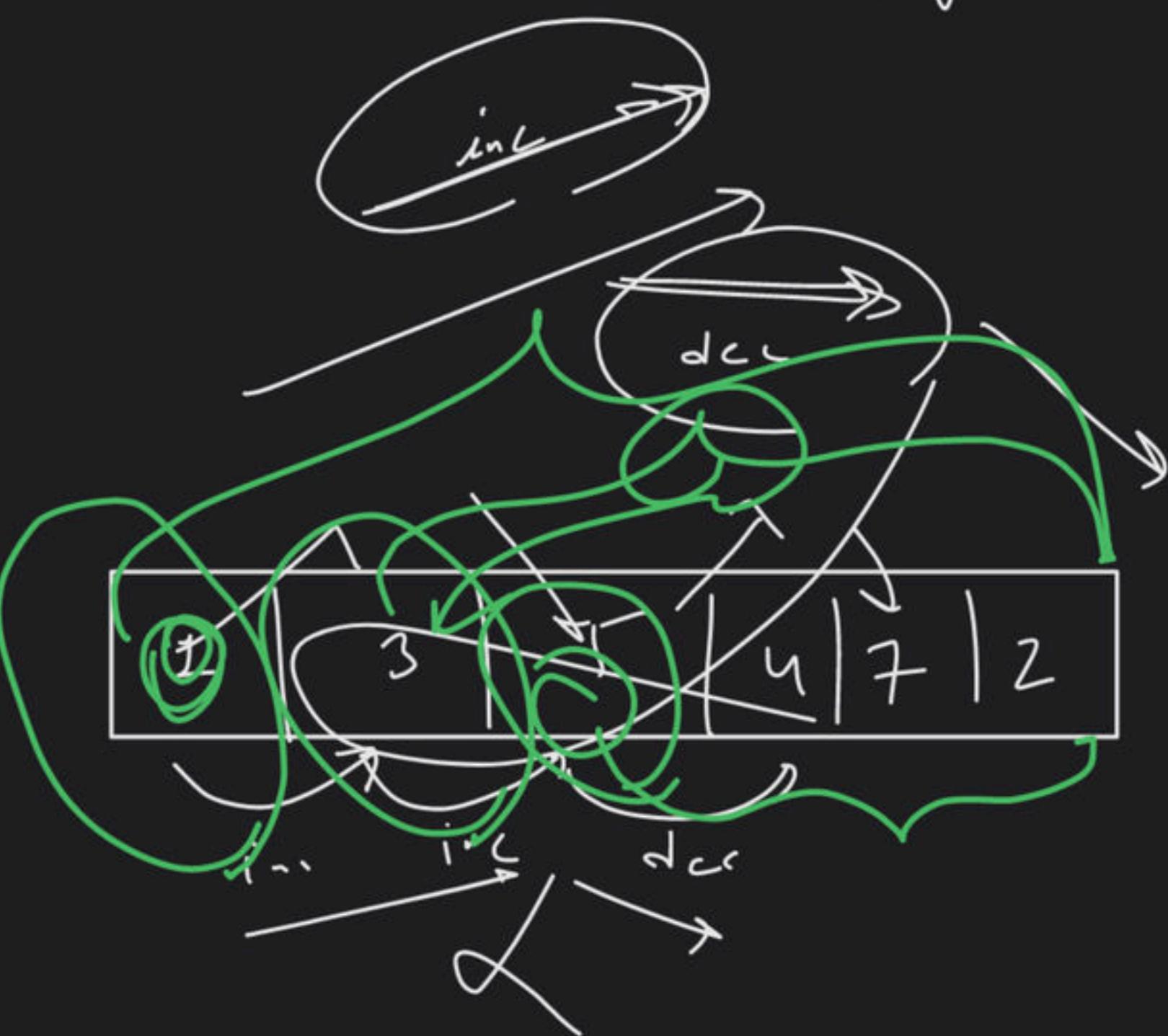


Sorting Techniques

Special class

Selection Sort :-

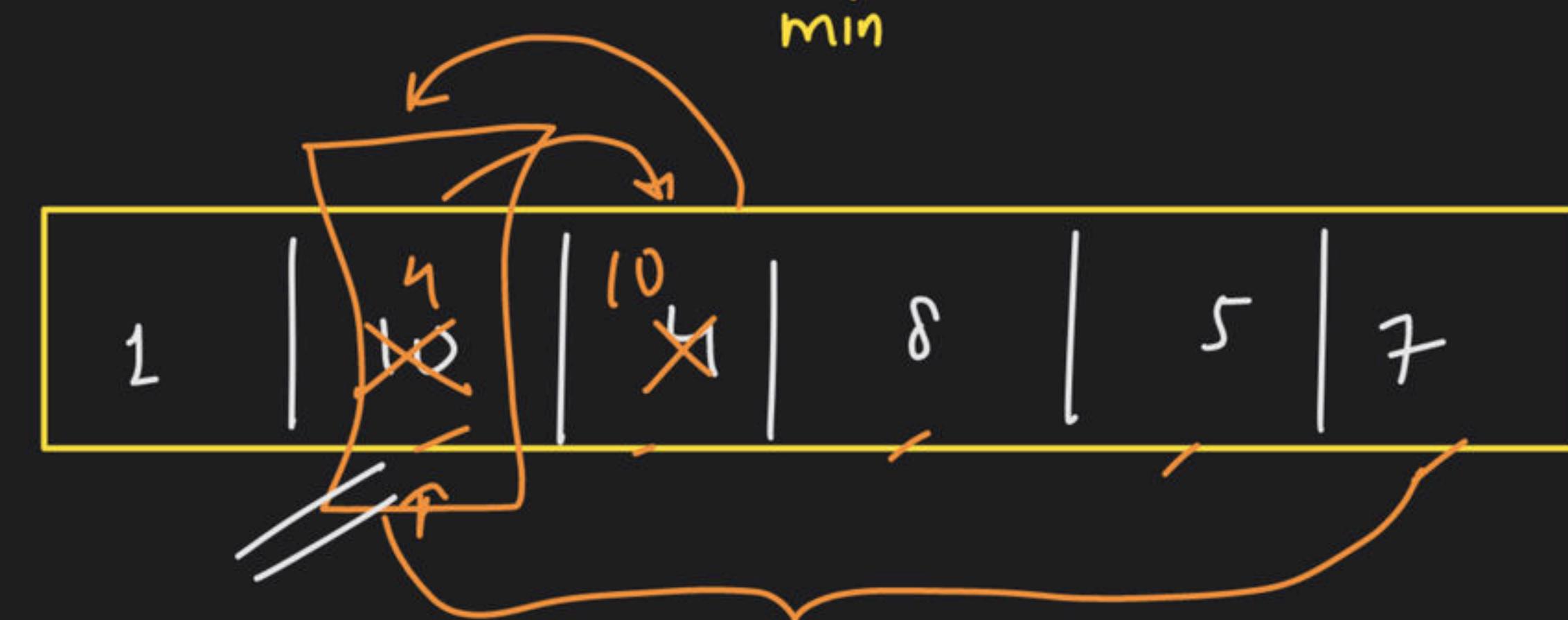
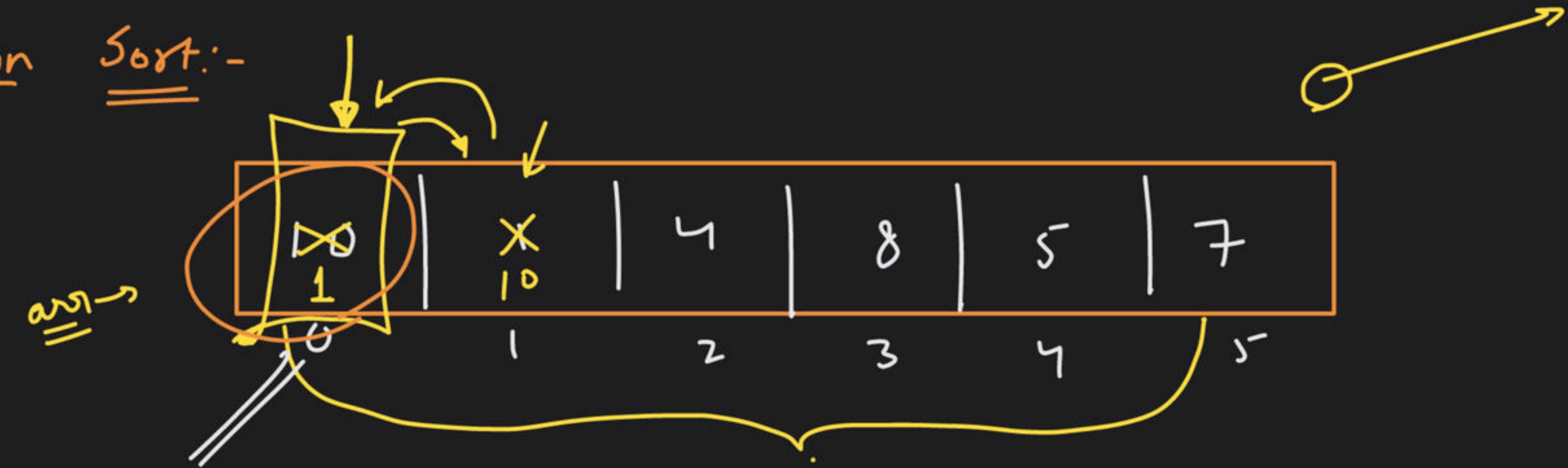
what is sorting?
=f

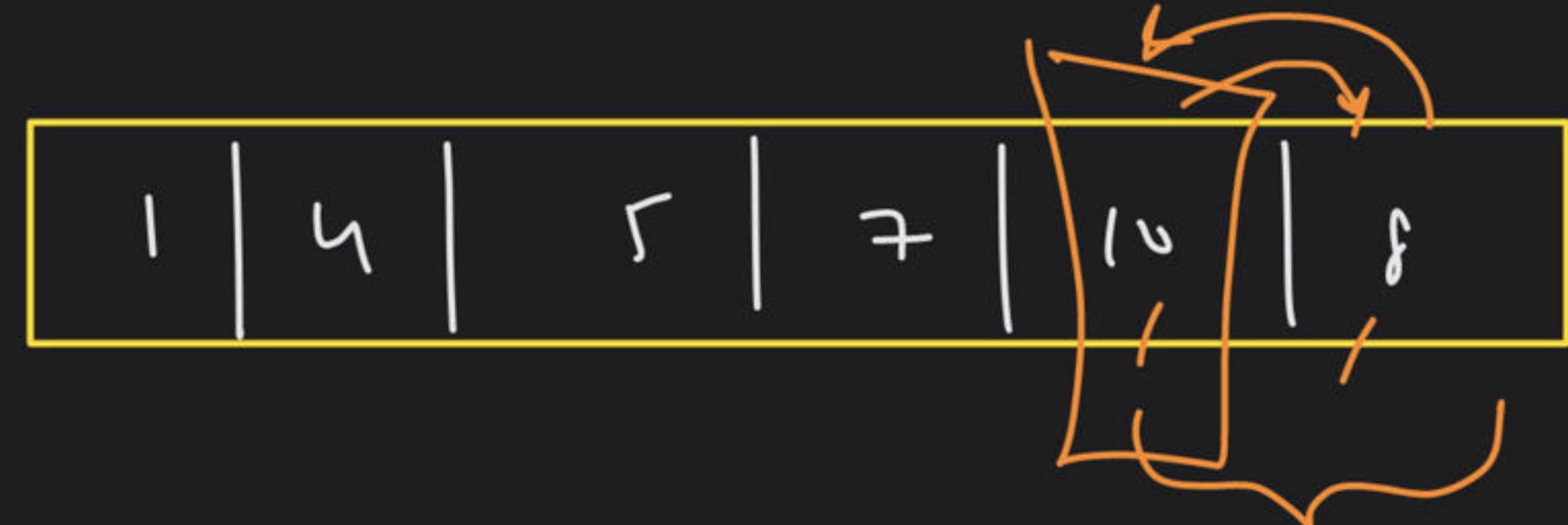
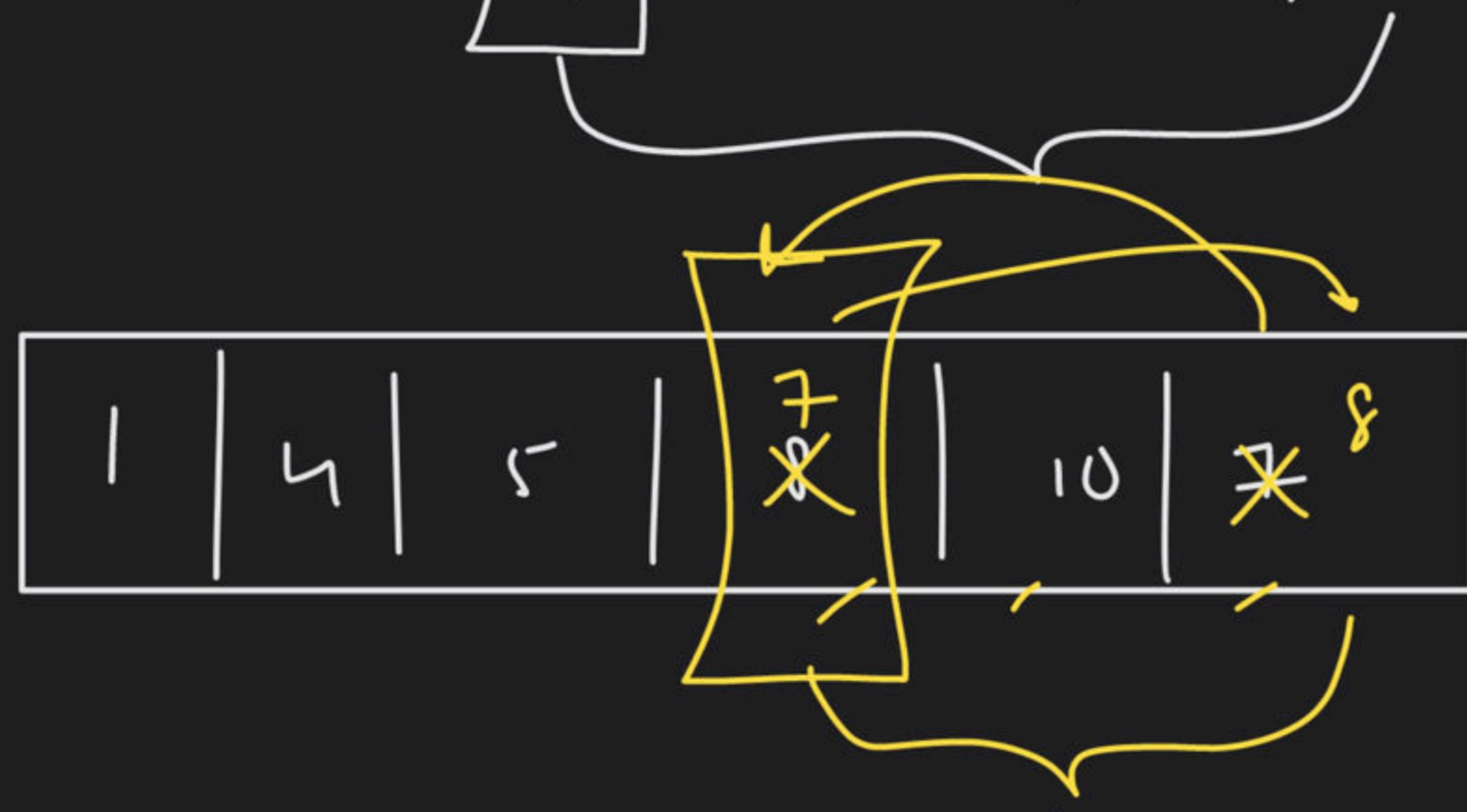
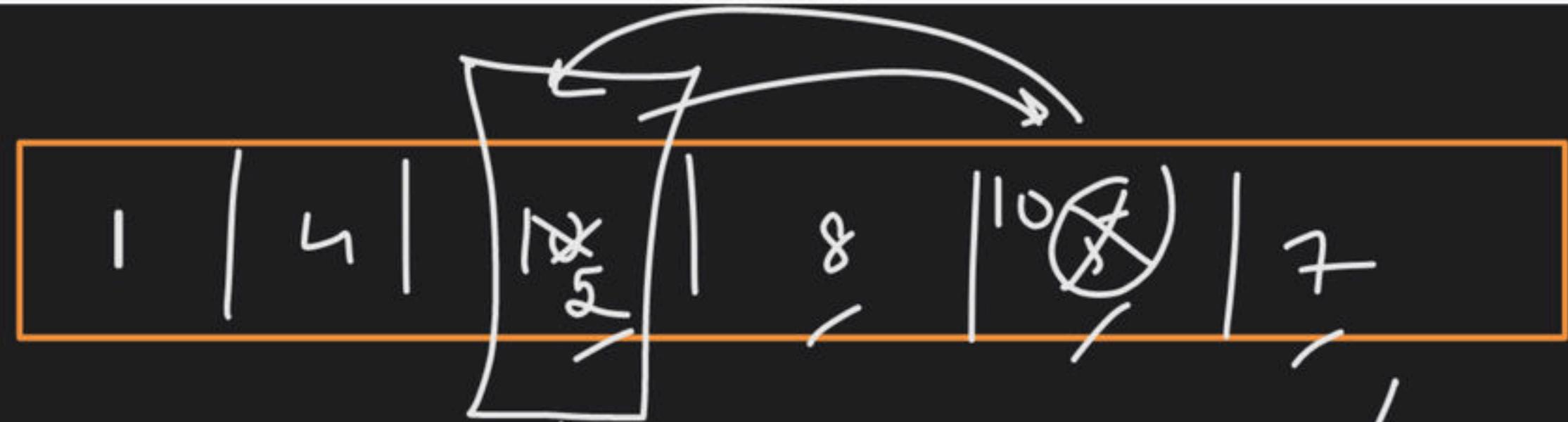


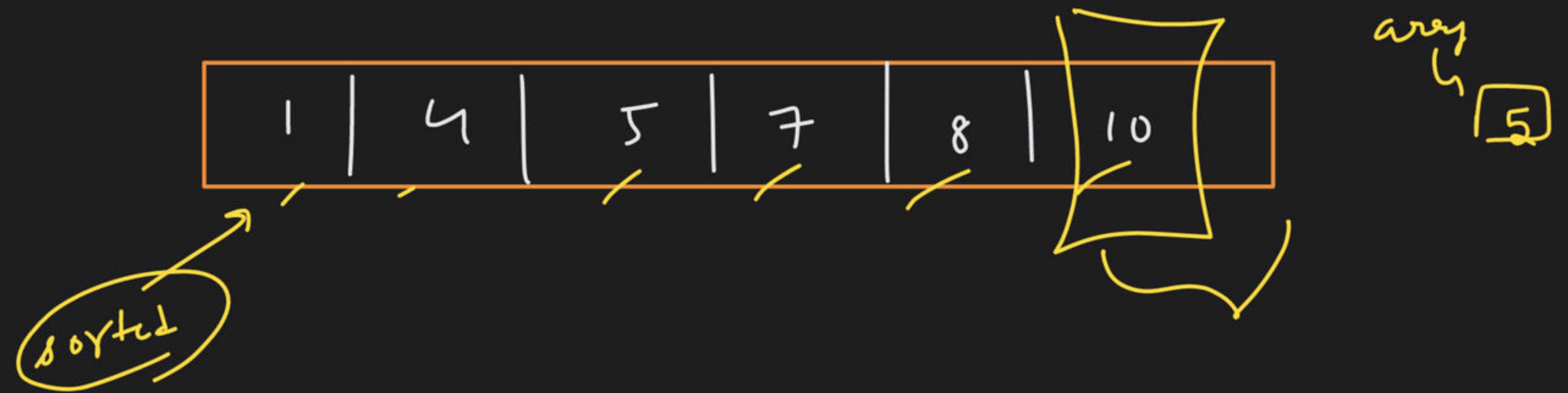
1 2 3 4 5 7

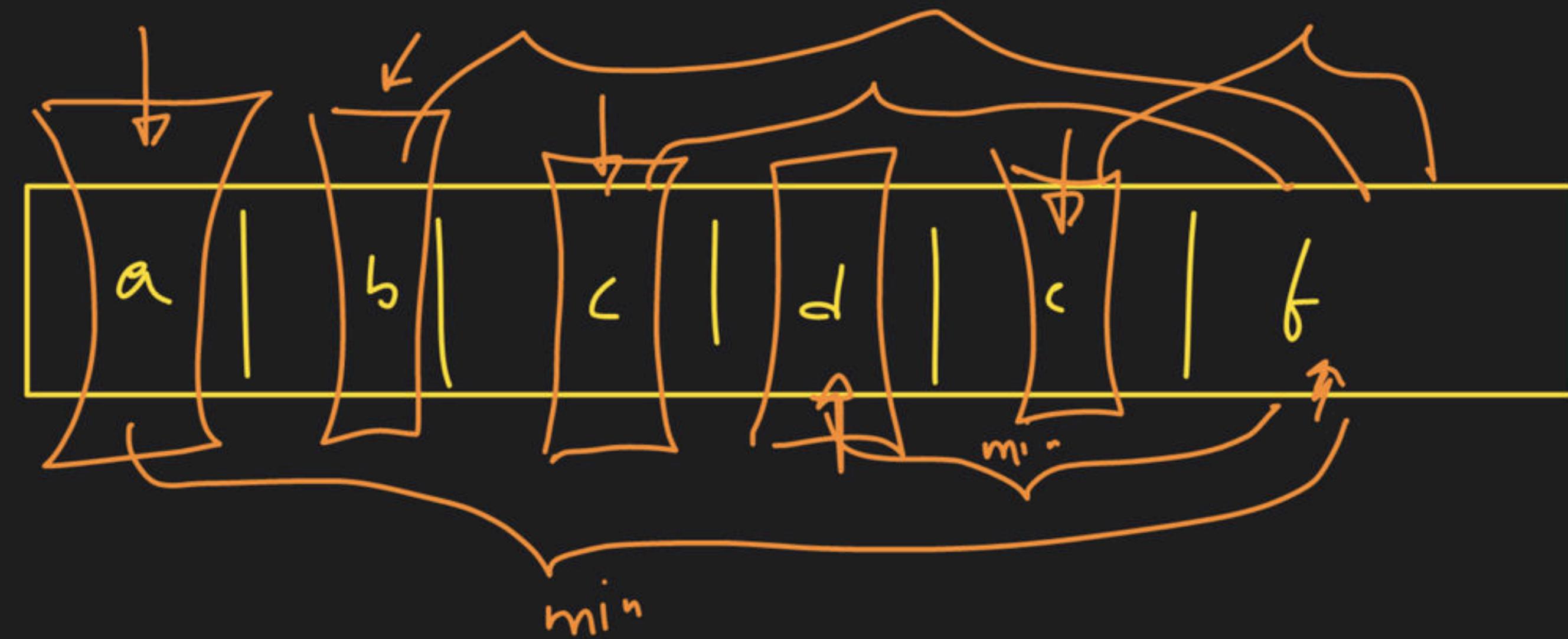
7 5 4 3 2 1

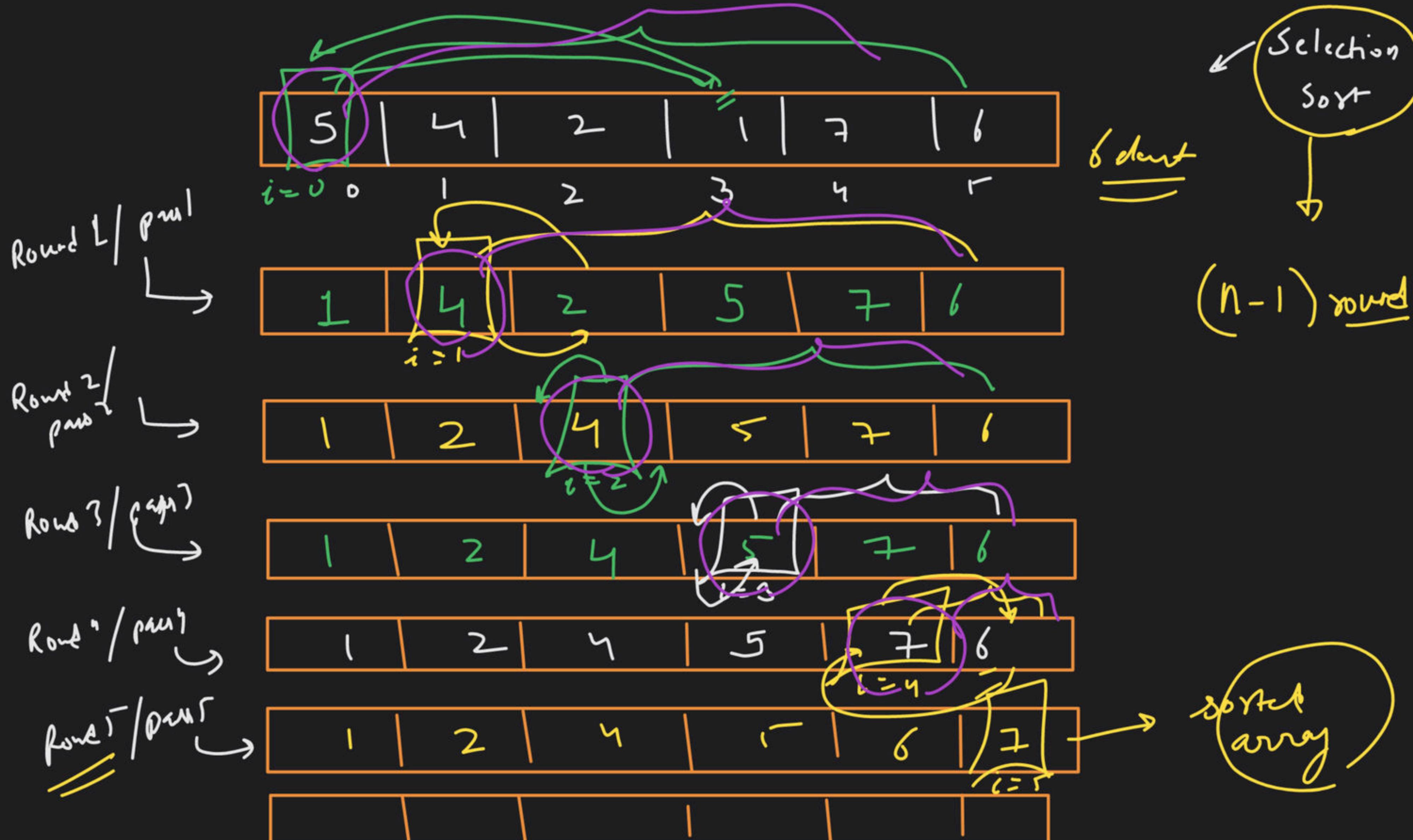
① Selection Sort:-

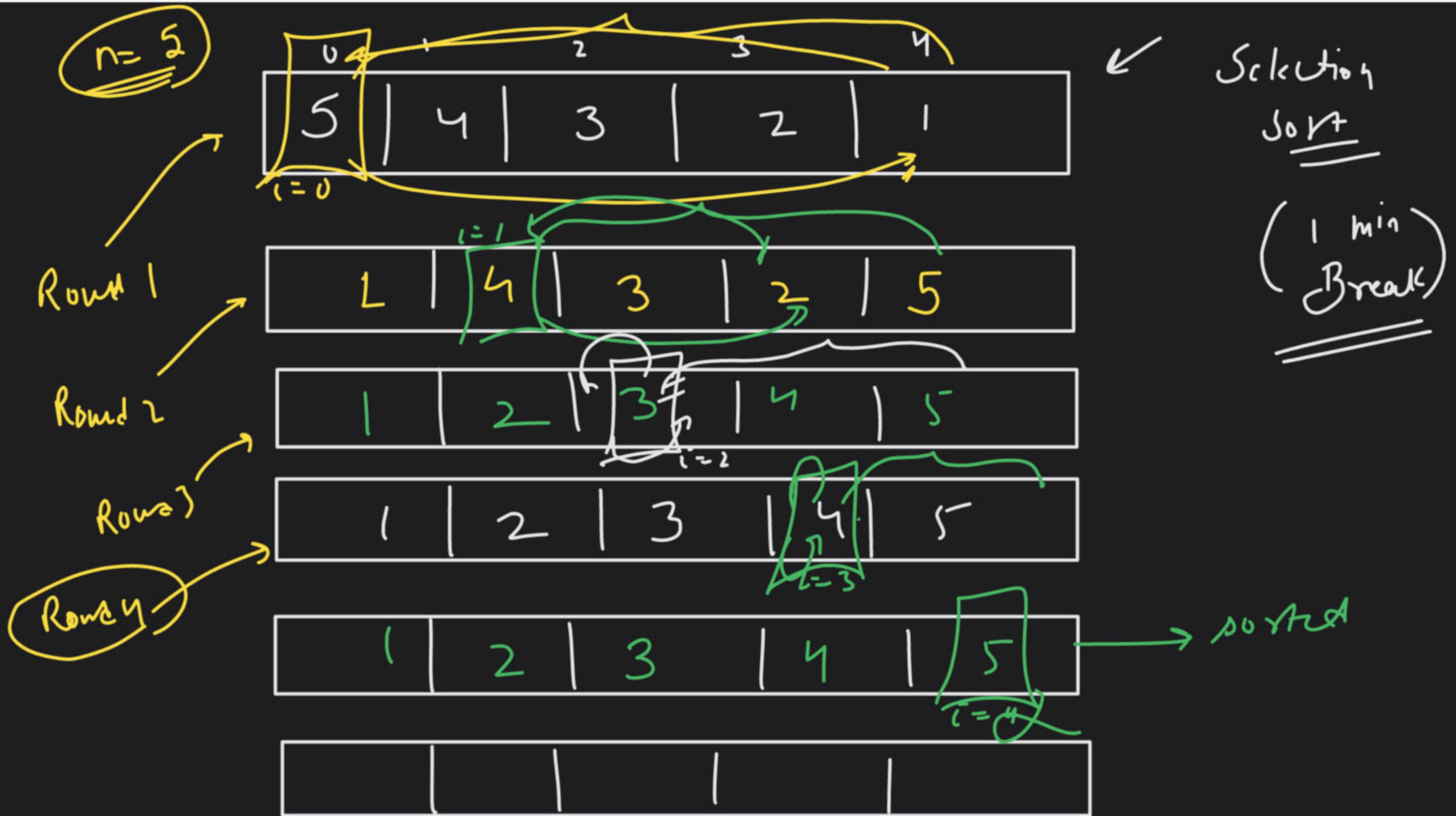




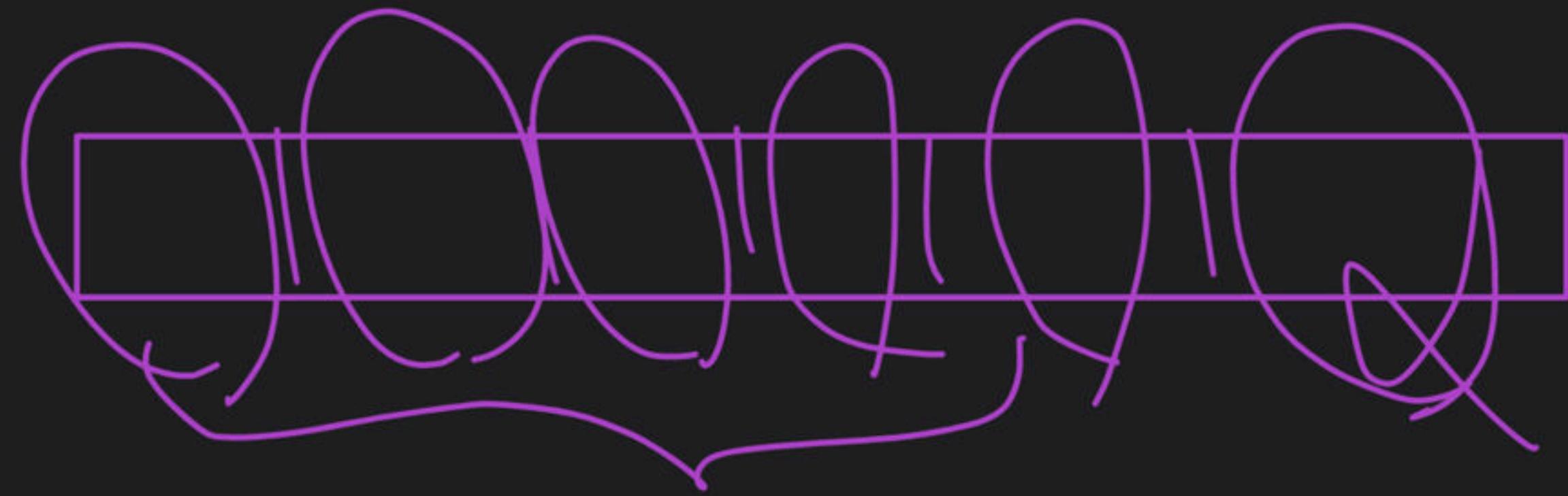
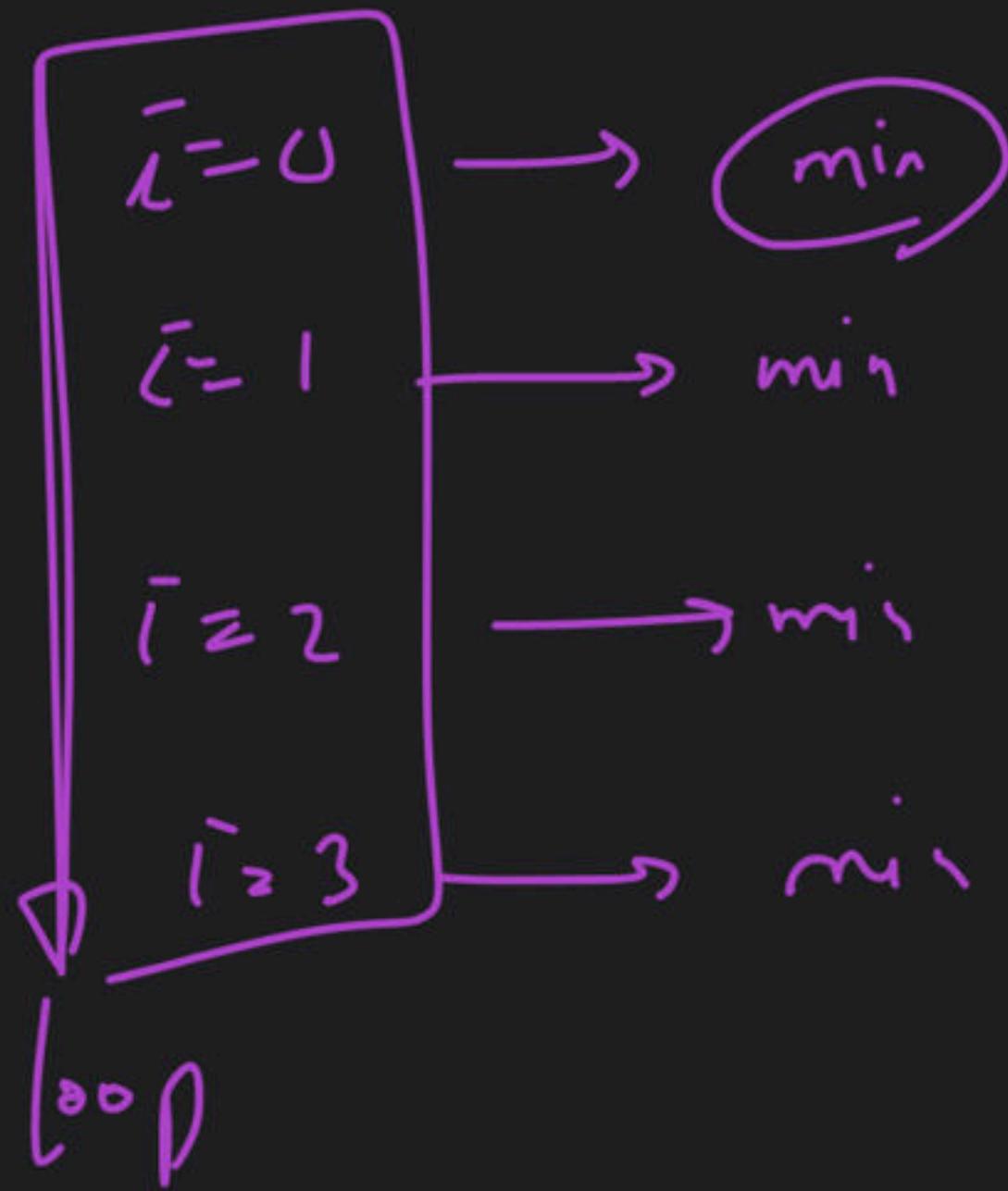






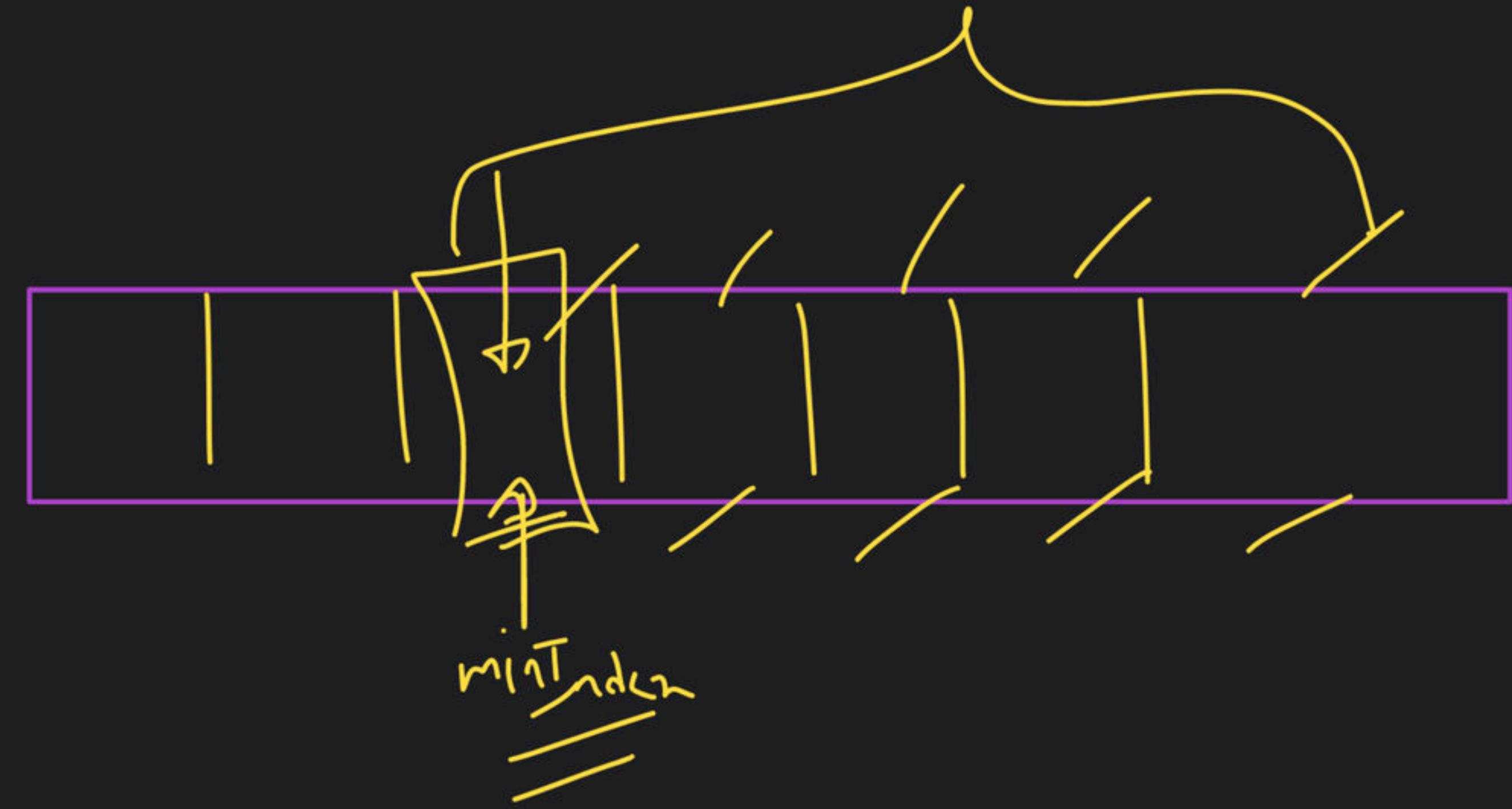


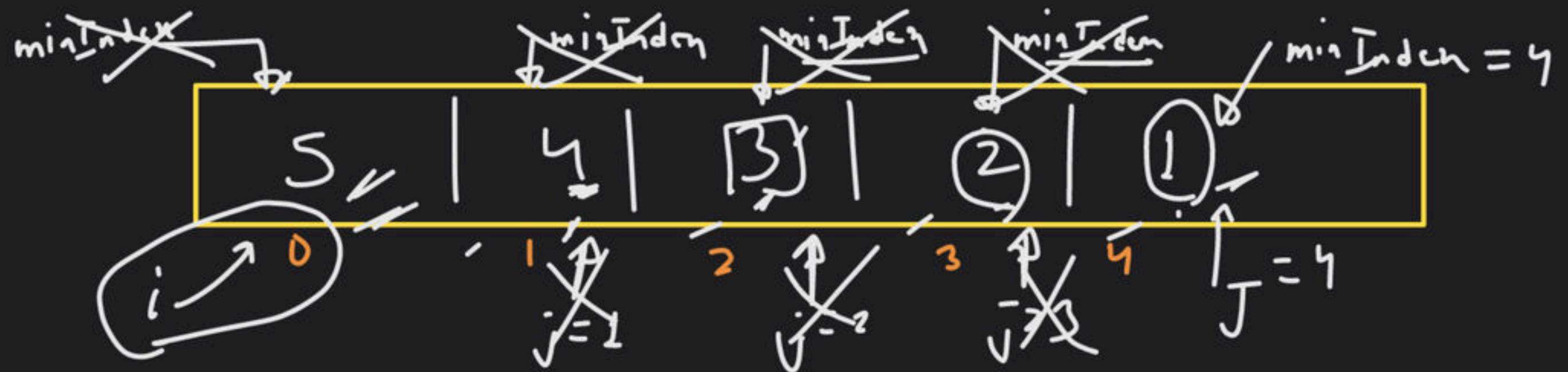




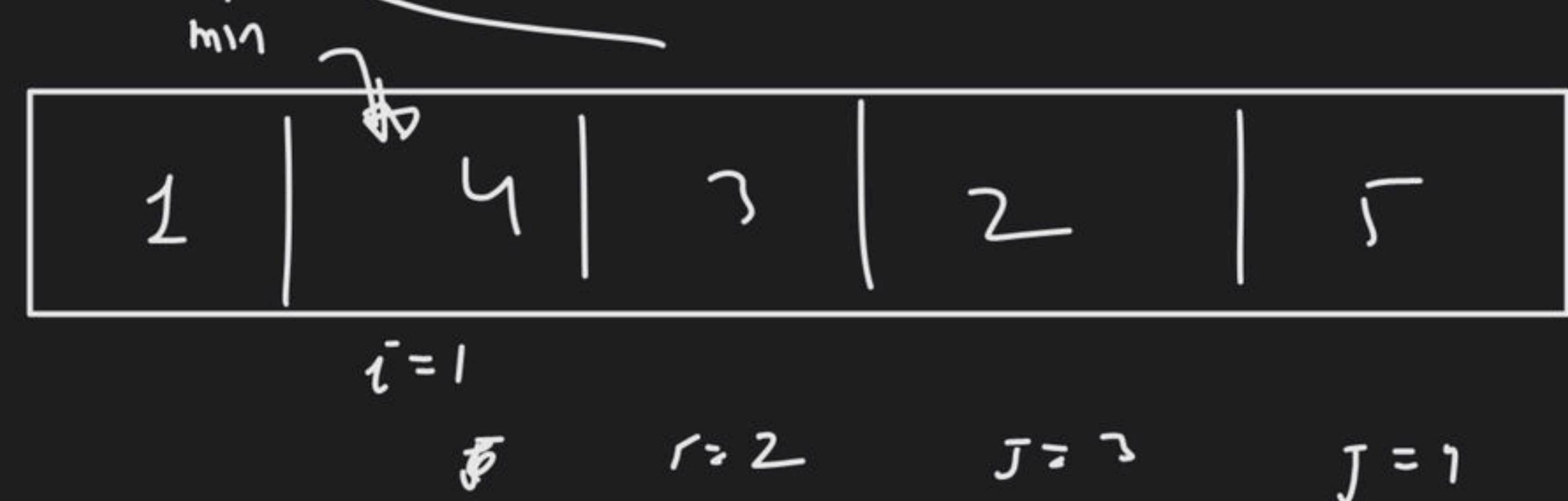
$< n$

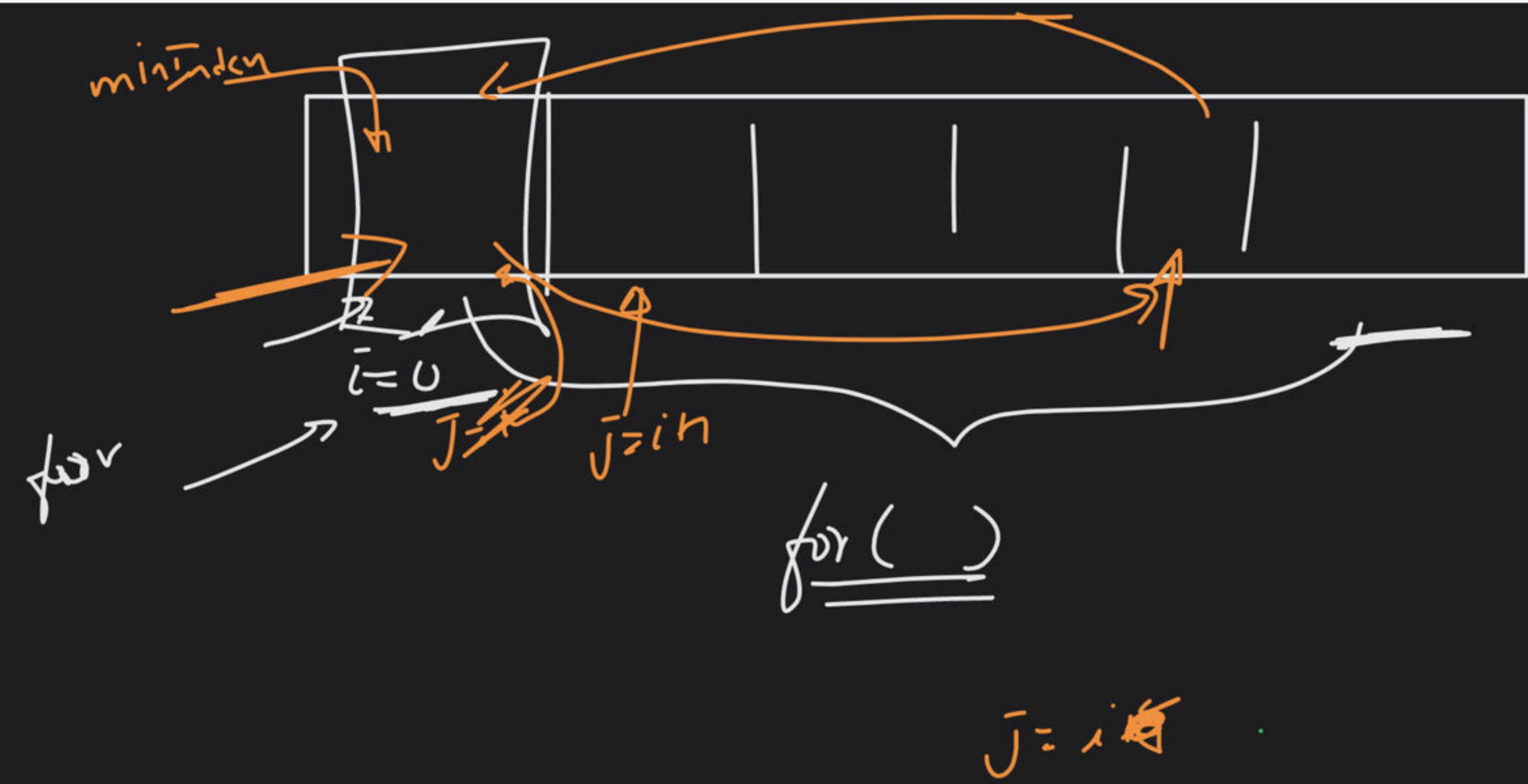
$< n-1$





RL $\rightarrow \underline{i=0}$
 $\underline{\text{minIndex} = 0}$
 $\bar{j} = i+1 \rightarrow < n$
 $\bar{j} = 1, \bar{j} = 2, \bar{j} = 3, \bar{j} = 4$







$i = 0$
 $j \rightarrow 1 \rightarrow$

$i = 0$
 $j \rightarrow [1, 2, 3, 4]$

$i = 1$
 $j \rightarrow [2, 3, 1]$

$i = 2$
 $j \rightarrow [3, 1]$

$i = 3$
 $j \rightarrow [4]$

for ($i = 0; i < n - 1; i++$)

 int minIndex = $i;$
 for ($i + 1 \leq j \leq i + 1; j < n; j++$)
 $i \rightarrow n$

 if ($arr[j] < arr[minIndex]$)

 minIndex = j

}

 swap ($arr[i], arr[minIndex]$);

S.C. $\Rightarrow O(1)$

constant
space

$$1 + 2 + 3 + \dots + n - 1 = \frac{n(n-1)}{2}$$

$$T.C \rightarrow$$

$$\frac{n(n-1)}{2}$$

$$= \frac{n^2}{2} - \cancel{\frac{n}{2}}$$

$$\geq \frac{n^2}{2} - \cancel{\frac{n}{2}}$$

$$\geq n^2$$

$$O(n^2)$$

```
for ( i = 0 → < n )
```

n^2

{

```
for ( j = 0 → < n )
```

|

}

$i - 1$

$\frac{n \times (n-1)}{2} = n^2$

```
for ( [i-1] → n )
```

{

```
for ( j = i + 1 → < n - 1 )
```

{

}

②

Bubble Sort

i^{th} round

i^{th} layout element K_0

its right position pr
place K_0

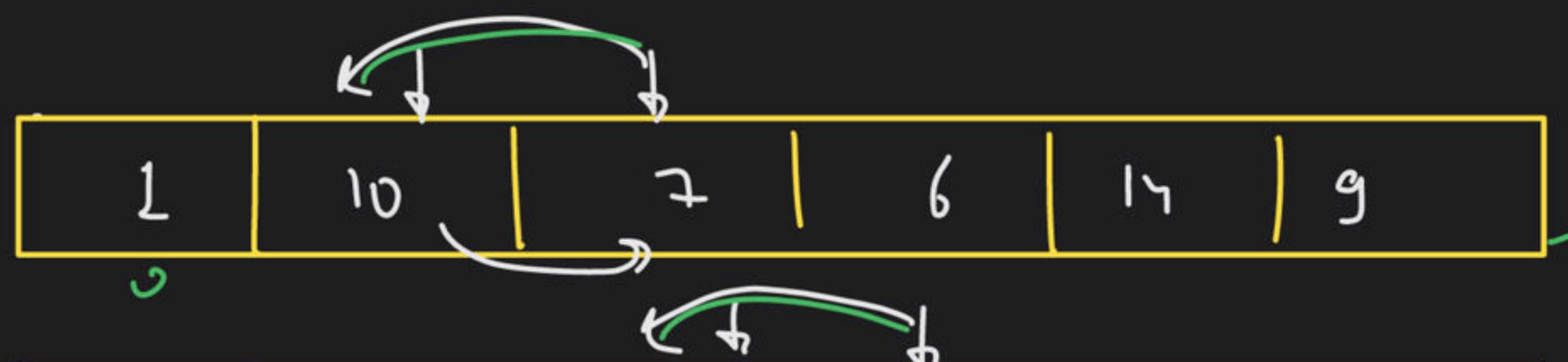
$$\boxed{a > b}$$



swap



Round 1



$j = 4$



Round = 1

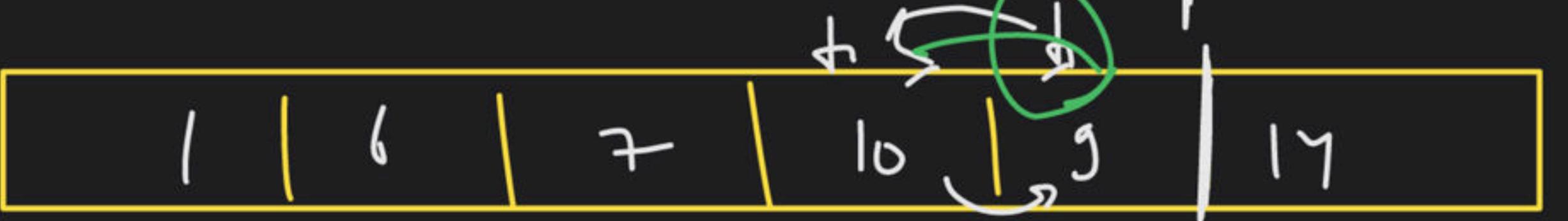
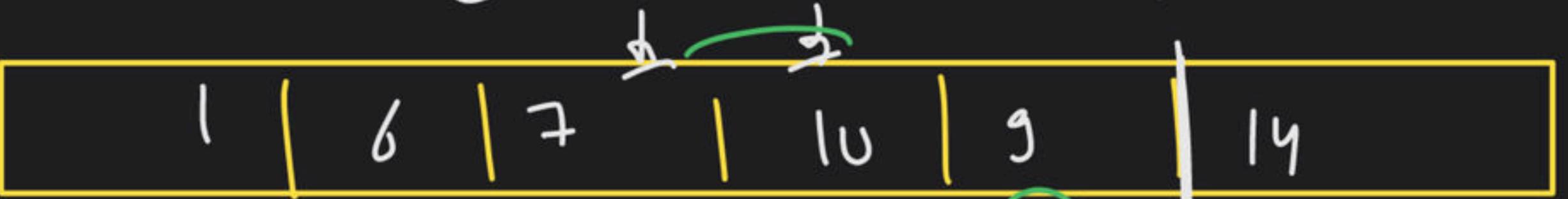
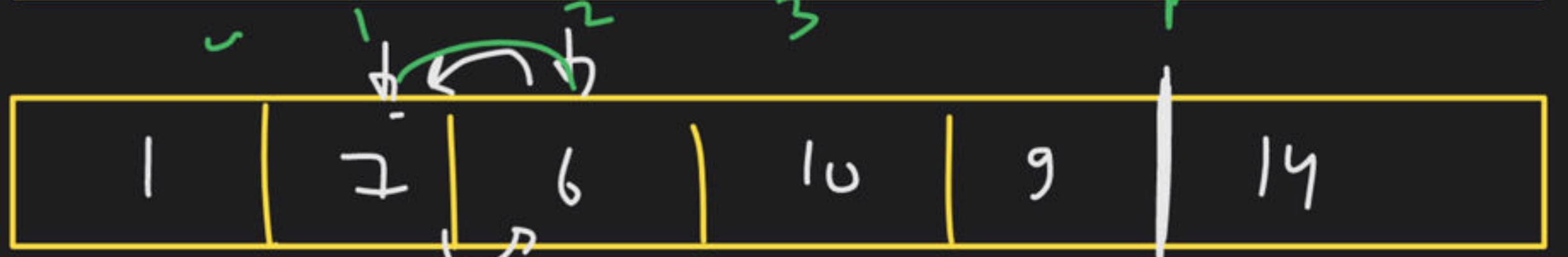
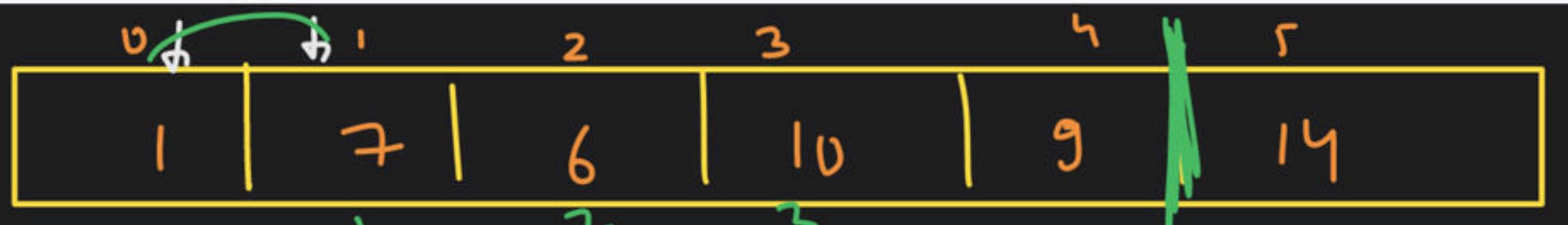


1st largest element

10111



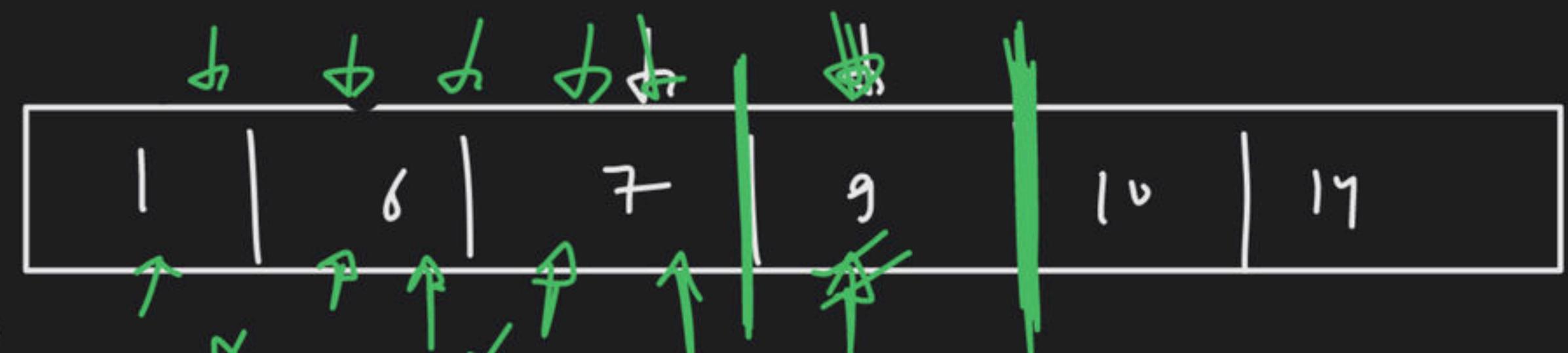
arr →
 Row 2
 2nd largest
 element
 ↴
 ↴



$$\frac{n(n-1)}{2}$$

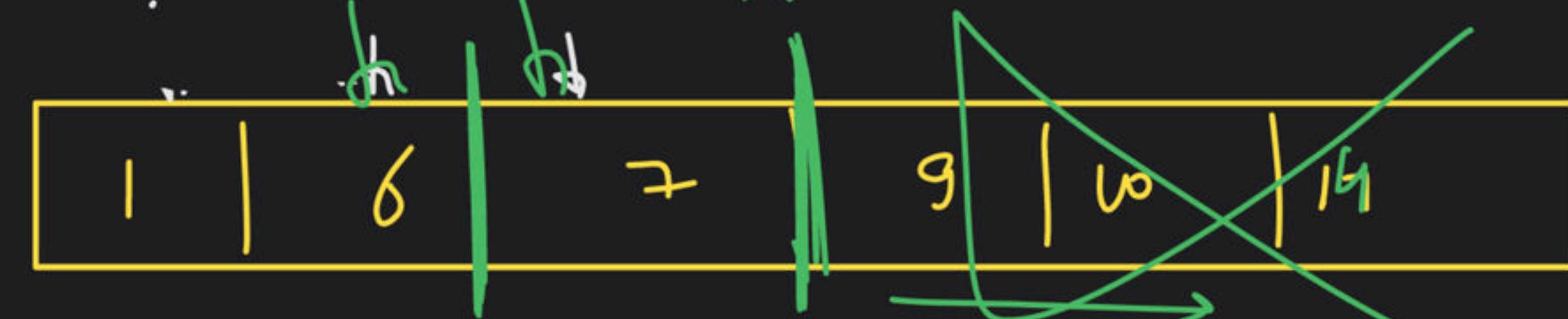
O(h²)
 O(h²)

1 +
 2 +
 3 +
 2 +
 1

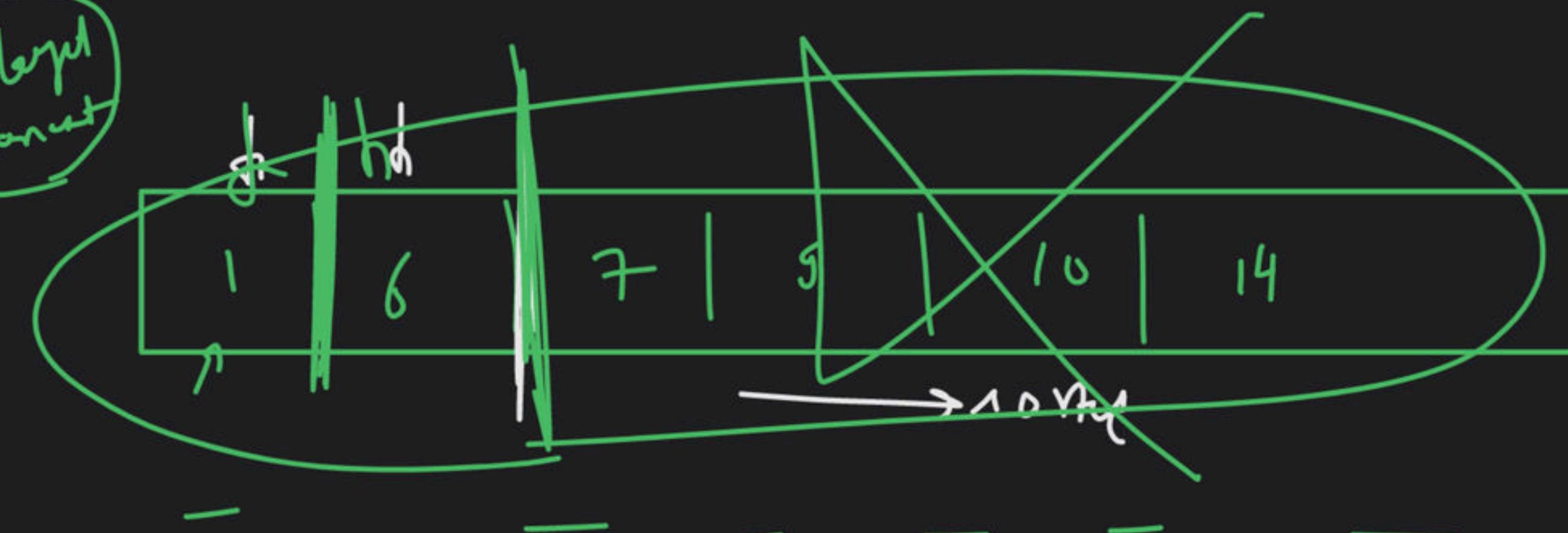


No. swap
Sorted

Round 2
3rd largest elem
done



Round 3
4th largest elem



Round 4

Can we optimise bubble $\underline{O(n^2)}$?

n-round

$$6^{-1} \\ = 5^{-1}$$

n-round -1

Rt

$n=6$

$R1$ $\rightarrow j=4$

$R2$ $\rightarrow j=3$

$R3$ $\rightarrow j=2$

$R4$ $\rightarrow j=1$

$R5$ $\rightarrow j=0$

Sorting \rightarrow But law

already sorted

$B.S \rightarrow O(n^2)$

$B.S \rightarrow O(n)$

w.c.

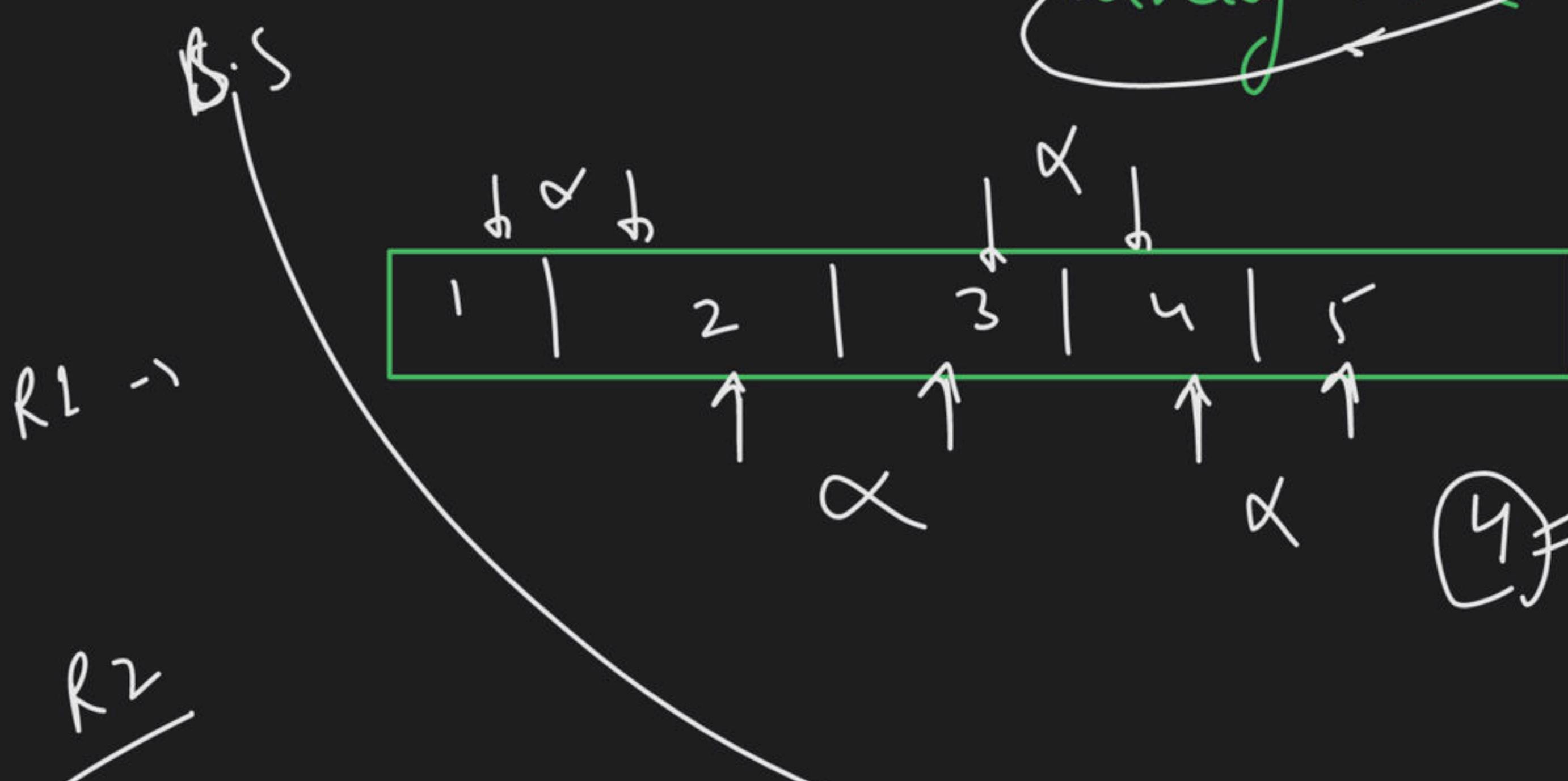
$n = 5$

$(n-1) \text{ com}$

④ Find

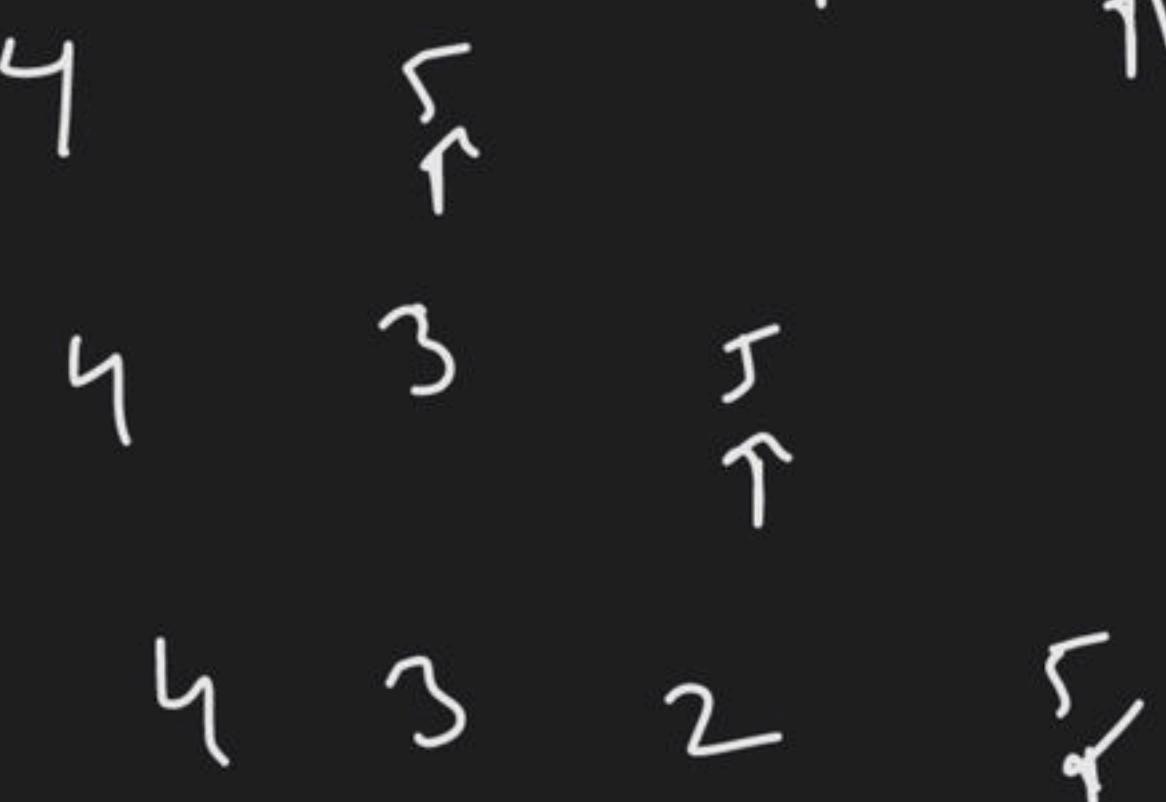
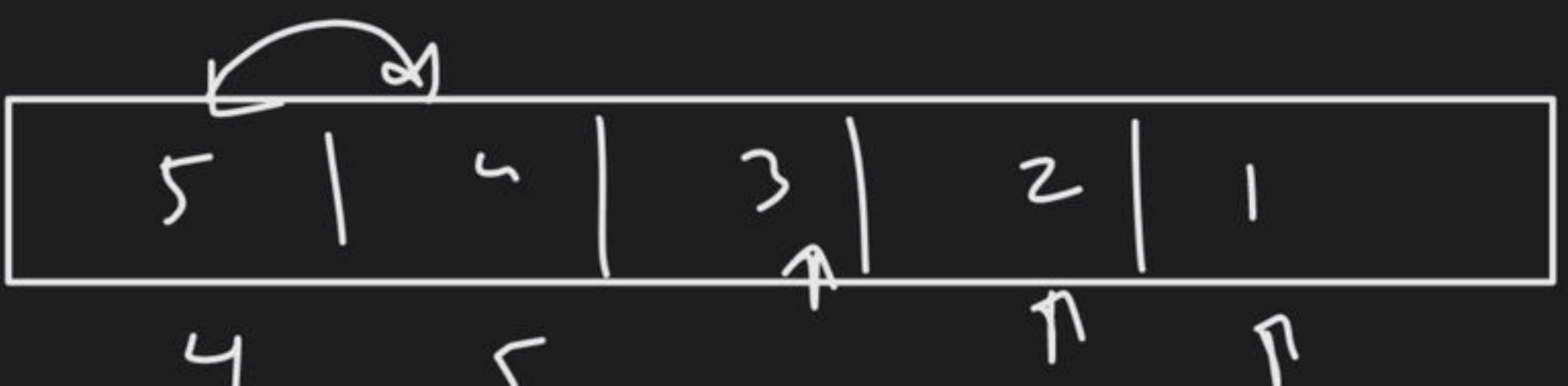
$O(n-1)$

$TTC \rightarrow = O(n)$



R2

Worst
Case \rightarrow Reverse - Sort



$B.S \rightarrow T.C \rightarrow O(n)$

$O(n^2)$

(4)

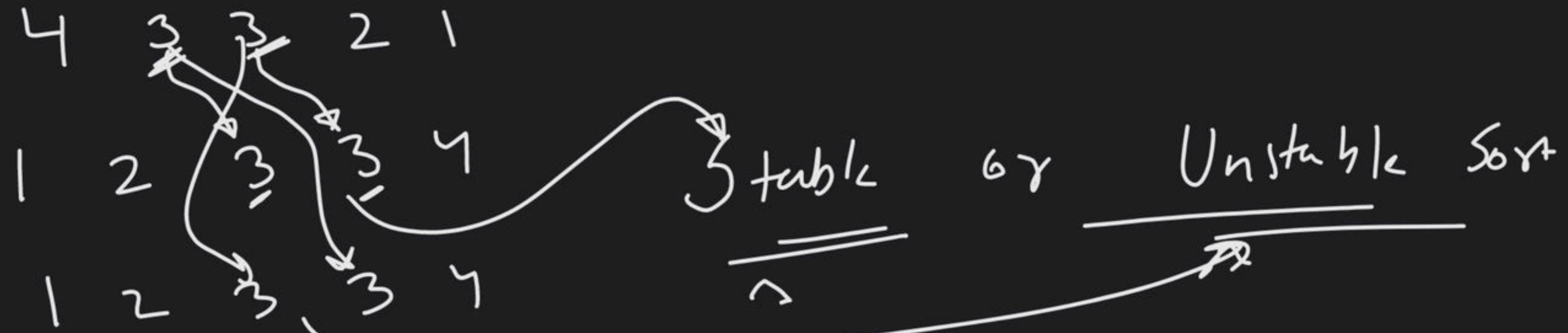
(3)

(2)

(1)

$\frac{n \times (n-1)}{2}$

$O(n^2)$



Selection Sort



Bubble Sort

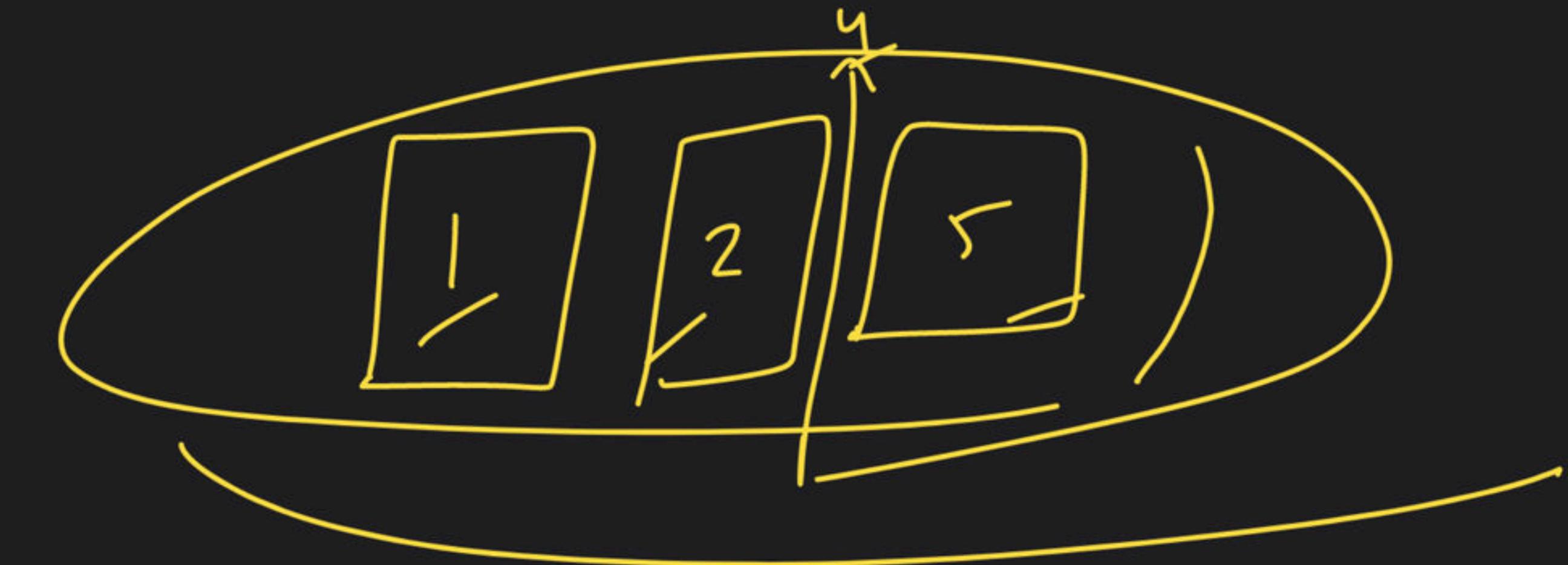
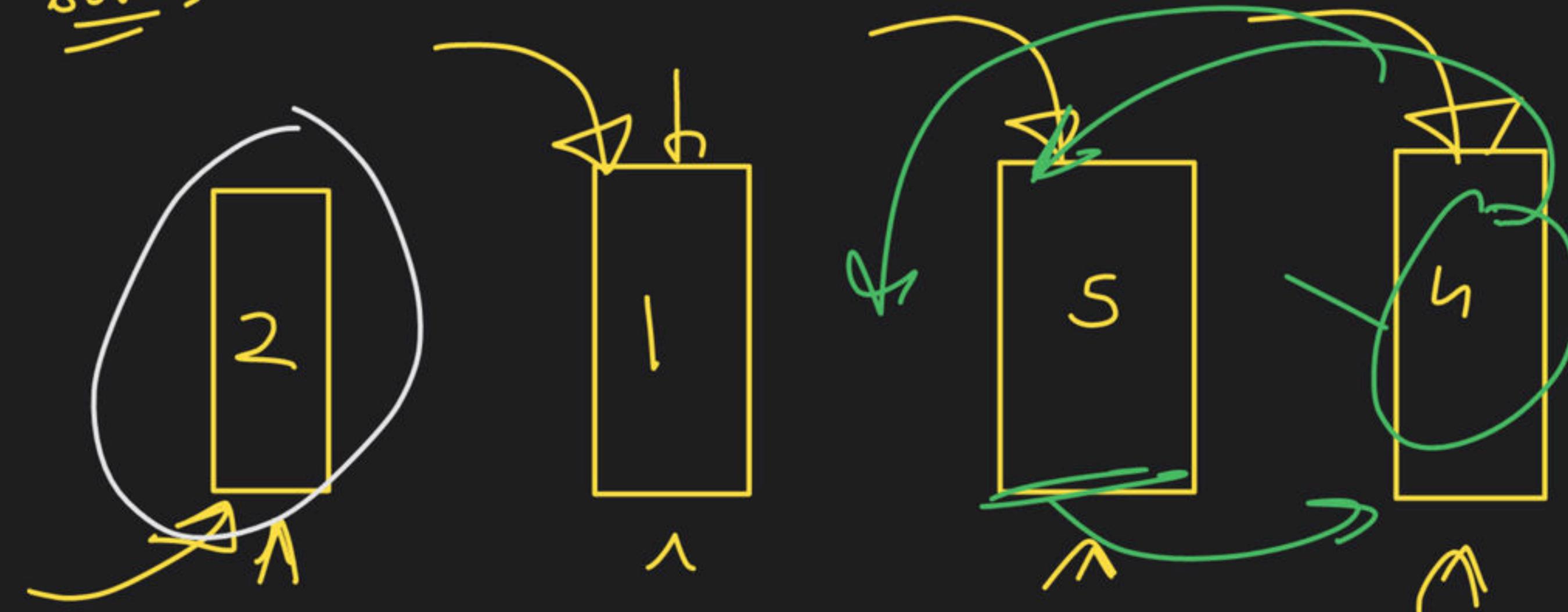


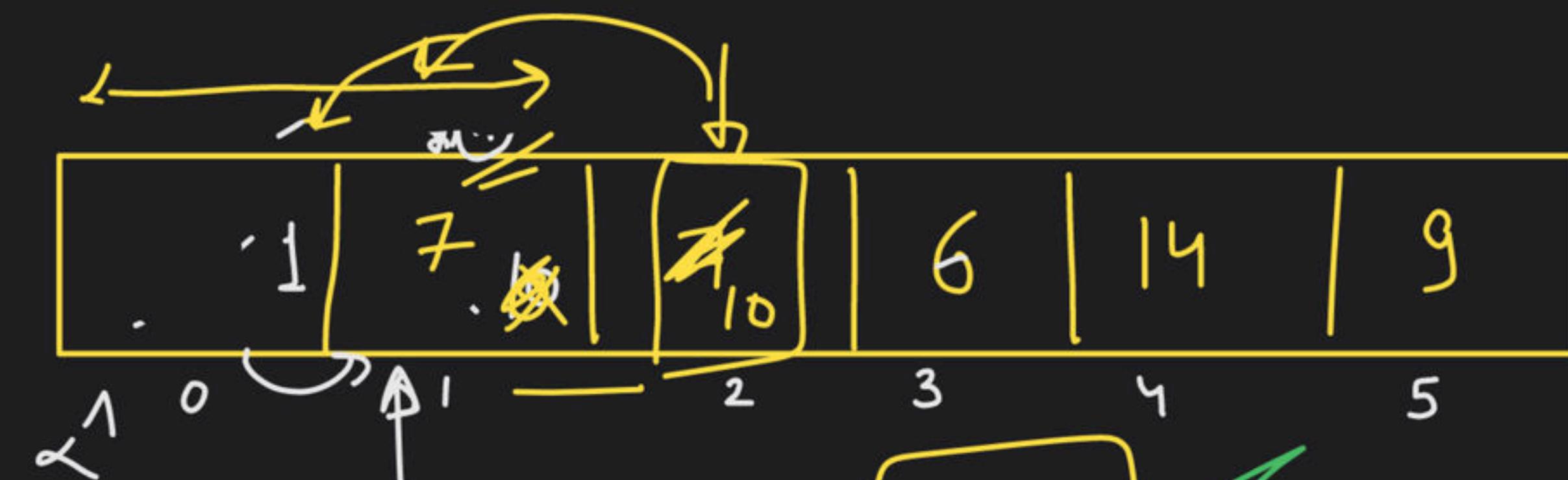
Dry Run



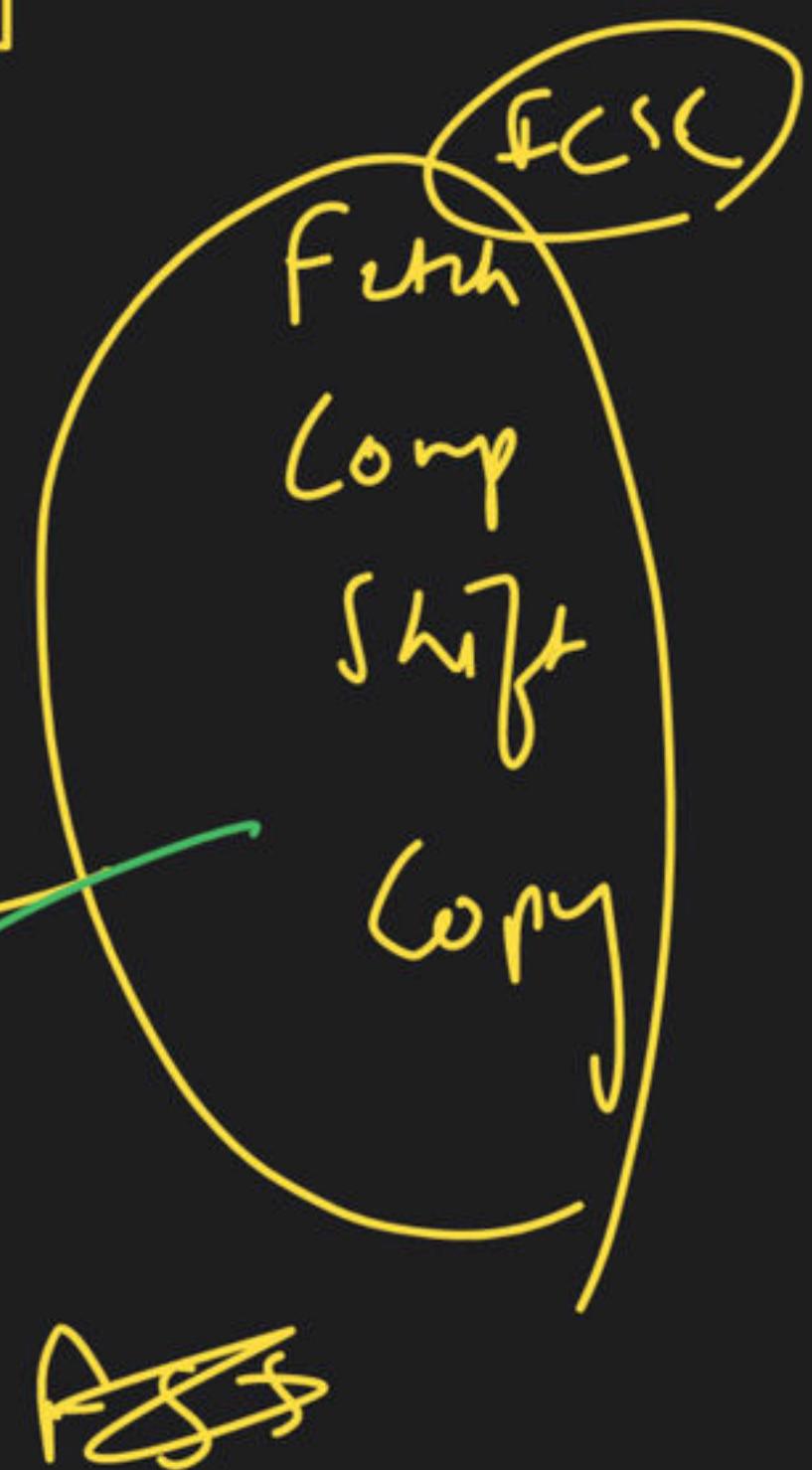
H/W

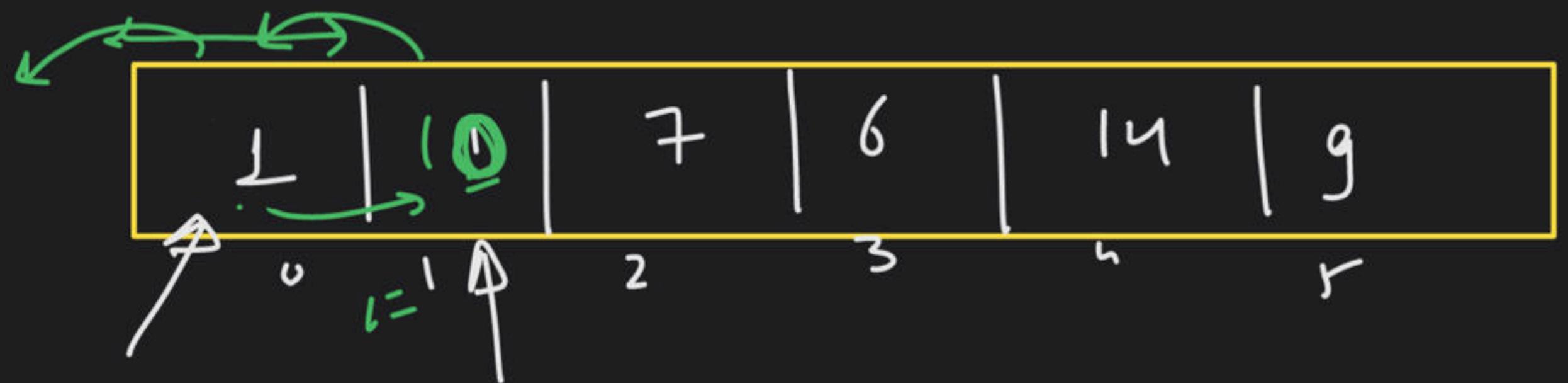
Injection for :-





- (A) $\boxed{\text{Val} = 1}$
- (B) $1 < 10$ → comparison
- (C) Shift \rightarrow LV → shift
- (D) empty space \rightarrow local variable \rightarrow copy





Round 1

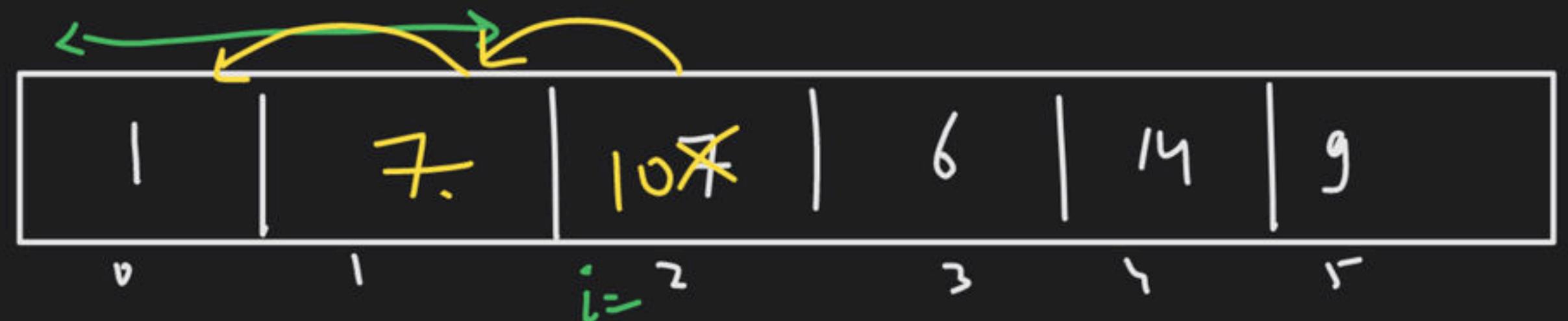
$i=1 \rightarrow$ right position by place

(A) $\underline{\underline{val = 1}}$

(B) $1 < 10 \rightarrow L[0, 10) \in \text{phlc rank heap}$

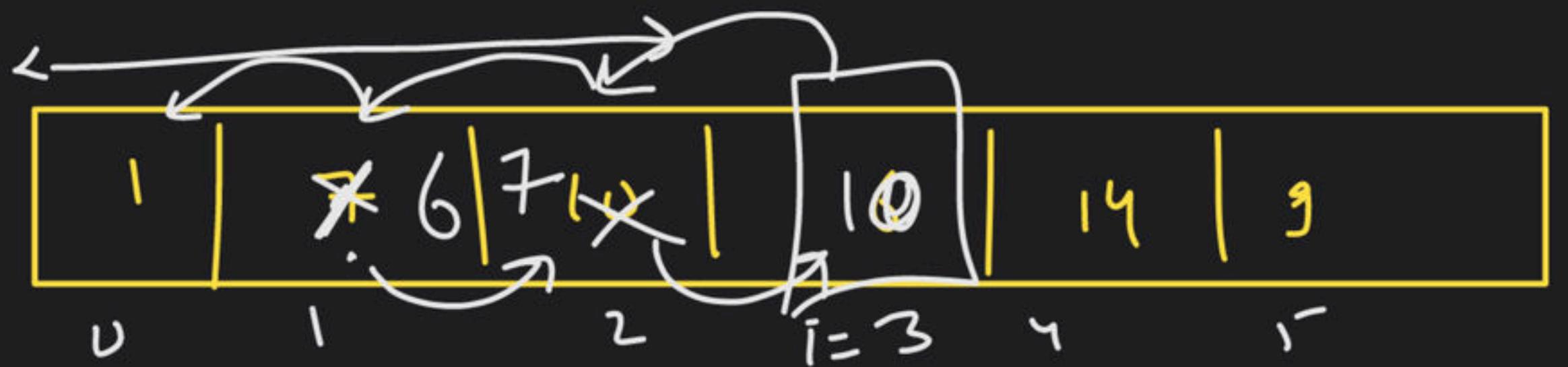
(C) shift

(D) copy



Round 2 → $i=2 \rightarrow$ right position

- (A) $\text{val} = 7 =$
- (B) Compare → $1 \rightarrow (7) \leftarrow 10$
- (C) shifting
- (D) copy



R3 \rightarrow $i=3 \rightarrow$ right position

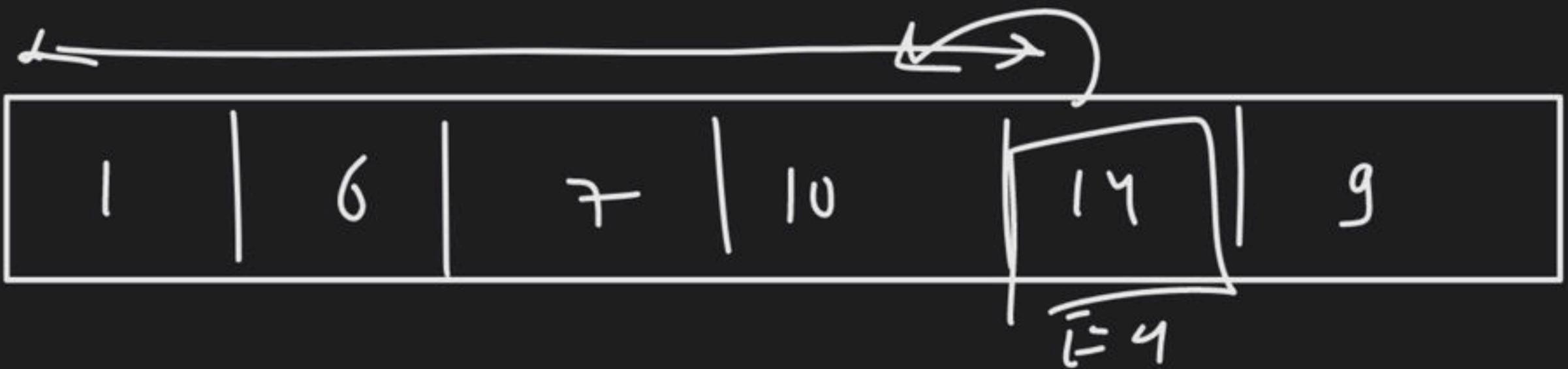
(A) val = 6

(B) Cmp \rightarrow 1 - 6 \leftarrow 7

(C) shift

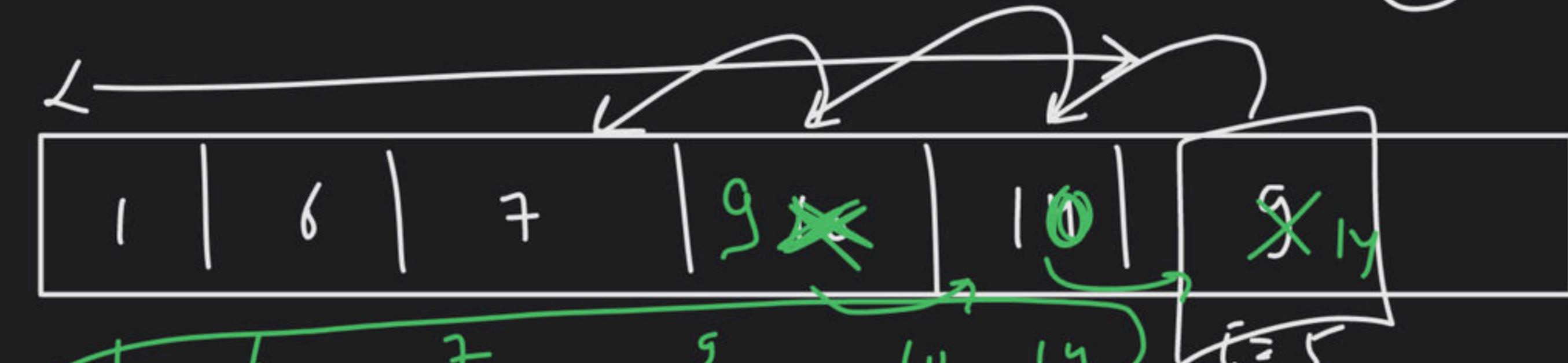
(D) copy

1 6 7 10 14 9



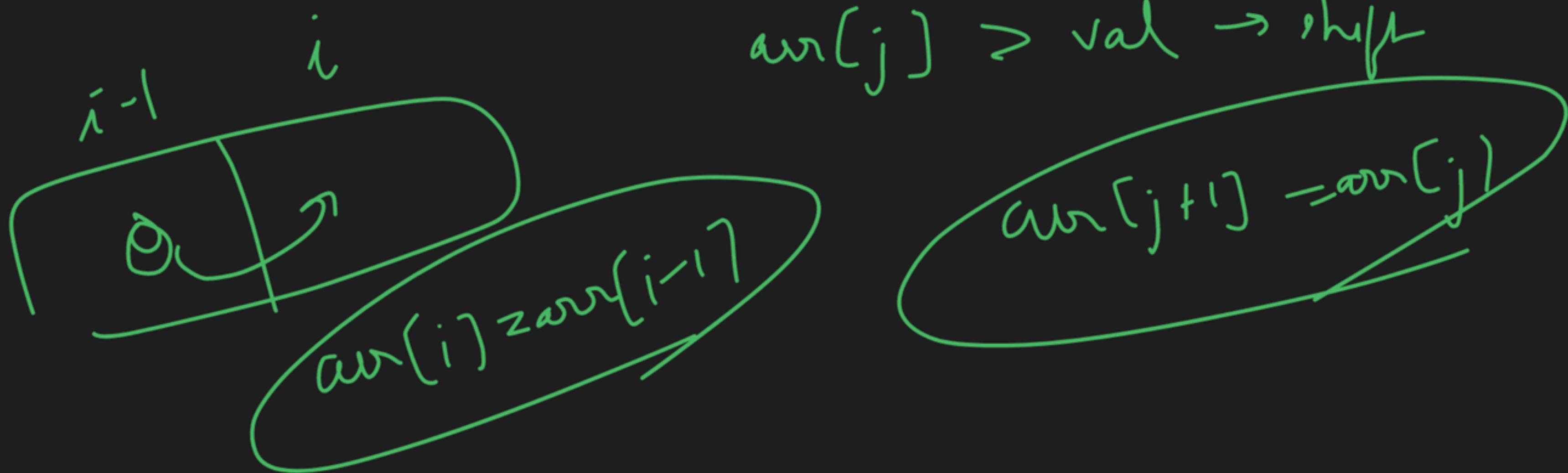
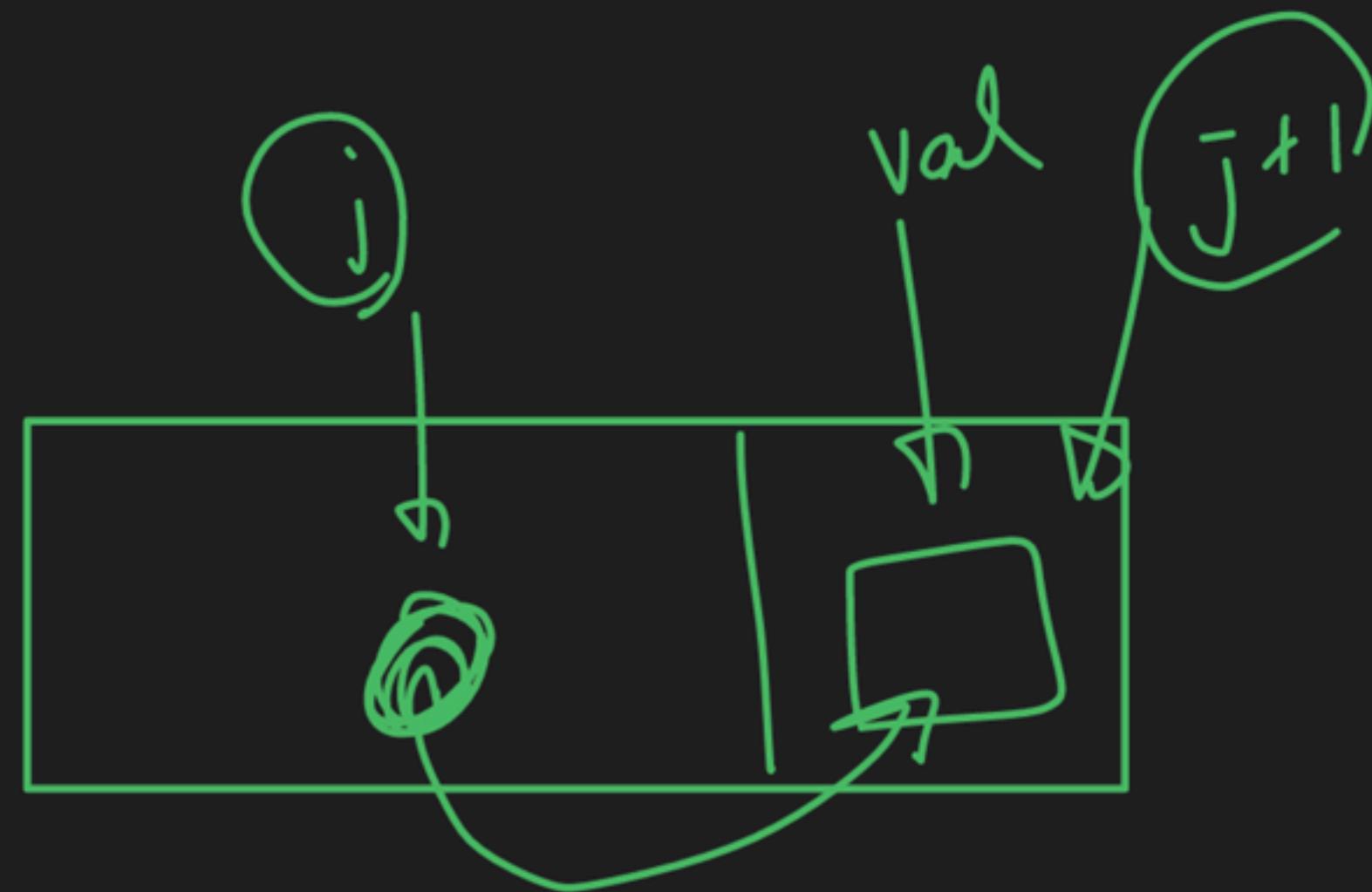
R4 →

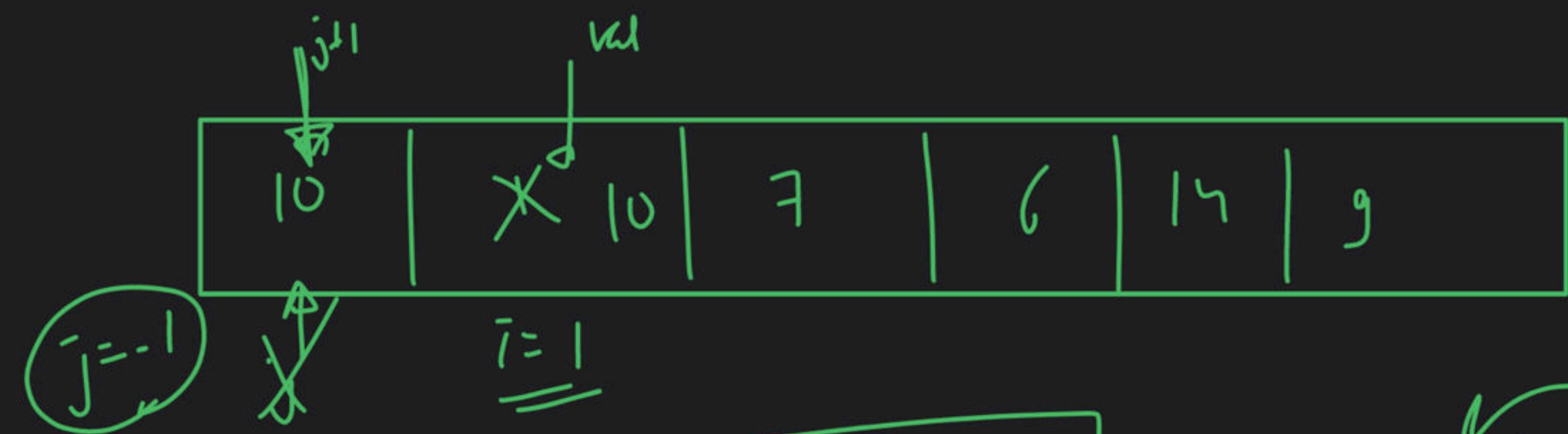
- (A) val = 14
- (B) up
- (C) shift
- (D) copy



R5 ←

- (A) val = 9
- (B) up → 7 → (9) ← 10
- (C) shift
- (D) copy



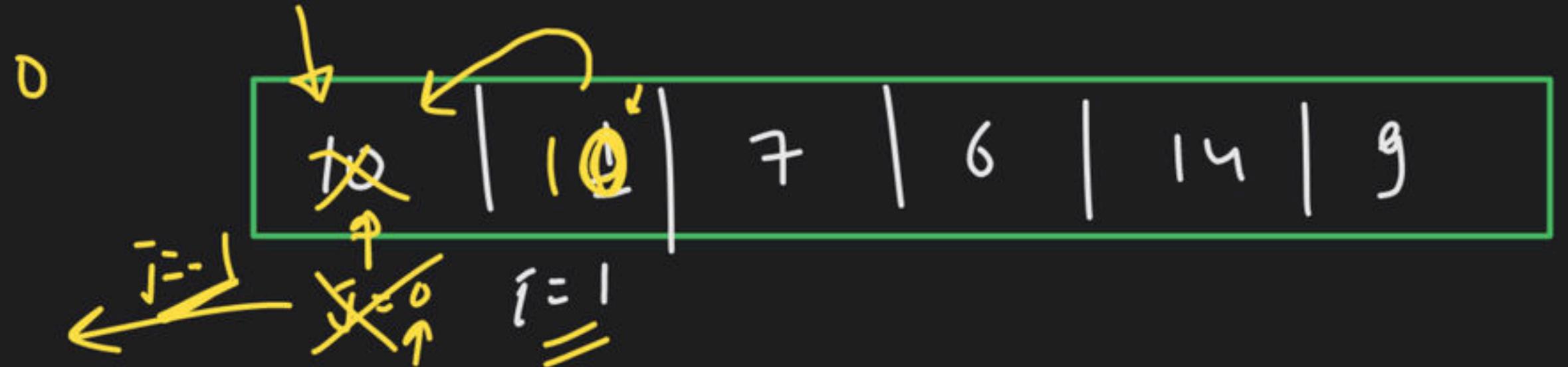


$arr[j] > val$

$arr[j+1] = arr[j]$

$arr[j+1] = val$

$$\begin{array}{l} i=j=1 \\ j+1=0 \end{array}$$



$$R_L = i=1$$

$$\underline{\underline{val = 1}}$$

$10 > 1$
↳ shifting

$$\begin{array}{l} \text{copy } arr[j+1] = val \\ \hline \hline \end{array}$$

1, 10, 7, 6, 14, 9

	j^+
	
$i = 2$	
$j = 3$	
$val = 7$	

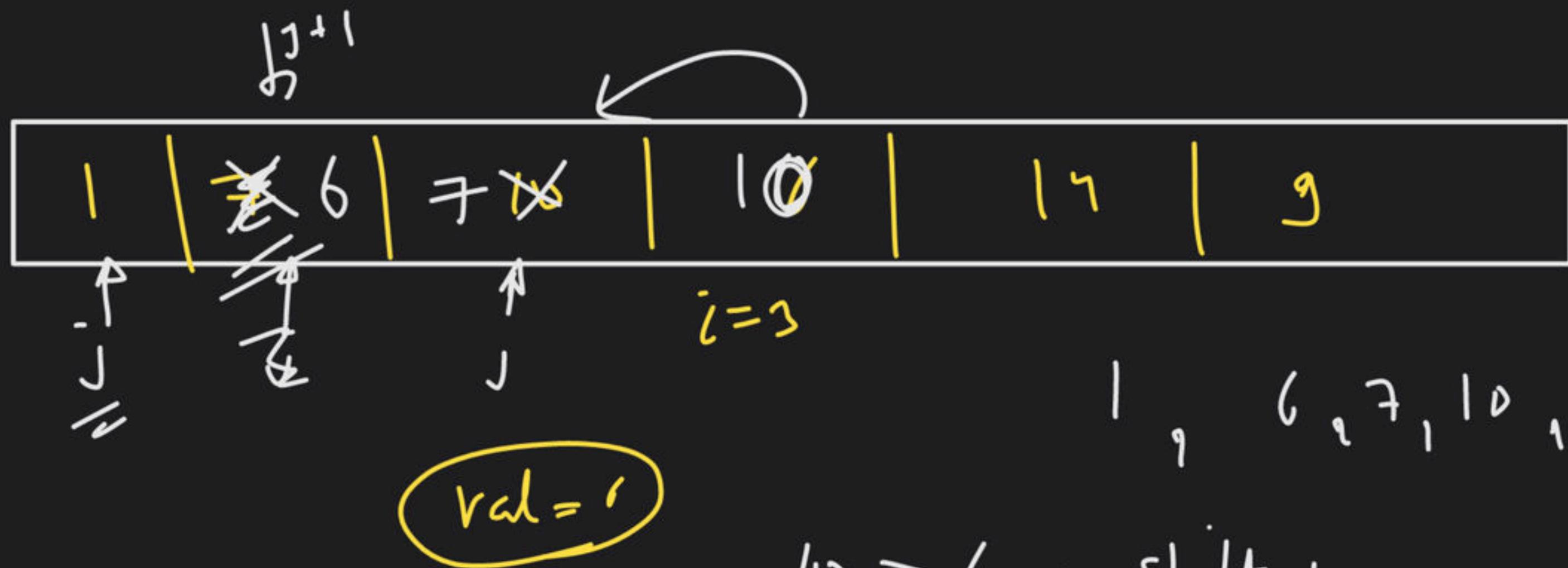
$\boxed{1 \ 2 \ 10 \ 6 \ 14 \ 9}$

$10 > 7 \rightarrow \text{shift}$

$1 < 7 \rightarrow \text{break}$

$arr[j+1] = val$

R>



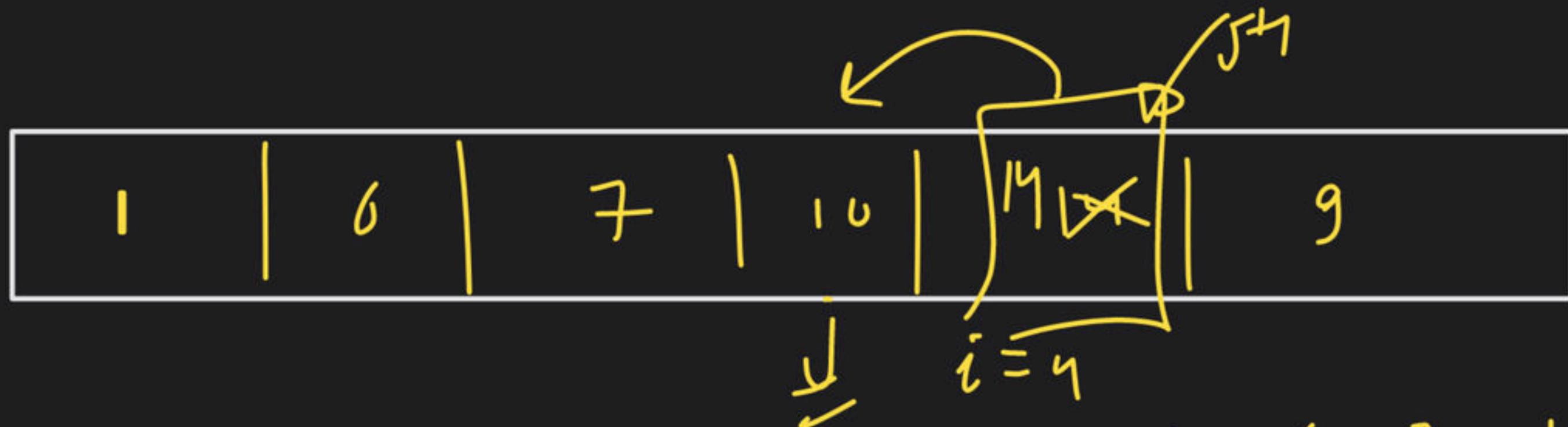
$10 > 6 \rightarrow \text{shift -}$

$7 > 1 \rightarrow \text{shift}$

$1 < 6 \rightarrow \text{break}$

$\text{arr}[j+1] = \text{val}$

1, 6, 7, 10, 11, 9



R_9

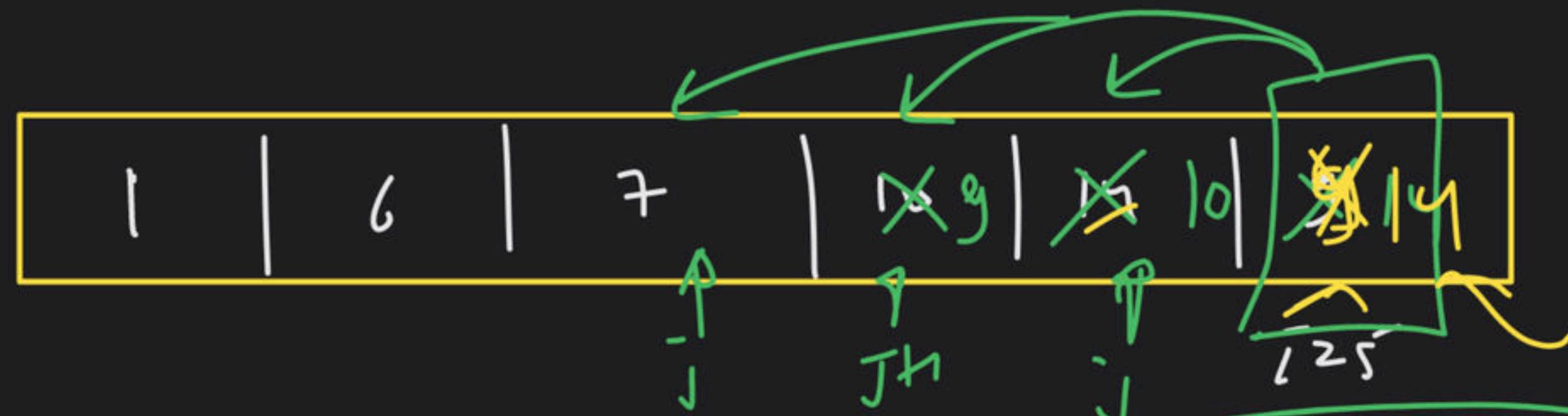
$\text{val} = 14$

tmp

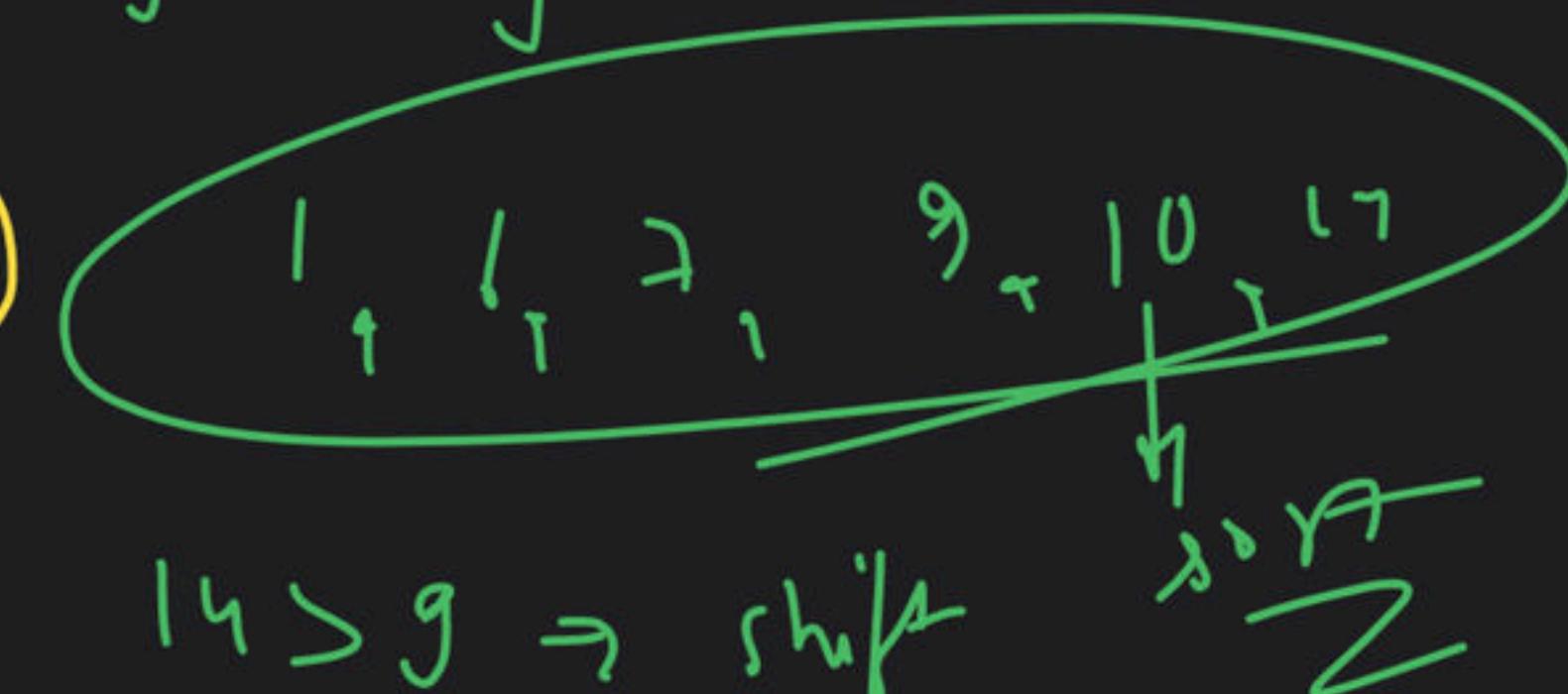
$10 < 17 \rightarrow \text{break}$

$\text{arr}[j+1] = \text{val}$

$1, 6, 7, 10, \underline{14}, 9$



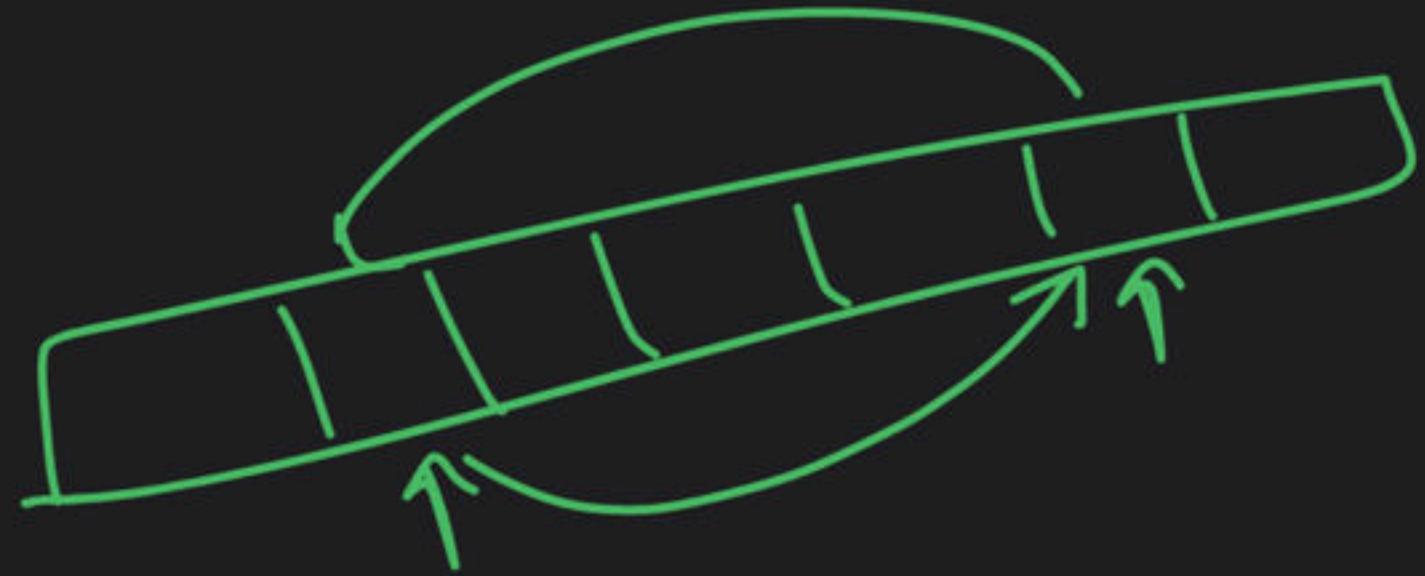
RS



$14 > 9 \rightarrow \text{shift}$

$10 > 9 \rightarrow \text{shift}$

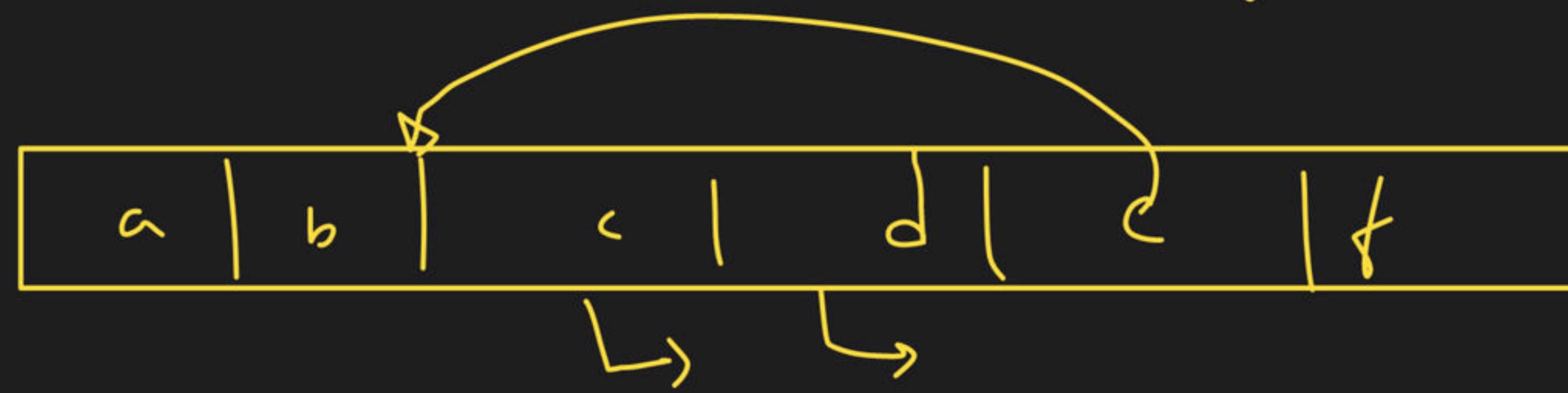
$7 < 9 \rightarrow \text{break}$



copy $\rightarrow arr[j+1] = val$

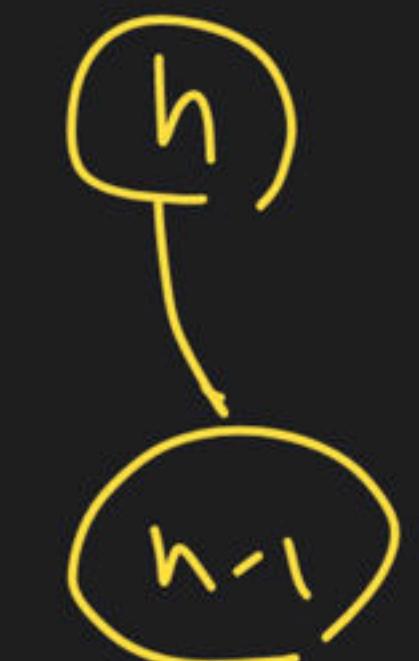


swap → a e < d b f



$i = 1 \rightarrow h$

$j \rightarrow 0 \rightarrow 0$



$h-1$

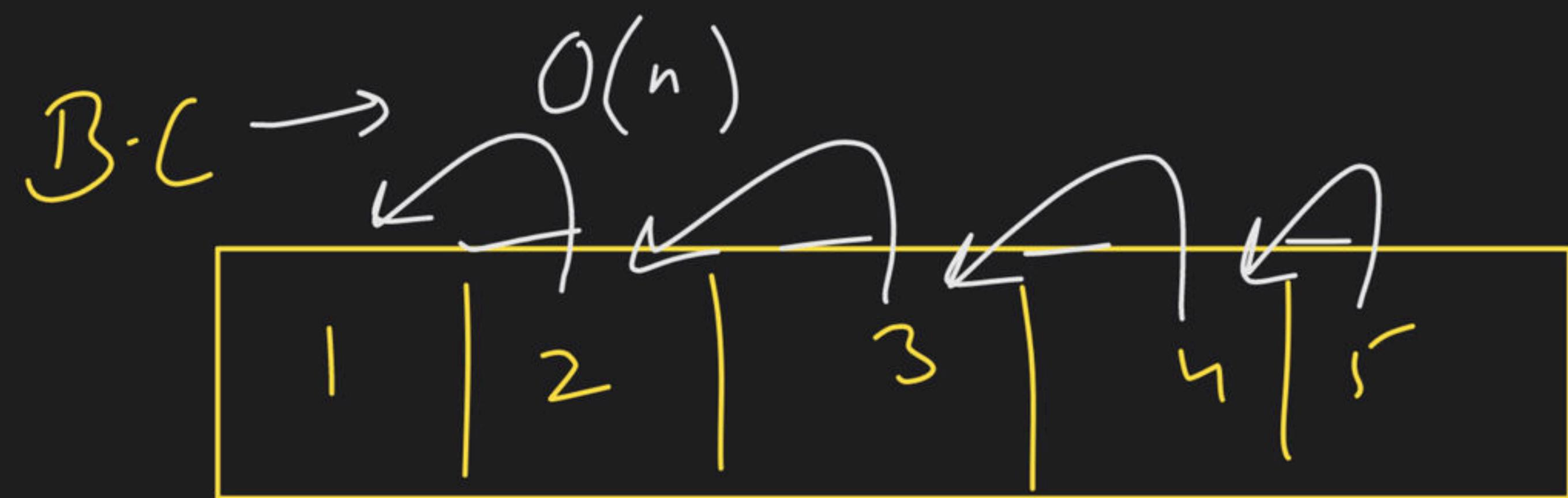
for ($i_2 \leq 1 \rightarrow < n$

{

for ($i-1 \rightarrow >= d$)

$T \cdot C \rightarrow O(h) \cup \underline{O(n^2)}$

$S \cdot C \rightarrow \underline{O(1)}$



$\hat{i} = 0$ $i = 1$ $i = 2$ $i = 3$ $i = 4$

$B \cdot C \rightarrow B \cdot S[1..5]$

$O(n)$

$\omega \cdot C \rightarrow O(n^2)$

s | Unstable

Selection
Sort

Bubble
Sort

Insertion
Sort

	$N \cdot c$	$B \cdot c$	$W \cdot c$
$T \cdot c$	$S \cdot c$	$T \cdot c$	$S \cdot c$
$S \cdot c$	✓	✓	✓
$T \cdot c$	-	-	-
$S \cdot c$	-	-	-

