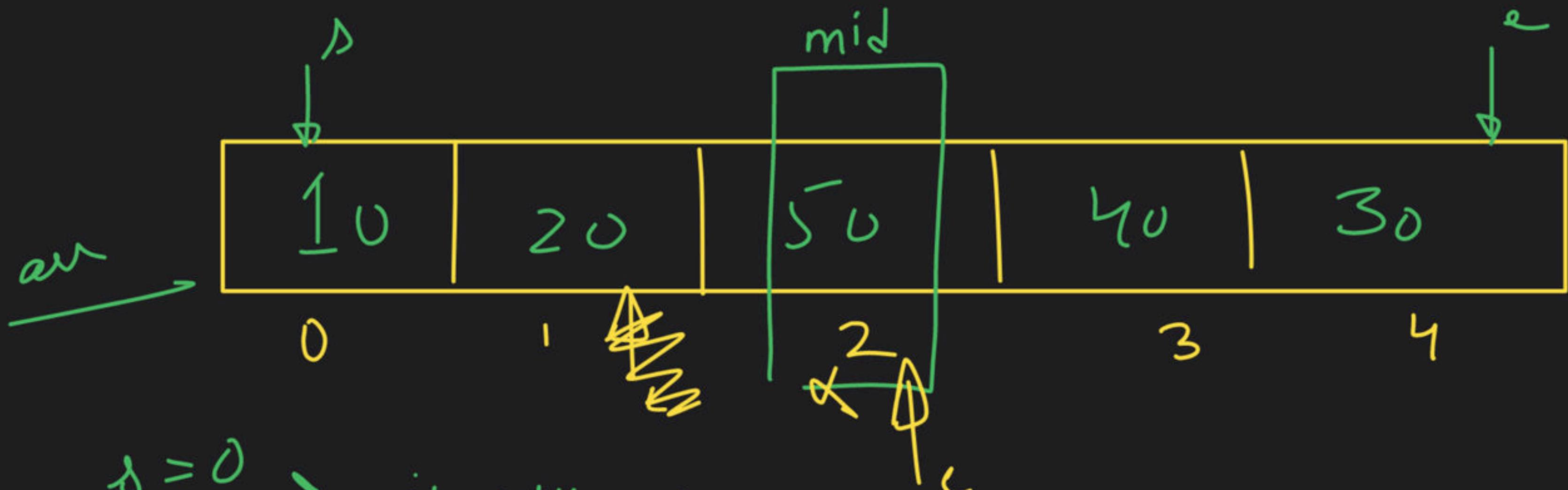
$\text{ans} = 50 \rightarrow o/p$

Karr ↗?

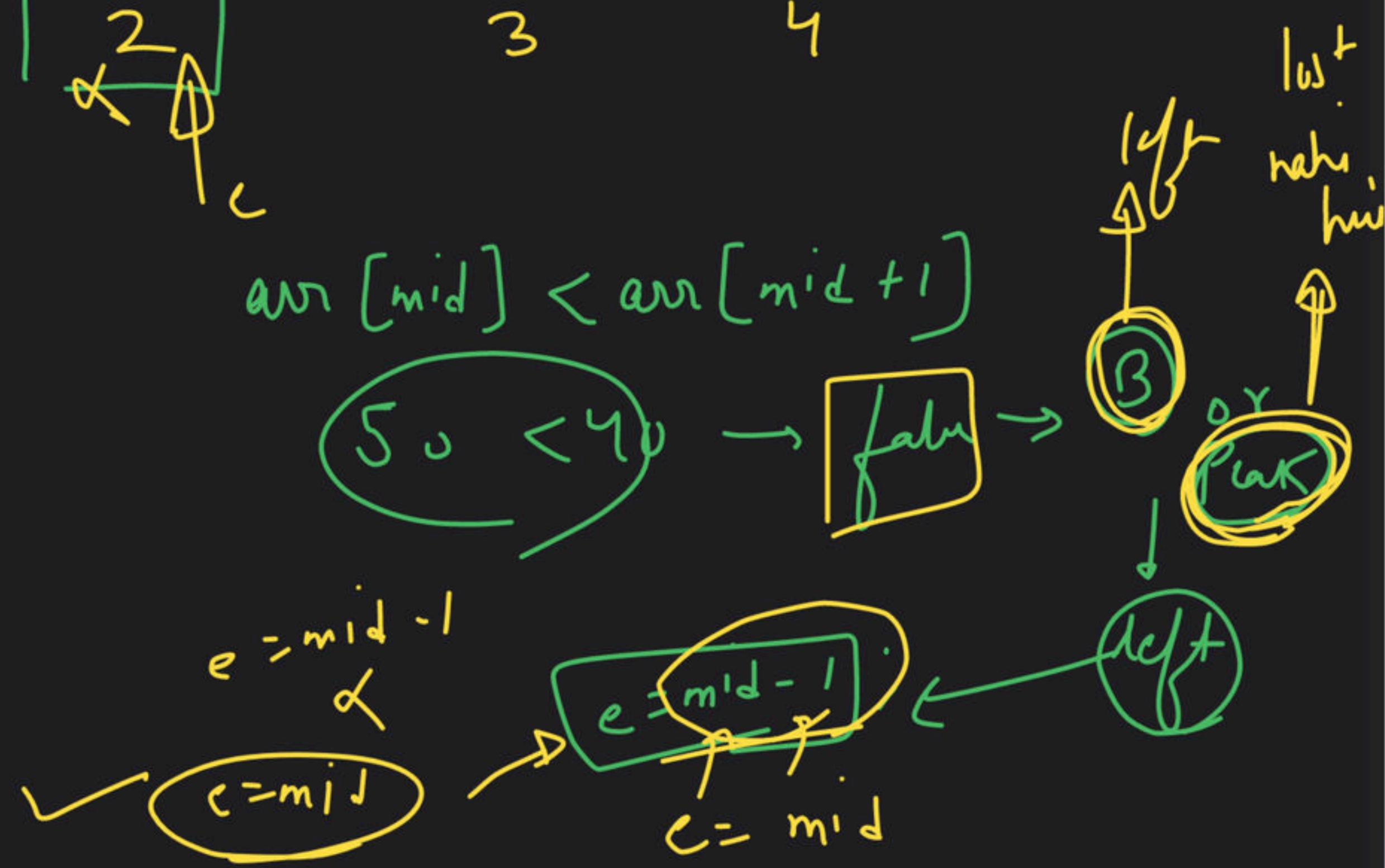
peak point

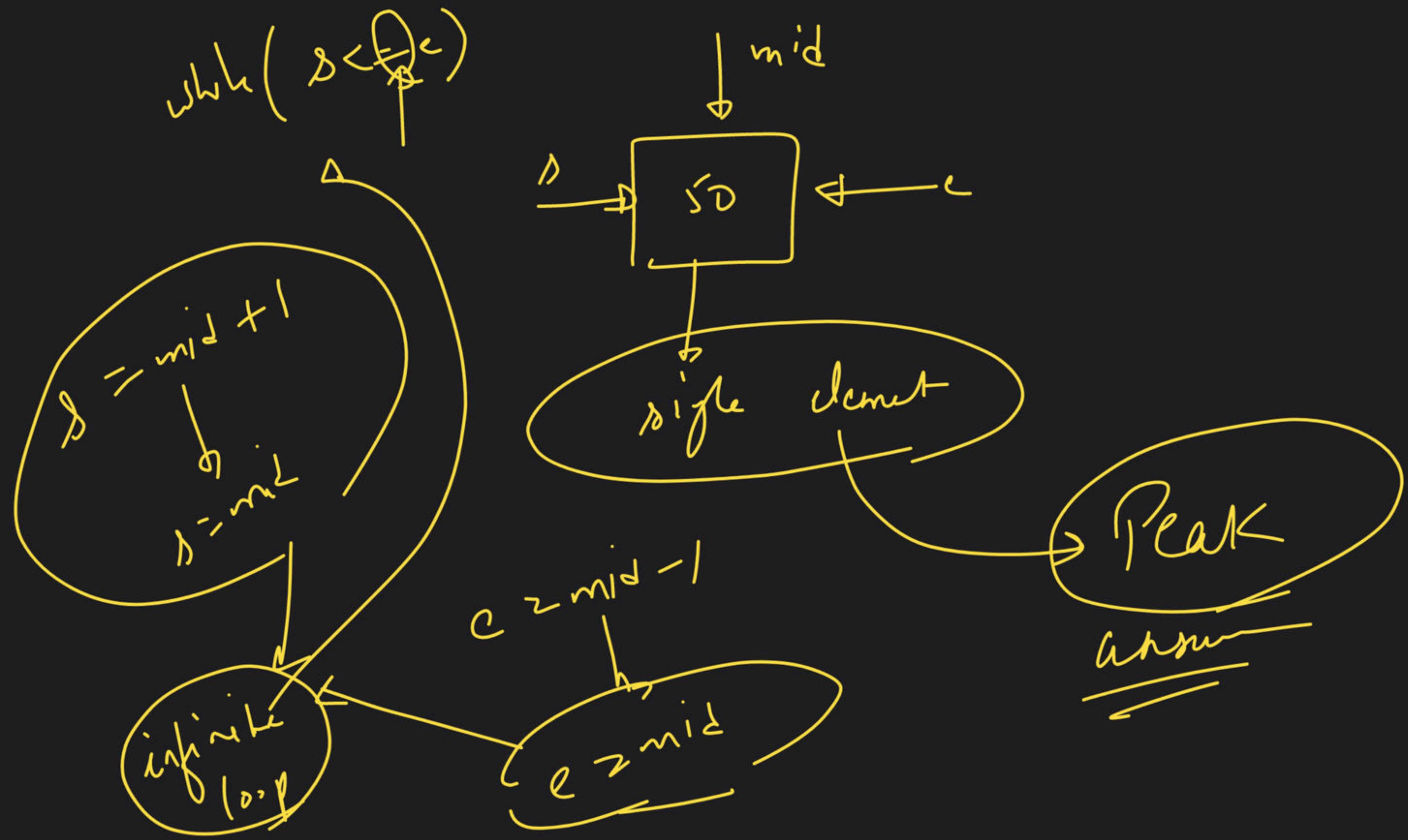
$\text{arr}[i-1] < \text{arr}[i] > \text{arr}[i+1]$





$d = 0$ ,  $c = 2$ ,  $mid = 1$   
 $20 < 50 \rightarrow \text{true}$   
 Right.





10	20	30	90	70	60	50	40
0	1	2	3	4	5	6	7

over

0 P

1

2 P

3

4

5

6

7

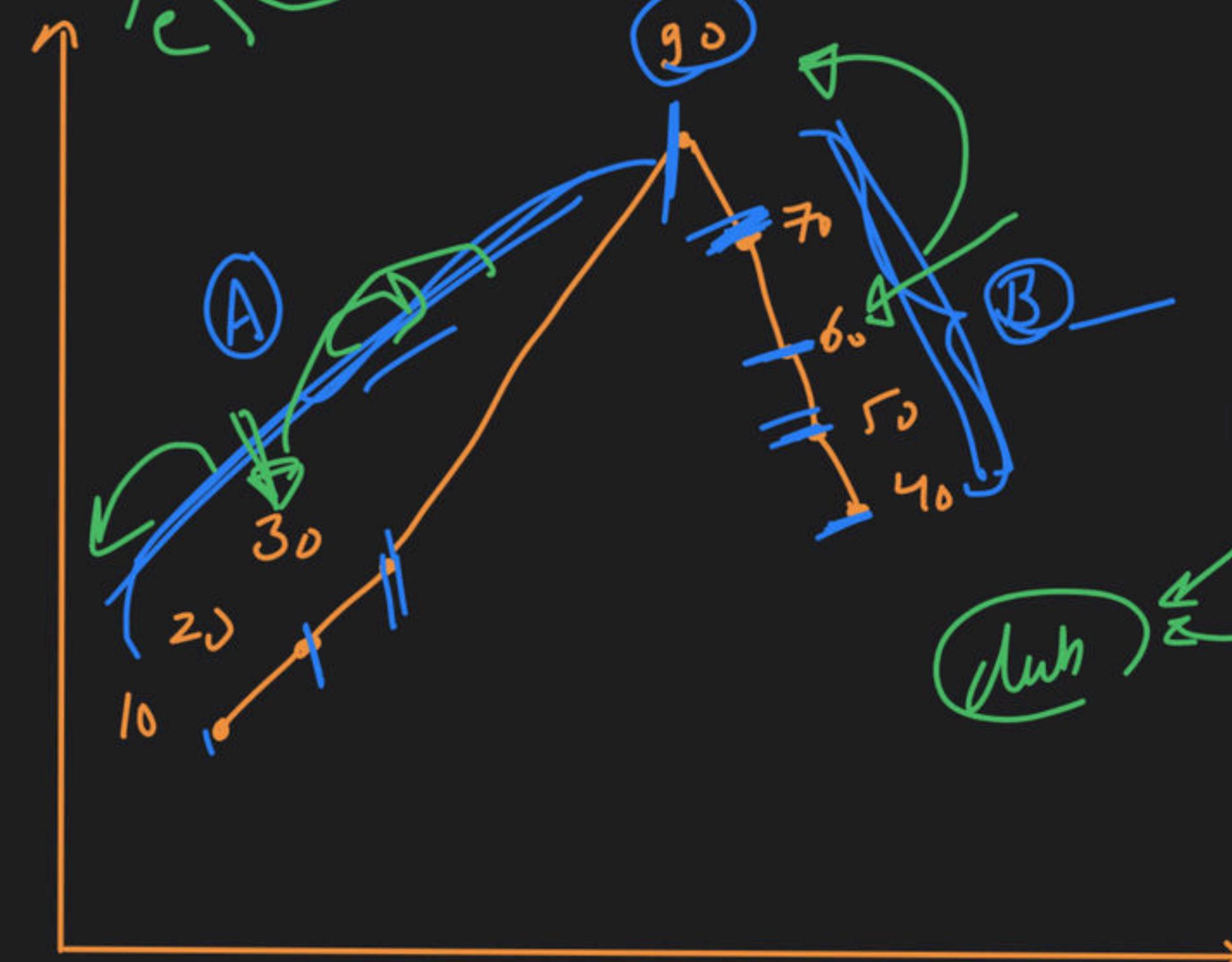
(A) element

(B) right

(B)

kT

Peak  
within py  
richta



peak

90

70

60

50

40

30

20

10

duh

Time

arr[i] < arr[i+1]

arr[i] > arr[i+1]

Peak

arr[i] > arr[i-1]

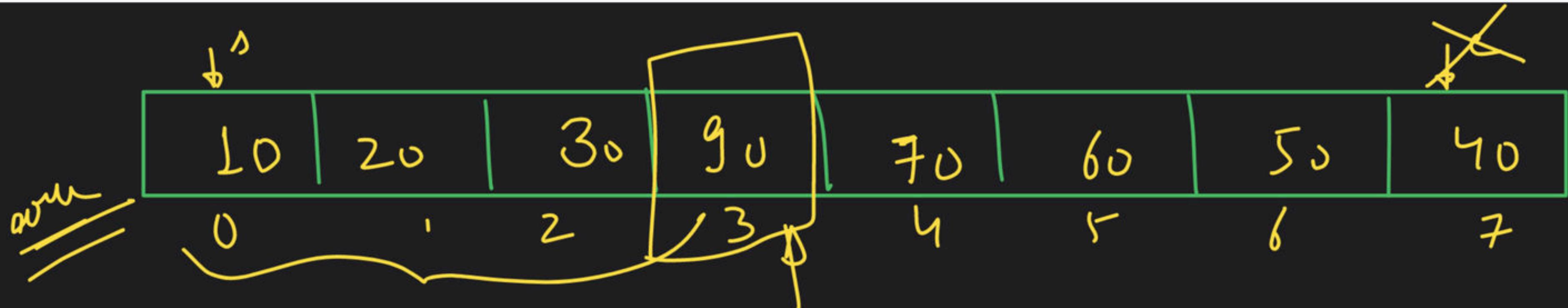
arr[i] > arr[i+1]

$s < e$

$\Delta^2 = c$

```
if (arr[mid] < arr[mid + 1]) → true → A
{
    // right
    s = mid + 1
}
else
{
    // left
    e = mid;
}
```

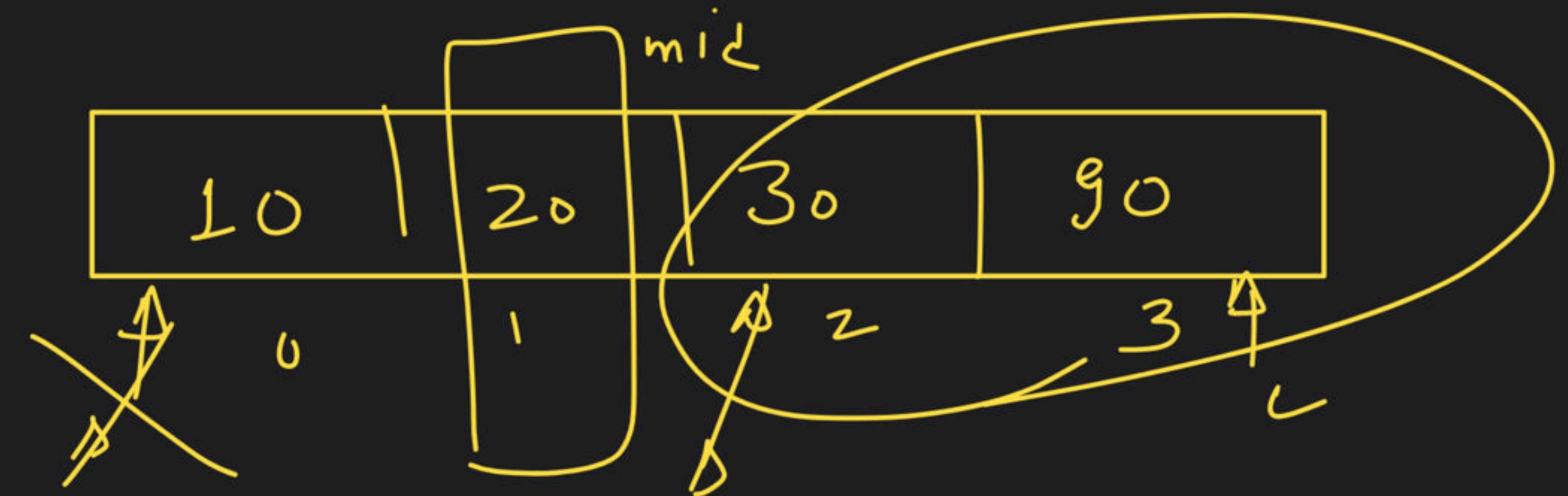
A flowchart diagram is shown on the right side of the code. It starts with a green oval labeled 'A'. An arrow points from 'A' to a green oval labeled 'B'. From 'B', an arrow points to a green oval labeled 'Pcalc'. A curved arrow originates from the bottom of 'Pcalc' and points back to the 'else' block of the code.



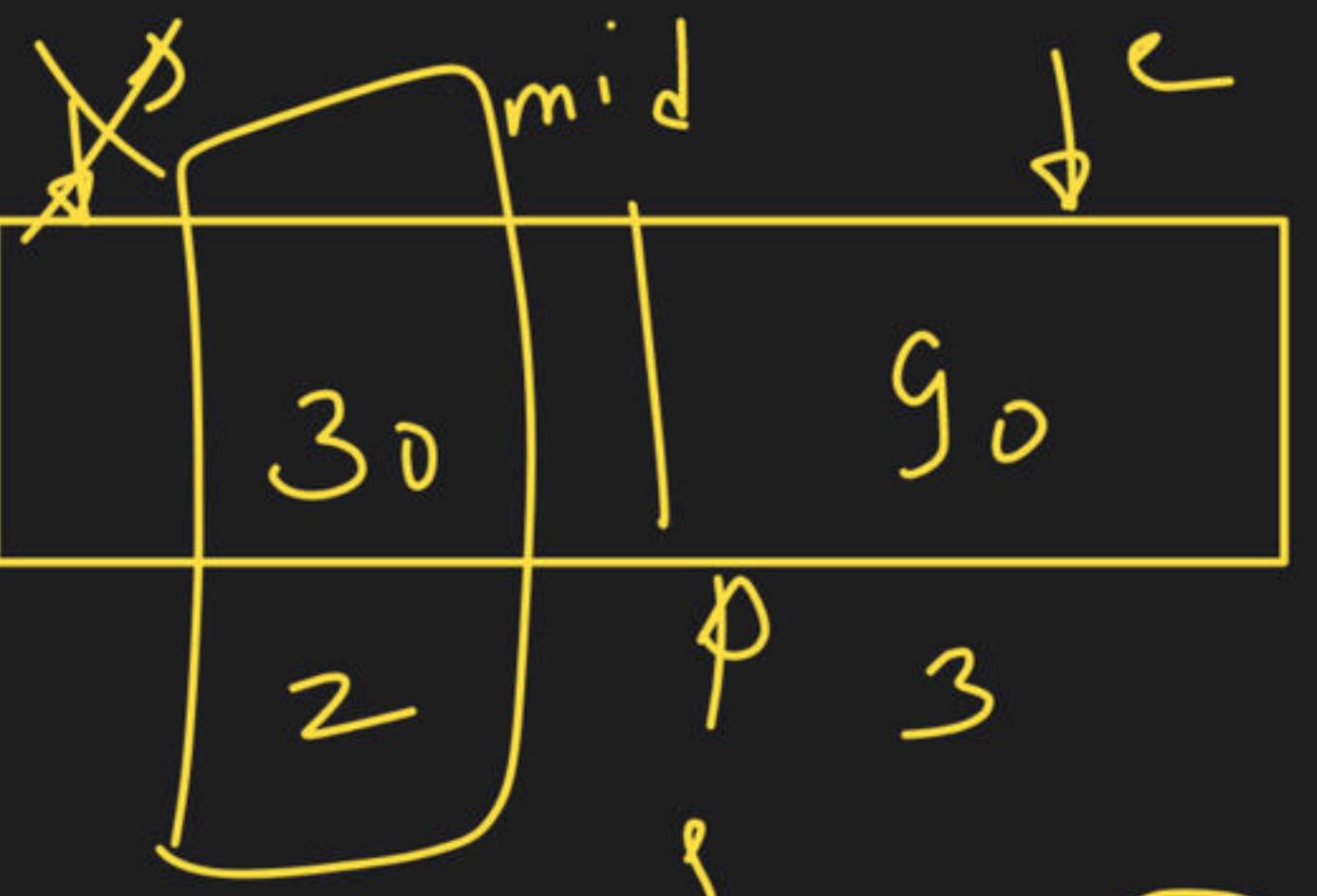
$$g = 0 \quad c = 7 \quad \rightarrow \quad \text{mid} \rightarrow \frac{0 + 7}{2} = 3$$

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

$90 < 70 \rightarrow \text{false} \rightarrow c = \text{mid}$



$\frac{0=0}{c > 3} \rightarrow \text{mid} = \frac{0+3}{2} = 1$   
 $\text{arr}[\text{mid}] < \text{arr}[\text{mid}+1]$   
 $20 < 30 \rightarrow \text{true}$   
 ↗ right



$$s = 2$$

$$c = 3$$

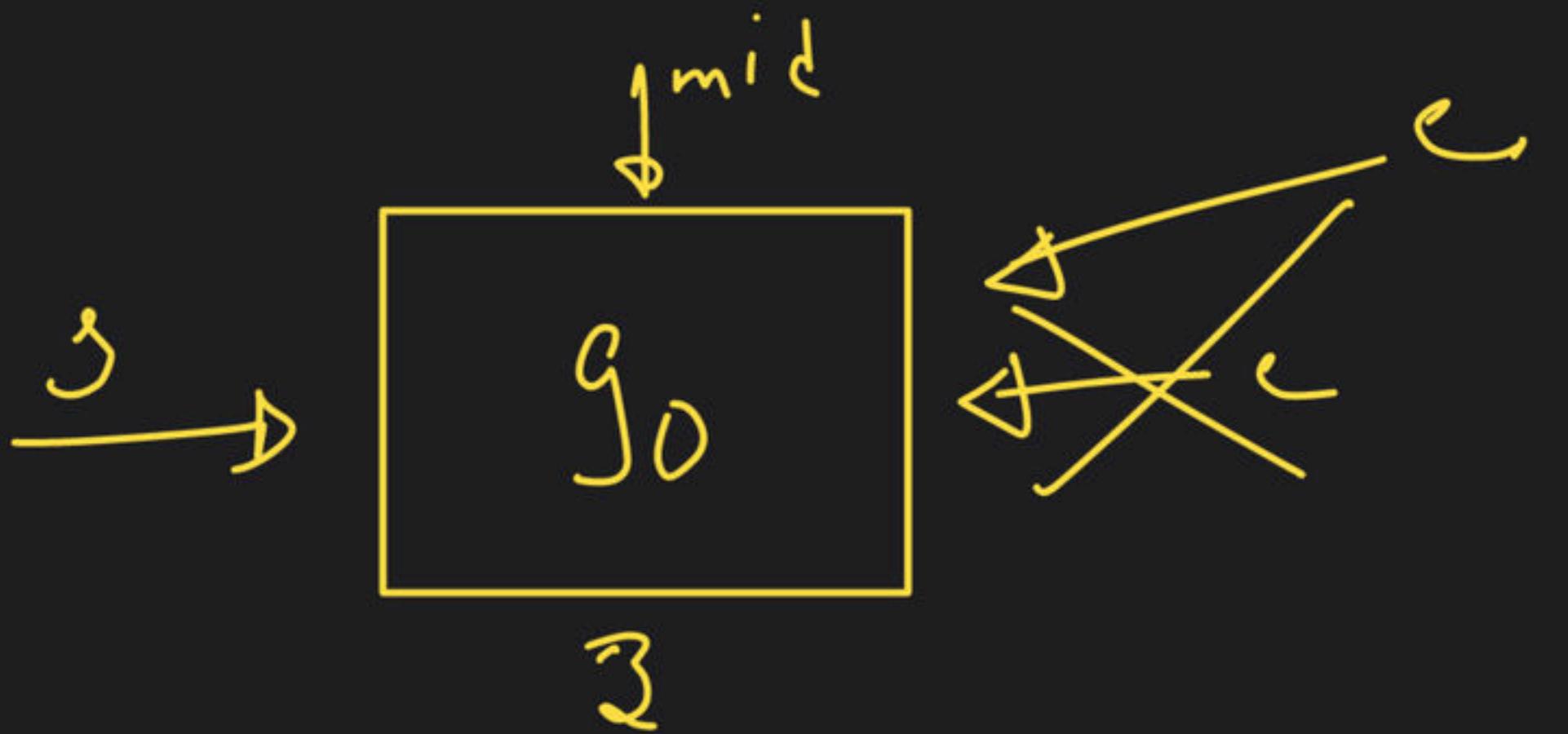
$\text{mid} = \frac{2+3}{2} = 2$

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

$3_0 < 5_0 \rightarrow$

$s = \text{mid}$        $c = \text{right}$

*true*

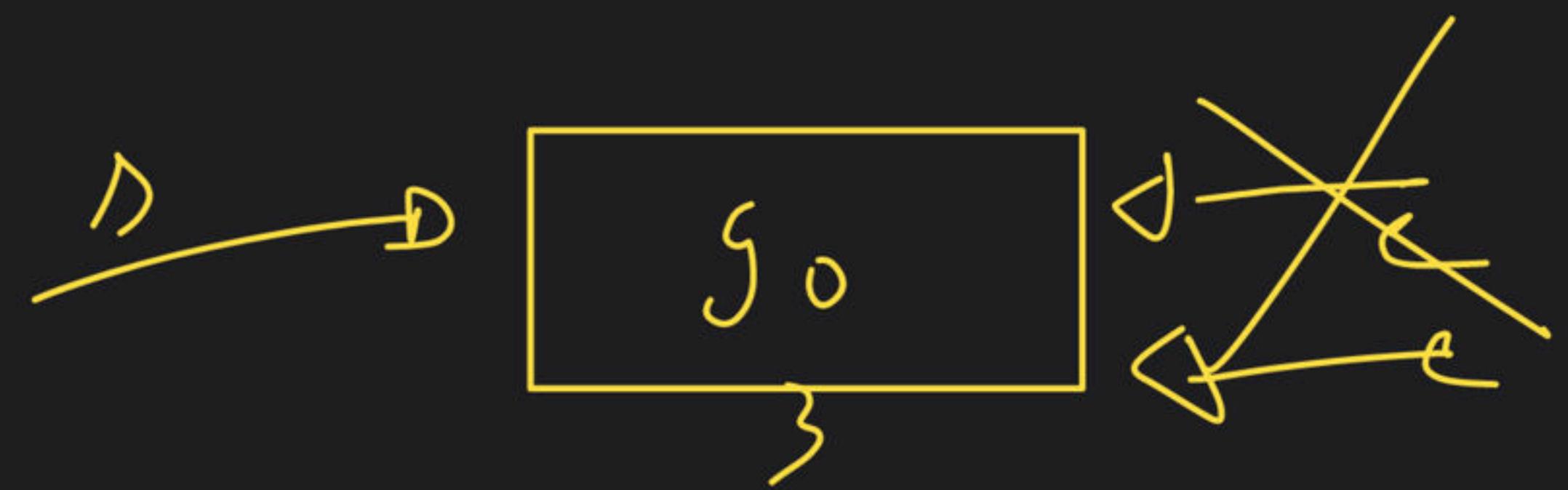


$l = 3$   
 $r = 3$

$$\text{mid} = \frac{3+3}{2} \sim 3$$

$\text{arr}(\text{mid}) < \text{arr}[\text{mid} + 1]$   
 $g_0 < r_0 \rightarrow$

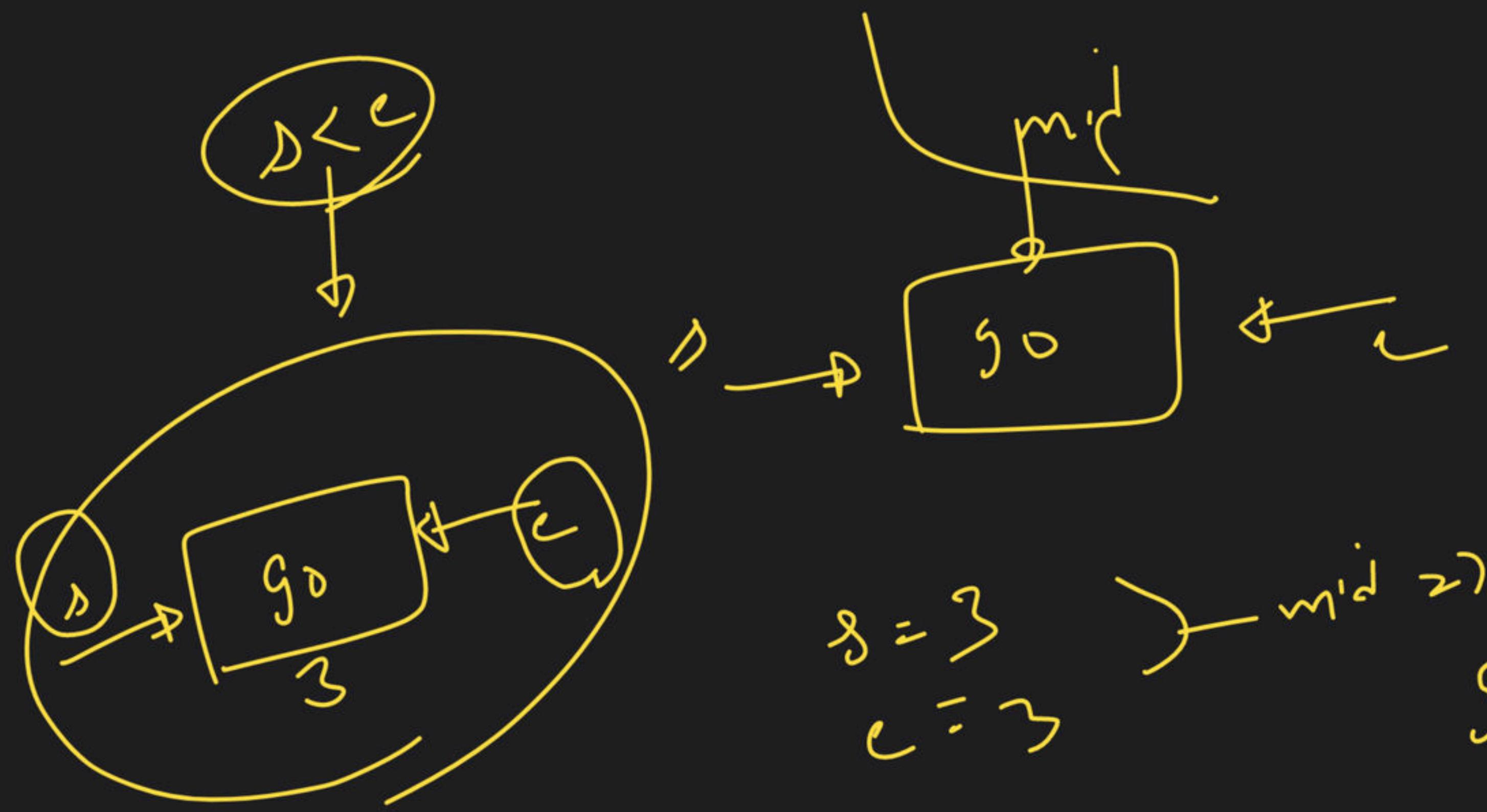




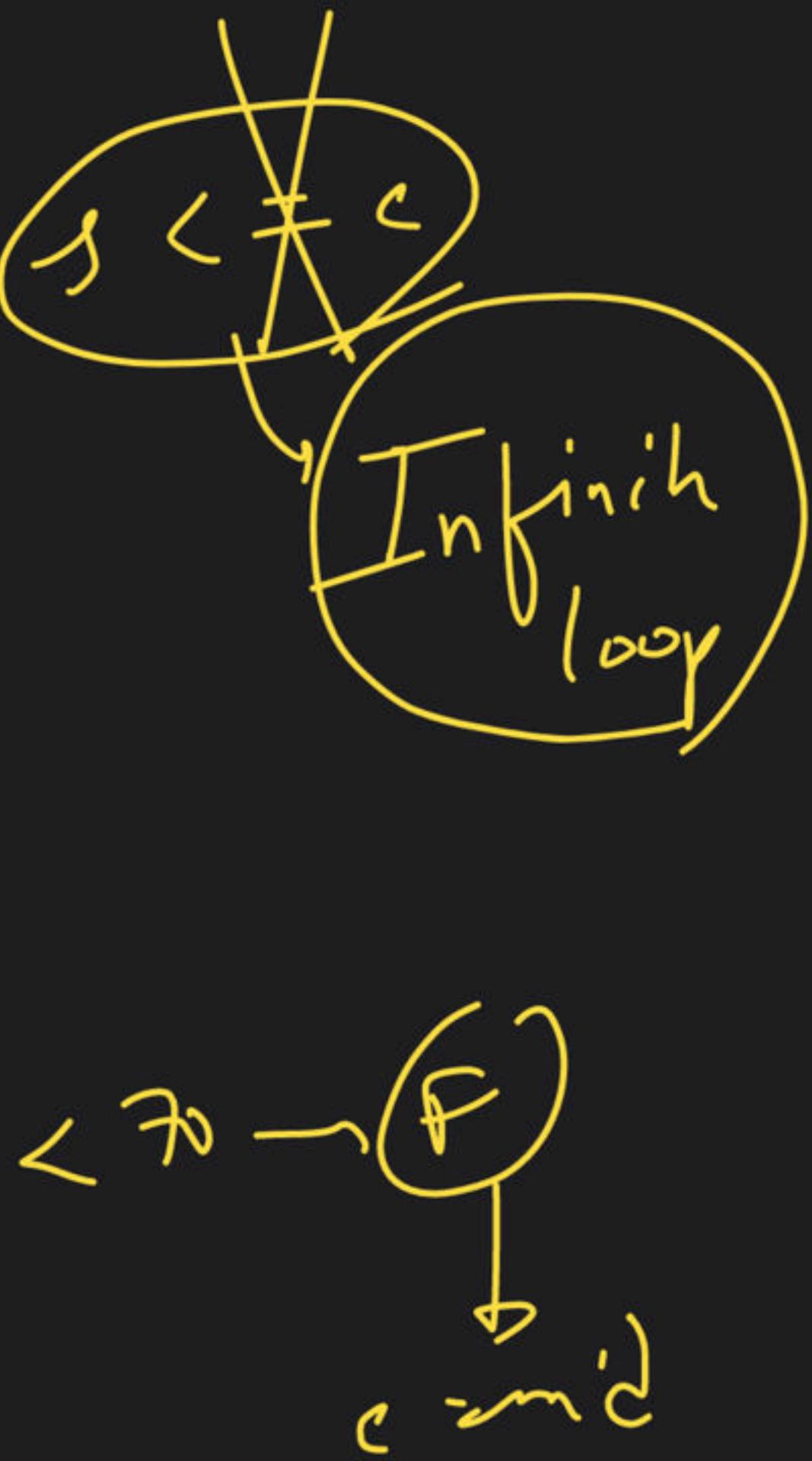
$s = 3 \rightarrow$       mid  $\rightarrow 3 \rightarrow$        $s_0 < 70 \rightarrow F$

$c = 3$

$c = mid$



$$\begin{array}{l}
 S = 3 \\
 C = 3
 \end{array}
 \quad \rightarrow \quad
 \begin{array}{l}
 m^{\text{mid}} = 2 \\
 S_0 < T_0 \rightarrow F
 \end{array}$$



Find pivot element



GFB