Faculty of Mathematical Economics

Data Structures and Algorithms

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DSEB Class of 2021 - 2024

Homework Assignment Week 9

Topic: Tree Traversal Algorithms
Date Created: March 30, 2023

Problem 1: Tree Traversal Algorithms Implementation

a. Implement these following tree traversal algorithms in `BinaryTree` class.

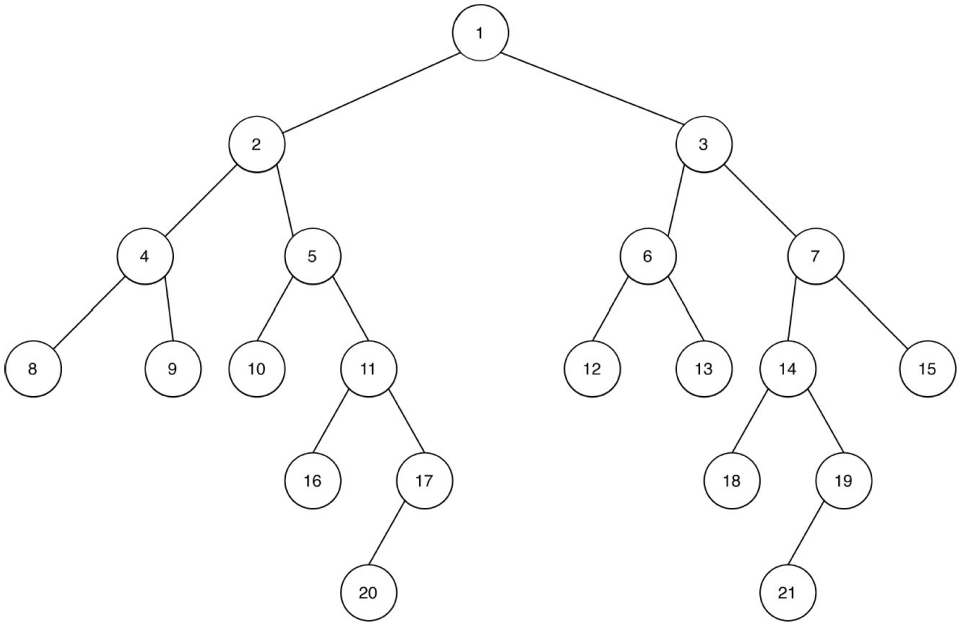
- Preorder Traversal
- Postorder Traversal
- Breadth - First Tree Traversal
- Inorder Traversal

Note:

- The pseudo-code, figure and examples of these algorithms are all in textbook (Part 8.4 - from page 328). Bear in mind that you should follow these instructions to standardize your implementation (since these algorithms are basic ones).
- In `Breadth - First Tree Traversal`, you should use `Queue` (Array-based) class you have implemented before.

b. Performing these tasks:

- Create a tree as below:



- Use postorder traversal algorithm to travel the tree and print out the result.
- Use traversal algorithm to print out: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21.
- Use traversal algorithm to print out: 8, 4, 9, 2, 10, 5, 16, 11, 20, 17, 1, 12, 6, 13, 3, 18, 14, 21, 19, 7, 15.

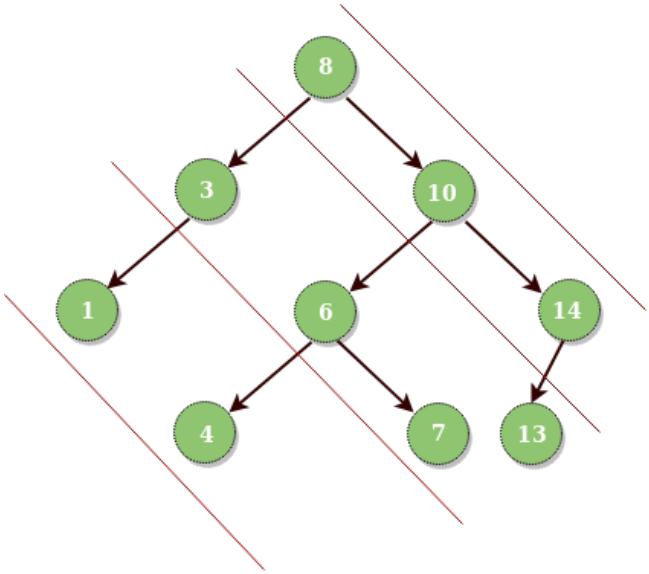
Problem 2: Tree Traversal Applications

The following problems are based on tree traversal algorithms.

- Write a function based on any tree traversal algorithm that you learned to print out the total number of nodes in a tree.
- Write a function based on any tree traversal algorithm that you learned to print out number of nodes that has the value smaller than a given number (for example: 9).
- Write a function based on `Breadth - First` traversal algorithm to calculate the sum of all elements in the tree.
- Write a function based on any tree traversal algorithm that you learned to print out the depth of the tree.

Problem 3: Special Traversal of Binary Tree

Given a binary tree as below, identify all diagonal elements that belong to the same line as the nodes that intersect lines with a slope of -1, and output them. Name of this traversal algorithm will be **revealed** at the tutor class.



`Output`:
Special Traversal of binary tree:
8 10 14
3 6 7 13
1 4
`Observation`: Root and root -> right values will be prioritized over all root -> left values.

Implement this tree traversal algorithm in `BinaryTree` class.

Guidelines for submission

- Your submission must be under the `.ipynb` format.
- Your submission will be graded and it is likely that homework grade will contribute as a component in your GPA.
- If your submission is later than the due date without special consideration approval, you will receive a penalty on your mark.