Universityé Mohammed VI Polytechnics **Year 2020-2021**
Licence LSD **Data Structures**

PRACTICE SESSION
SESSION IV

Overview :

In computer science, a tree is a widely used abstract data type that simulates a hierarchical tree structure, with a root value and sub-trees of children with a parent node, represented as a set of linked nodes. A tree data structure can be defined recursively as a collection of nodes (starting at a root node), where each node is a data structure consisting of a value, together with a list of references to nodes (the "children"), with the constraints that no reference is duplicated, and none points to the parent.
In the following exercises we are going to implement some famous tree data structures such as (`B-Tree`, `BST`, `AVL`) and understand their advantages vs disadvantages, then use them to solve the rest of the exercises.

Part 1:

Exercice 1. *A Binary Tree is a type of data structure in which each node has at most two children (left child and right child). Binary trees are used to implement binary search trees and binary heaps, and are used for efficient searching and sorting. A binary tree is a special case of a K-ary tree, where k is 2.*

1. *Implement the binary tree data structure,*
2. *Write a function "tree_depth" that find the depth/high of the tree.*
3. *Write a function "tree_diameter" that find the diameter of the tree (The diameter of a tree is the number of nodes on the longest path between two leaves in the tree).*
4. *Write a function "leaf_sum" that calculate the sum of leaves values.*
5. *Create a program to test your functions*

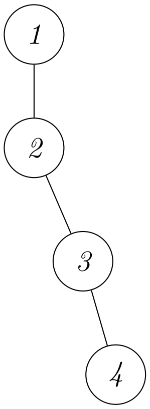
Exercice 2. *binary search tree, also called an ordered or sorted binary tree, is a rooted binary tree whose internal nodes each store a key greater than all the keys in the node's left sub-tree and less than those in its right sub-tree*

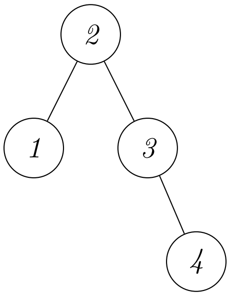
1. *Implement the binary tree data structure*
2. *Write an iterative function to insert an element into a binary search tree.*
3. *Write a recursive function to search an element into a binary search tree.*
4. *Write a recursive function" max_depth()" that prints the maximum depth of the tree.*
5. *Write a recursive function "tree_size()" that prints the number of elements in the tree.*
6. *Create a program to test your functions*

Exercice 3. *AVL tree is a self-balancing Binary Search Tree (BST) where the difference between heights of left and right sub-trees cannot be more than one for all nodes.*
A Given a binary search tree, return a balanced binary search tree with the same node values.

Date: May 28, 2021.

If there is more than one answer, return any of them.





Input: root = [1,null,2,null,3,null,4,null,null]
Output: [2,1,3,null,null,null,4]
Explanation: This is not the only correct answer, [3,1,4,null,2,null,null] is also correct.

Part 2:

The really interesting part is Coming Soon ˆˆ