while (low <= high)

low < high ↑

Generic low < high

≤

[Search Space]

①

low ≤ high


s
6
low
high

Predicate function

✓ ⟶ True

false

f(x) = True if x > 10

Monotonicity

Strictly Decreasing / Increasing

$$f(x_1) \gtrless f(x_2) \quad \text{for } x_1 > x_2$$

$\geq$

$x \longrightarrow 1, 2, 3, 4 \cdots$

$f(x) = y = 10, 10, 11, 12, 12, 13$ $\longrightarrow$

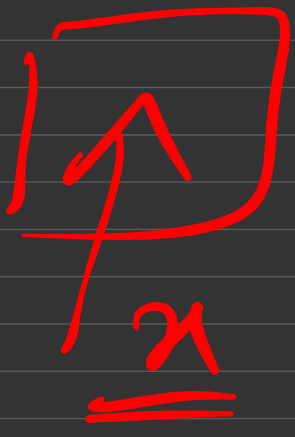
$$f(x) = \boxed{BB} = y$$

x

Increasing fnc

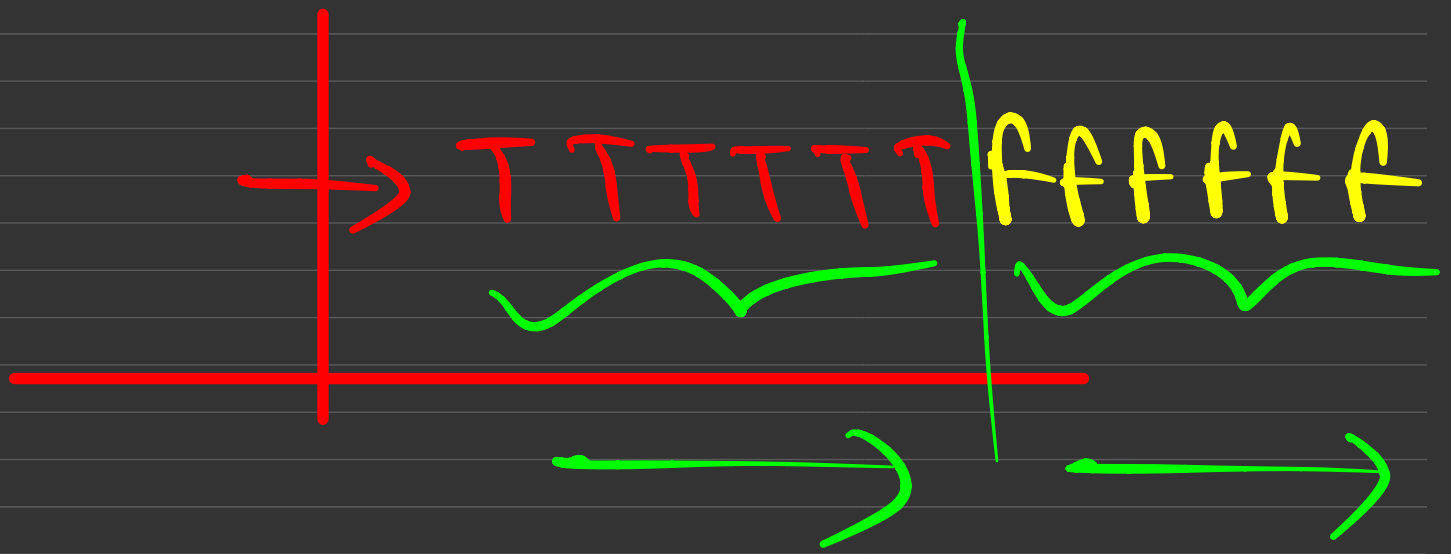
$x \rightarrow$ time

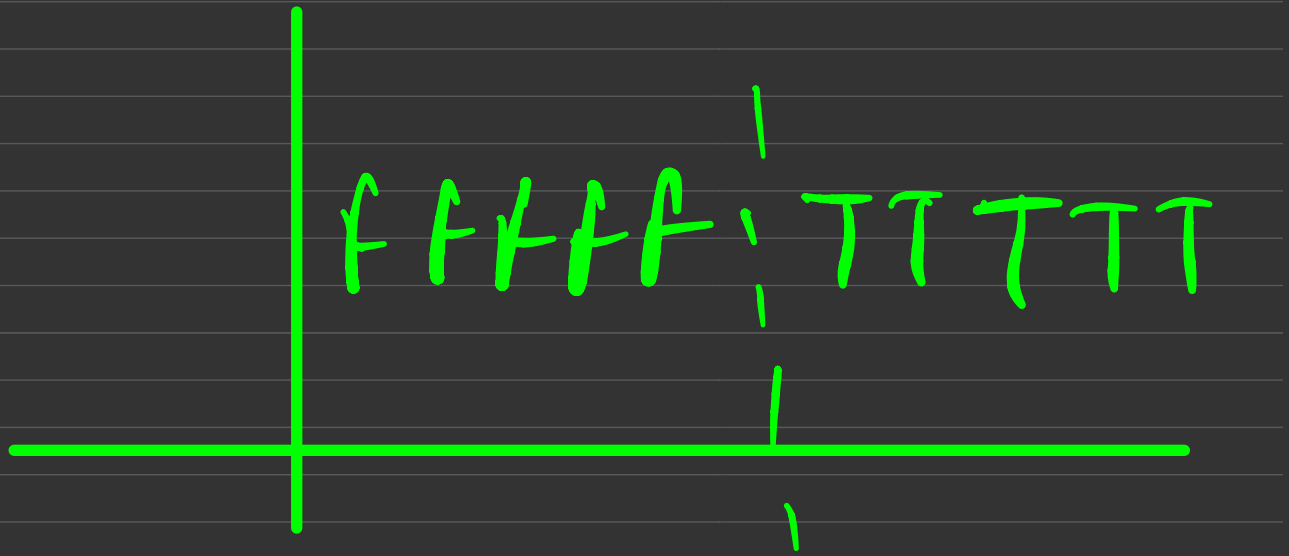
$f(x) \rightarrow T/F$




T
x = 11
x = 10

Monotonic Predicate



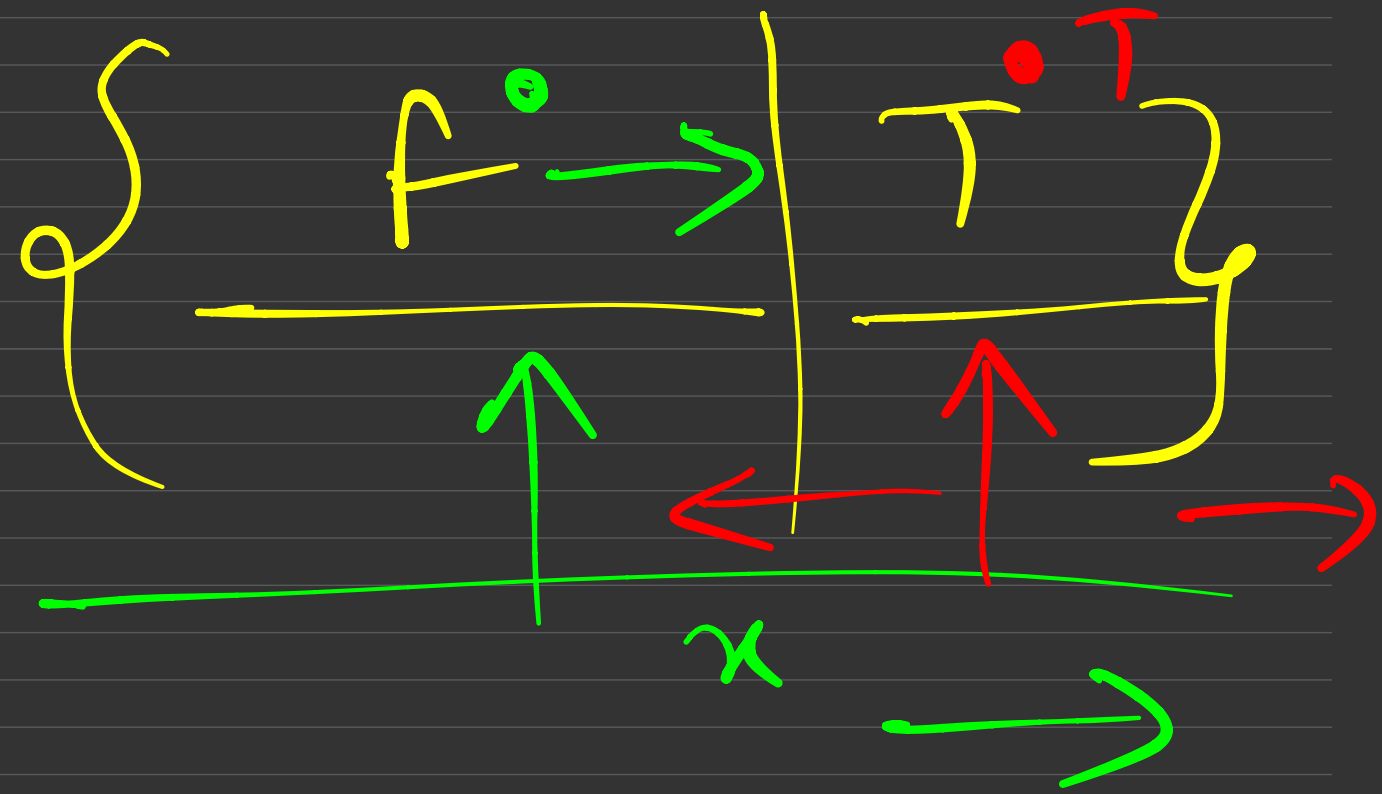

f f f f f
T T T T T

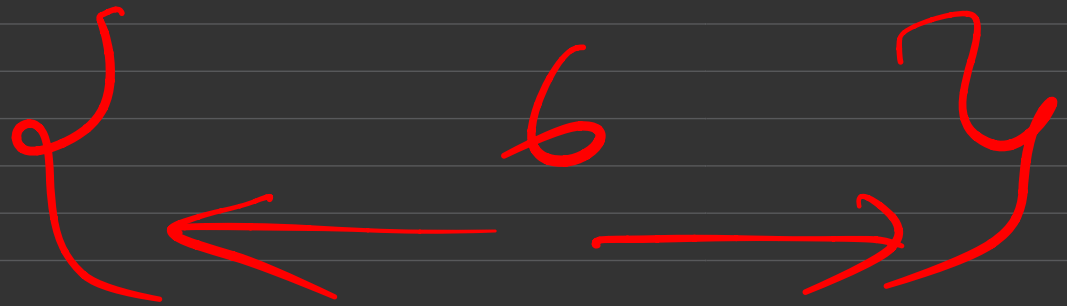
MP → f(x) $\sqrt{}$ ← T

F F F F F F F T T T T T

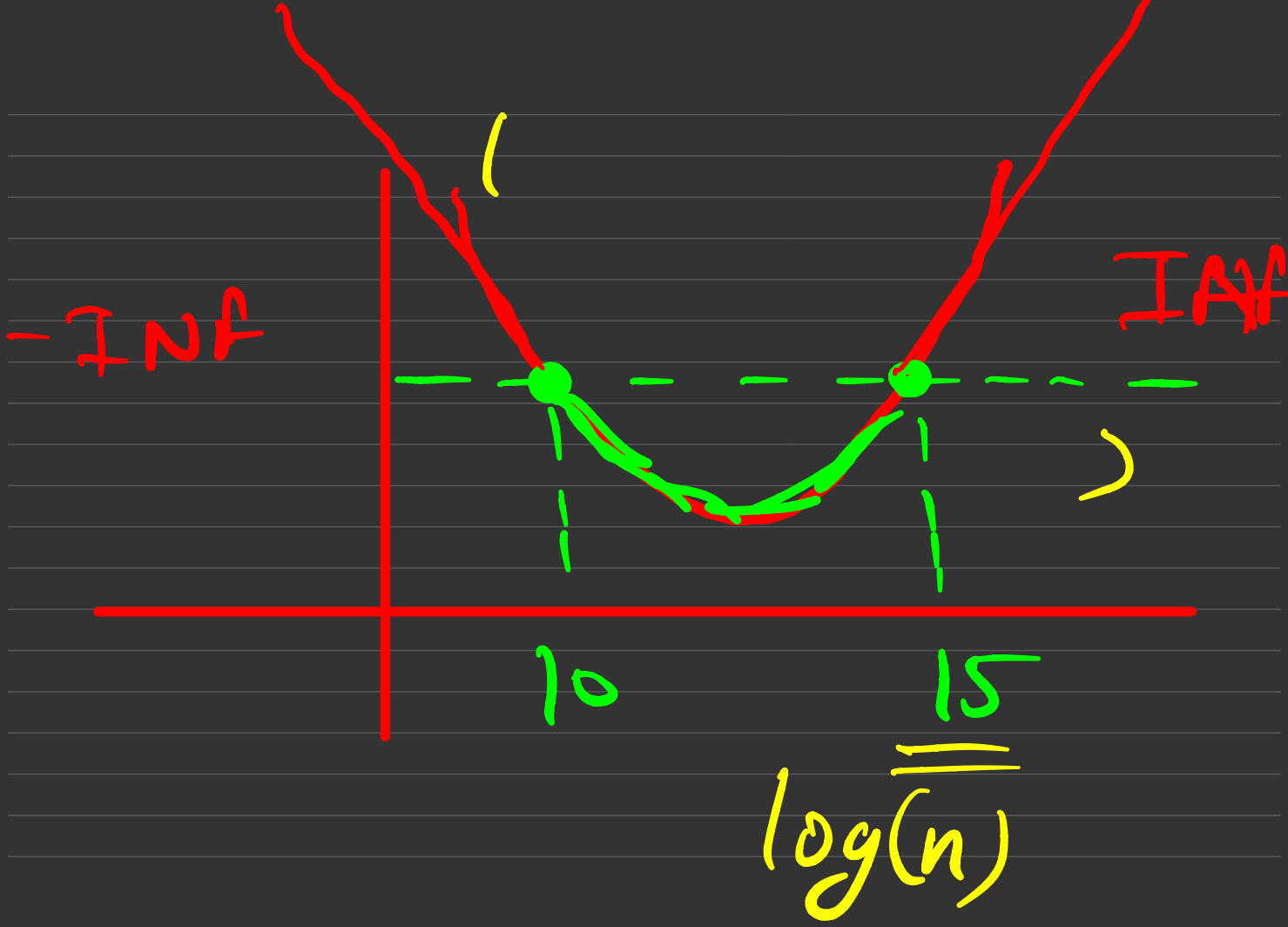
1 2 3 4 5 6 7 8 9 10 11 12

← F →

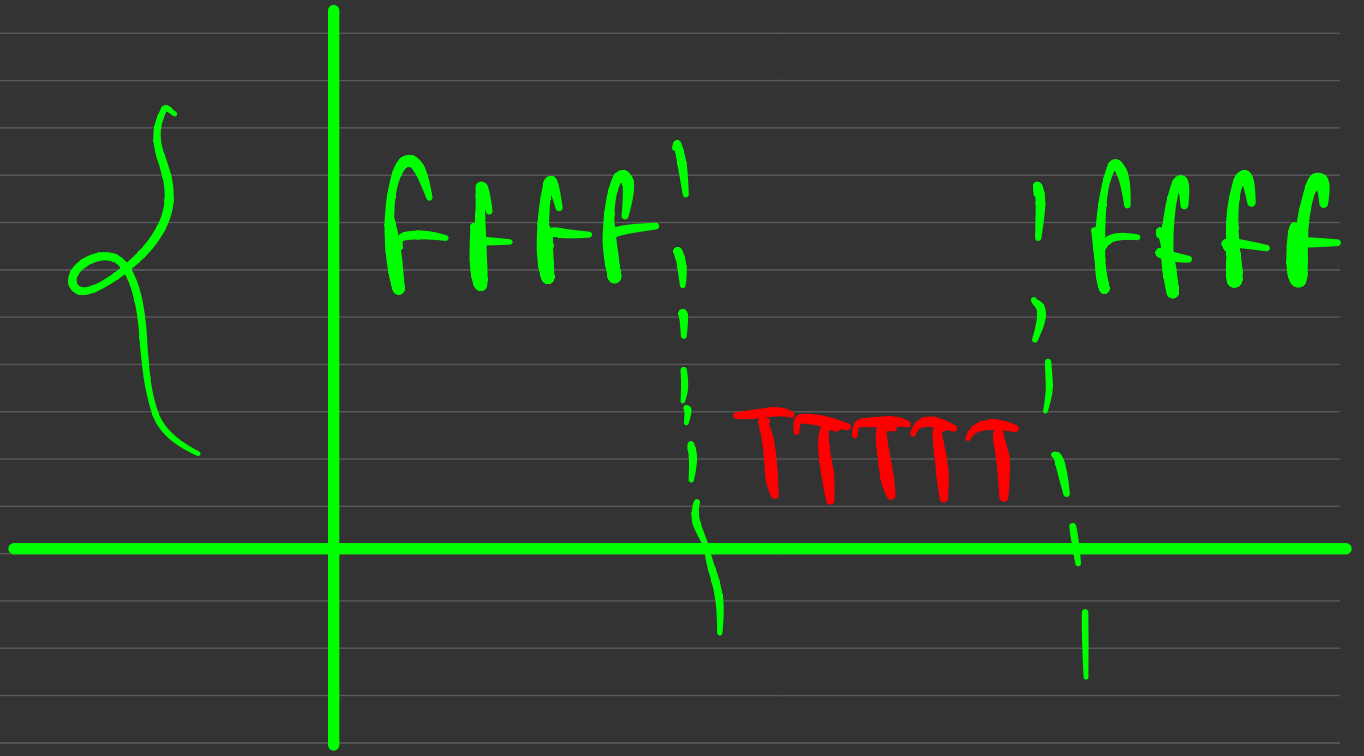

f
T
T
x




TTTTTfffffff
fffff...TTTTTTT...fffff

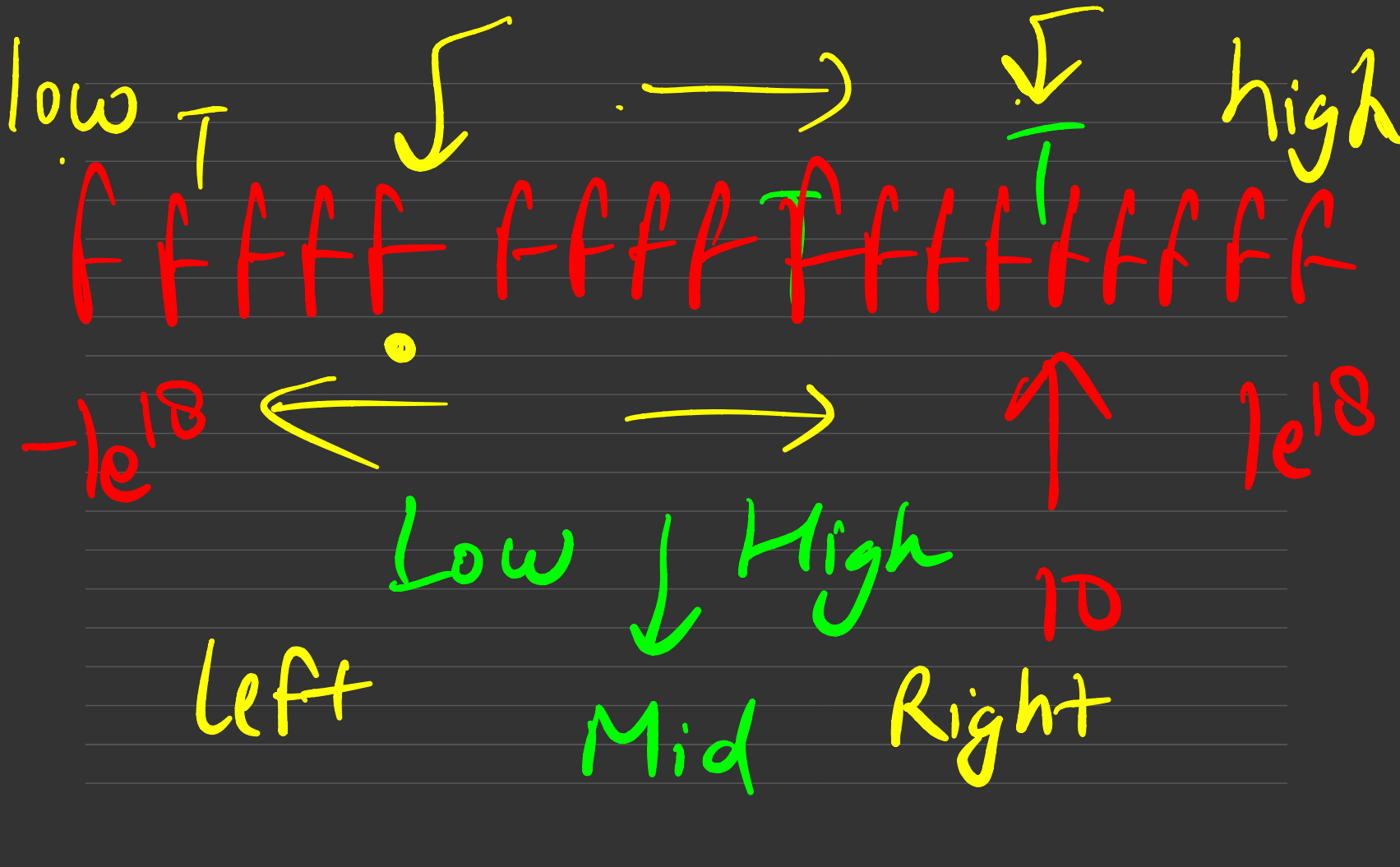


$\log(n)$


f
FFFF
FFFFF
TTTTT


Low
High
Mid

Ternary Search

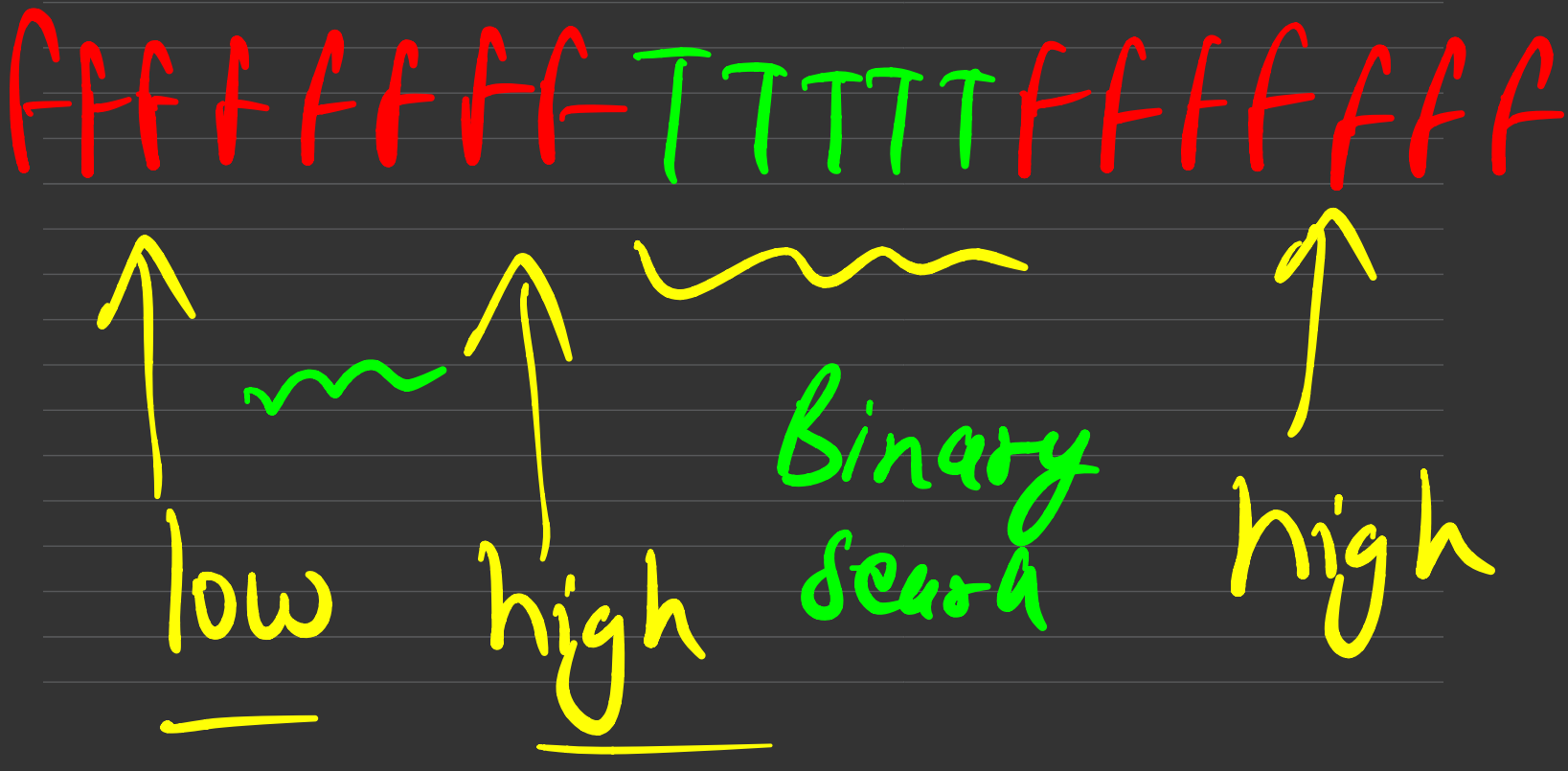

low
high
-1e18
1e18
Low
High
10
Left
Mid
Right

low

high

mid

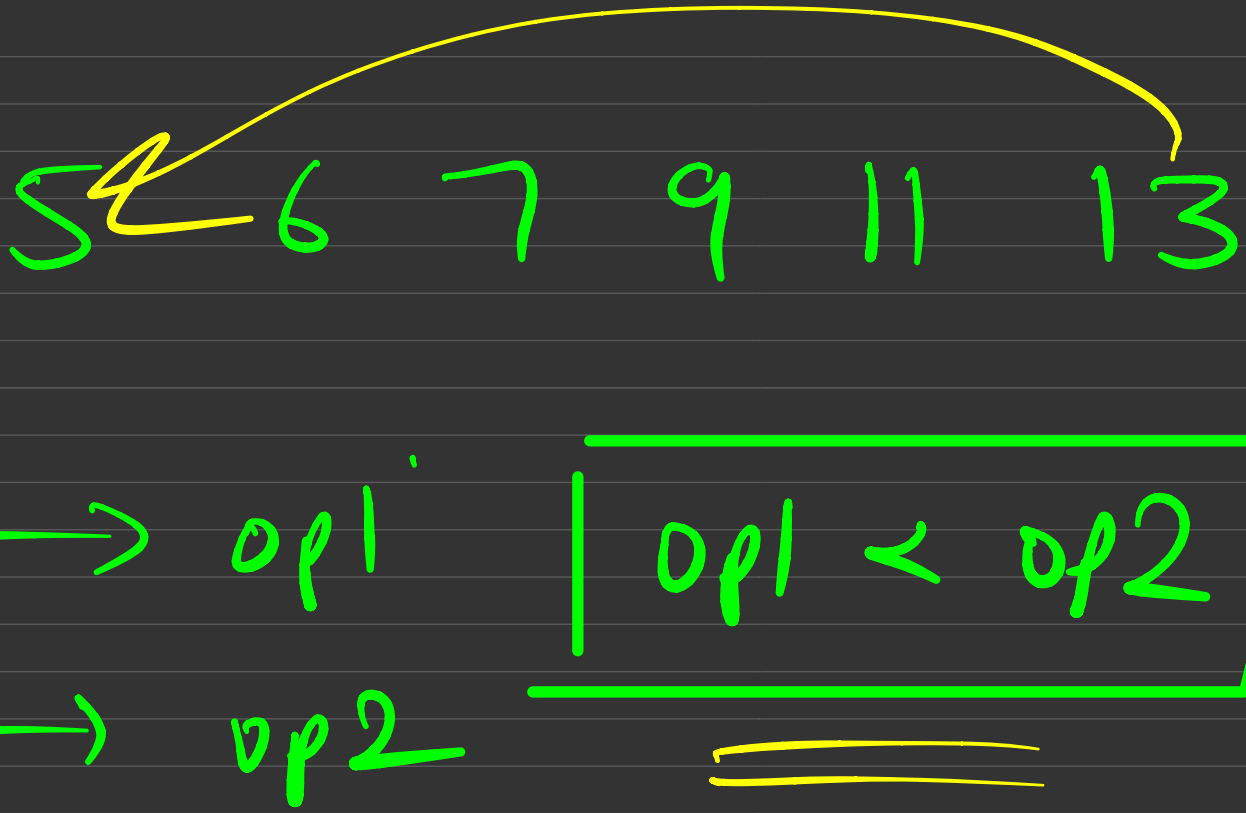
Teenage

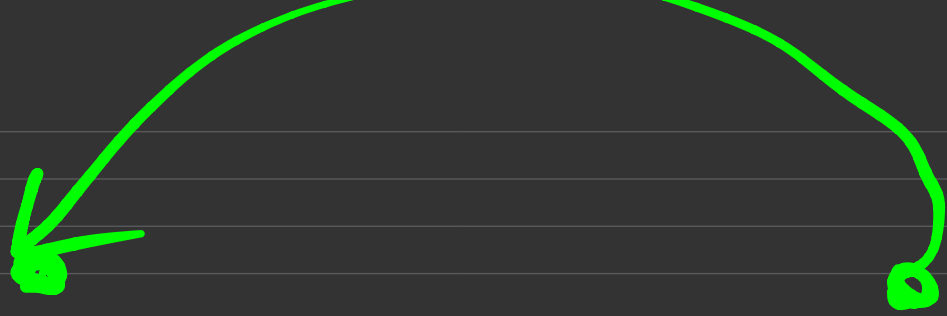


f(low) = f

f(high) = f

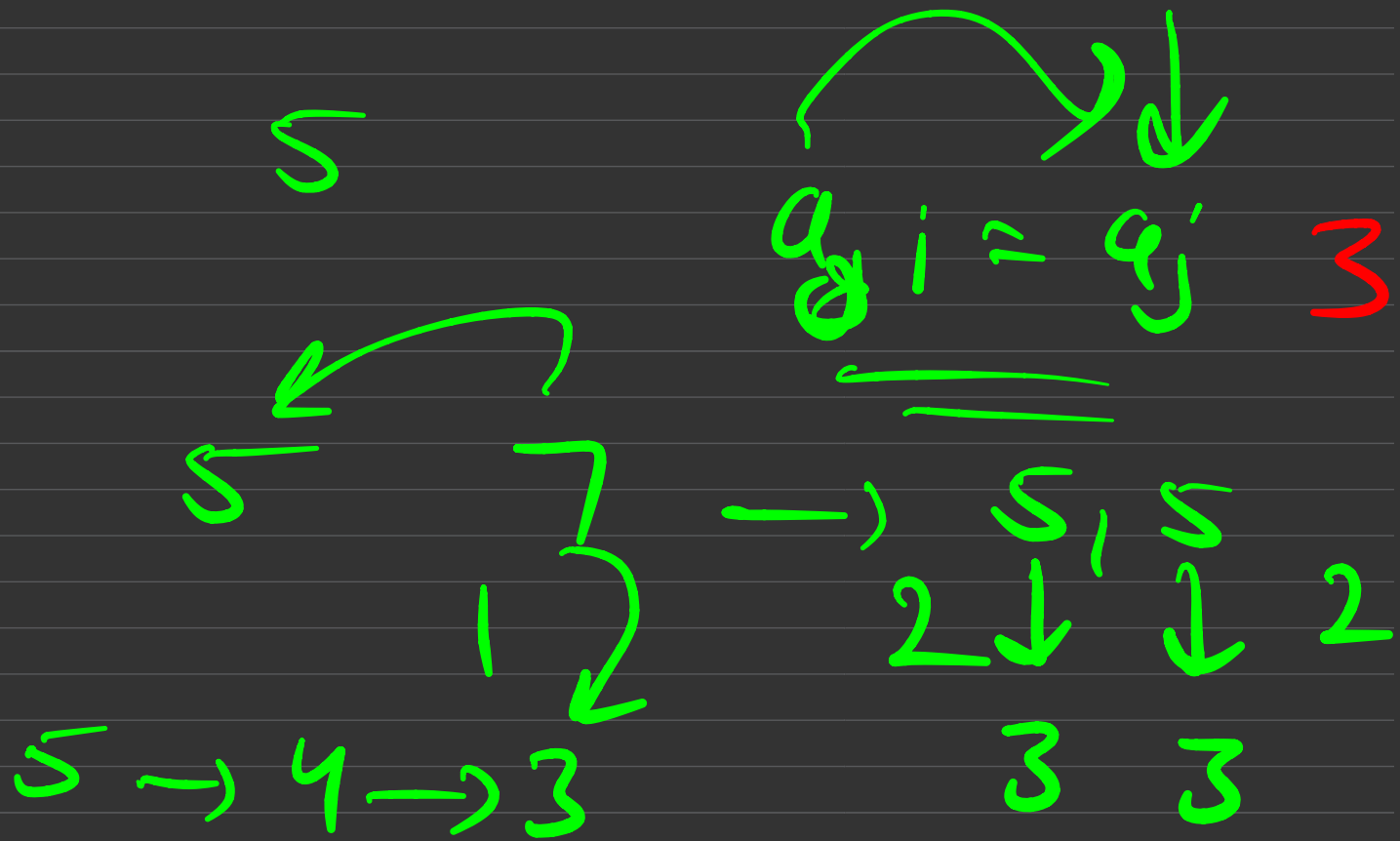
Ternary

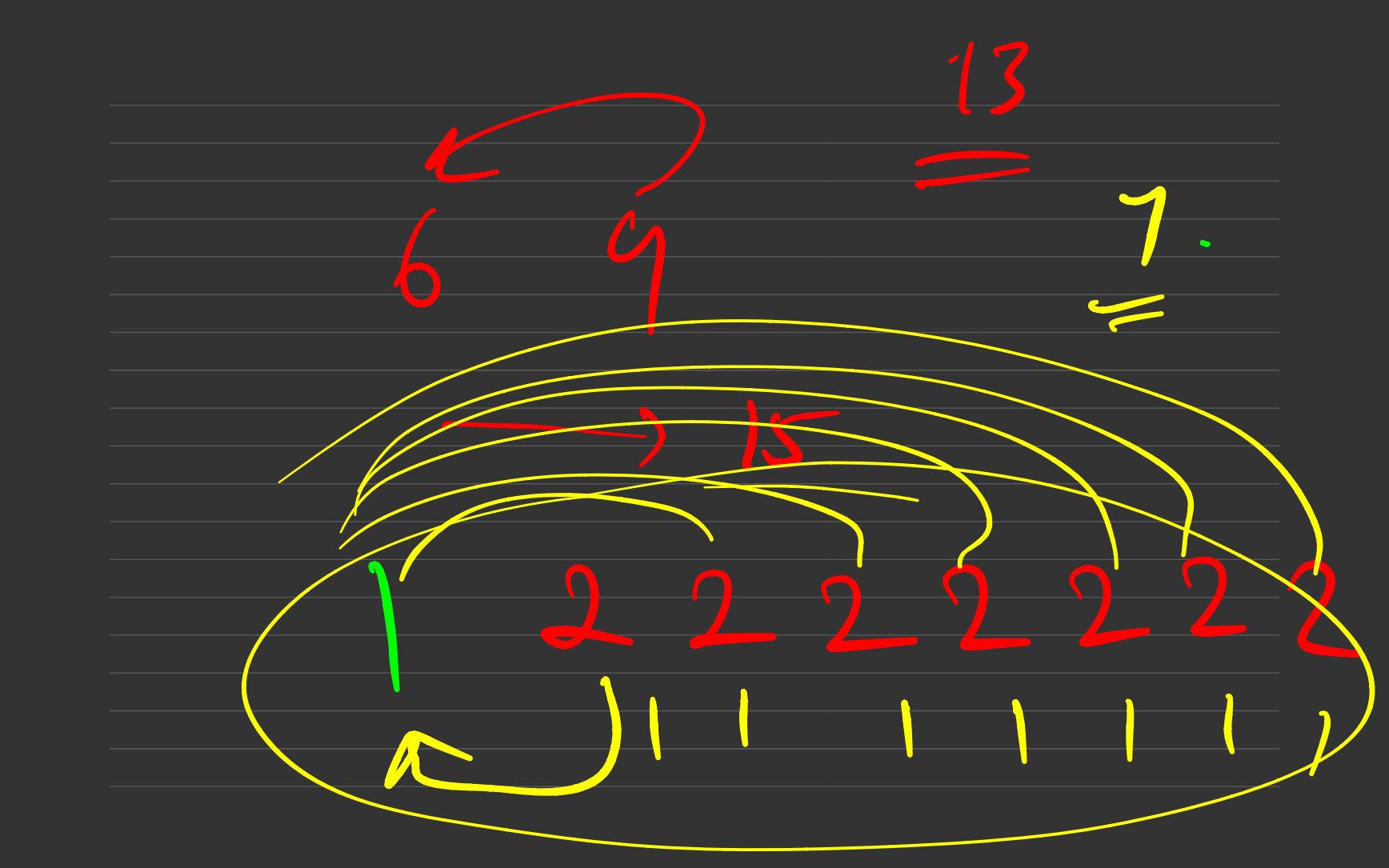

5 6 7 9 11 13
op1
op2
op1 < op2



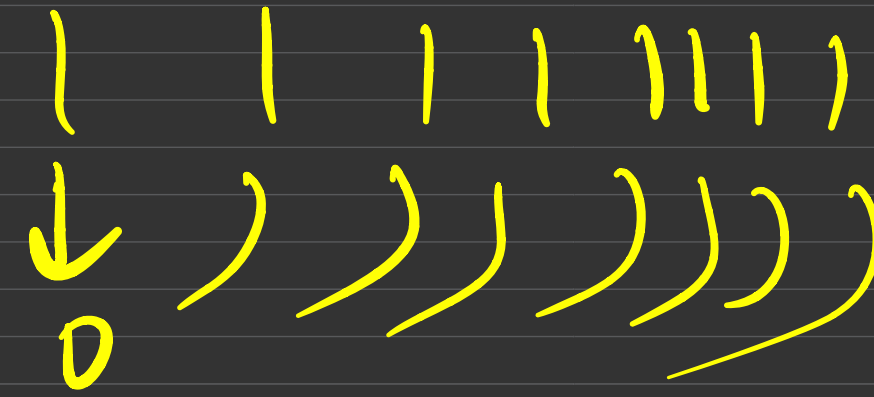
$a_i = a_j$

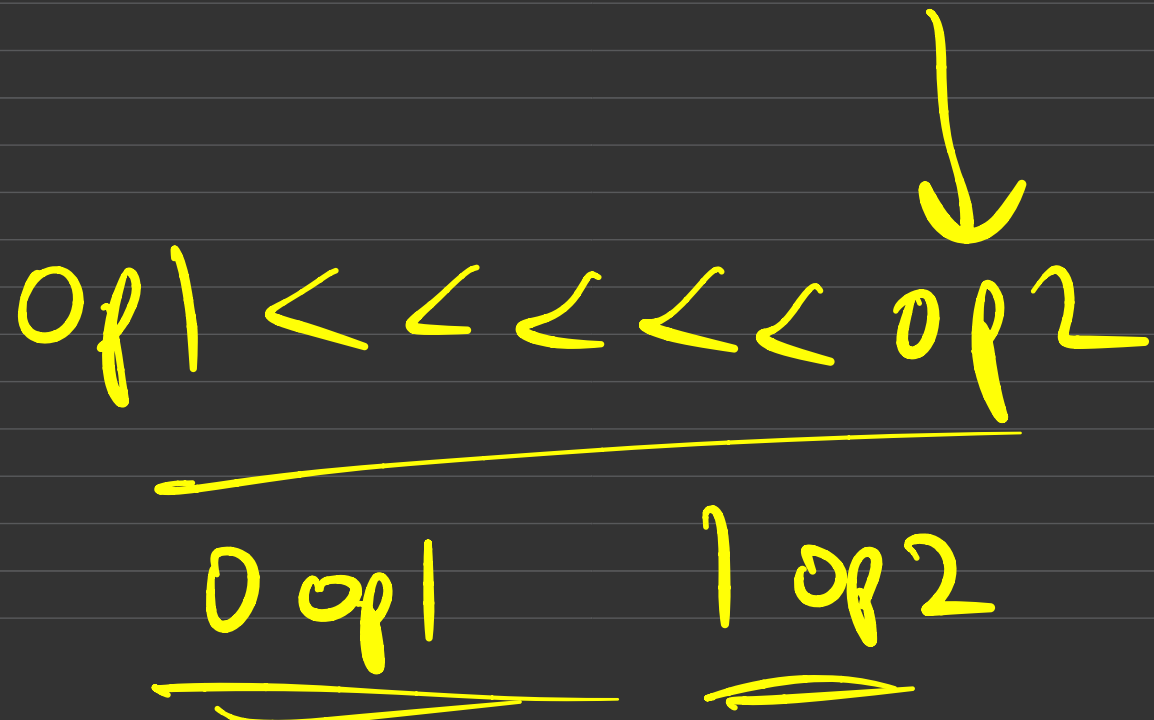
$a_i > a_j$


5
$q_i = q_j$
3
5
1
2
5 → 4 → 3
5, 5
2 2
2
3 3


13
6
9
7.
15
1
2 2 2 2 2 2 2

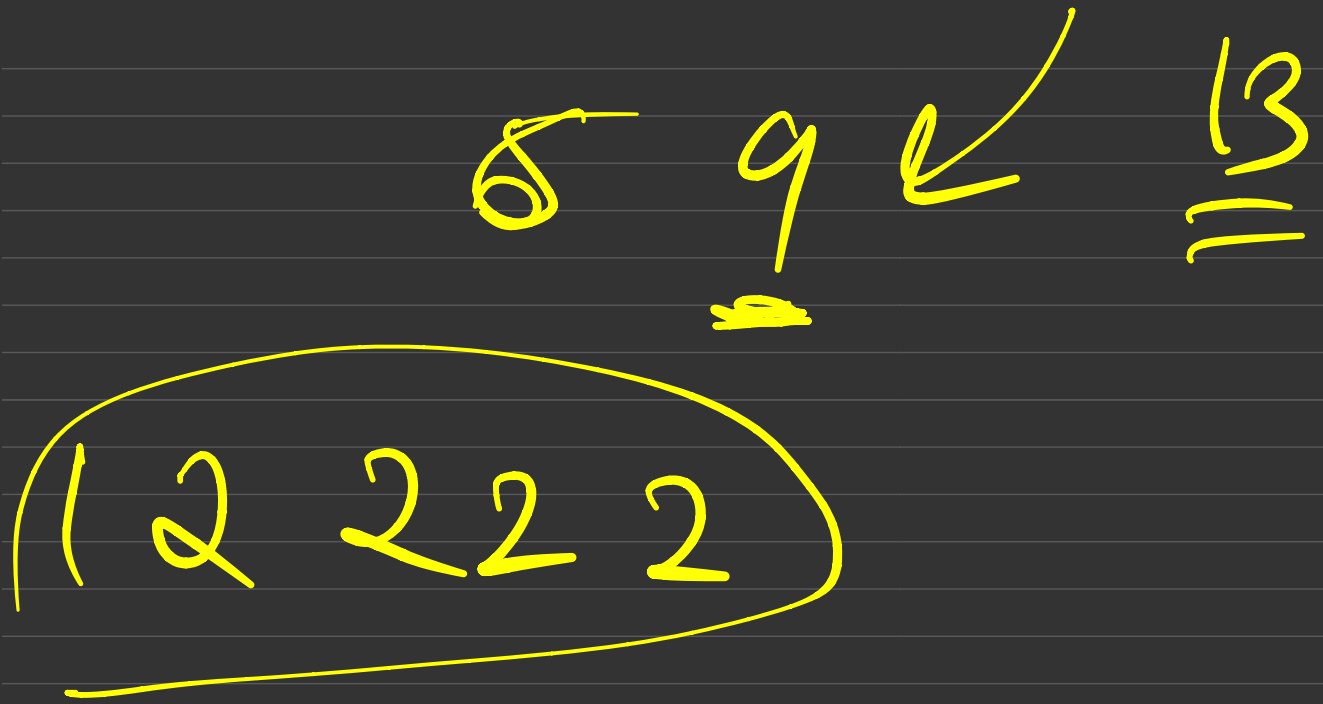
op1 < op2

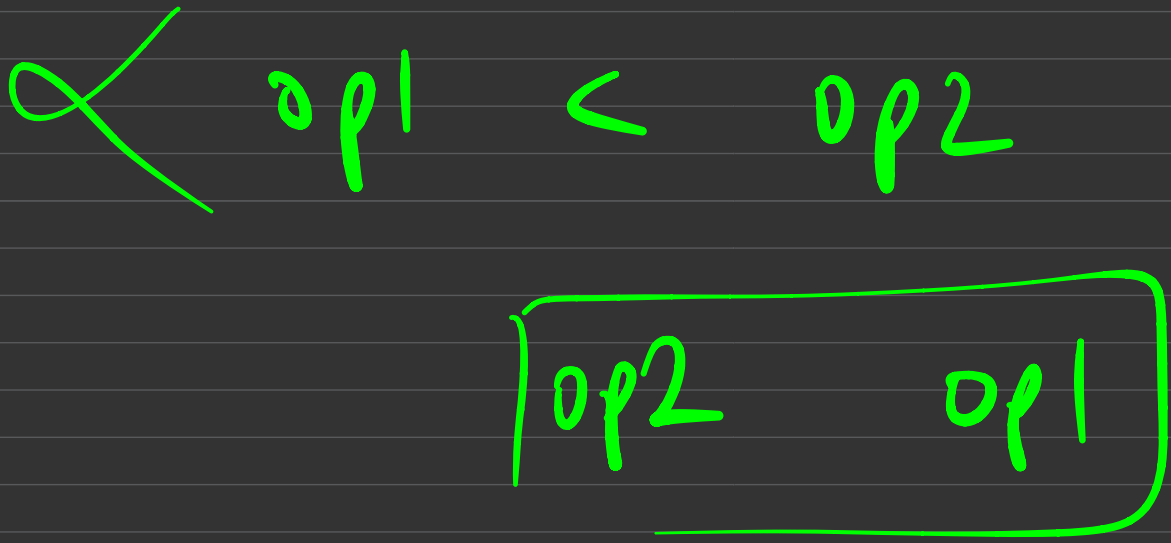


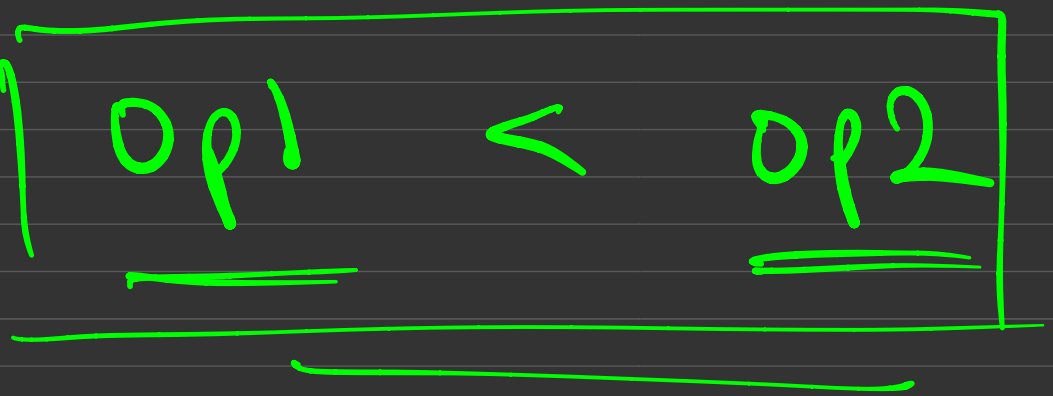

op1 << << << op2
0 op1
1 op2

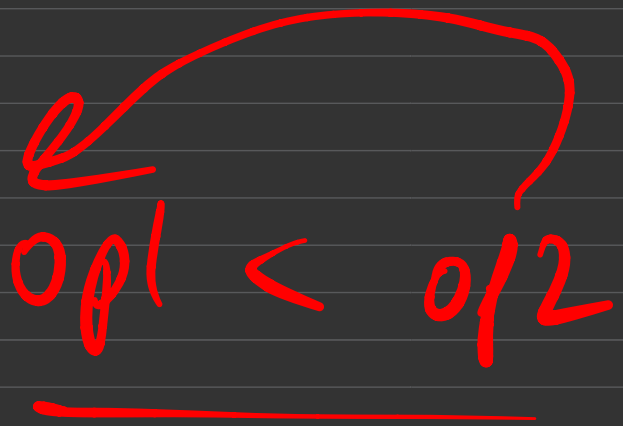
op2

op2


6 9 13
1 2 2 2 2


op1 < op2
op2 op1

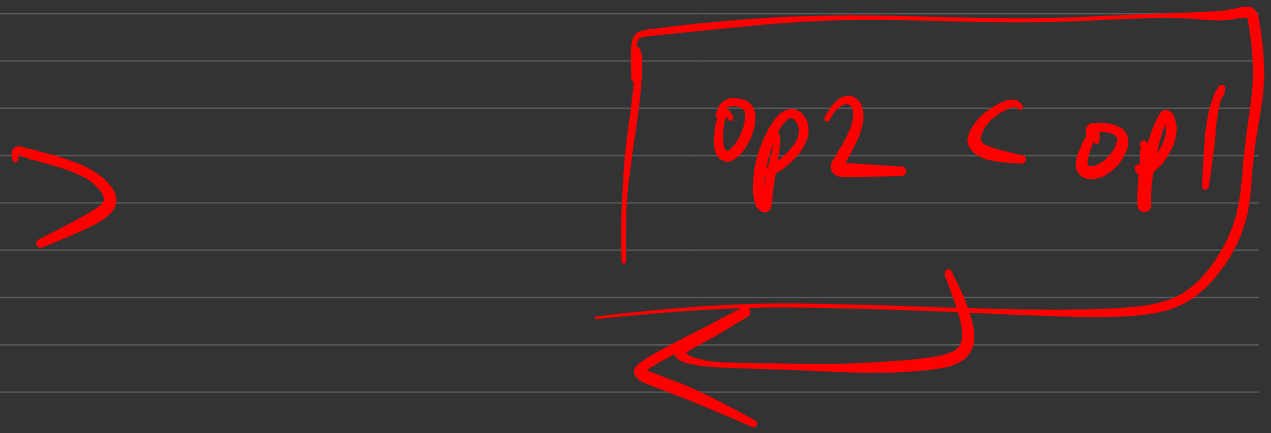

op1 < op2

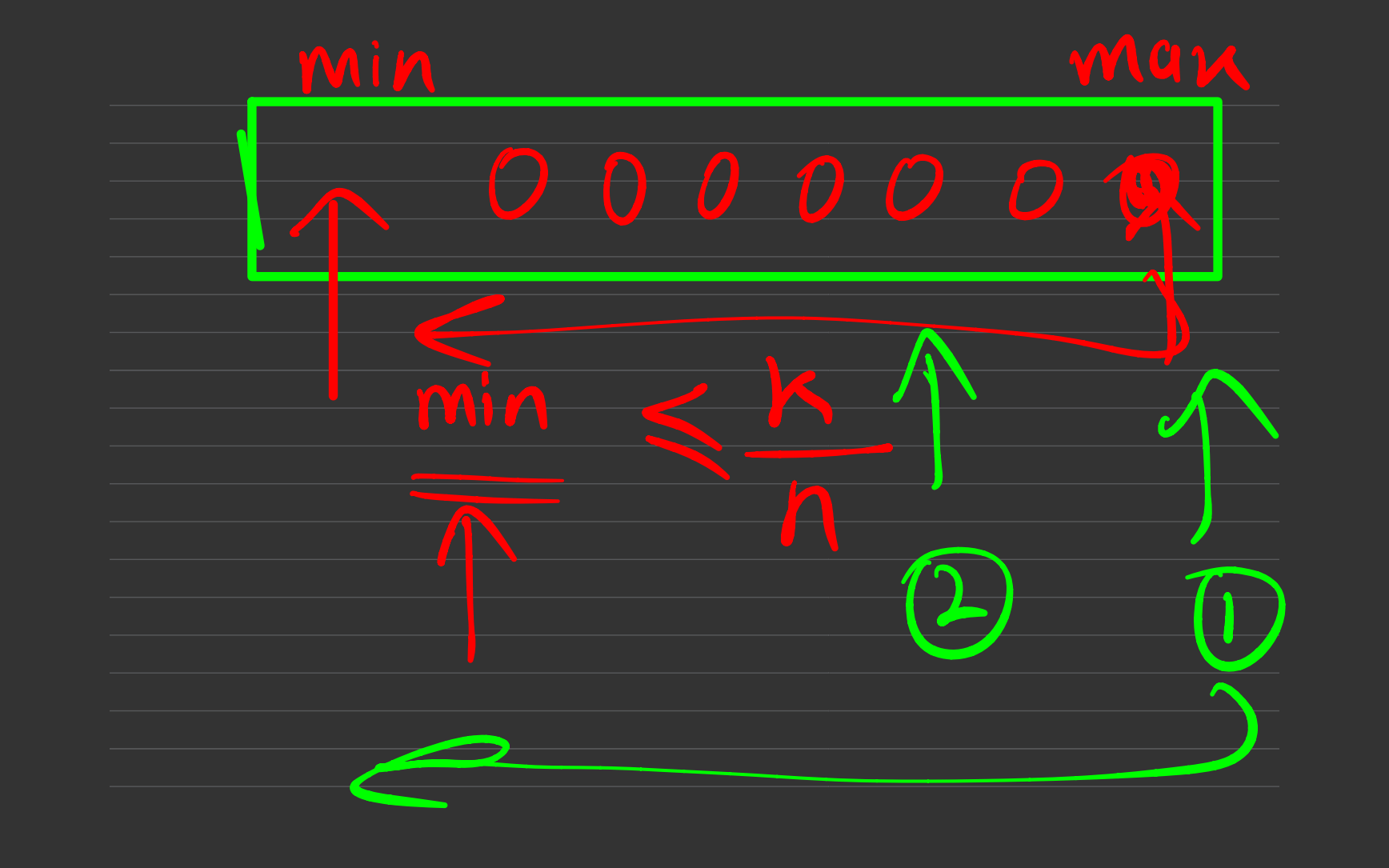

op1 < op2

Exchange Argument

→ Greedy

Obl → Ob2


op2 < op1

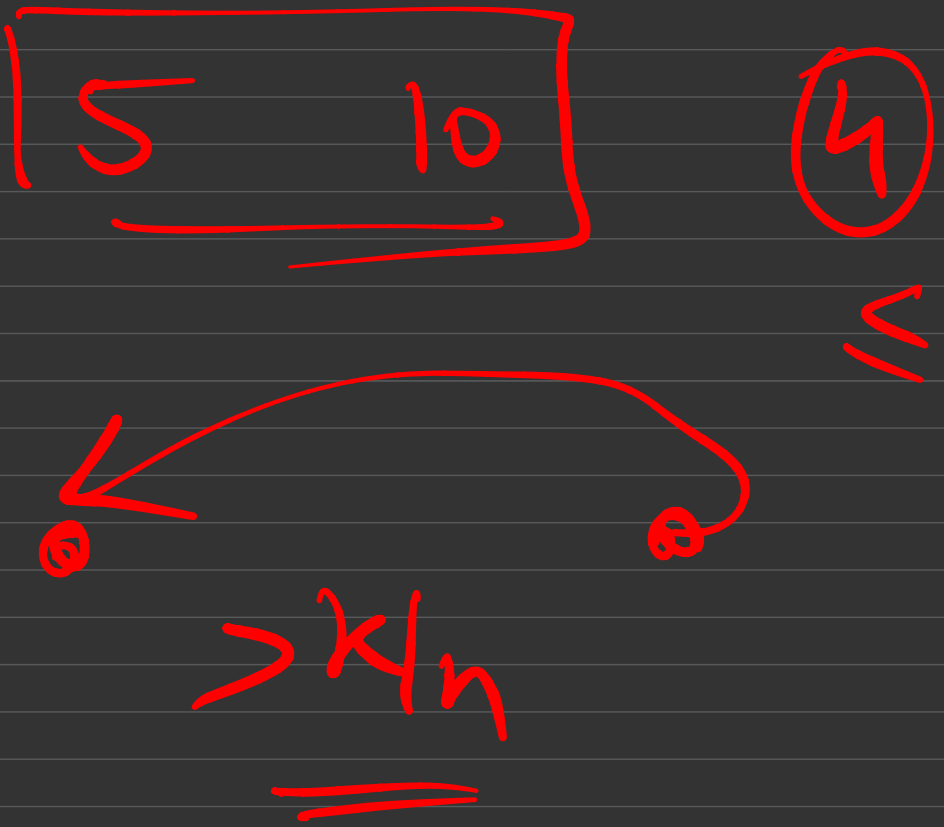

min
max
min
k
n
2
1

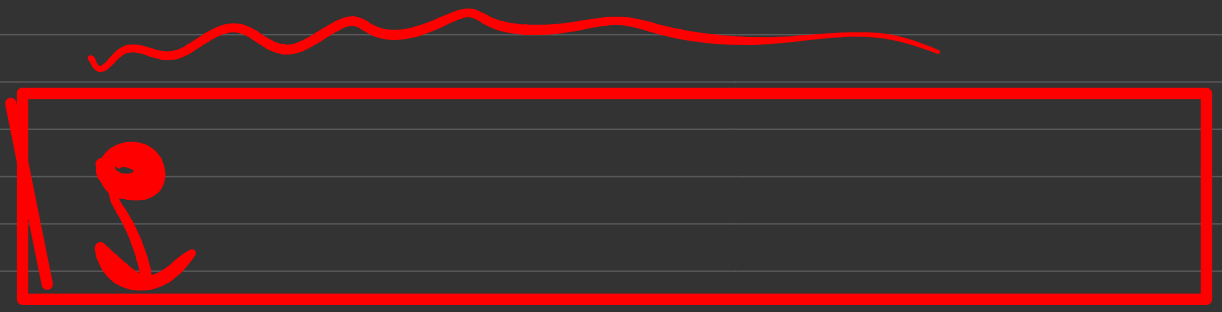
$$\min \leq \frac{k}{n} \quad op2$$

$$\min > \frac{k}{n}$$

$$> k/n \quad > k/n \quad > k/n \quad > k/n$$

op2 $> k$

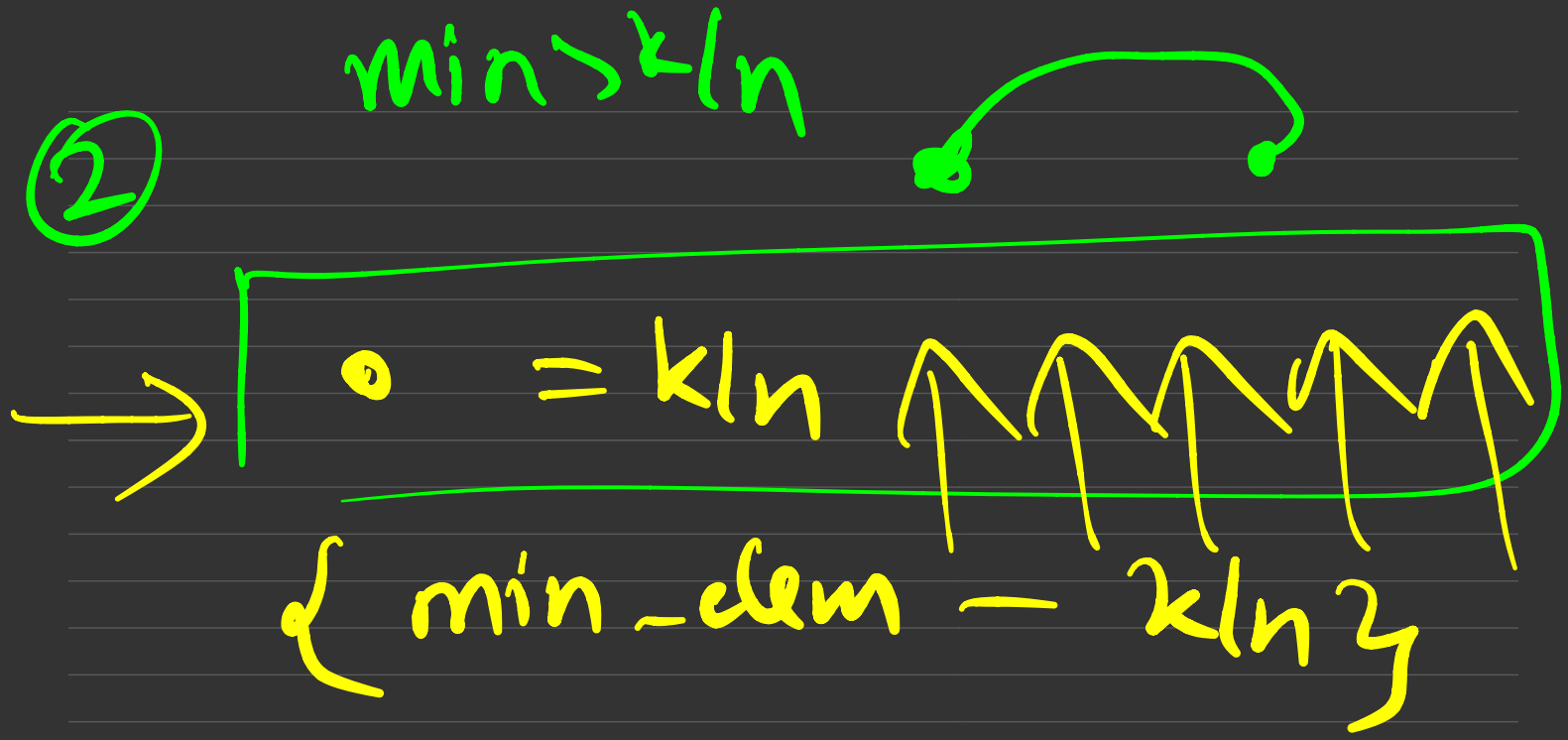

5
10
4
≤4
>4/n

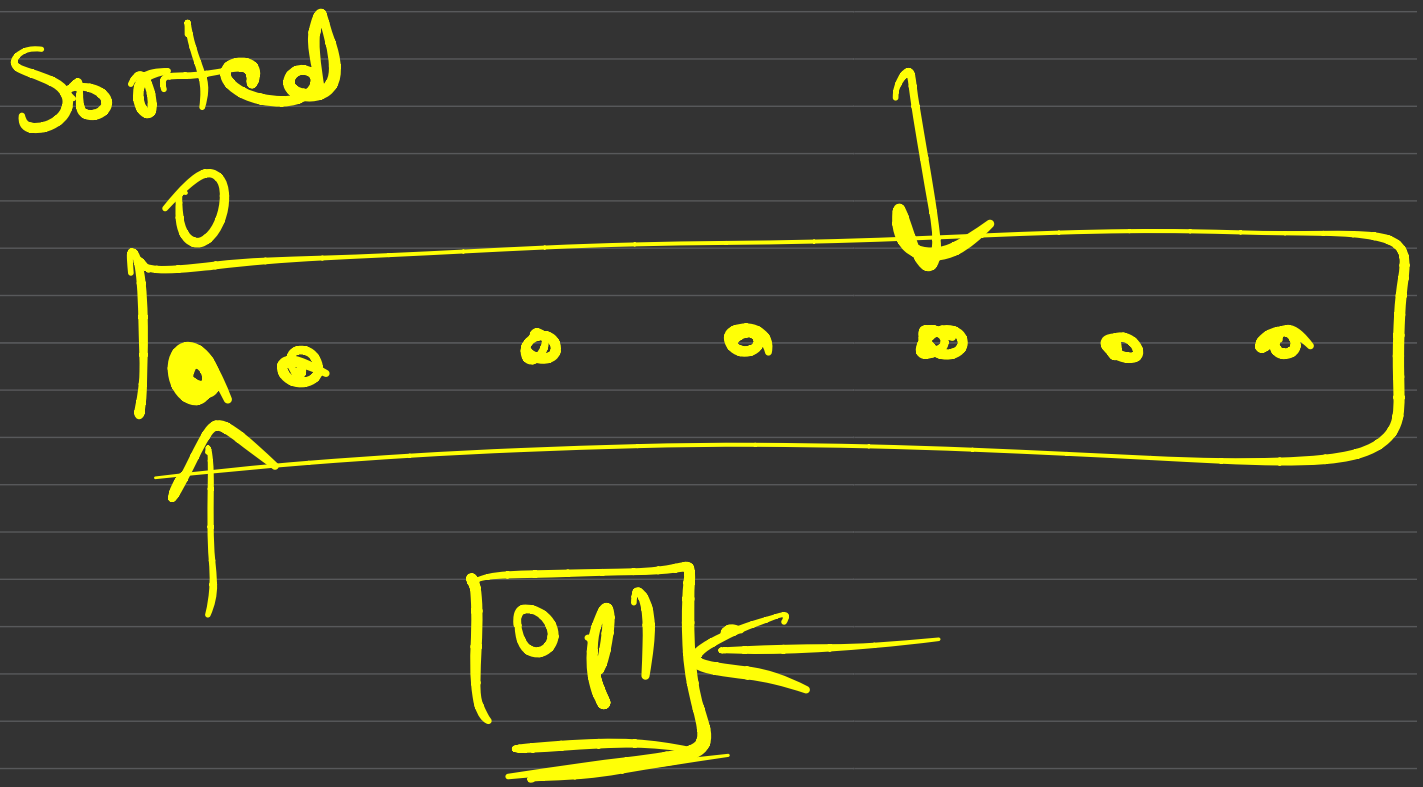


$k \ln$ $\boxed{k \ln}$ greedy

$O(n)$

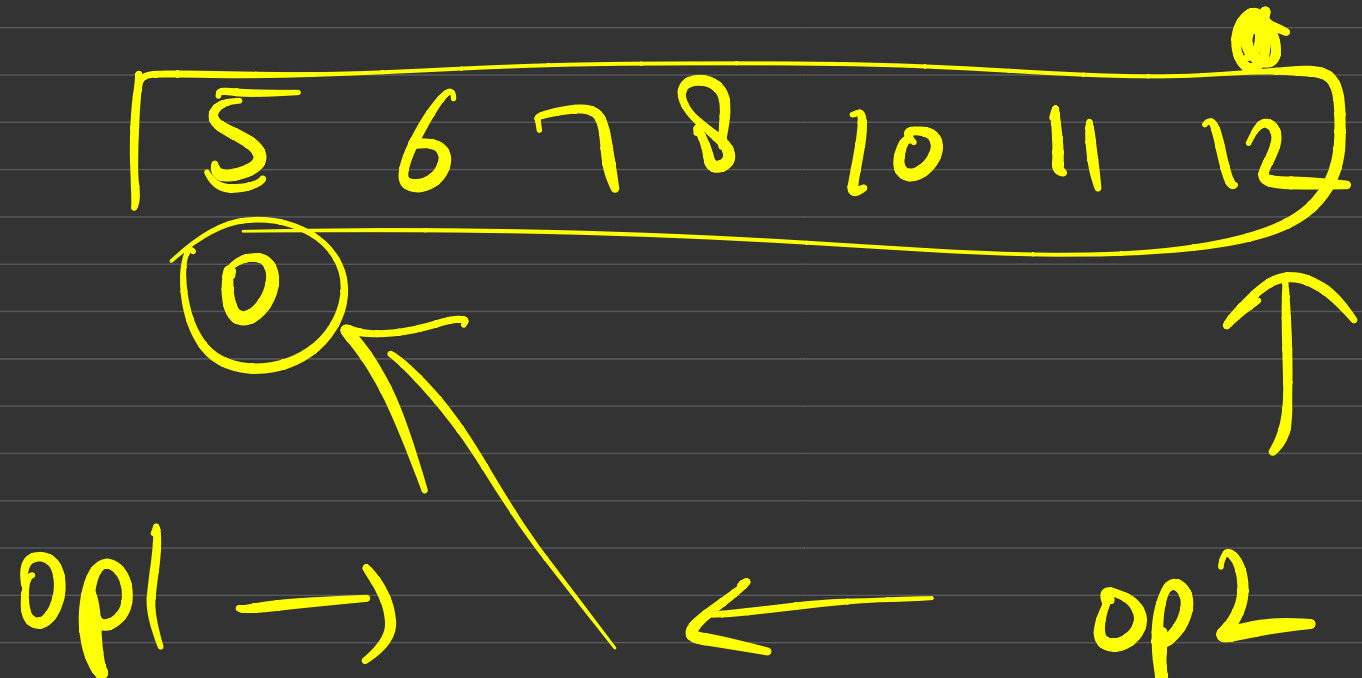

① min ≤ k/n
= ans
≤ kth
opp
≤ k

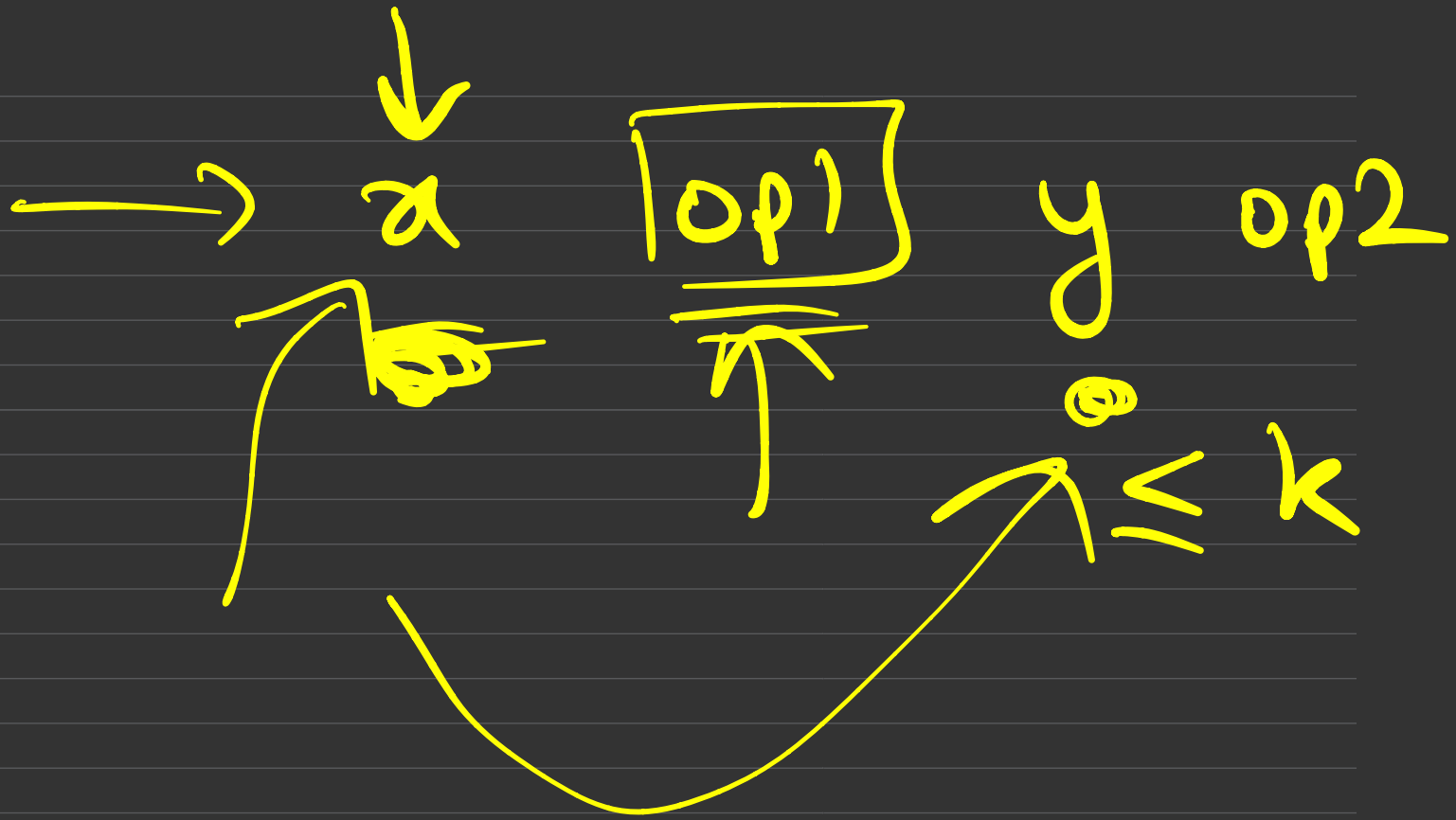

min > k/n
②
0 = k/n
{ min_elem = 2/n }


Sorted
0
011

→ 5 op1 → 1st element

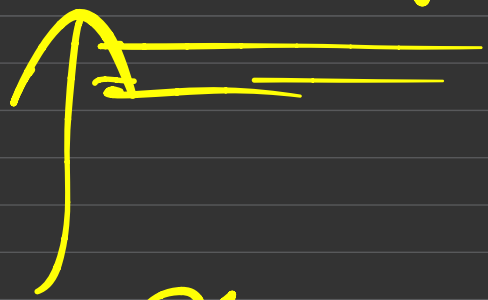
op2


5 6 7 8 10 11 12
0
op1
op2

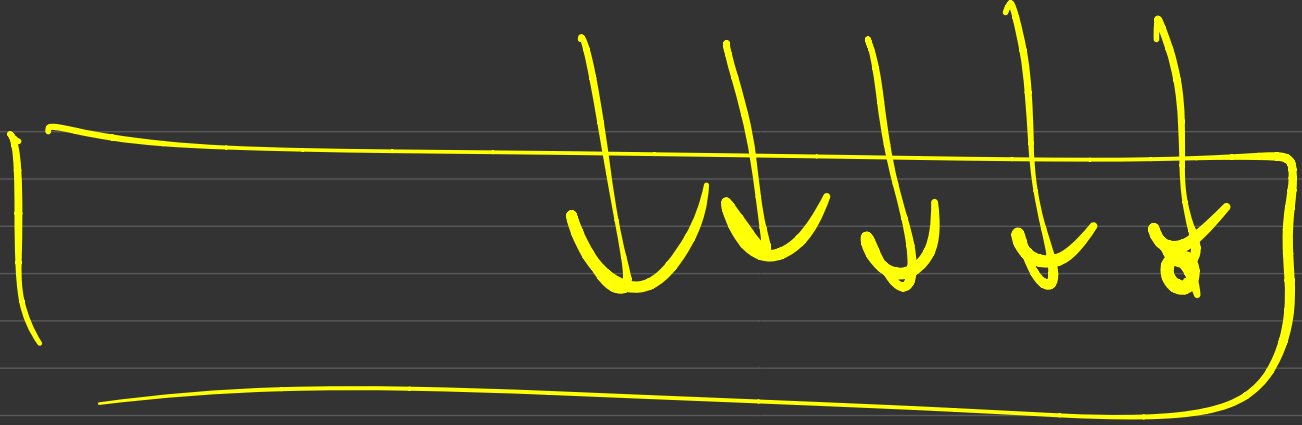

x
op1
y
op2
i ≤ k

→ x → fixed

10 op1 → 1st element



x → y

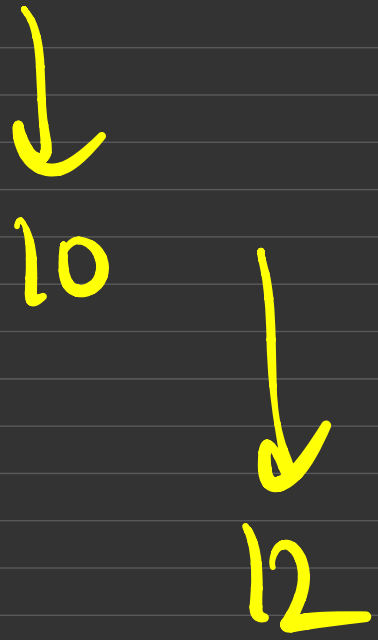


$x \rightarrow y \qquad \lesssim k \rightarrow y$

$x = 10$, $y = 20$

$\uparrow$ $\uparrow$ $\leq k$

$x = 12$, $y \leq 20$

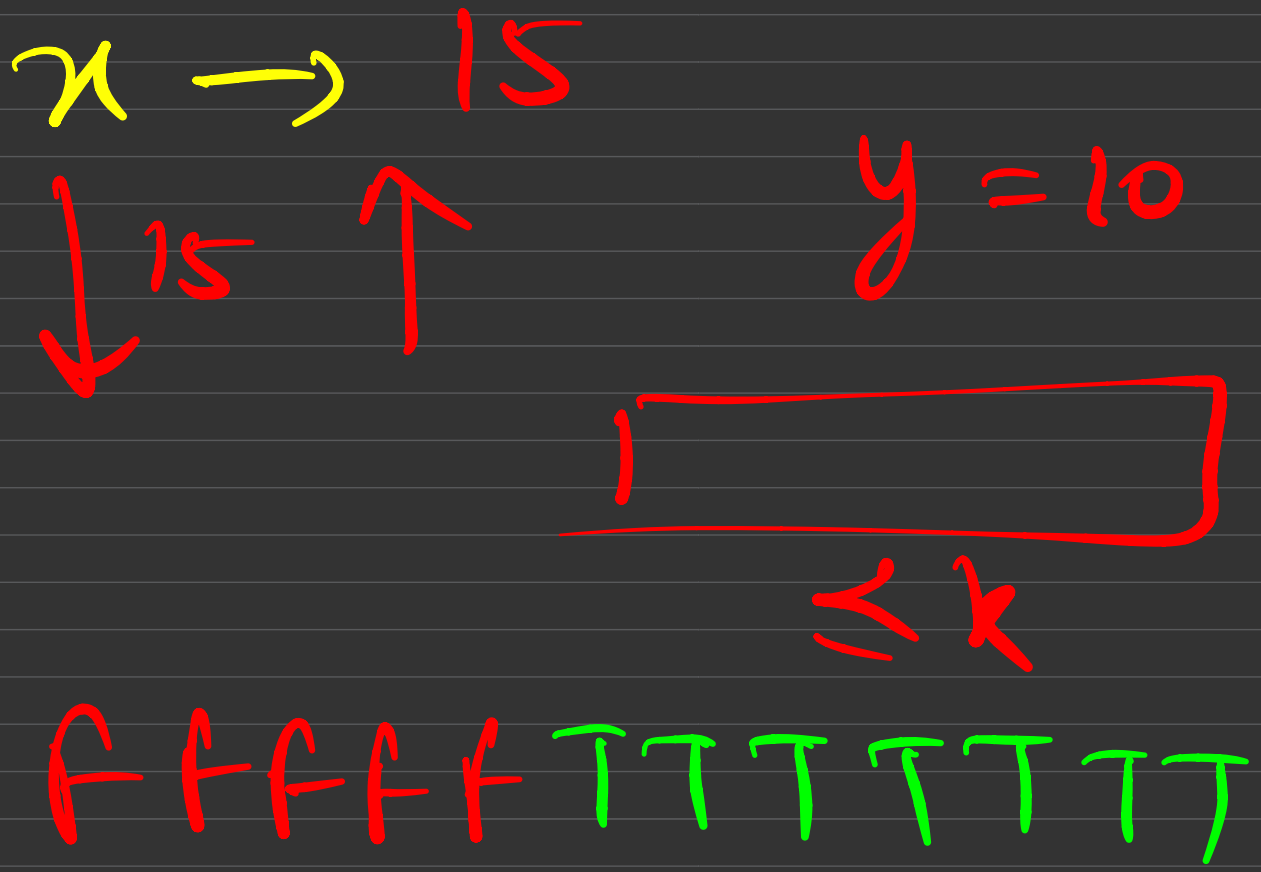


$$= 20$$

$$\leq 20$$

$y = 10 \longrightarrow$ 10 elements

$x \rightarrow 8 \cdot 5$


x → 15
15
y = 10
≤ k
F F F F F T T T T T T

$x = 20$ → op1

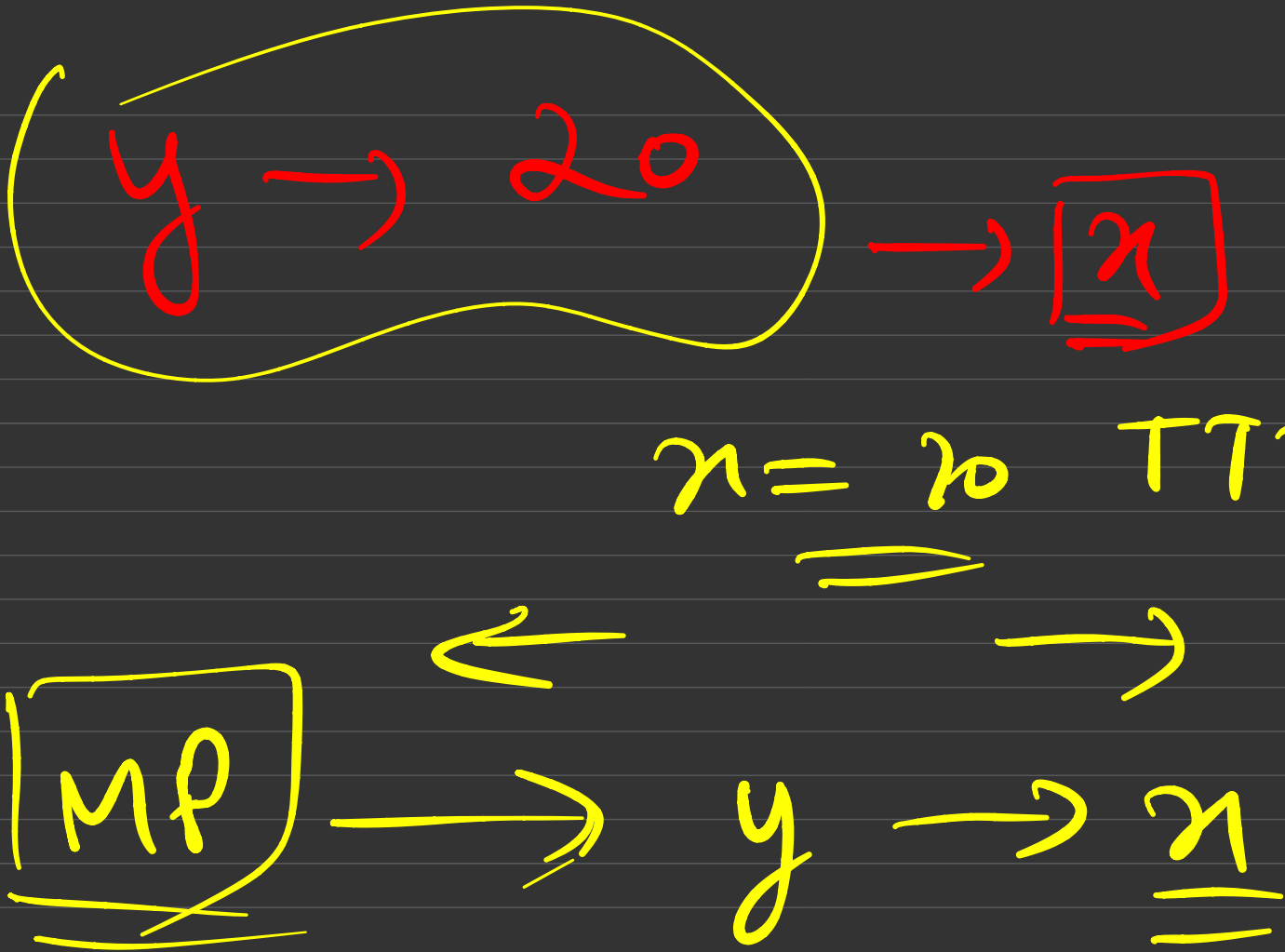
$x = 21$

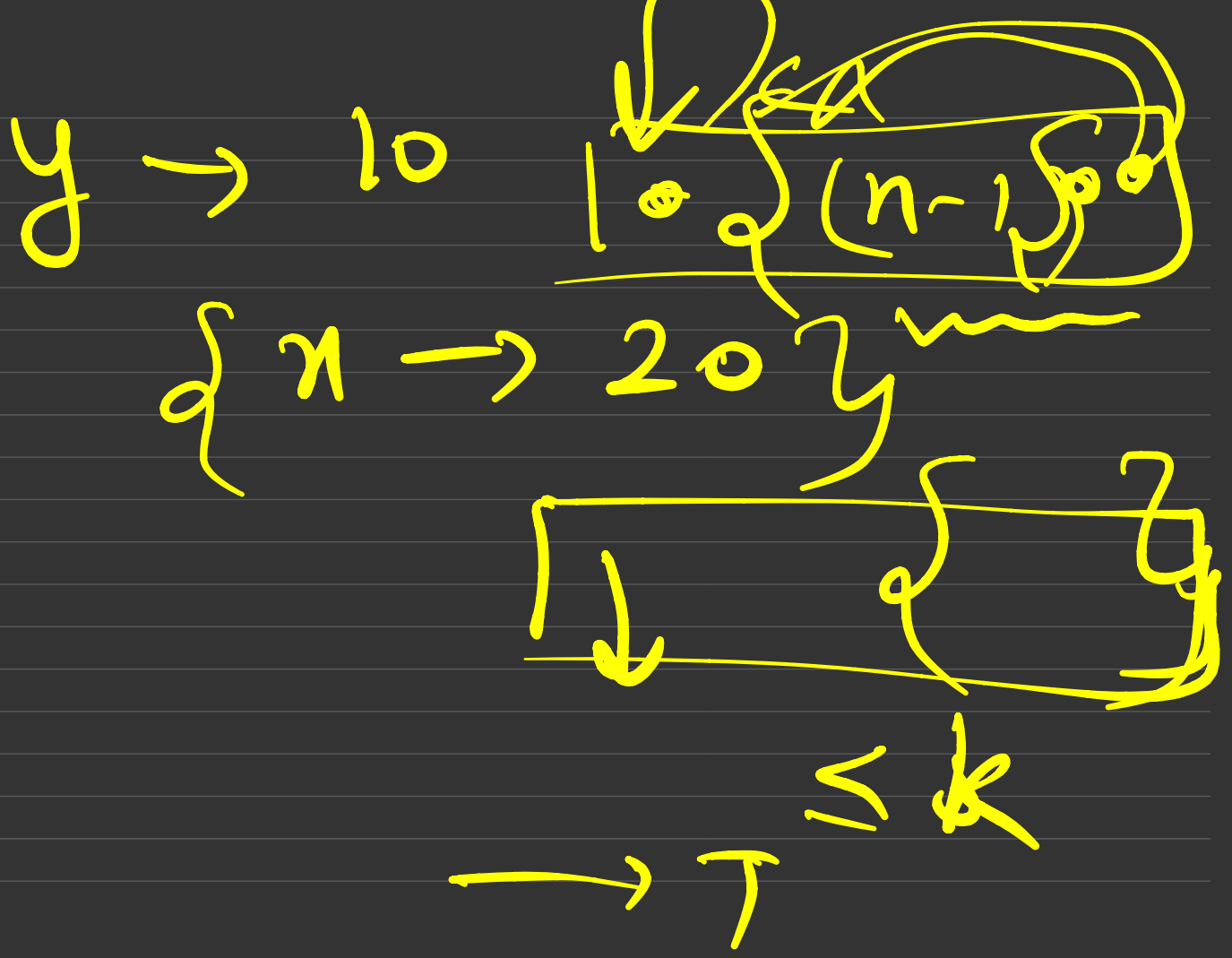
$x = 22$

$x = 23$

$\leq x$

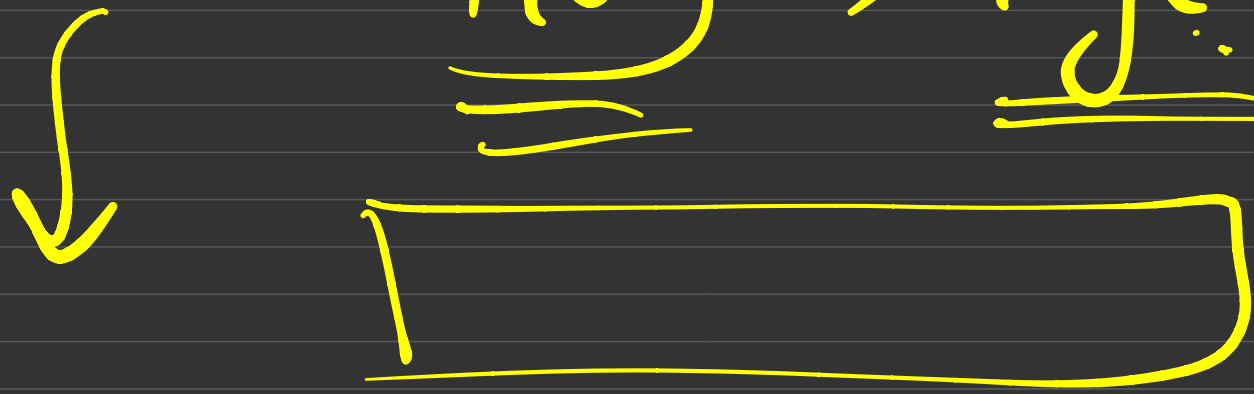
$y = 10$

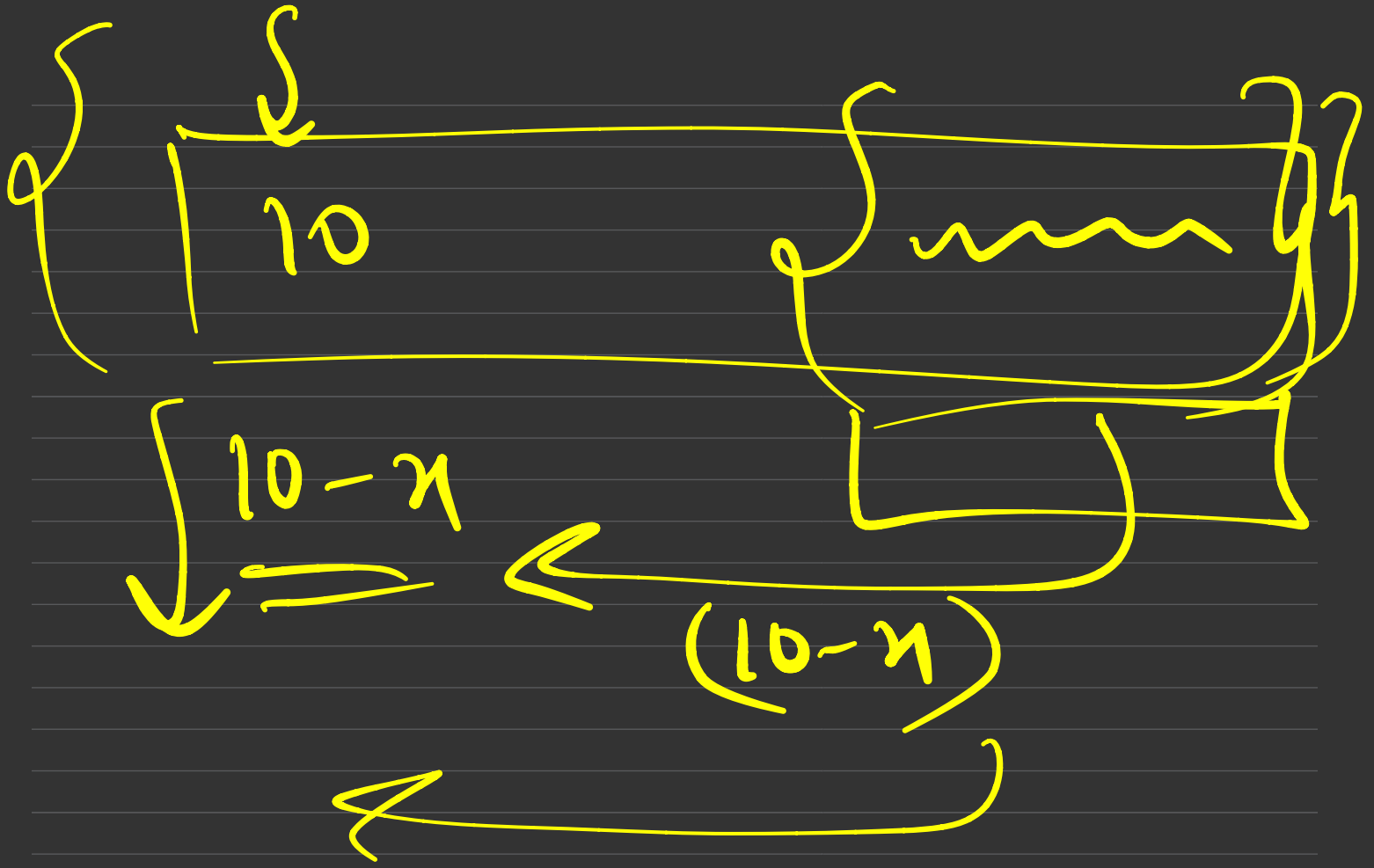

y → 20
→ x
x = 20 TTT
MP
→ y → x


y → 10
1
(n-1)
{x → 20
≤ k
→ T

$y \rightarrow n-1 \rightarrow O(n)$

$n \rightarrow 10^9 \rightarrow \log(10^9)$

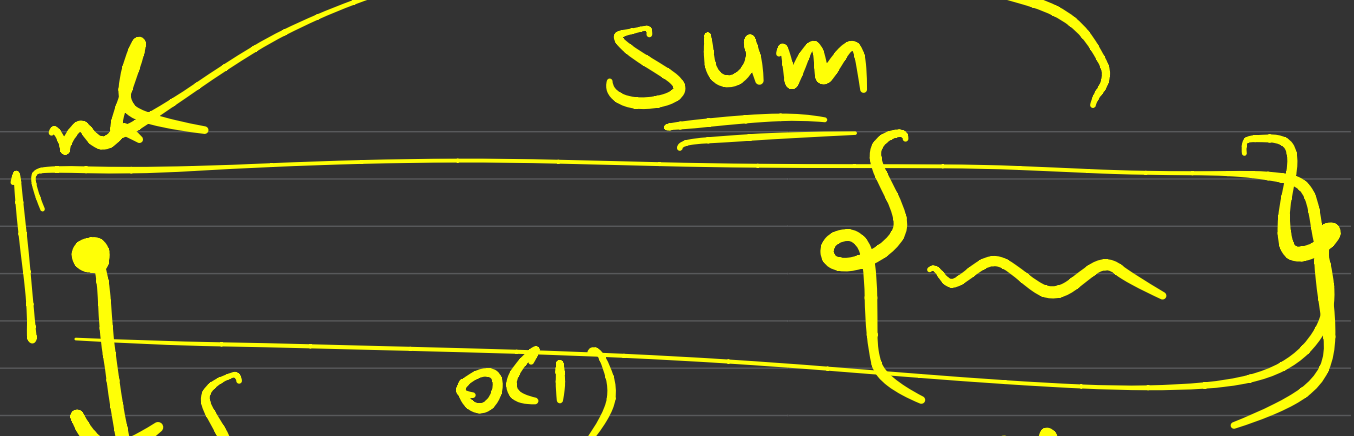



10
sum
10-n
(10-n)

$y \rightarrow O(n)$

↳ $x \rightarrow O(\log 10^9) = 30$

↳ Predicate $\rightarrow O(n)$



$$\{ sum - x - suffix[y] + y \times [a[0] - x) \}$$

$O(1)$ $O(1)$ $O(1)$

$O(n)$

$y \rightarrow O(n)$

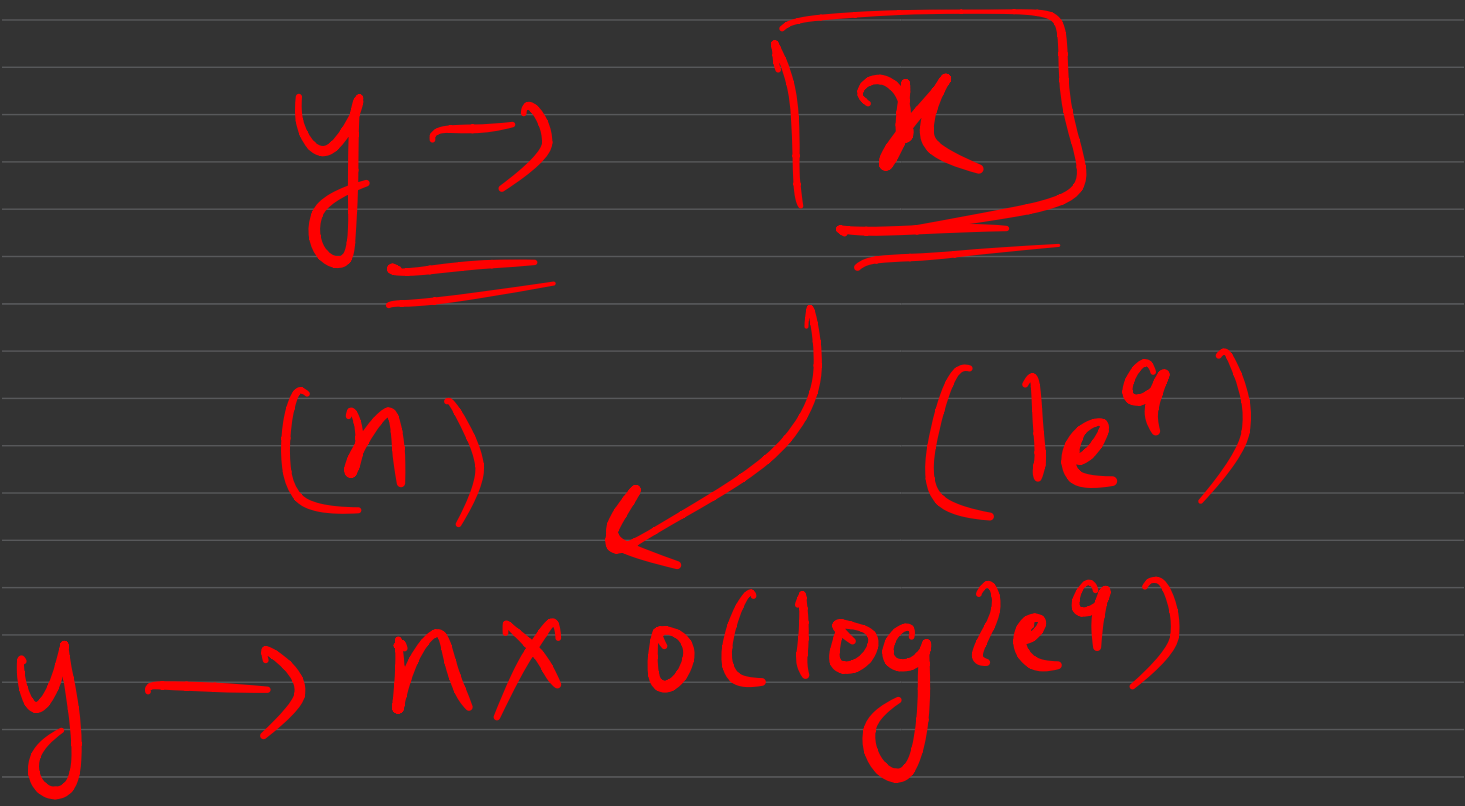
$x \rightarrow O(\log) = 30$

$\hookrightarrow O(1)$

$\min(y_i + a_i) \quad i \leq 1 - n-1$

$O(n \log \log e^9)$

n


y → x
(n)
(1e9)
y → nx o(log 1e9)

$n \rightarrow le^9 \times O(\log n)$