

## Assignment 4

### 1 Sorting using a BST

- The tree traversal suitable in this case is the inorder one: it will give the following sequence: a a e e g i l m n o p r s t x.
- A sorting method consists on building a BST using successive insertions at the leaf and then using the inorder traversal. The first operation takes  $O(\text{height of the tree} * n)$ , where  $n$  is the size of the array to be sorted. The traversal takes  $O(n)$ .

### 2 Remove operation in a BST

**Algorithm 1. *remove*:  $tree \times item \rightarrow tree$**

1.  $remove(\langle x, emptyTree(), emptyTree() \rangle, x) = emptyTree()$
2.  $remove(\langle x, emptyTree(), d \rangle, x) = d$
3.  $remove(\langle x, g, emptyTree() \rangle, x) = g$
4. if  $g$  and  $d$  are different from the empty tree then  $remove(\langle x, g, d \rangle, x) = \langle max(g), \bar{max}(g), d \rangle$

**Algorithm 2. *max*:  $tree \rightarrow node$**

1.  $max(\langle r, g, emptyTree() \rangle) = r$ .
2. if  $d \neq emptyTree()$ , then  $max(\langle r, g, d \rangle) = max(d)$

**Algorithm 3. *māx*:  $tree \rightarrow tree$**

1.  $māx(\langle r, g, emptyTree() \rangle) = g$
2. if  $d \neq emptyTree()$  then  $māx(\langle r, g, d \rangle) = \langle r, g, māx(d) \rangle$

### 3 Quicksort: example

A S O R T I N G E X A M P L E  
A A O R T I N G E X S M P L E  
A A M E L I N G E O S X P T R  
A A G E L I E M N O P R S T X  
A A E E G I L M N O P R S T X