CSE 101 5-6-21

Pa4 : ext. 1 last day (to Sun.)

BST ... continue ...

Queries:

- TreeSearch (x, k) ✓
- TreeMinimum (x)
- TreeMaximum (x)

TreeSearch(x, k)

Idea: use BST properties.

- see pseudo-code.

Runtime (worst case)

$\Theta(height(T))$

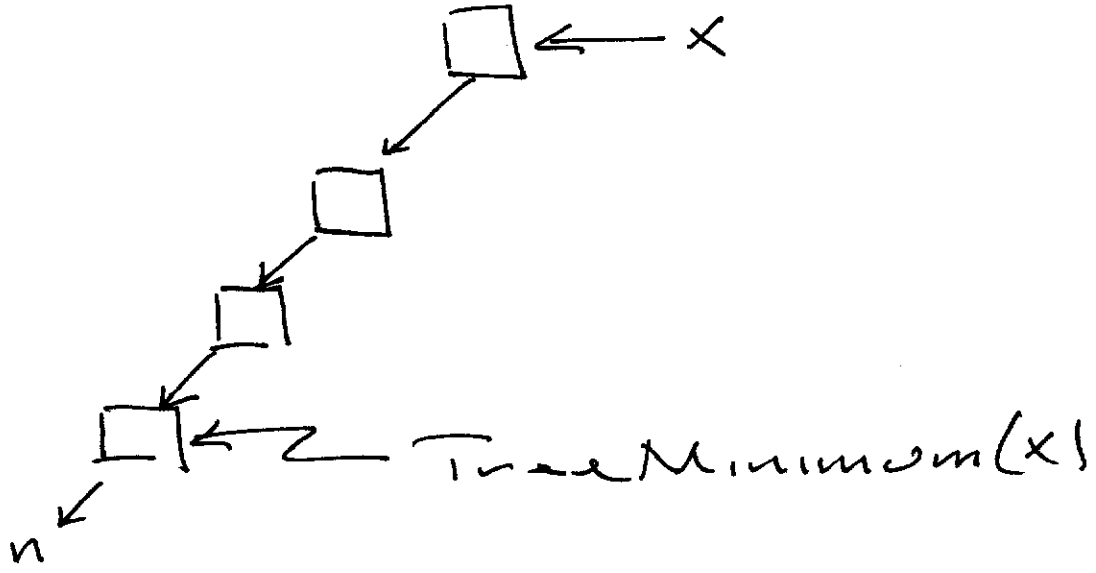
↑ length of longest line of ancestry

Defn depth of a node x:
the distance of x to root.

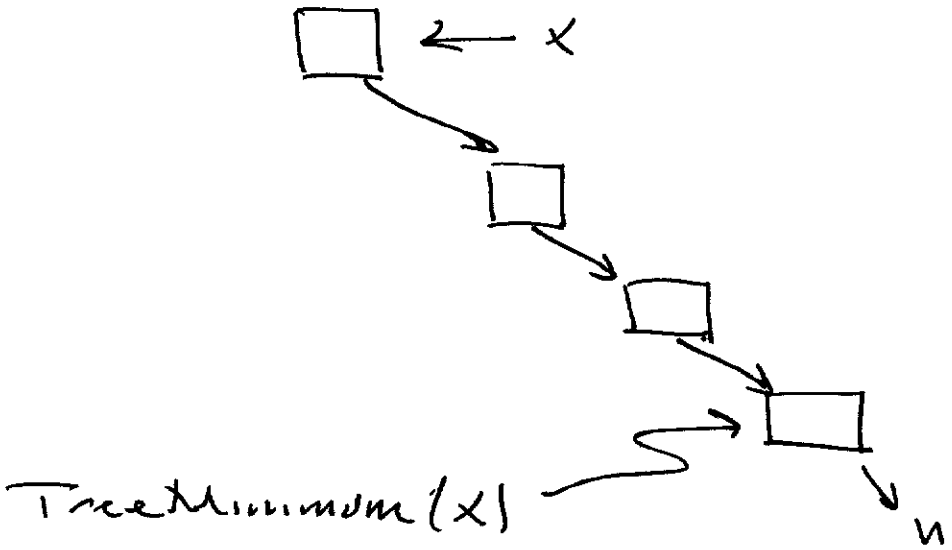
Defn height[T]: depth of the deepest leaf.

Defn height(x): height of subtree rooted at x.

- TreeMinimum(x)



- TreeMaximum(x)



Worst case runtime:

Θ(height(x))

2 more Queries

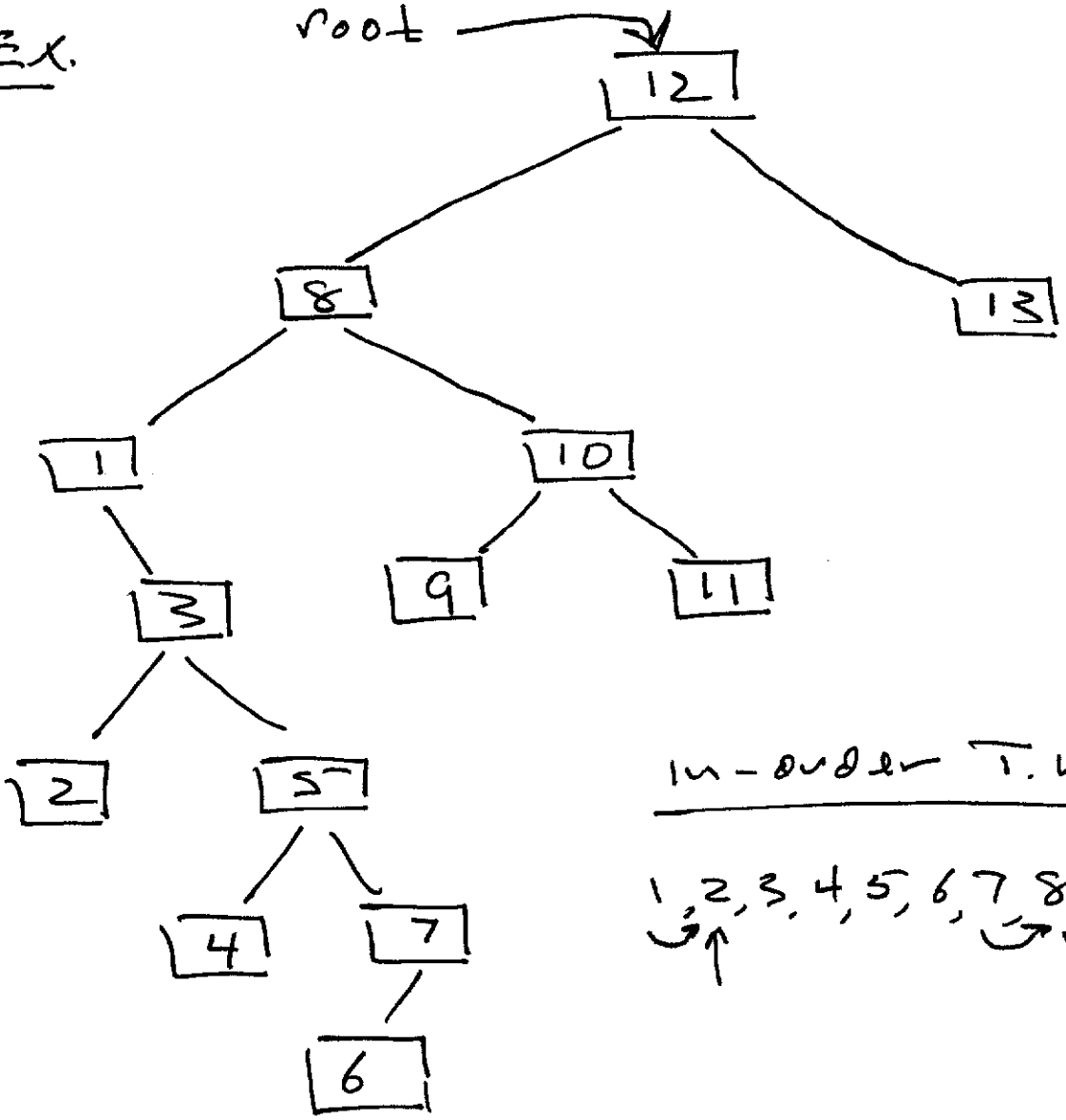
Tree Successor(x) ← we do this

Tree Predecessor(x) ← exercise

Defn

The Successor of a node x is the next node after x to be printed in an in-order Tree Walk.

Ex.



In-order T.W:

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 13

Successor(1) = 2

Successor(8) = 9

Successor(7) = 8

we have 2 cases for Tree-Successor :

Case 1 : x has a right child.

successor of x is the leftmost descendant of that right child

Case 2 : x has no right child.

Successor of x is the lowest ancestor of x whose left child is also an ancestor of x.
(note : x is its own ancestor)

see pseudo-code

Exercise

- define Predecessor of x
- Write algorithm for

  TreePredecessor(x)

Runtime (worst case)

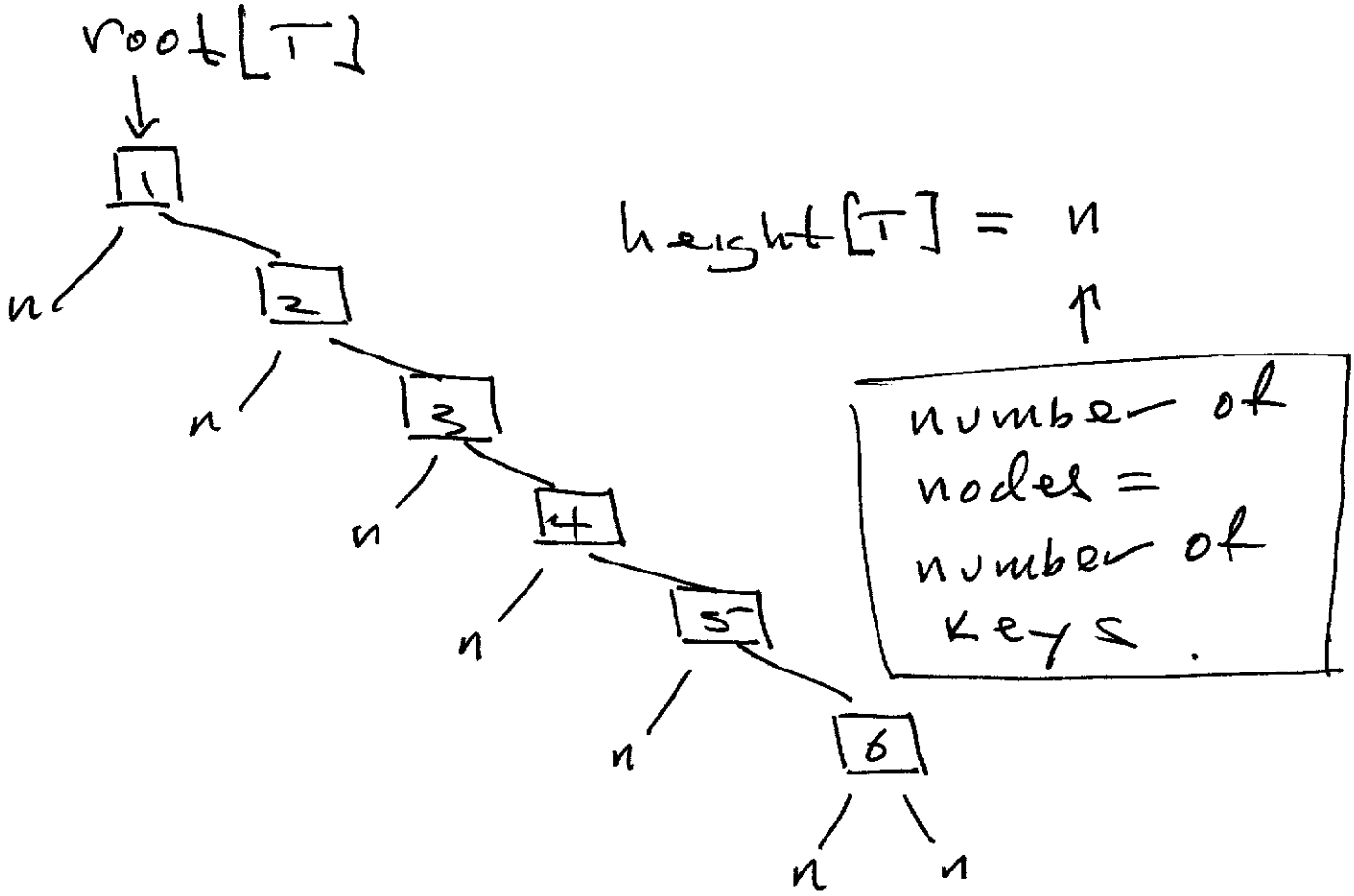
$\Theta(height[T])$.

Summarize:

TreeSearch(x, k)
TreeMinimum(x)
TreeMaximum(x)
TreeSuccessor(x)

} worst case $\Theta(height[T])$

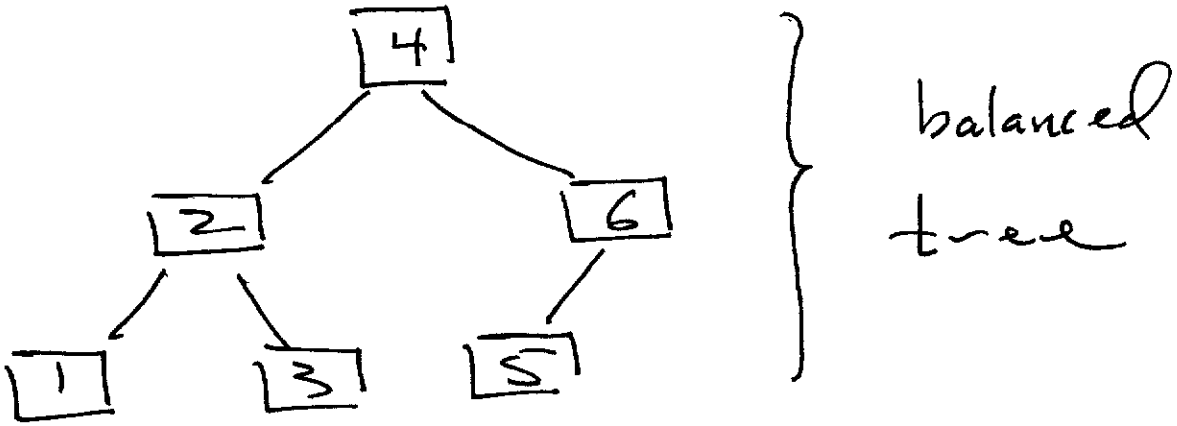
worst BST for Queries:



cost of a query : $\Theta(n)$

worst BST: every node (internal) has exactly 1 child.

Best BST: every internal node has exactly 2 children



Cost of query: $\Theta(\text{height}[T]) = ?$

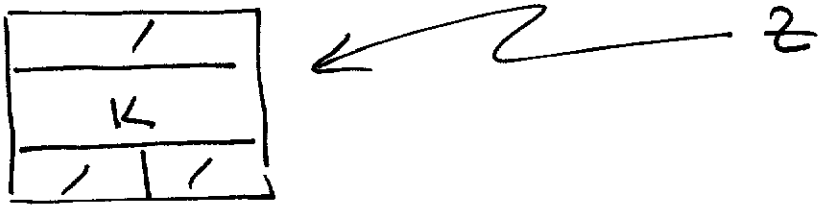
In general: $\Theta(\log n)$

Sec. 12.3 in CLRS

Insertions and deletions.

- Insertion: must maintain the BST properties.

Let z be the node to be inserted



- set z.key = K

  z.parent = z.left = z.right = nil.

- find a node to adopt z as left or right child.

- strategy: Do a search for key k in T, find the (a) nil child where k would reside if it were in T.

see TreeInsert(T, z) Pseudo-code

next time

- examples of insert
- deletion