Last name	
First name	
Group	

Grade

1	
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Algorithmics
Undergraduate 1st year S2
Final Exam #2 (P2)
May, 22th 2019
Answer Sheets

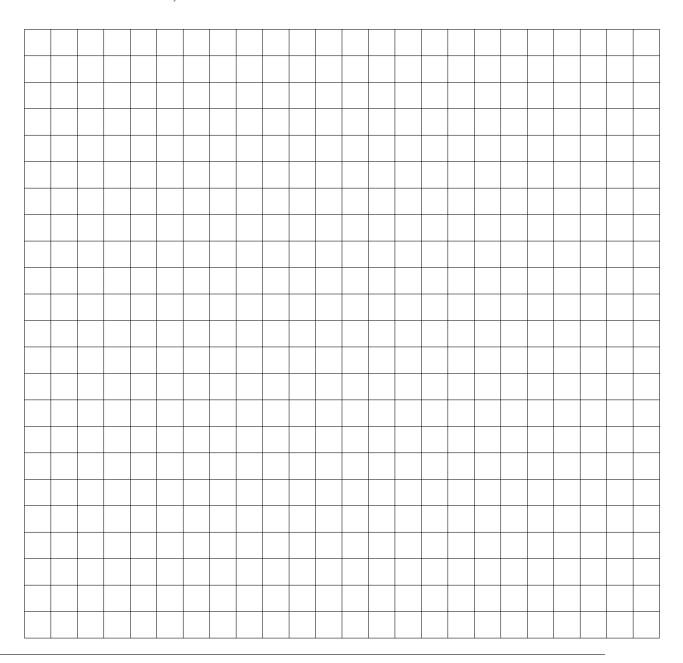***Answers 1*** (**Add the size** − *4 points*)

Specifications:

The function copyWithSize(B) with B a "classic" binary tree (BinTree) returns a copy of B with the size specified in each node (BinTreeSize).

***Answers 2* (Insertion with size update − *4 points*)**

Specifications:
    The function addwithsize(B, x) adds x in leaf in the binary search tree B (BinTreeSize) unless
    it is already present. It returns a pair: (the tree after a potential insertion, a boolean that indicates
    if the insertion occurred).

***Answers 3* (Median − *7 points*)**

1. B BST with n elements such that the kth element ($1 \le k \le n$) is in the root:

    size(l(B)) = _____

    size(r(B)) = _____

2. *Abstract definitions of the operations nth and median*

   OPERATIONS
   $kieme$: BinaryTree × Integer → Node
   $median$: BinaryTree → Node

   PRECONDITIONS
   nth (A, k) **is defined if-and-only-if** $1 \leq$ k $\leq size$(A)
   $median$ (A) **is defined if-and-only-if** A $\neq$ emptytree

   AXIOMS

   _____

   _____

   _____

   _____

   _____
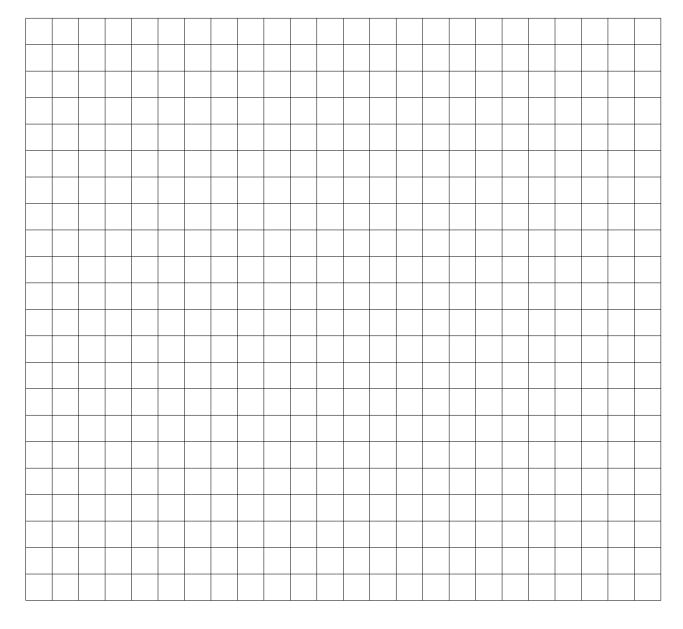
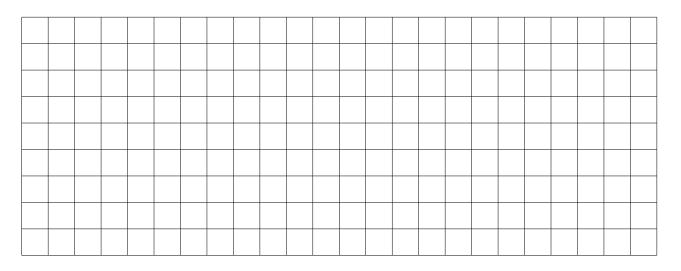   A $\neq$ emptytree $\Rightarrow median$ (A) $= nth$ (A, ($size$ (A)+1) div 2)

3. **Specifications:**
   The function `nthBST`(B, k) with B a non empty BST and $1 \leq k \leq size(B)$ returns the tree
   with the kth element of B as root.

Specifications:
The function median(B) returns the median value of the binary search tree B if it is non empty. Otherwise, it returns None.

Answers 4 (**AVL – 3 points**)

Tree built by insertions of 5, 15, 20, 2, 4, 1:

Tree after insertions of 32, 25, 22 :

Answers 5 (**AVL - Re-balancing** − *3 points*)

Specifications:
The function `rebalancing(A)` takes the non empty AVL A whose root has its balance factor in $[-2, 2]$. If necessary, it performs a rotation to re-balance A. It returns a pair: the possibly modified tree and a boolean indicating if the tree height has changed.