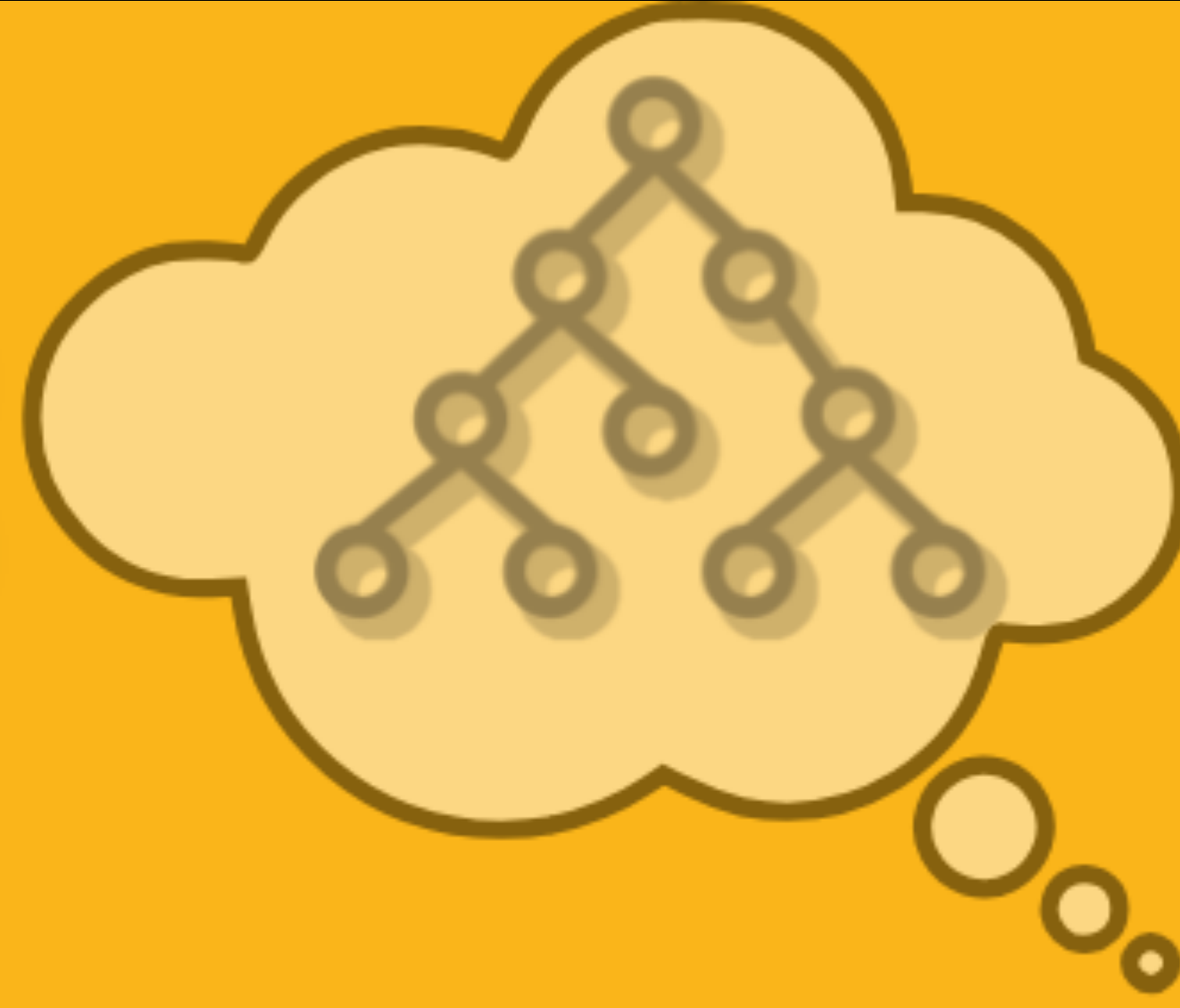


# DATABASE INDEXES B & B+ TREES



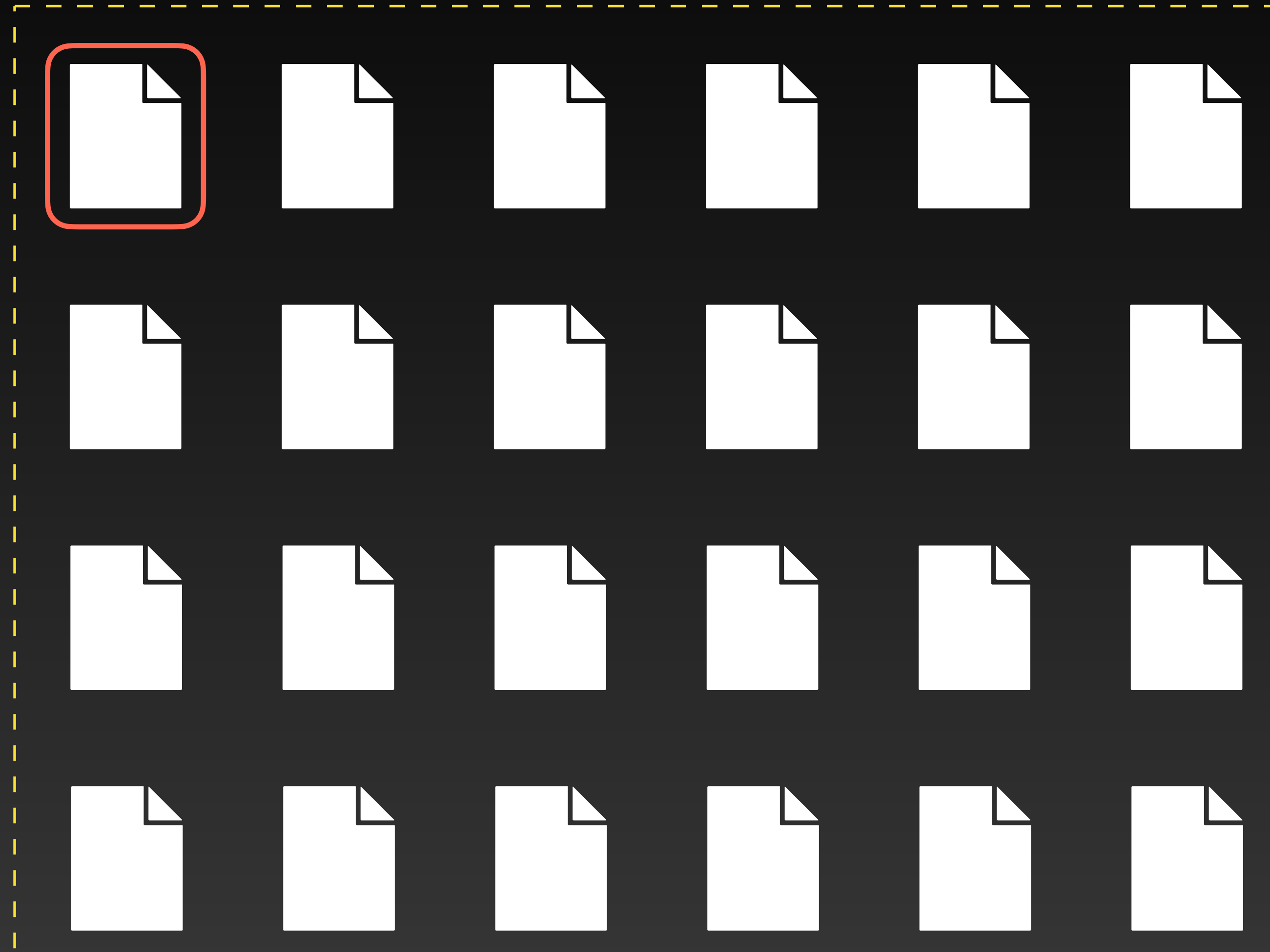
Amr Elhelw's  
**TECH**  
**VAULT**

باللغة العربية



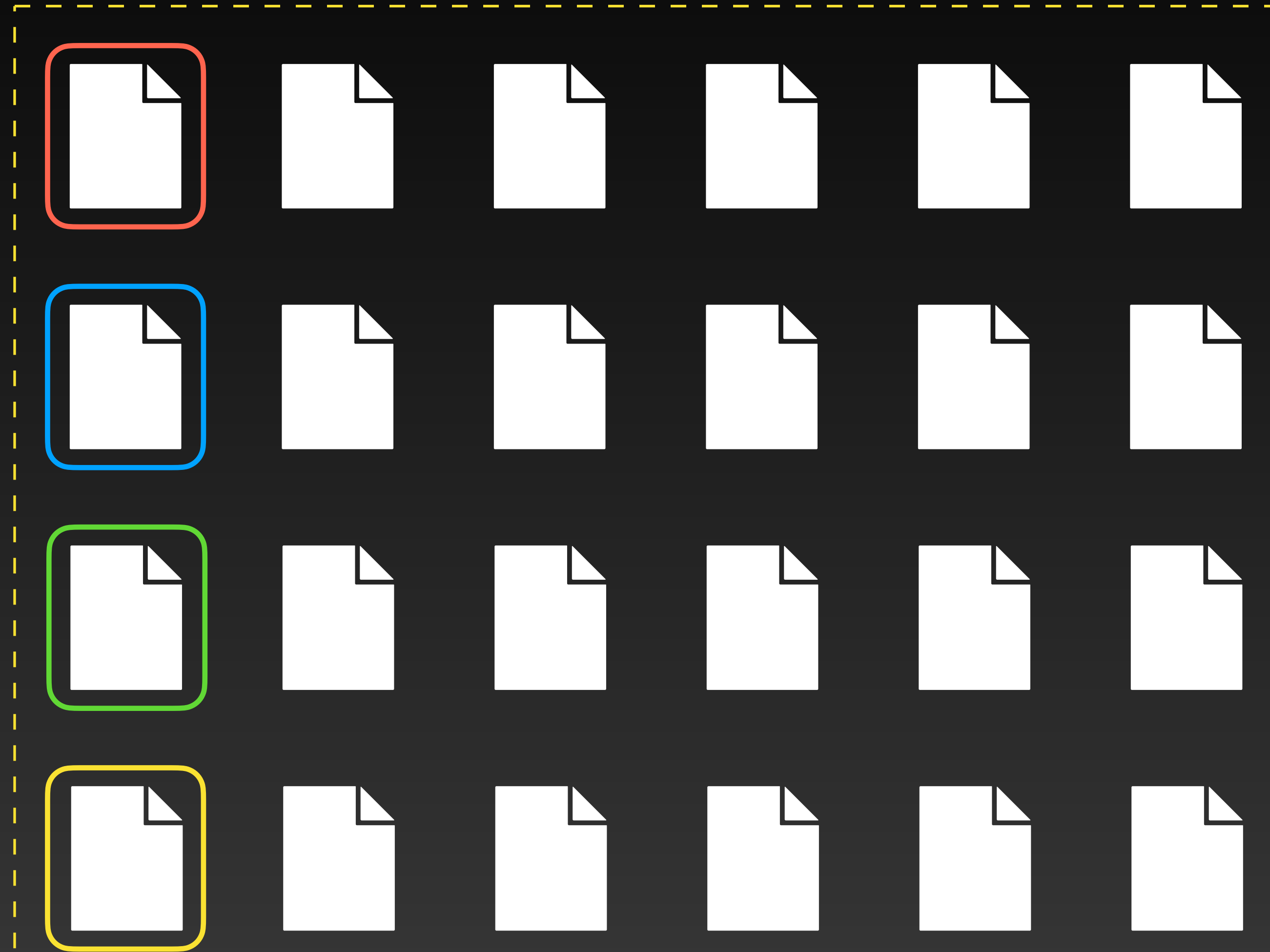
# Find rows with $x=25$

All pages  
for table **T**



# Parallel Scanning

All pages  
for table **T**



# Partitioning

$x = 25$  ?

$0 \leq x < 10$



$10 \leq x < 20$



$20 \leq x < 30$



$30 \leq x < 40$

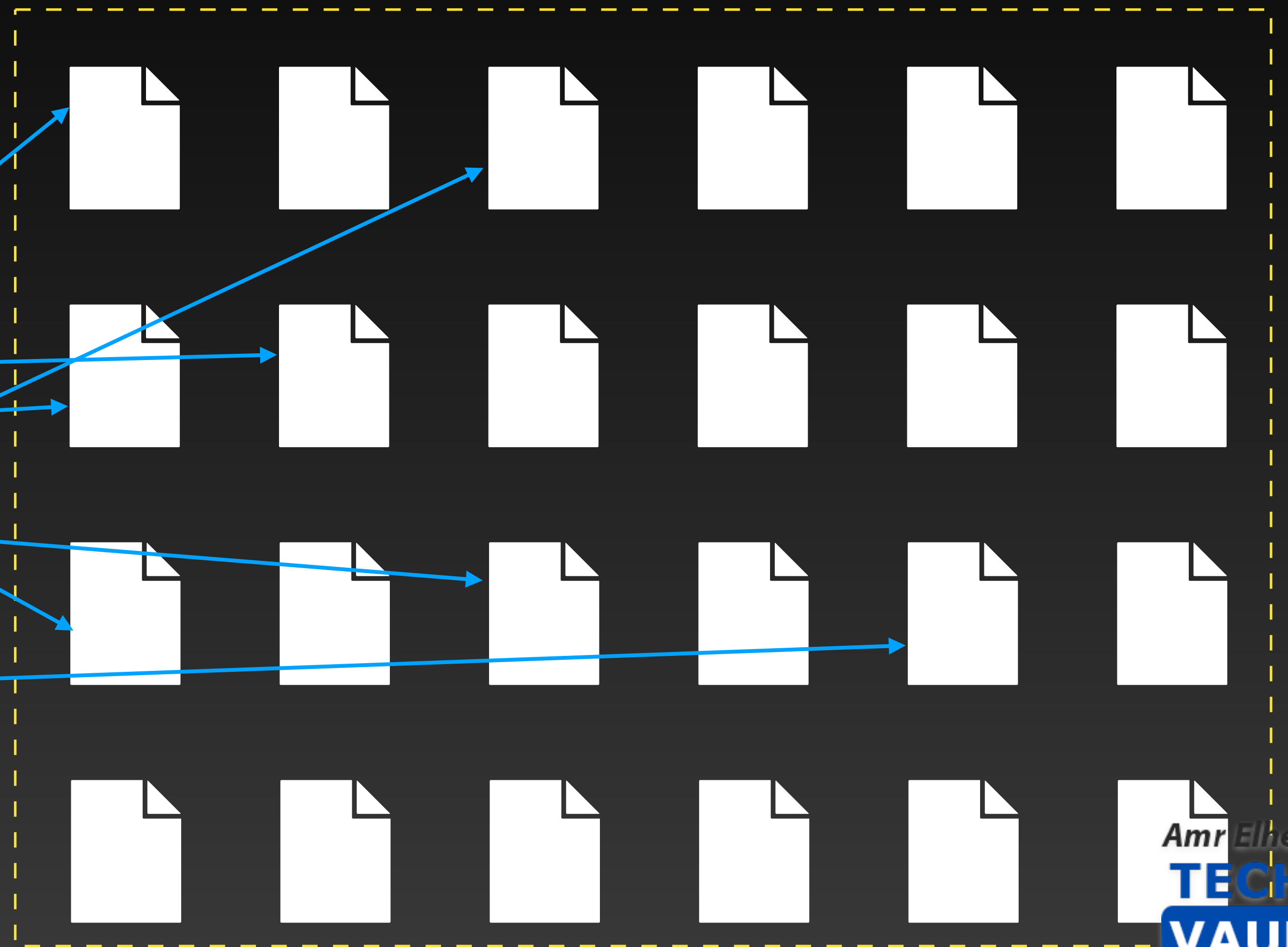


# Index

Table T

Index on  
attribute **x**

Key	Loc
3	•
10	•
17	•
22	•
25	•
31	•
55	•



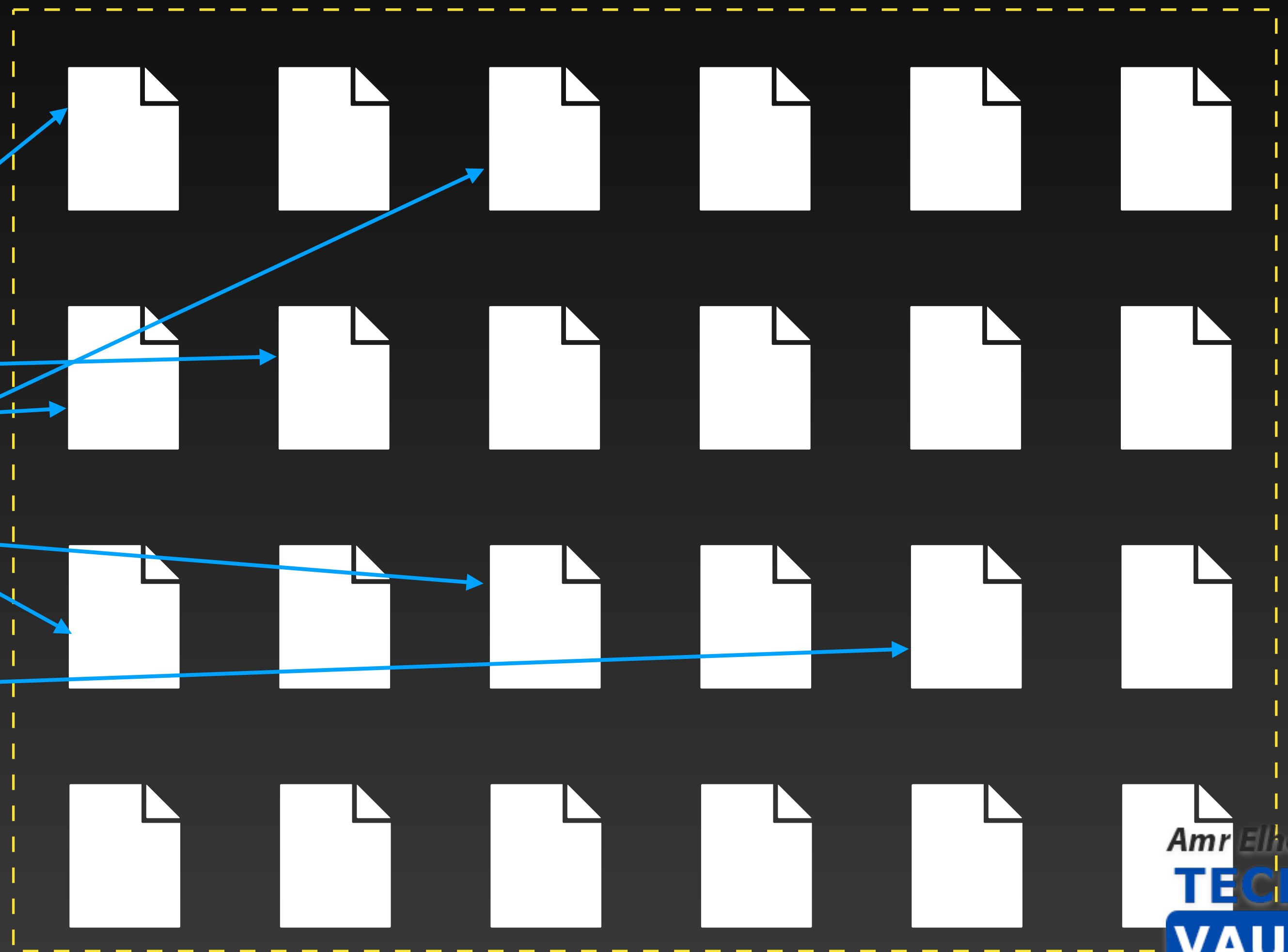
# Naive Approach - List

$x = 25$  ?

Index on  
attribute  $x$

Key	Loc
3	•
10	•
17	•
22	•
25	•
31	•
55	•

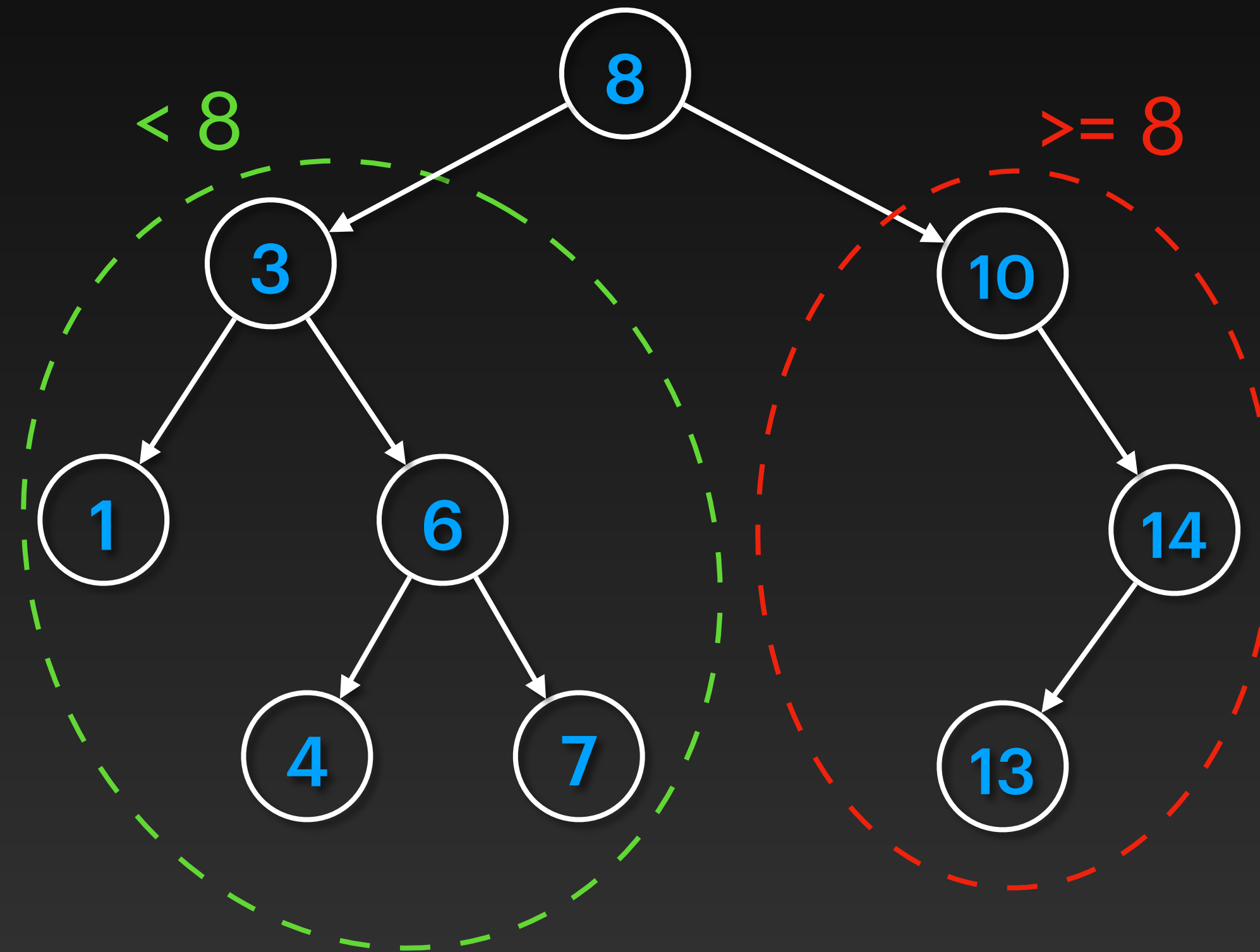
Table  $T$



Search:  $O(n)$

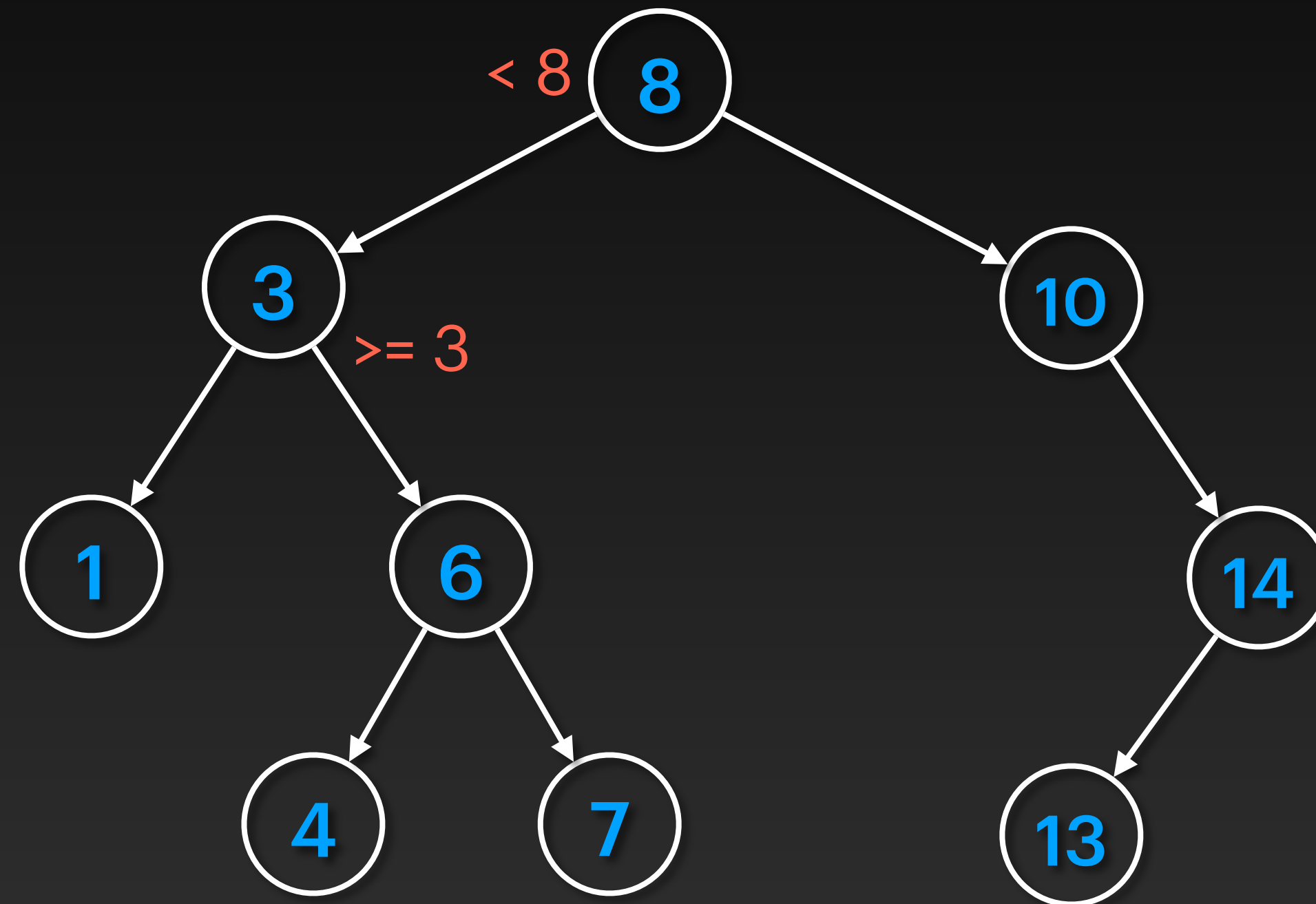


# Binary Search Tree (BST)



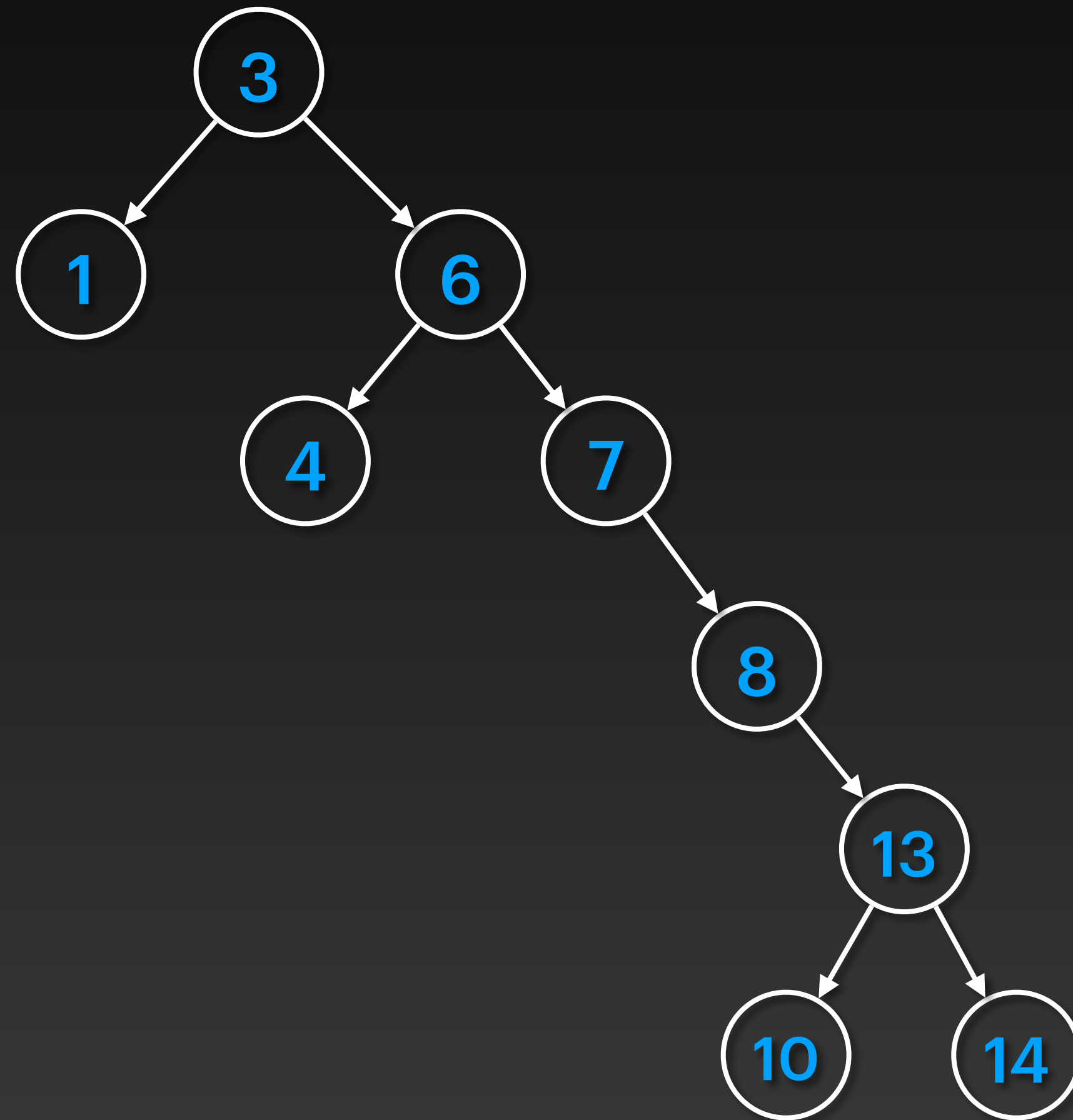
# Binary Search Tree (BST)

$x = 6$  ?





# Binary Search Tree (BST)

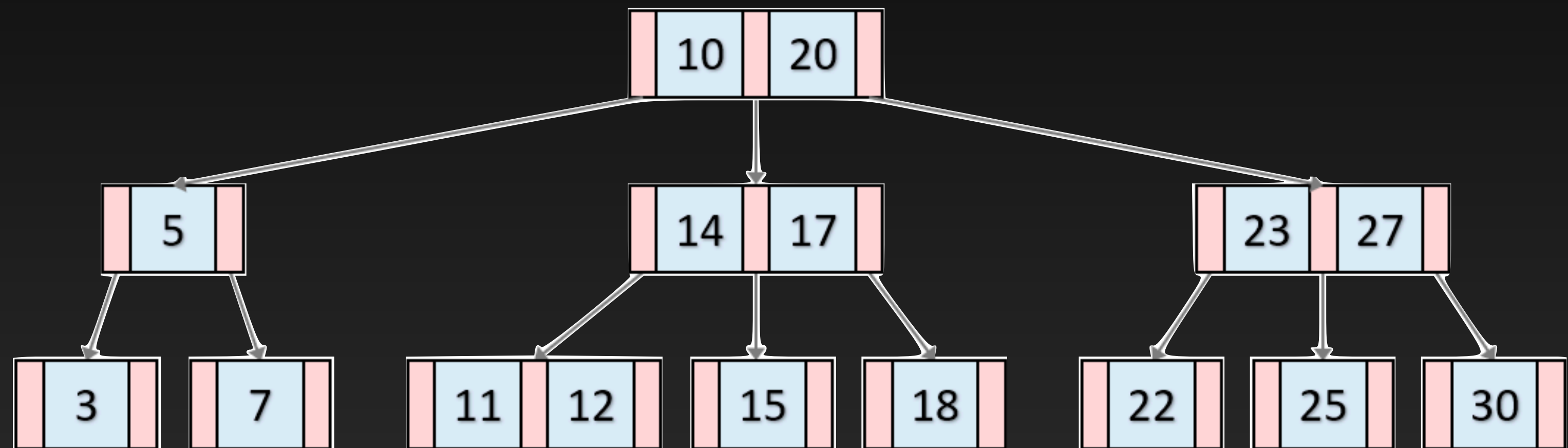


Search:  $O(n)$

# B-tree

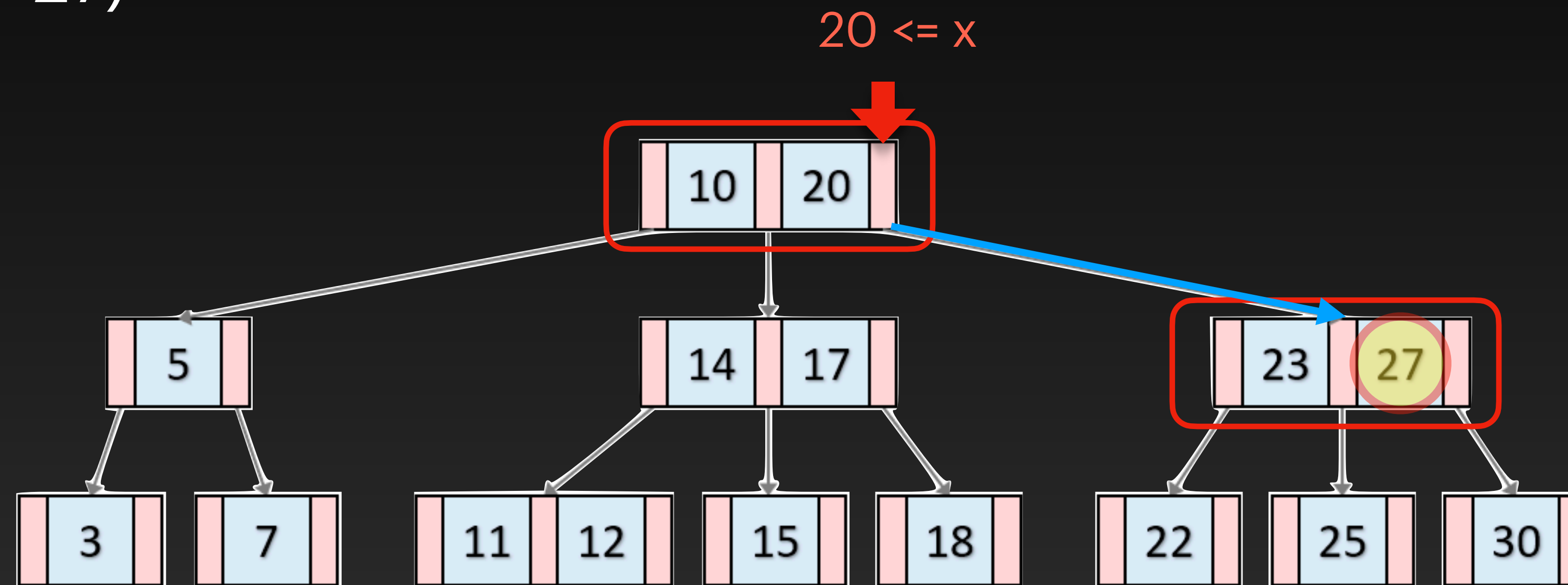
$$k = 3$$

- Ordered
- Each node can have up to  $k$  children (and  $k-1$  keys).
- Balanced
- Every node (other than the root) must be at least half full



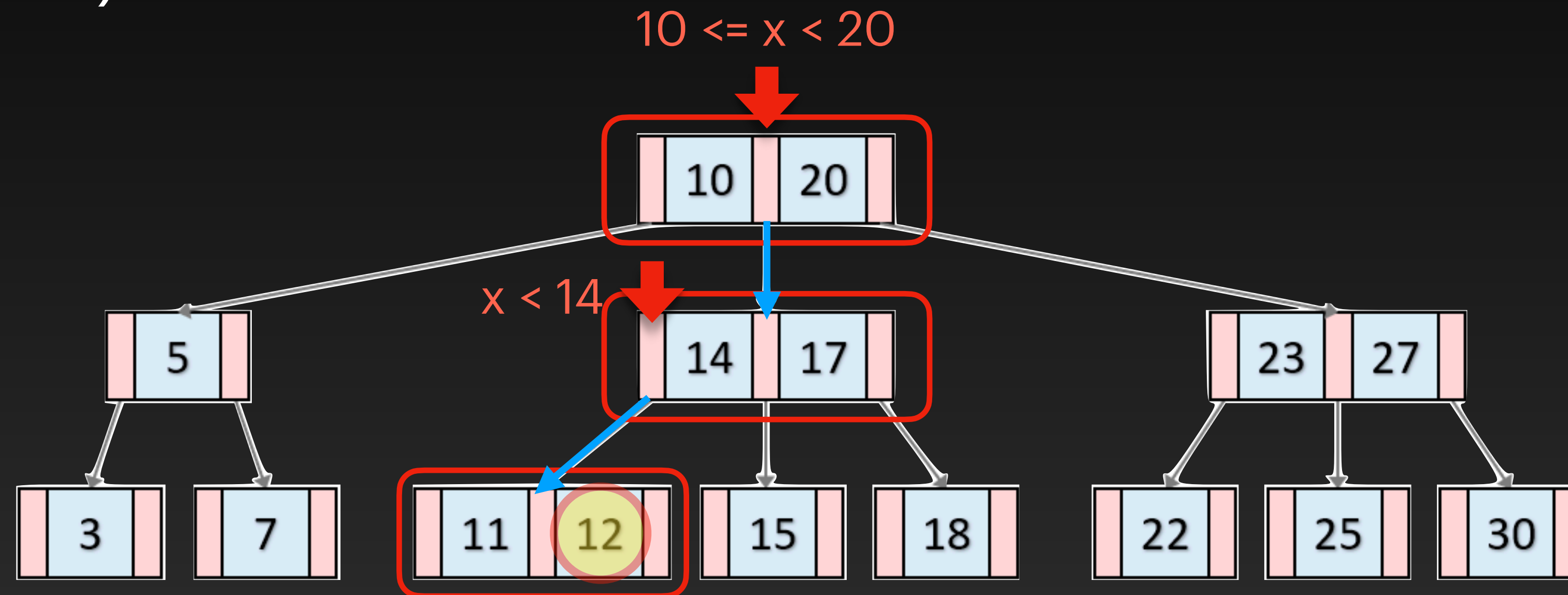
# B-tree

Look for ( $x = 27$ )



# B-tree

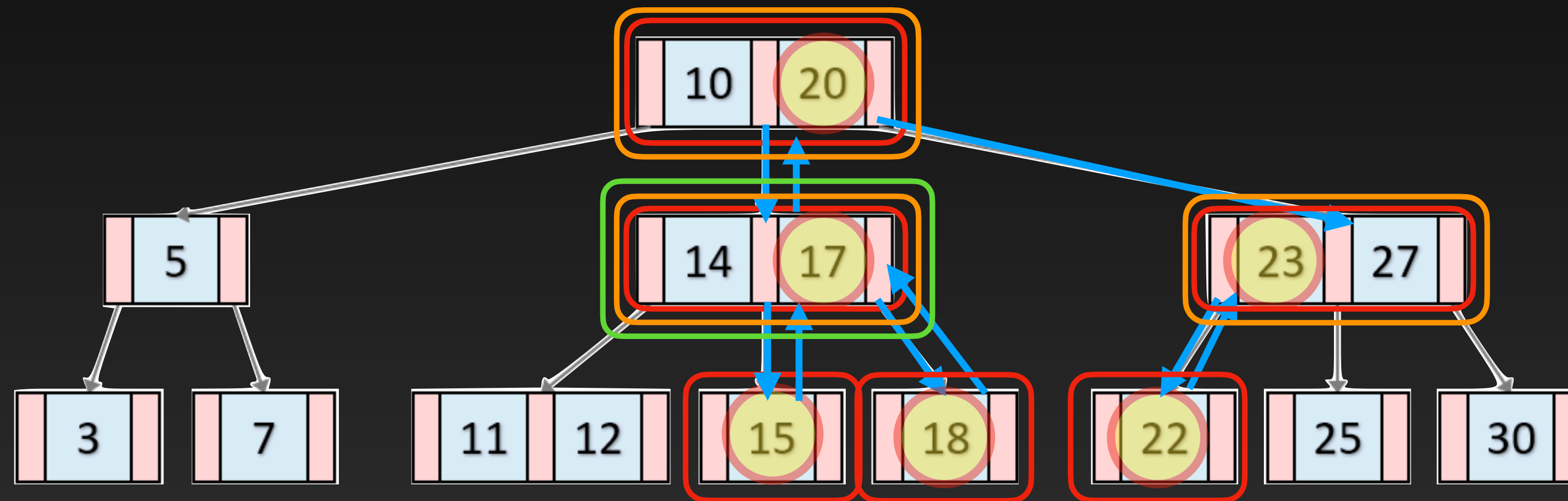
Look for ( $x = 12$ )



Search:  $O(\log n)$

# B-tree

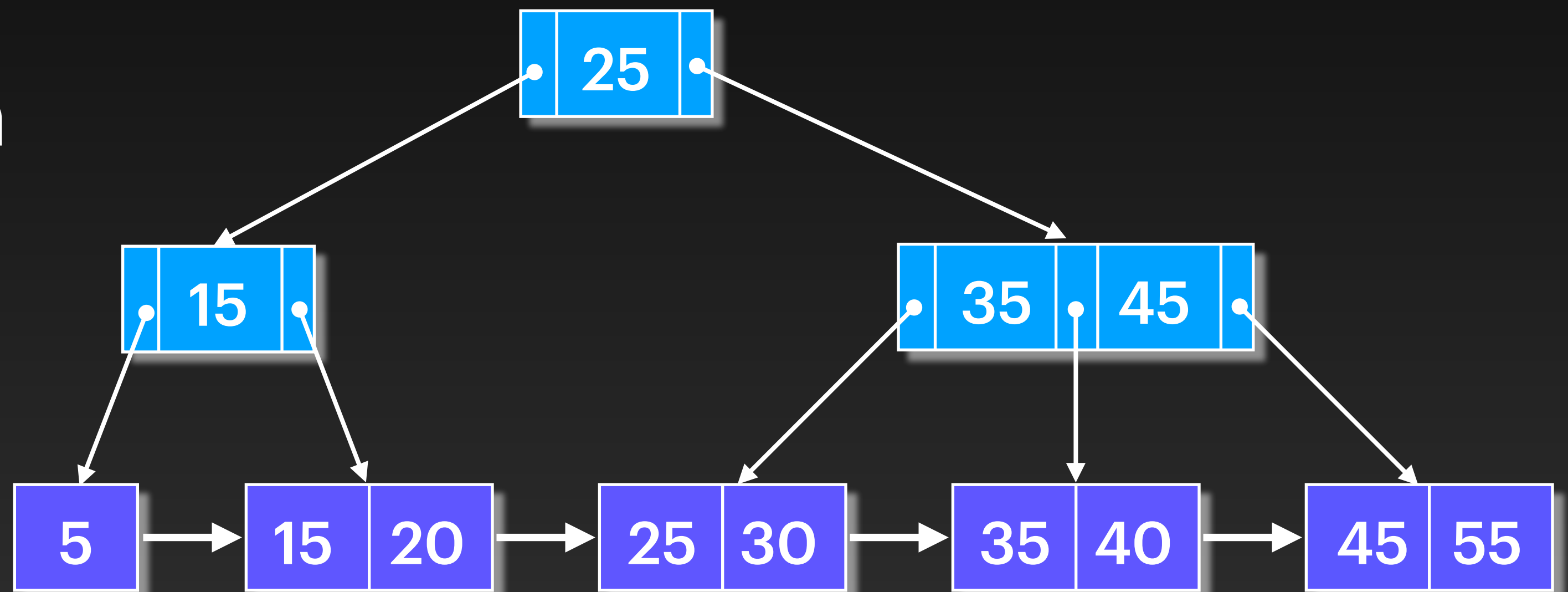
Look for  $(15 \leq x < 24)$



# B+ tree

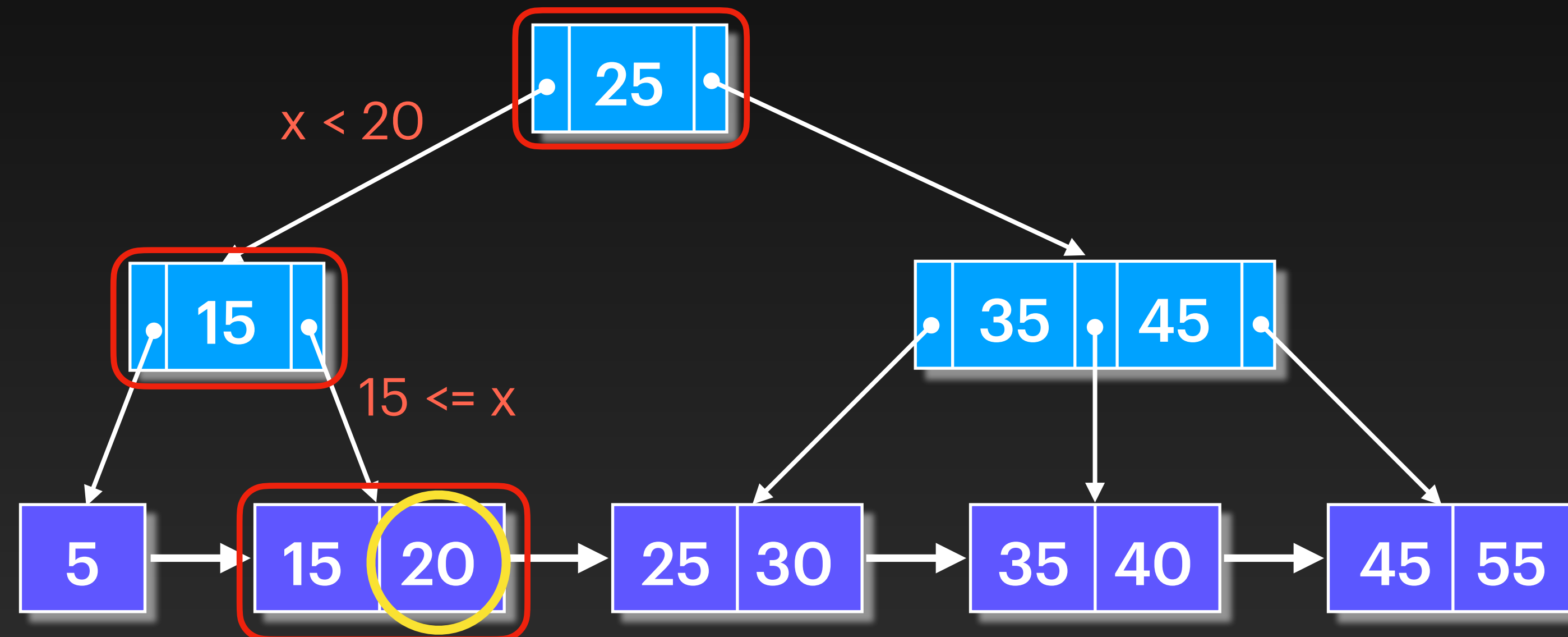
$k = 3$

- Data pointers in the leaf nodes only
- Leaf nodes link to each other (possibly in both directions)



# B+ tree

Look for ( $x = 20$ )





# B+ tree

Look for  $(20 \leq x \leq 35)$

