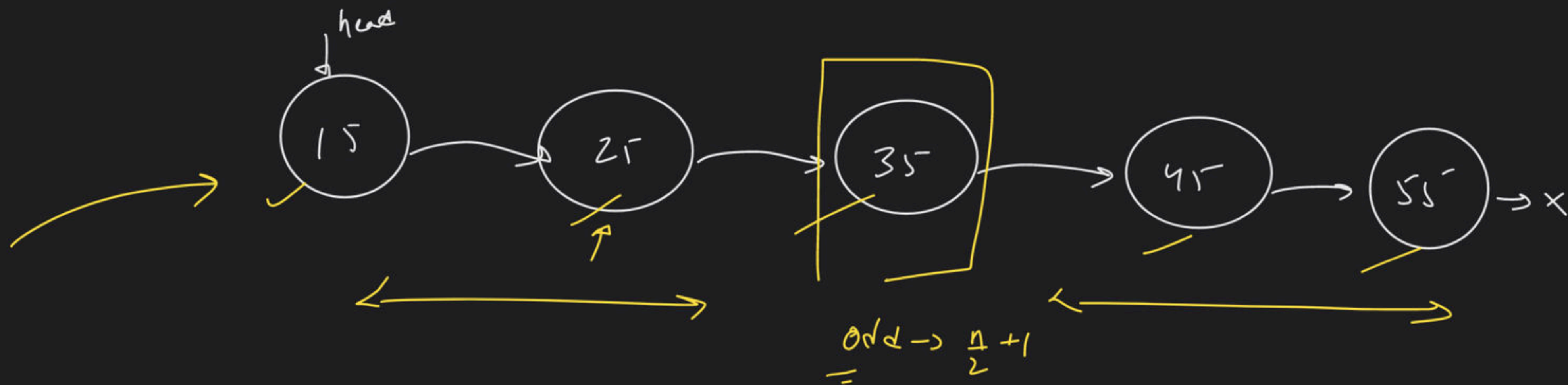
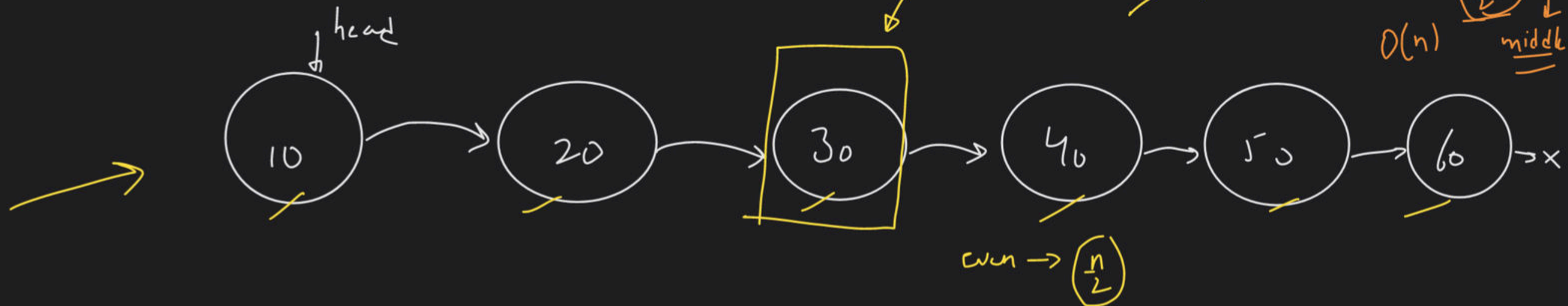


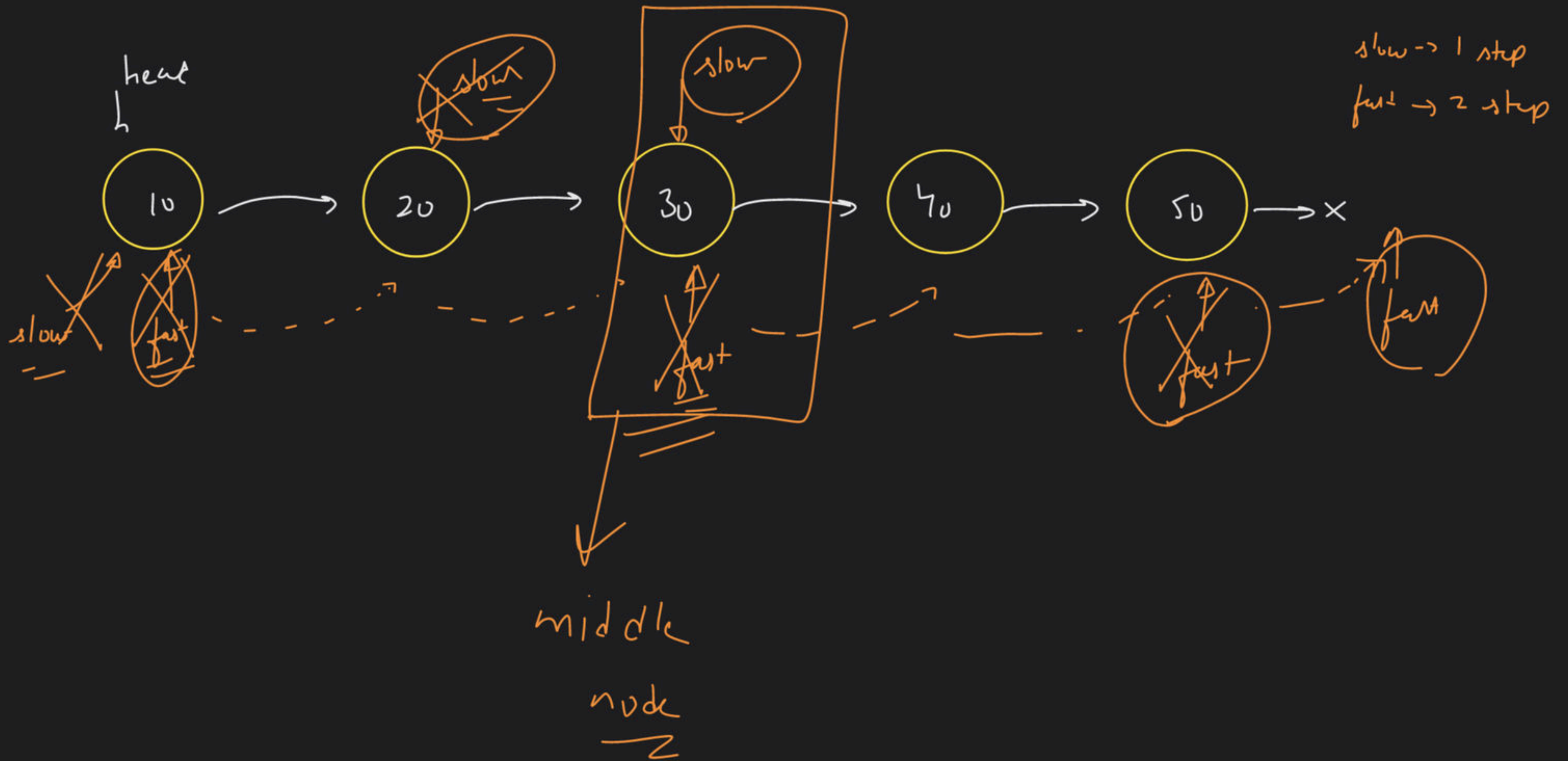
LL Class - 3

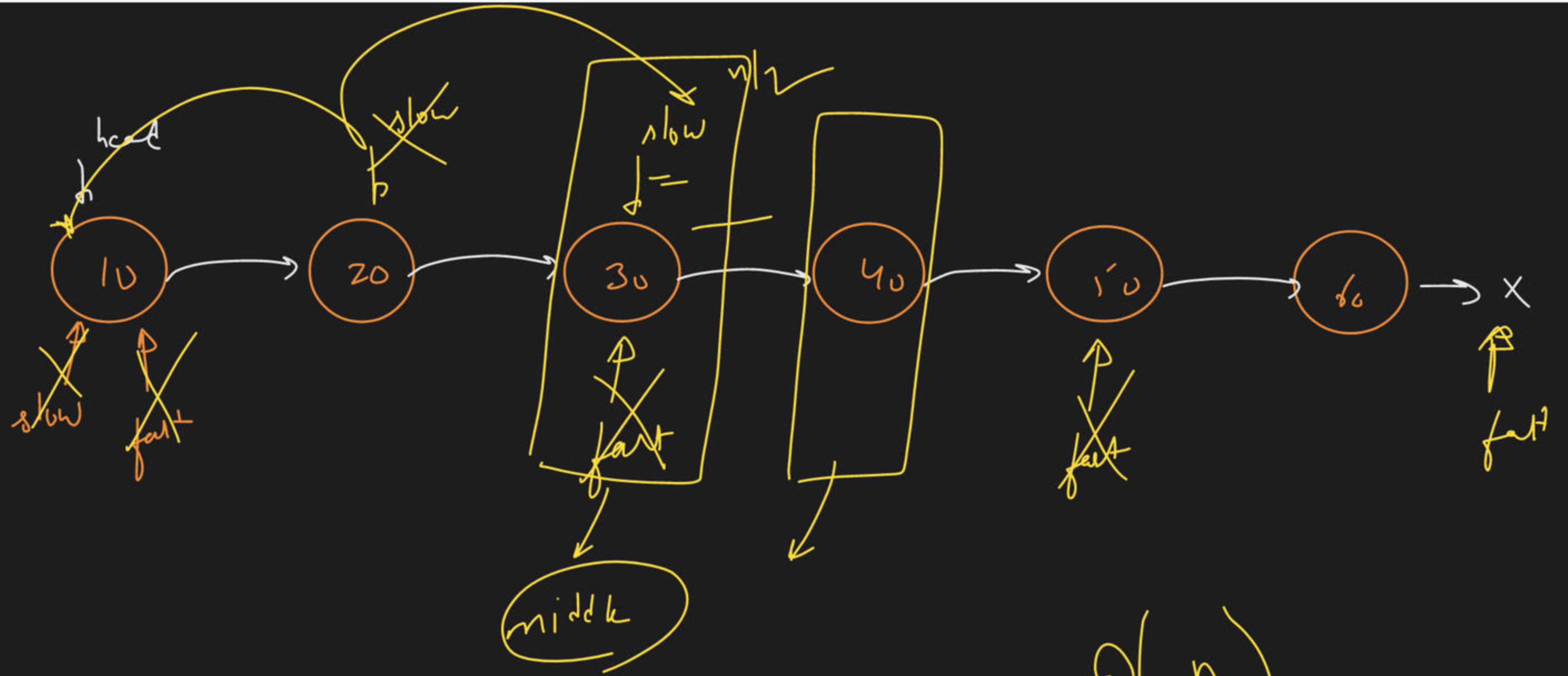
Special class

→ find Middle of LL

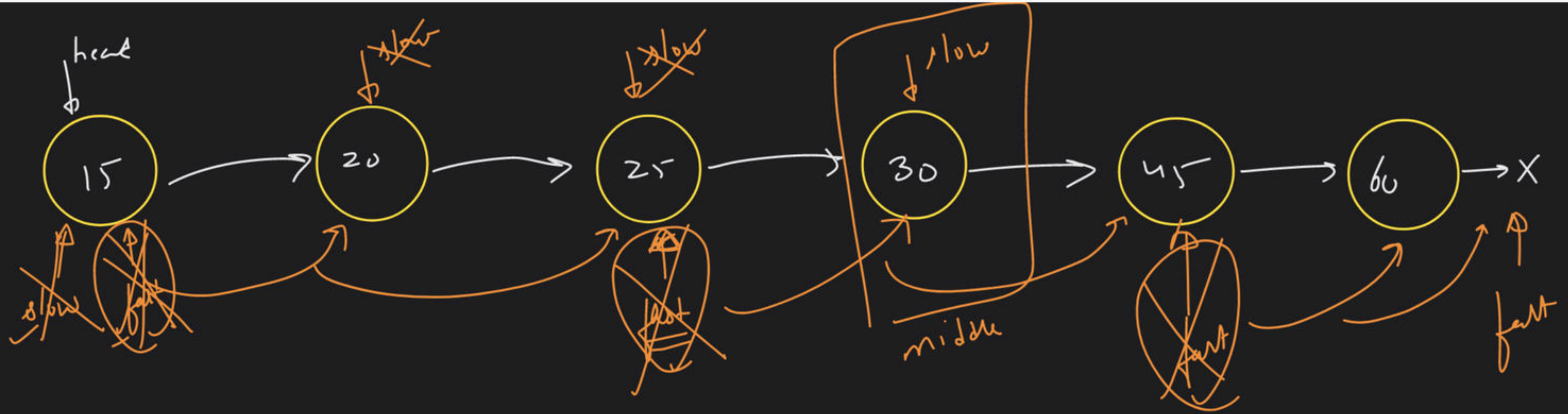
H/W
a p approach
length → $O(n)$
len → even → $n/2$
odd → $n/2 + 1$
 $O(n)$
middle







$$\frac{\mathcal{O}\left(\frac{n}{2}\right)}{\mathcal{O}(n)}$$



(A) slow = head
fast = head

(B)

fast = 2 step
slow = 1 step

while LL
entirely traverse
na ho jaye

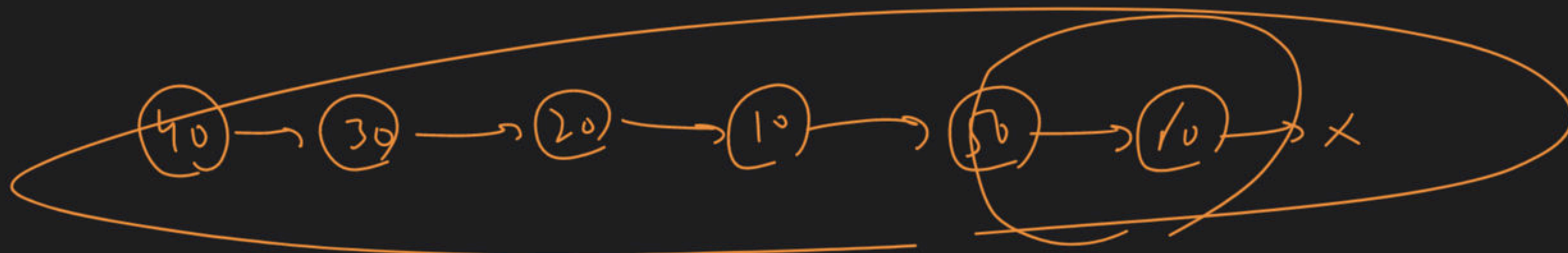
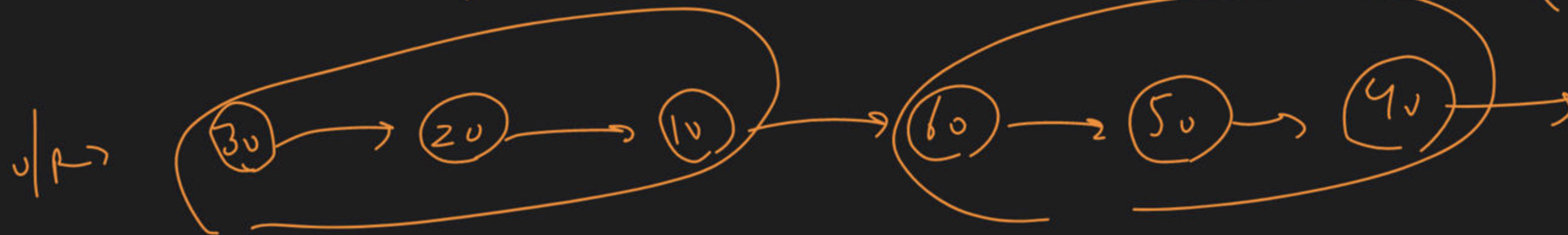
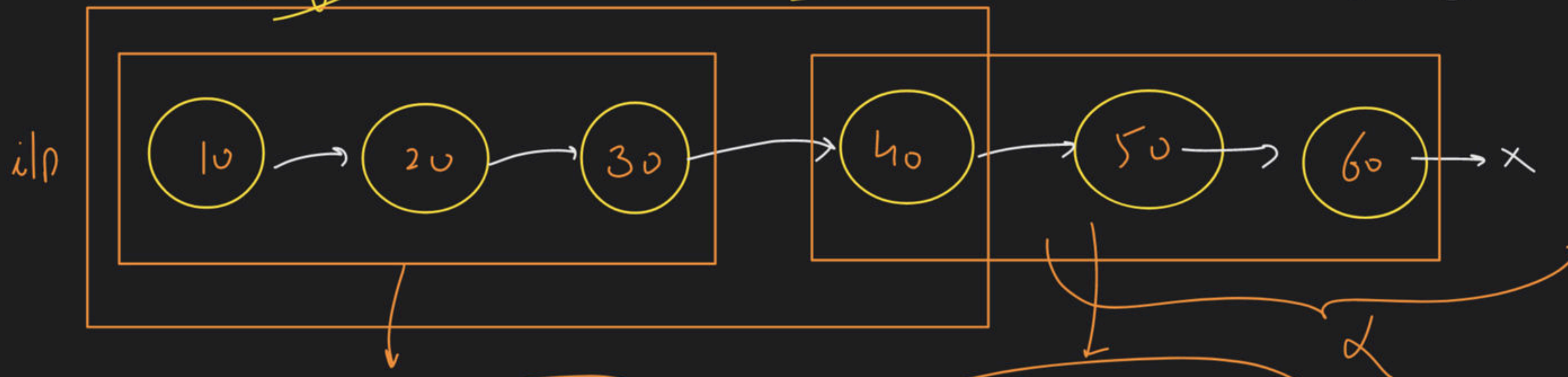


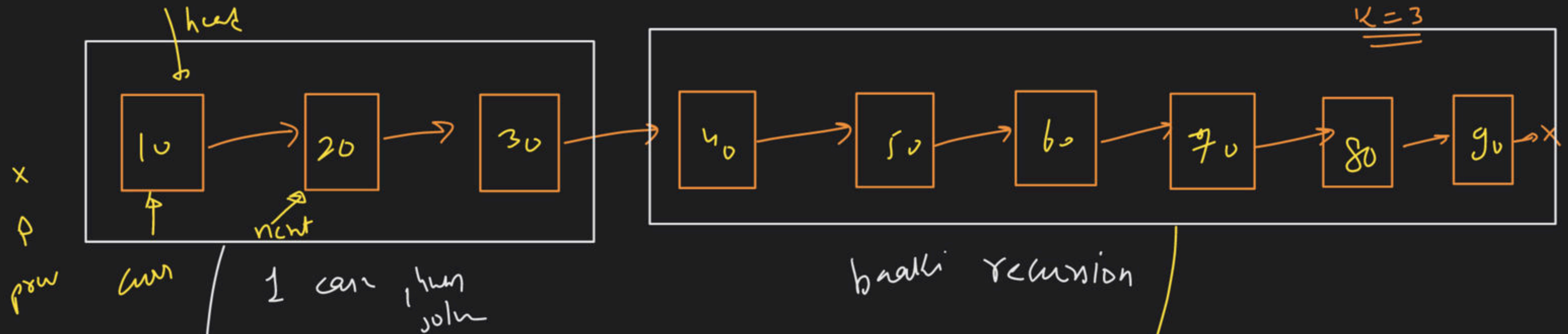
→ 10 mcho



→ 5 m

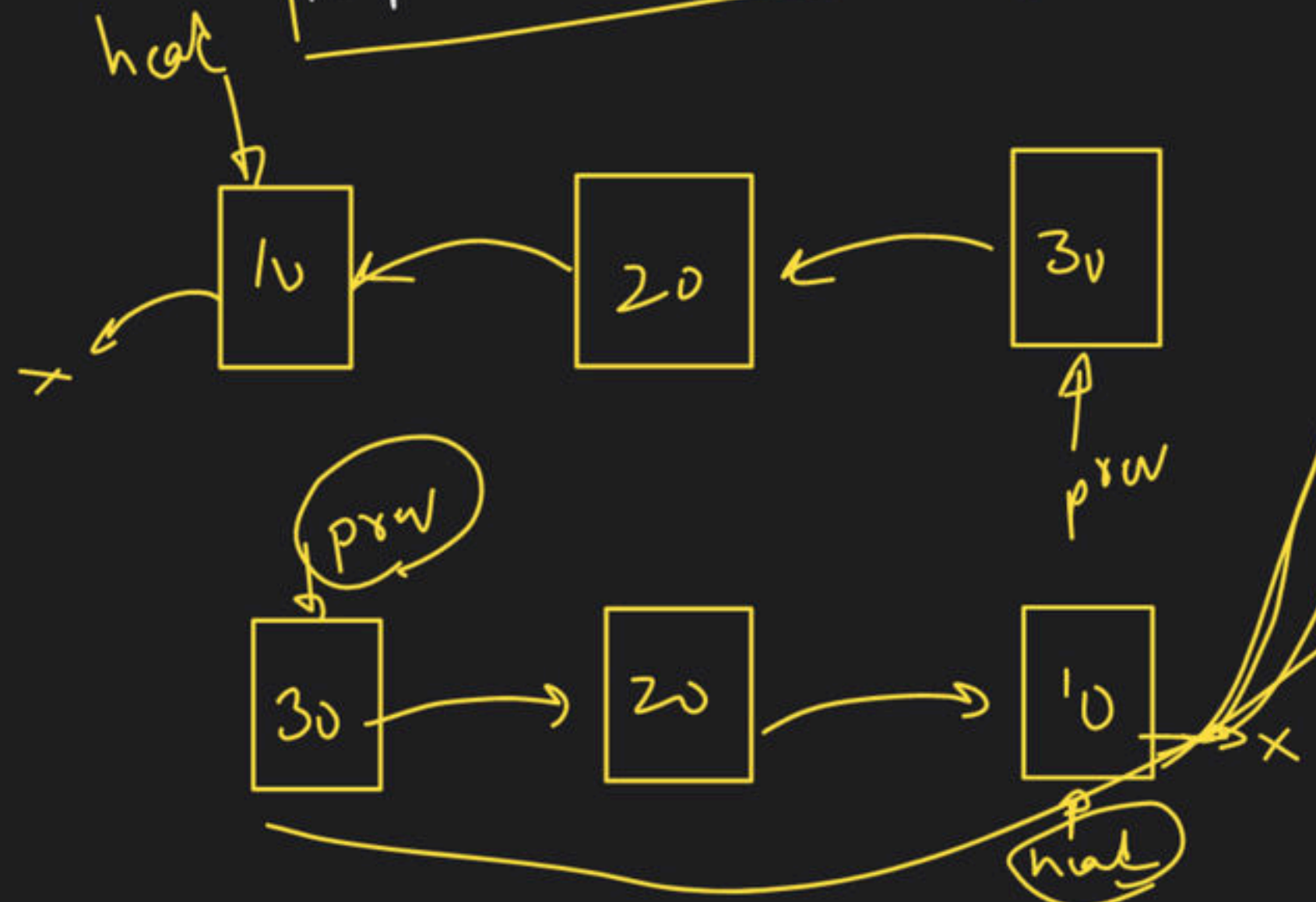
\nearrow K groups \rightarrow $v.v.v.v.v.v$ 20 review KL \rightarrow 3 hr \rightarrow worth it
 $K-3$





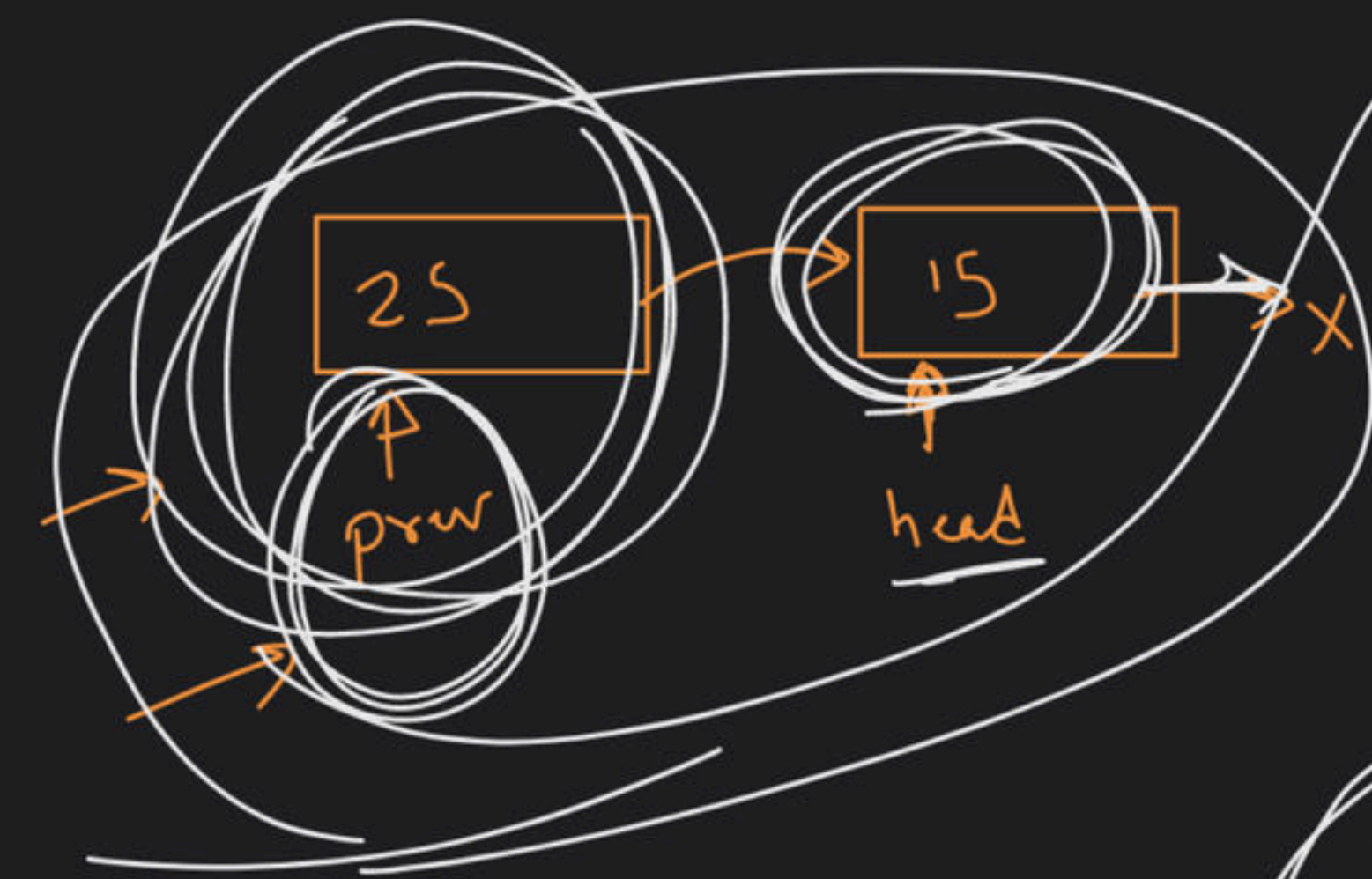
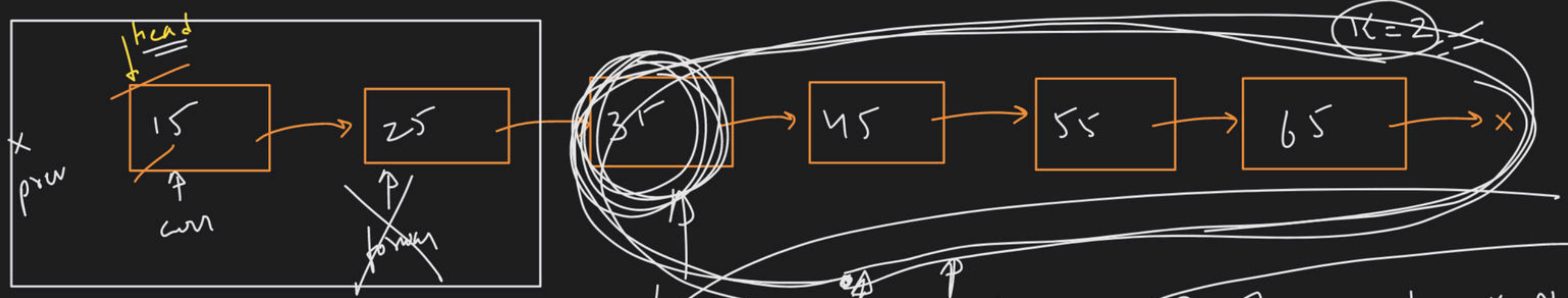
baaki recursion

(A) loop \rightarrow reverse K nodes



(B) head \rightarrow next = recursionKaAns

(C) return prev



forward

recursion

Node recursionKaAns

$$= \text{reverseNode} \left(\begin{array}{cc} \text{forward} & K \\ \uparrow & \uparrow \\ \text{head} & K \end{array} \right)$$

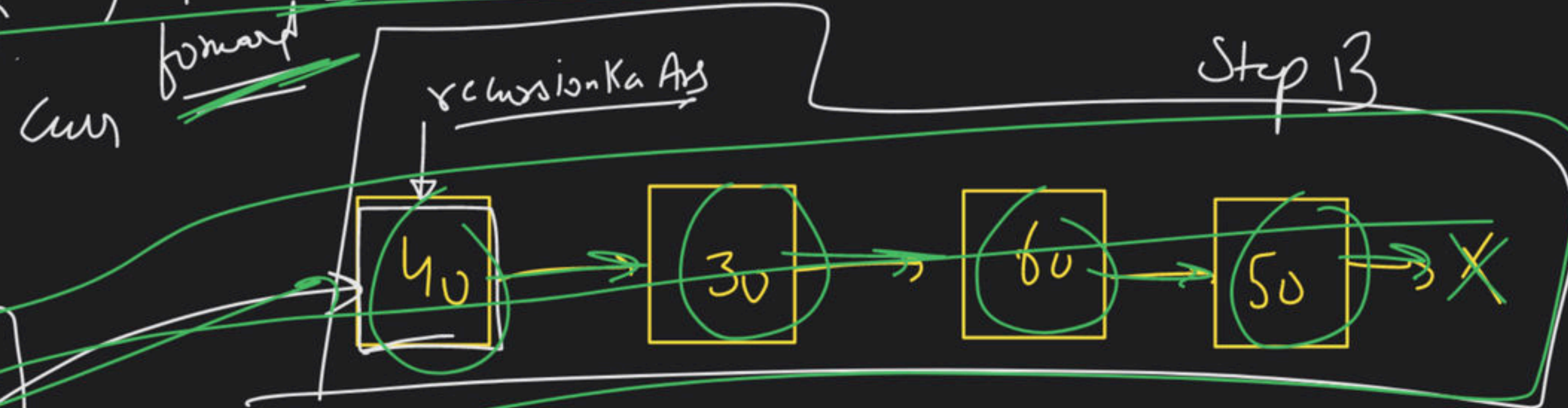
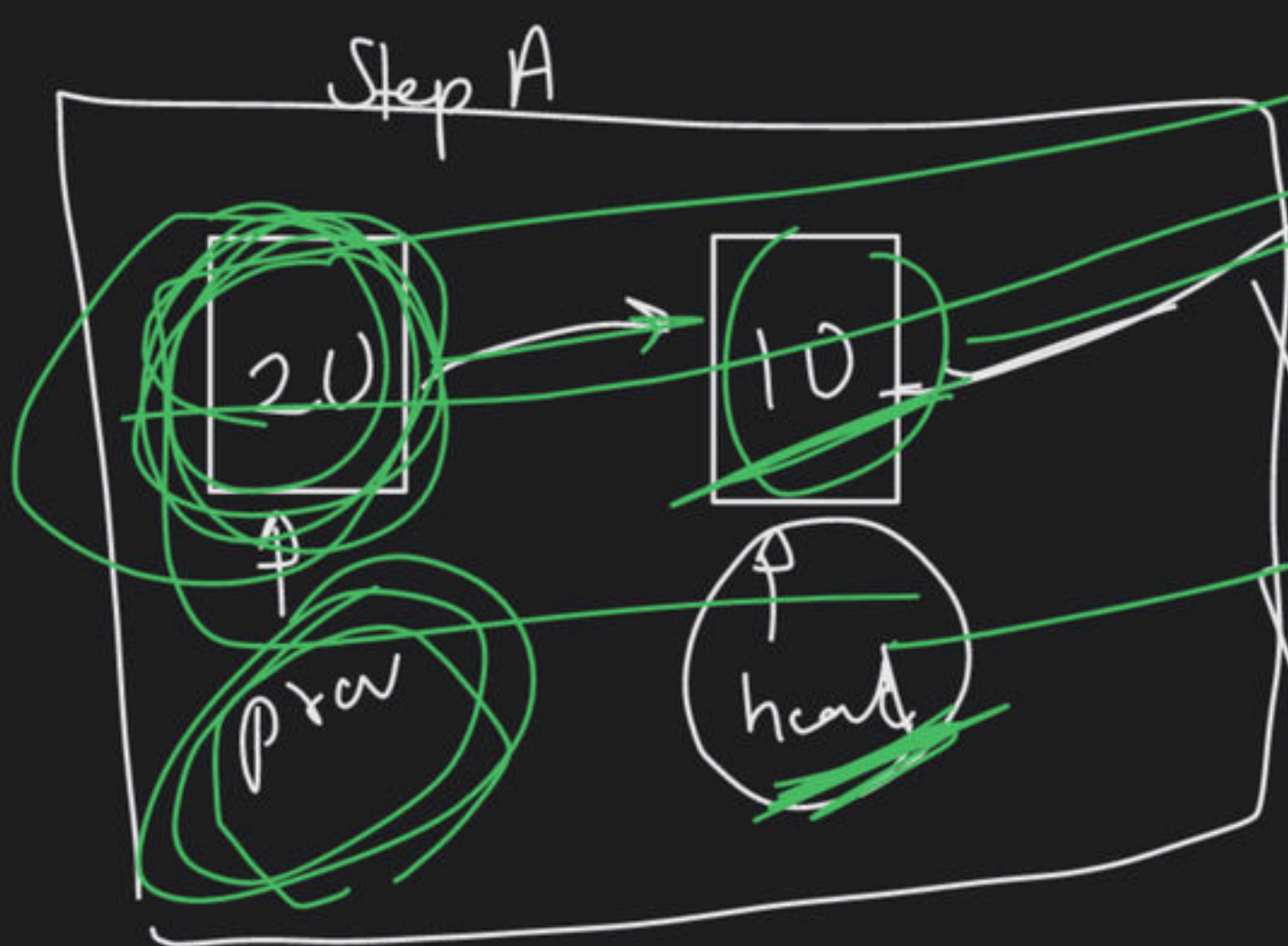
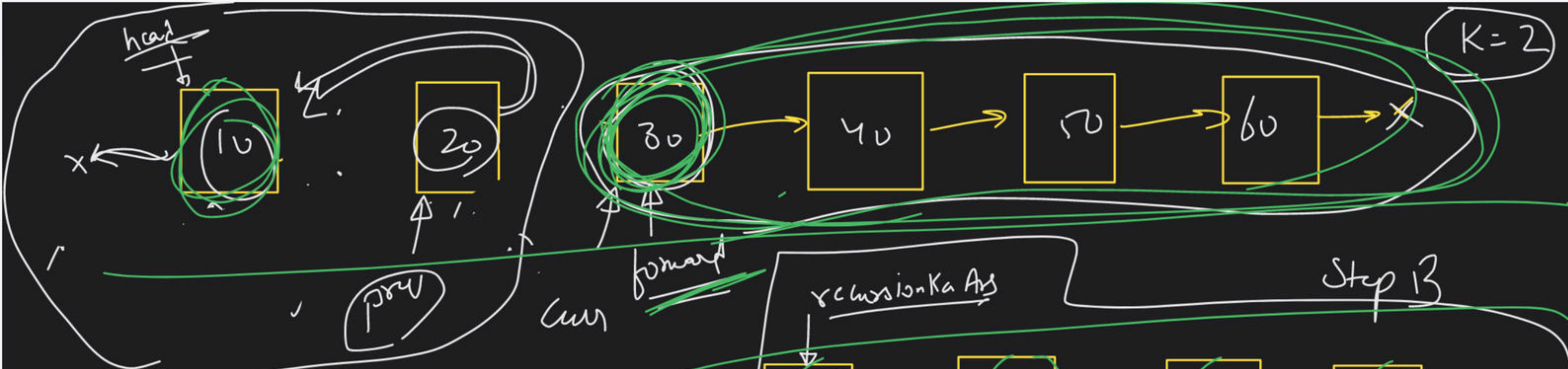
(A) Reverse first K Nodes

(B) find recursionKaAns

(C) $\text{head} \rightarrow \text{next} = \text{recursionKaAns}$

(d) return prev

K=2



head \rightarrow next = recursionKa Ans

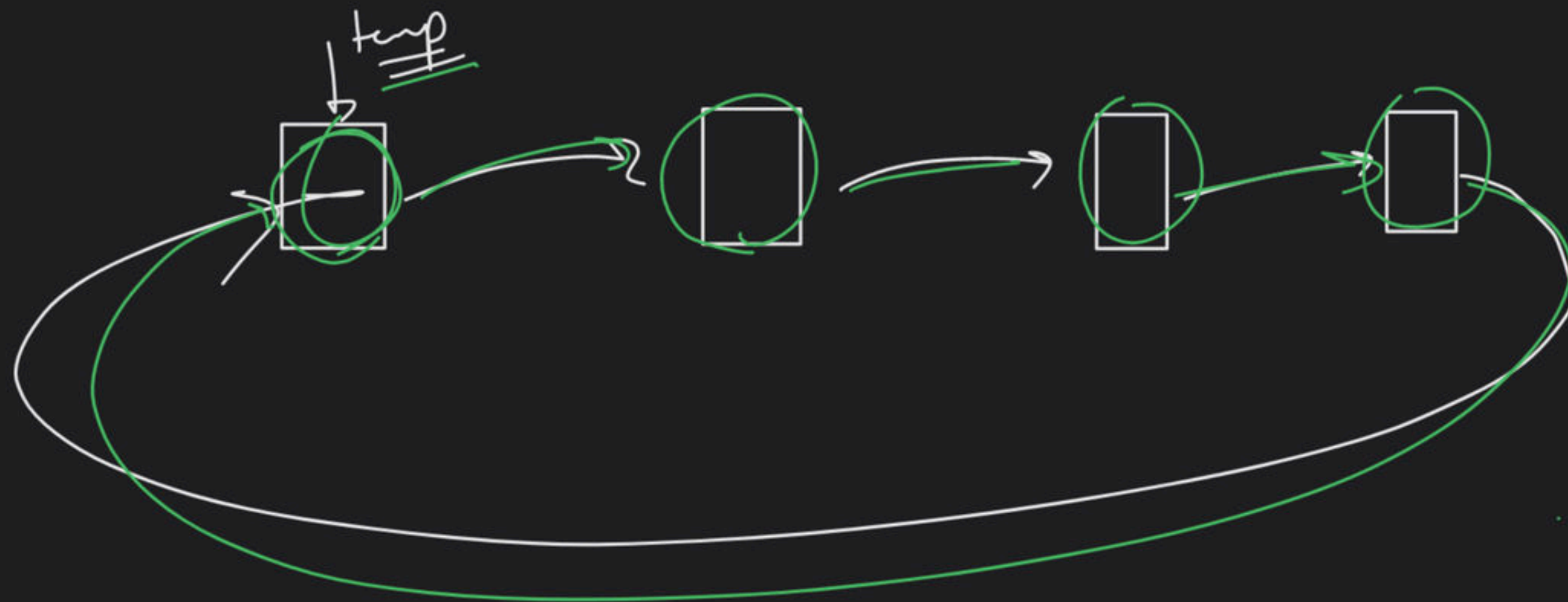
step 3

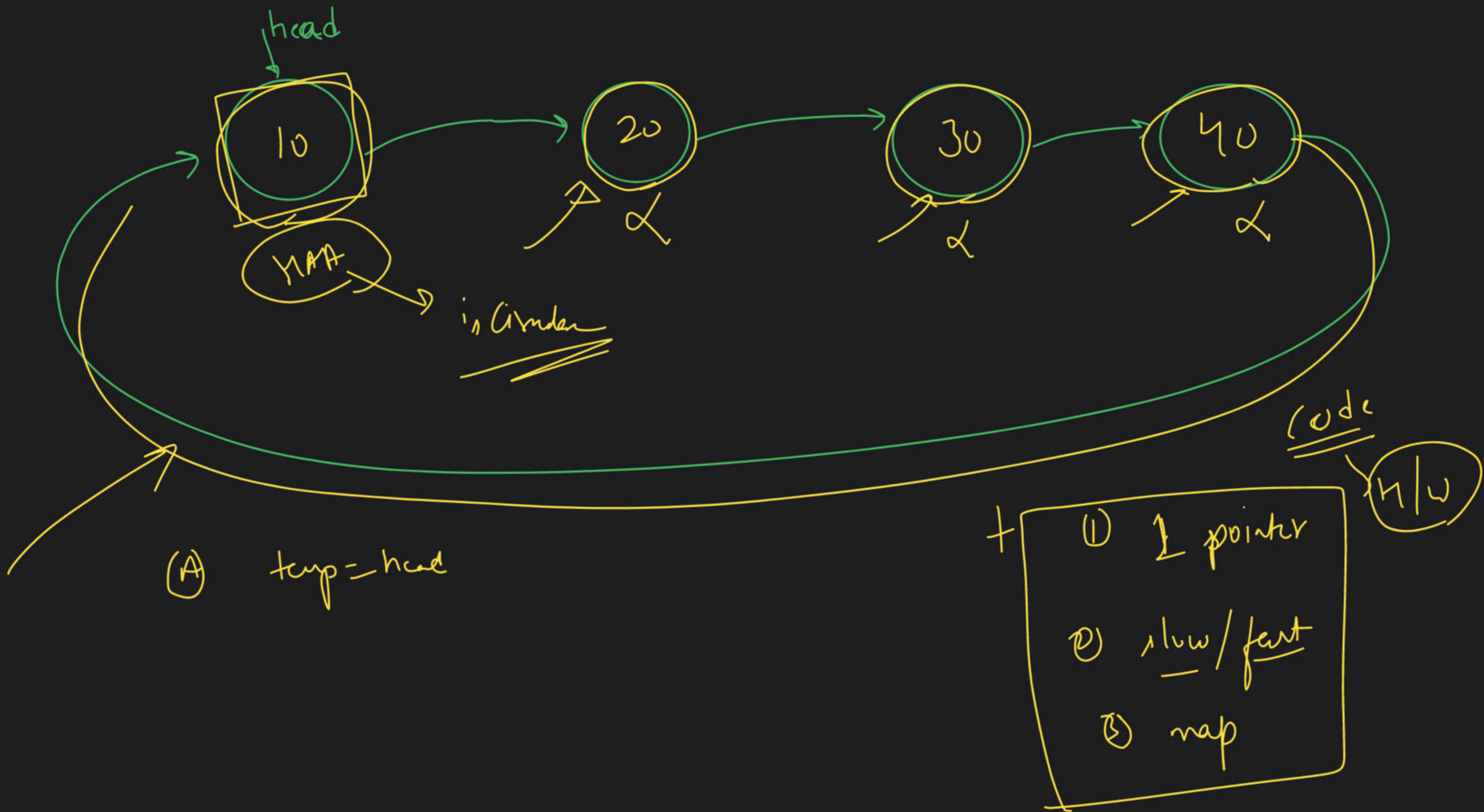
return prev \rightarrow Step 4



i/p \rightarrow LL \rightarrow

is Circular \rightarrow T/F





→ Detect & Detect Loop

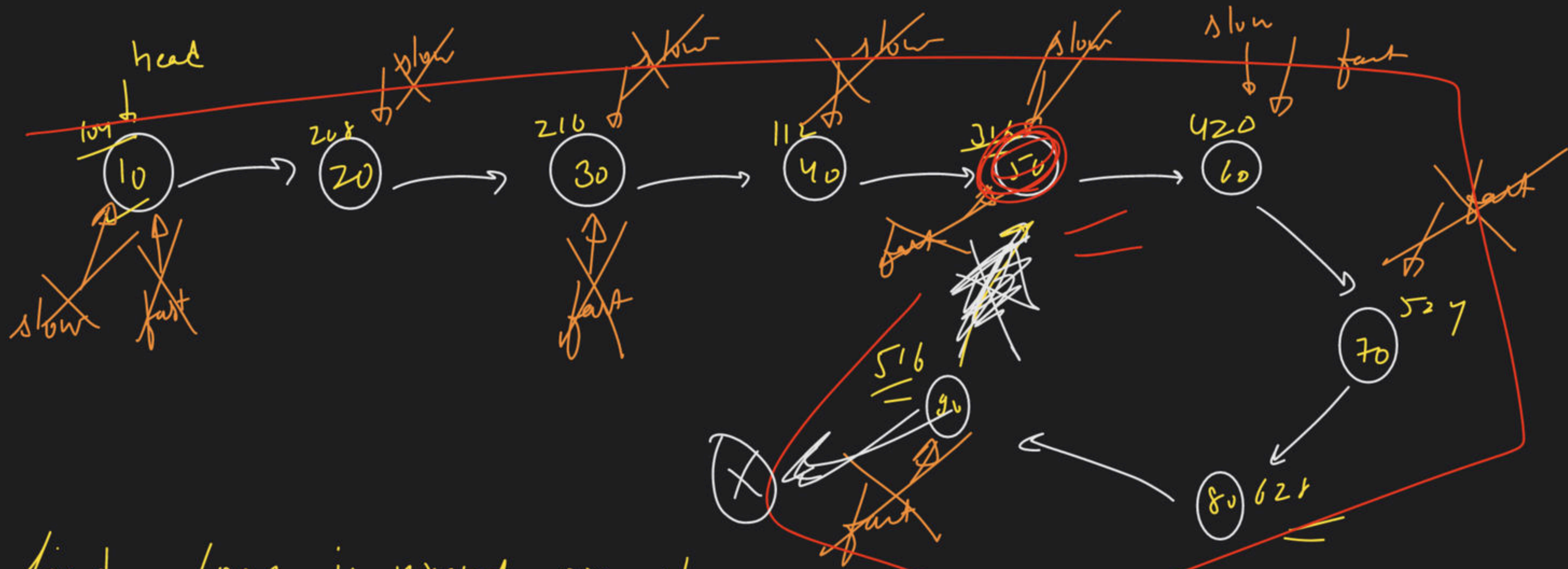
check loop is present in LL or not

starting point of loop

remove loop

6 hr

work it



① find loop is present or not

→ Approach #1

FCD

$\text{slow} == \text{fast} \rightarrow \text{loop present}$
 $\text{fast} == \text{NULL} \rightarrow \text{loop absent}$

map < Node*, bool >

map [top] = true

Key	Value
address	bool
104	→ True
208	→ True
216	→ True
112	→ True
316	→ True
420	→ True
524	→ true
628	→ True
516	→ true

already
→ print

↓
loop
print
—



→ 4 node

→ 3 node

→ 2 node

with each
pass

distance

blu fast / slow

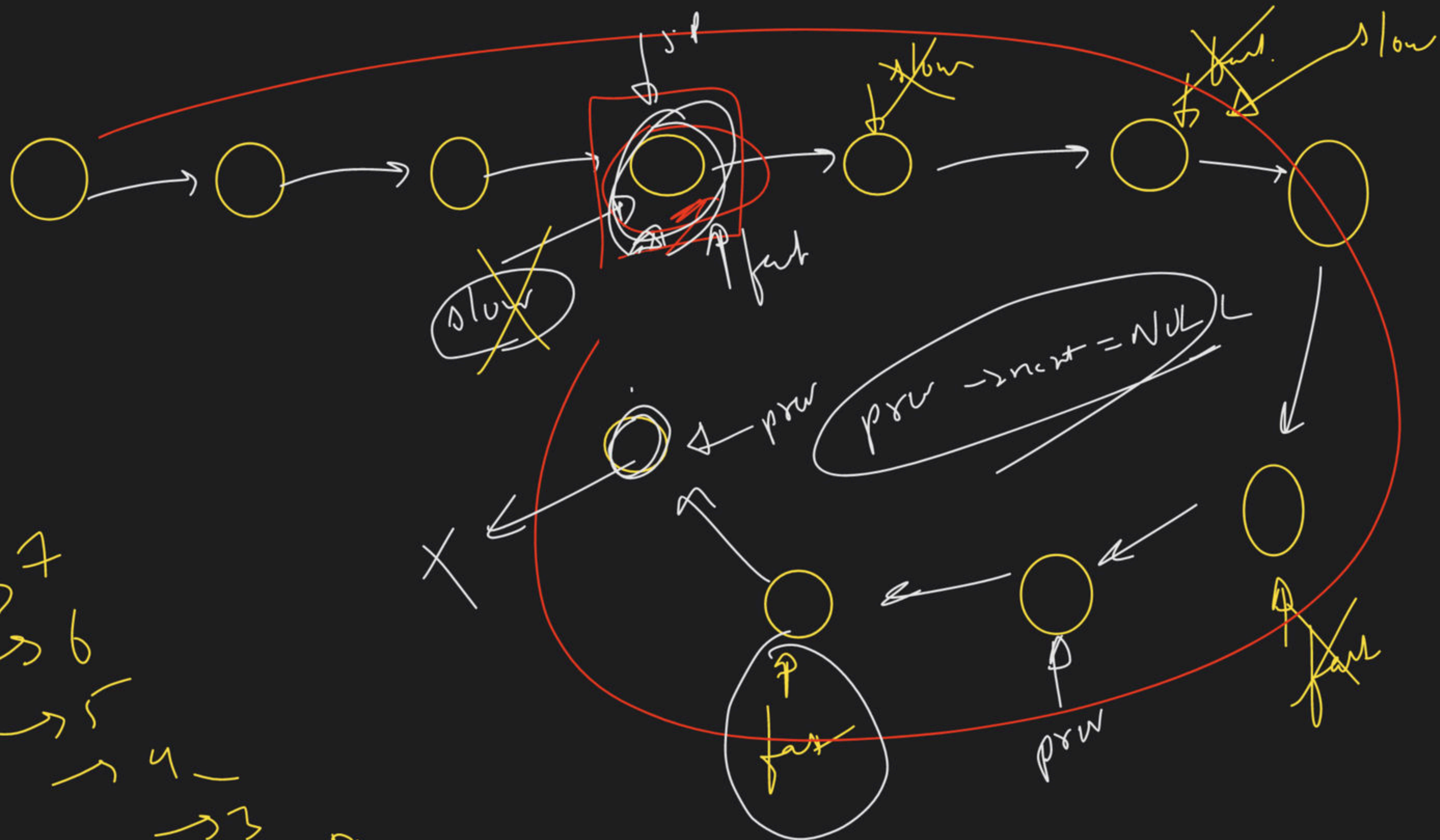
pointer is getting reducing
by 1

$n + n-1, n-2, n-3$ — (0)

$$6 \rightarrow 1$$

$$6-1 \rightarrow 5 \rightarrow 4 \rightarrow 3 \rightarrow 2 \rightarrow 1 \rightarrow 0$$

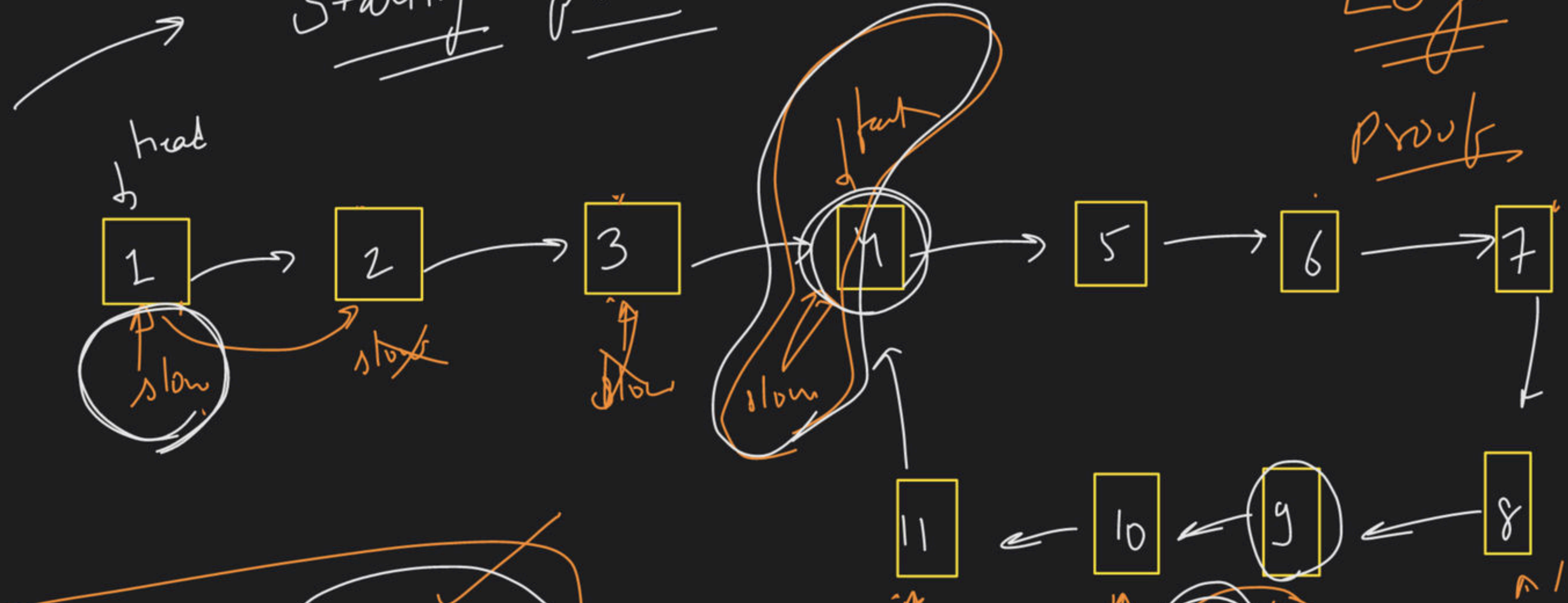
$$5 \rightarrow 7 \rightarrow 3 \rightarrow 2 \rightarrow 1 \rightarrow 0$$



7
→ 6
→ 5
→ 4
→ 3
→ 2
→ 1

starting point

Logic
proof

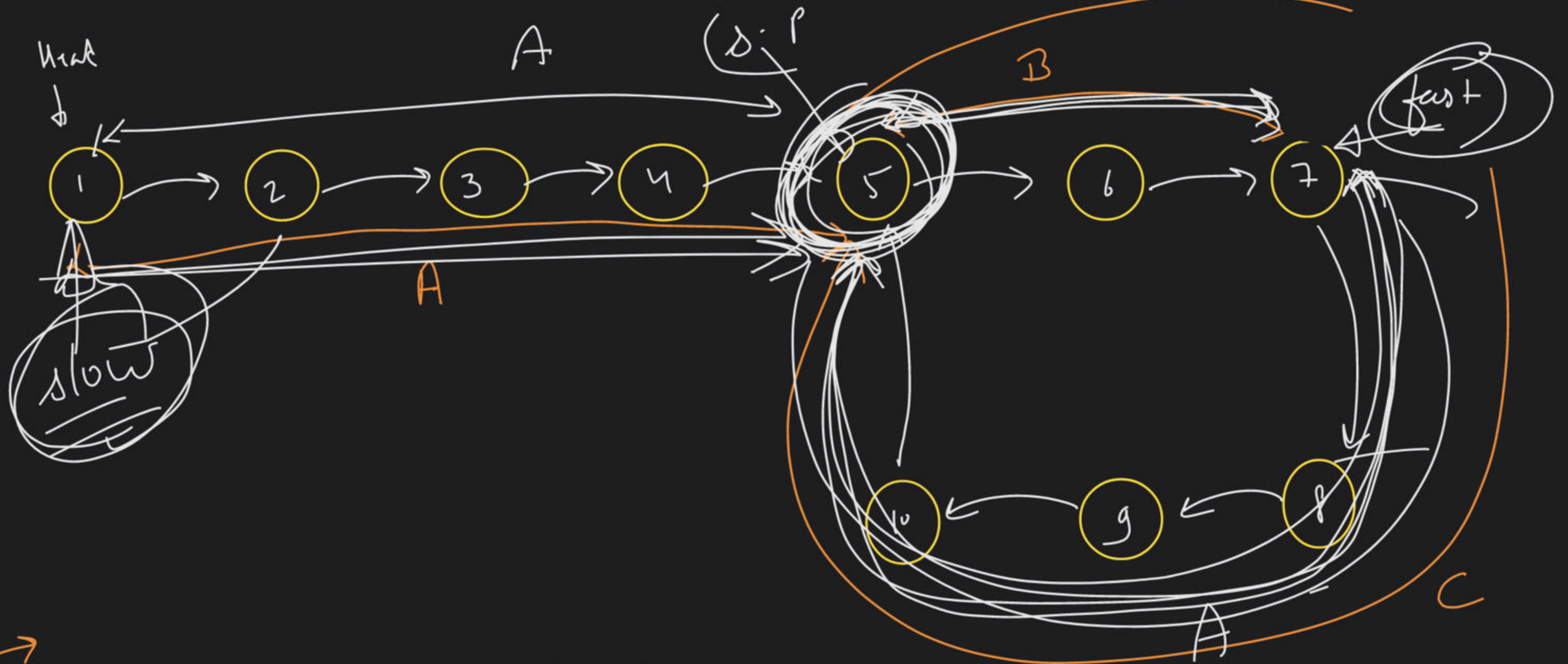


(A) slow or fast meet Karwa

(B) slow = head

(C) slow / fast → 1 step → meet → starting point

why



Distance travelled by fast pointer = 2 * Distance travelled by slow pointer

$$\underline{\underline{A}} + \underline{\underline{nC}} + \underline{\underline{B}} = 2 \star (A + yC + B)$$

$$A + nC + B = 2A + 2yC + 2B$$

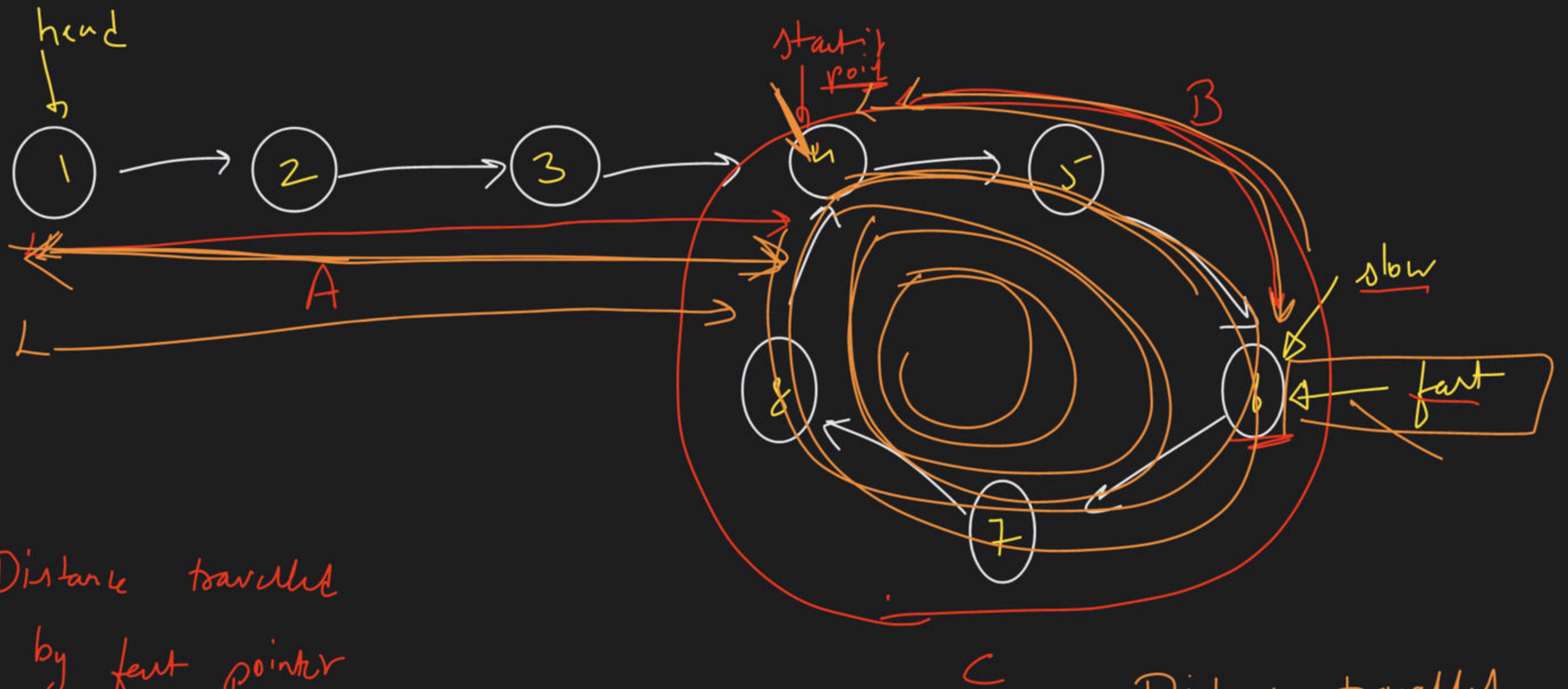
$$(n - 2y)C = A + B$$

$$\text{let } n - 2y = K$$

$$A + B = \underline{\underline{K}} \star C$$

$$\underline{B + A}$$

$$\begin{aligned} &\rightarrow 1y \\ &\rightarrow 2y \\ &\rightarrow 3y \end{aligned}$$



Distance travelled
by fast pointer

$$= A + \cancel{n}C + B$$

Distance travelled
by slow pointer

$$= A + \cancel{y}C + B$$

Distance travelled
by fast pointer = 2 * Distance travelled
by slow pointer

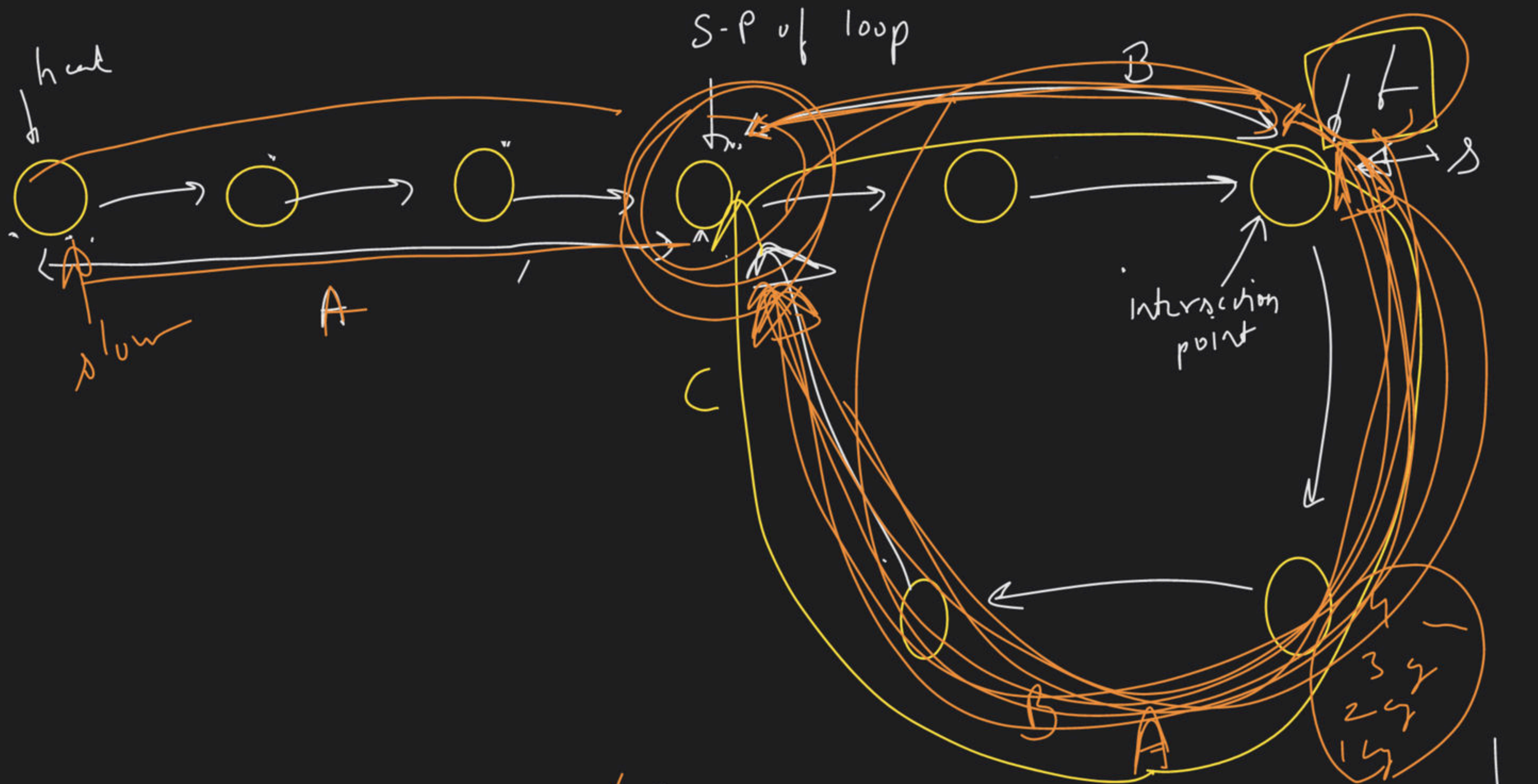
$$A + nC + B = 2 * (A + yC + B)$$

$$A + nC + B = 2A + 2yC + 2B$$

$$(n - 2y)C = A + B$$

Let $K = n - 2y$

$$\boxed{A + B = KC}$$



$$A + nC + B = 2 \star (A + yC + B) \rightarrow$$

$$\boxed{A + B = \underline{K} \star C}$$











