CS2302 LAB ASSIGNMENT #2: BINARY TREES, BST, AVL

COMPLETION DATE: OCTOBER 15

OBJECTIVES

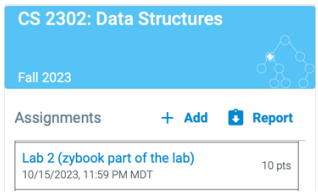
This lab assignment will allow you to explore concepts covered in class about binary trees, binary search trees, and balanced binary search trees (we will do AVL trees). Part of this assignment is to be completed on zybook, the other part is a collection of problems you are expected to learn how to solve. For these problems (part 2 of this lab), we expect you to work with a proper IDE, and we recommend Spyder unless you are already fully familiar with another one.

WHAT TO DO?

You will complete the following two major activities as detailed below.

ACTIVITY 1. LAB 2 FROM ZYBOOK

1. Go to the online textbook for this course (zybook).
2. Access the assignments tab of your book.
3. You can now locate Lab 2 (see picture below).



4. You are expected to complete Zybook Lab 7.11 on AVL tree Nth largest operation.

ACTIVITY 2. SELECTION OF BINARY TREE PROBLEMS

You are expected to solve at least 5 out of the following problems.

Problem 1. Given the roots of two binary trees of integers, write a python function to check if the two trees are the same or not.

Note: two trees are considered to be the same if they have the same structure and the same values stored at each node.

Problem 2. Given the root of a binary tree, return the zigzag level order traversal of its nodes' values (i.e., from left to right, then right to left for the next level and alternate between).

Problem 3. Given an array of integers that are sorted in increasing order, convert it to a balanced binary search tree (AVL).

Problem 4. Given a binary tree, determine whether it is (height-)balanced.

Problem 5. Given the root of a binary tree of integers and a target sum, determine if the tree has a root-to-leaf path such that adding up the values along the path sums up to the target sum value.

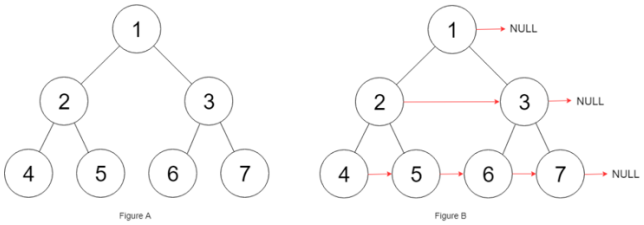
Problem 6. You are given a perfect binary tree, where all leaves are on the same level, and every parent has two children. The binary tree has the following definition:

Each node consists of:

- A value: int
- A node – left: pointer to left child
- A node – right: pointer to right child
- A node – next: pointer to node immediately to its right, at the same level (possibly null if this is the right-most node of a level)

Initially, all next pointers are set to NULL. Write a program that, given a binary tree with all next pointers set to null, populates each next pointer to point to its next right node.

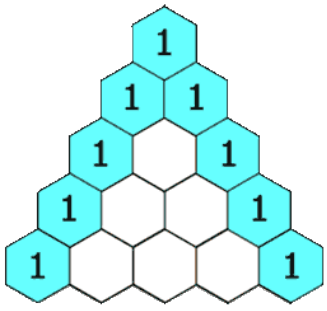
Example 1:



Problem 7. Given an integer n, return the first n rows of Pascal's triangle.

In Pascal's triangle (see below), each number is the sum of the two numbers directly above.

Example:



Input: n = 5, Output = [[1], [1,1], [1,2,1], [1,3,3,1], [1,4,6,4,1]]

HOW TO SUBMIT?

You do not need to submit anything for the zybook part of this lab. You will need to submit the second part of your lab to your TA.

Reminder: labs are not graded but we will provide you feedback so that's why we need to have access to your work and in all lab assignments, you will receive instructions about how to submit.

WHAT IS EXPECTED OF YOU?

1. **Meeting with your TA/IA:** You are expected to meet at least twice with your TA/IA:
    a. Once between September 20 and 30, and
    b. Once between October 1 and October 13.

    These specific meetings will be graded under professionalism (see syllabus). Meetings are preferably in person but can be arranged online under relevant circumstances.

    Of course, you are very welcome to meet with them earlier and as many times as you would like/need.

2. **What will you show and discuss at the first meeting?** At the first meeting with your TA/IA, you will show your progress in the lab and ask questions. Your grade will acknowledge:
    a. Evidence of the work you have done so far in the lab
    b. The quality of the questions you ask (they should be probing, not clarifying questions to count in your grade)
    c. The answers to the question we will ask you about your work

    Note: You are expected, by this time, to have read the lab assignment and gotten started. As a result, questions that are answered in the lab assignments are ok but will not count towards your grade and progress, because they should have been addressed before.
3. **What will you show and discuss at the second meeting?** At the second meeting, you will show evidence of your progress based on the feedback you received at the first meeting.
    Note: if at the time of your first meeting, you already completed the whole lab assignment and were able to answer all questions satisfactorily, then your TA/IA will be able to inform you if you do not need to schedule a second meeting.

Important note: we are well aware that online solutions exists, as well as that AI tools like chatGPT can solve these problems and more for you. However, we will hold you accountable to your progress through quizzes and exams, and we expect to see no (or minimal) discrepancy between current lab quality and answers to exams/quizzes.

Additionally, zybook has embedded tools to track your work and progress. We will be using these to assess your work and work ethics. If anything looks off, we reserve ourselves the right to give you an ad-hoc oral exam to check that you are not producing work that is not yours.