Data Structures and Algorithms – Lab10

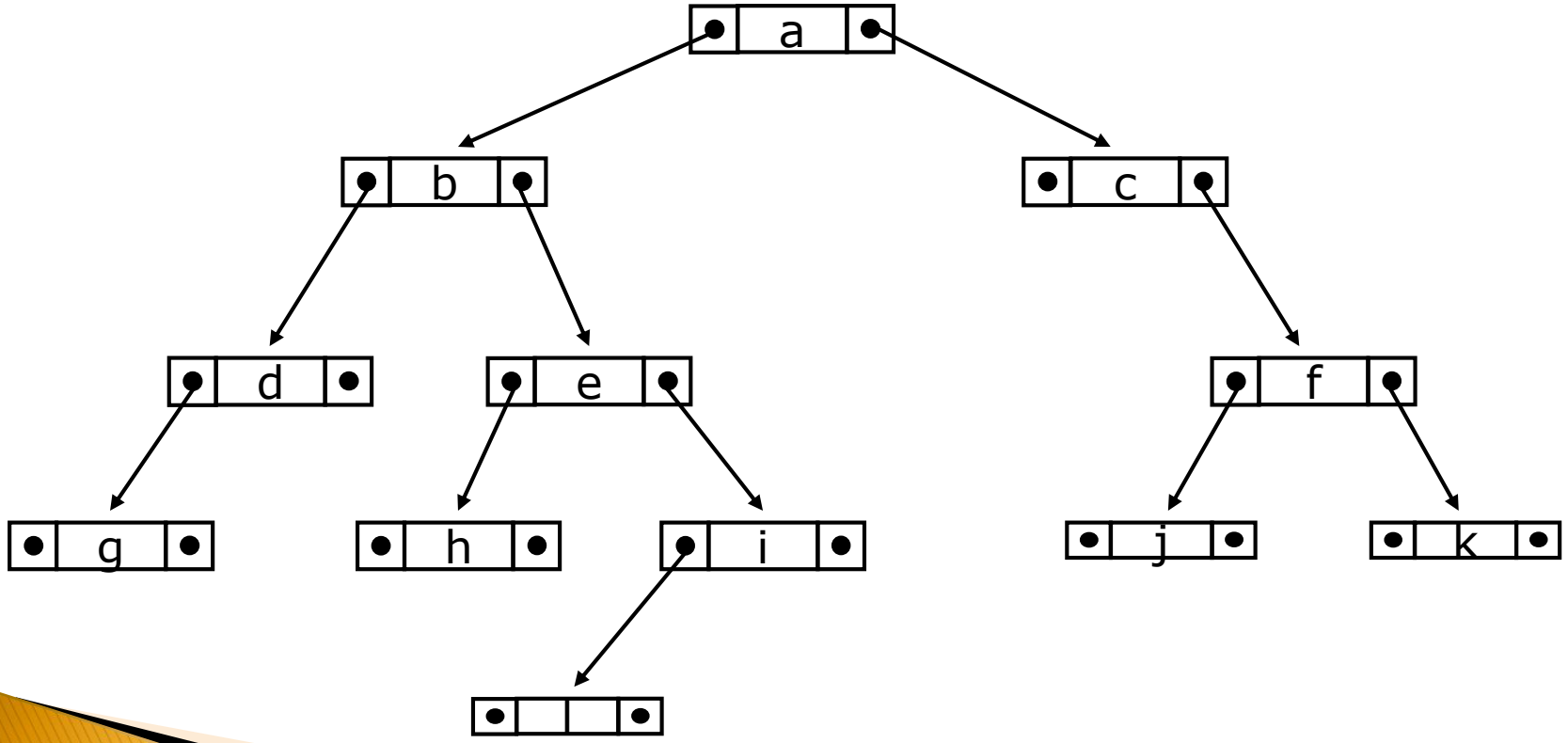
Iulia-Cristina Stanica
iulia.stanica@gmail.com

Roadmap

- Binary search trees

Binary trees (reminder)

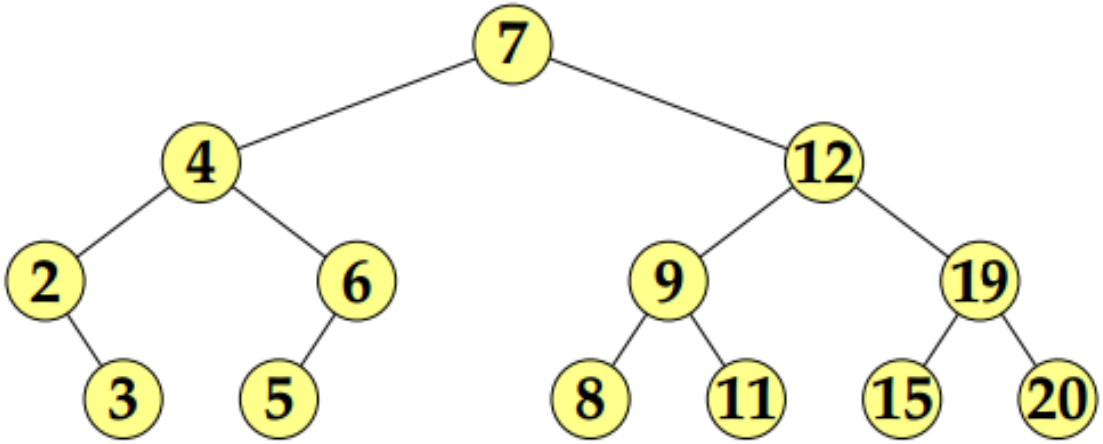
- If it is not empty, the binary tree has a root node.
- The nodes which have no children are called leaves.



Binary search trees

- Binary trees with additional properties:
  - The elements (infos) saved in the nodes are comparable
  - The elements from the left sub-tree of the node p are $\leq$ than the element saved in p
  - The elements from the right sub-tree of the node p are $>$ than the element saved in p
  - Fast search
  - Complicated deletion (we must maintain the properties of the BST)

Example



Pre-order	(Root Left Right)	7, 4, 2, 3, 6, 5, 12, 9, 8, 11, 19, 15, 20.
In order	(Left Root Right)	2, 3, 4, 5, 6, 7, 8 , 9, 11, 12, 15, 19, 20.
Post-order	(Left Right Root)	3, 2, 5, 6, 4, 8, 11, 9, 15, 20, 19, 12, 7

In order traversal of a BST gives a sorted sequence of values

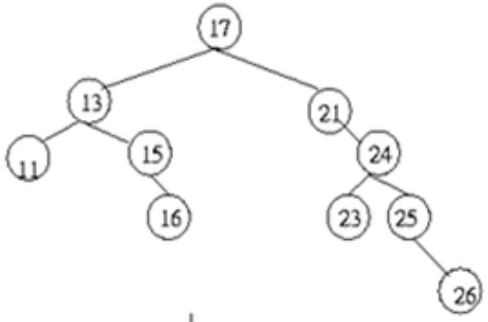
Ex 1.

- Draw the BST obtained after the execution of the program (after the insertions). How can we obtain a BST after deleting an element? (Hint)

Ex 2.

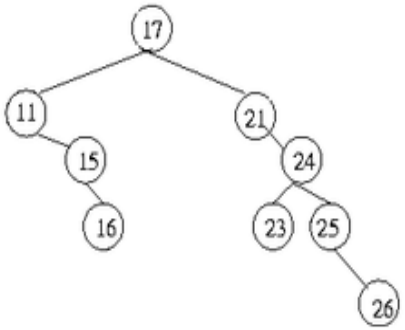
- Add the methods for the other 2 traversals: pre-order and post-order.

Reminder



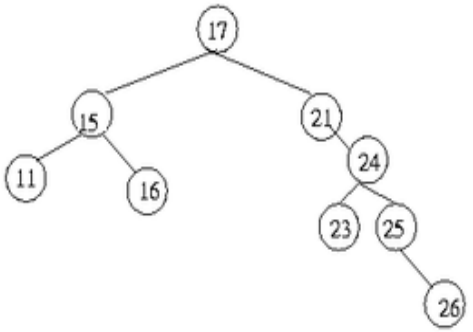
delete 13

/* delete node with both
left and right subtrees */



Method 1.

Find highest valued element among the descendants of left child



Method 2

Find lowest valued element among the descendants of right child

Ex 3.

- Write a function which determines the smallest value of a BST.

Suggestion:

- Traverse the tree from the root to the left, until the left pointer is NULL
- The node which has the left node NULL is the minimum
- BinarySearchTree<T> *p = this; - reference to the root

What do we do if we want to obtain the maximum value?

Ex 4.

- Calculate the "maximumHeight" of a BST – the number of nodes included in the longest path (which connects the root and the farthest leaf)

- Suggestion:
  - Recursive function
  - The max height of the BST is the maximum between the heights of its children.

Homework

- Finish the exercises started in class!