CS 445: Data Structures
Spring 2017

Assignment 5

Assigned: Wednesday, April 5 **Due:** Wednesday, April 19 11:59 PM

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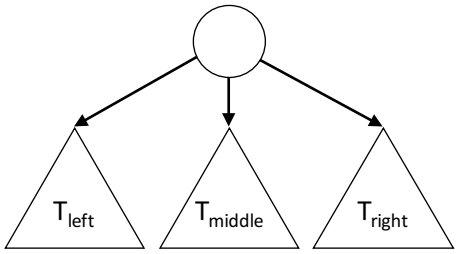
1 Motivation

In this assignment, you will be implementing a data structure as described in its ADT (represented using a Java interface). Specifically, you are provided with `TernaryTreeInterface`, an interface describing a tree where each node can have up to 3 children. Such a tree is defined as either:

1. Empty; or
2. of the following form, where $\mathsf{T}_{\mathsf{left}}$, $\mathsf{T}_{\mathsf{middle}}$, and $\mathsf{T}_{\mathsf{right}}$ are ternary trees.



When implementing this class, you can use the `BinaryTree` source code provided (package `cs445.binary`) as a starting point, or you can start from scratch. You are also allowed to use classes from the Java Collections Framework such as `java.util.Stack` or `java.util.LinkedList` (these may be useful, e.g., in implementing tree traversal iterators), but you **cannot** use any Java-provided tree-like structures (e.g., `javax.swing.tree.TreeNode`).

2 Provided files

First, carefully read the provided files, in the usual place on Pitt Box.

The `cs445.binary` package contains the textbook's implementation of a binary tree.

The `cs445.StackAndQueuePackage` provides the textbook's implementations of Stack and Queue ADTs, which are used in the binary tree implementation (in particular, for the tree iterators).

`TernaryTreeInterface` and its superinterfaces are provided in the `cs445.a5` package. Do not modify these provided files.

3 Tasks

You must implement a class `TernaryTree` that implements the interface `TernaryTreeInterface`. In implementing `TernaryTreeInterface`, you will also need to override the abstract methods declared in its superinterfaces, `TreeInterface` and `TreeIteratorInterface`.

`TreeInterface` requires basic tree operations such as `getHeight`, `getNumberOfNodes`, etc.

`TreeIteratorInterface` requires methods that create and return iterators for performing various traversals of the tree. Your `TernaryTree` class **must include the following inner classes that implement these iterators:** `PreorderIterator`, `PostorderIterator`, and `LevelOrderIterator`. These iterators *do not* need to support the `remove()` operation (i.e., the `remove()` method can simply throw `java.lang.UnsupportedOperationException` like the examples in the book).

Furthermore, **you do not need to implement an inorder iterator.** Instead, `getInorderIterator()` should also throw a `java.lang.UnsupportedOperationException`. In addition, **include in the comments** for this method a short explanation of why `TernaryTree` does not support inorder traversal.

In addition to the methods required by the interfaces, your class *must* have the following constructors:

- `public TernaryTree()`: initializes an empty tree
- `public TernaryTree(T rootData)`: initializes a tree whose root node contains `rootData`
- `public TernaryTree(T rootData, TernaryTree<T> leftTree, TernaryTree<T> middleTree, TernaryTree<T> rightTree)`: initializes a tree whose root node contains `rootData` and whose child subtrees are `leftTree`, `middleTree`, and `rightTree`, respectively.

You may want to develop a `TernaryNode` class to represent the nodes of the tree, similar to the `BinaryNode` class discussed in the textbook and in lecture. As noted above, you may use the source code provided with the textbook as a starting point.

> **Note:** You are highly encouraged to write a test client that allows you to test the functionality of your implementation of `TernaryTree` prior to submission. You will be graded on each method's functionality as it compares to the descriptions in the interfaces, so make sure you test each one to ensure it behaves as expected!

4 Grading

Your grade for this assignment will be based on each method's functionality as it compares to the descriptions in the interfaces and this document.

> **Note:** Code that cannot be compiled and tested will be given a grade of 0.

Method	Points
`TernaryTree()`	2
`TernaryTree(E)`	4
`TernaryTree(E, tree, tree, tree)`	6
`getRootData()`	2
`isEmpty()`	2
`getHeight()`	6
`getNumberOfNodes()`	6
`getLevelOrderIterator()`	16
`getPreorderIterator()`	18
`getPostorderIterator()`	20
`getInorderIterator()`	6
`clear()`	2
`setTree(E)`	4
`setTree(E, tree, tree, tree)`	6

5 Submission

Upload your java files in the provided Box directory as additions to the provided code.

All programs will be tested on the command line, so if you use an IDE to develop your program, you must export the java files from the IDE and ensure that they compile and run on the command line. Do not submit the IDE's project files. Your TA should be able to download your `cs445-a5-abc123` directory from Box, and compile and test your code. Specifically, `javac cs445/a5/TernaryTree.java` must compile your program, when executed from the root of your `cs445-a5-abc123` directory.

In addition to your code, you may wish to include a `README.txt` file that describes features of your program that are not working as expected, to assist the TA in grading the portions that do work as expected.

Your project is due at 11:59 PM on Wednesday, April 19. You should upload your progress frequently, even far in advance of this deadline: **No late submissions will be accepted.**