CSc 225 Assignment 5: Trees

Due date:

The submission deadline is 11:55pm on Monday, July 20th, 2020

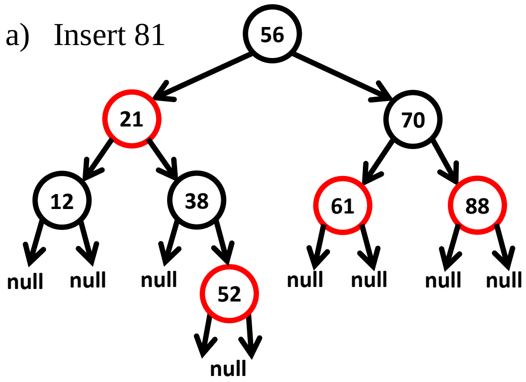
How to hand it in:

Submit a **.pdf** file (Part I and Part II) and the `HuffmanTree.java` file(for Part 3) through the Assignment 5 link on the CSC225 ConneX page.

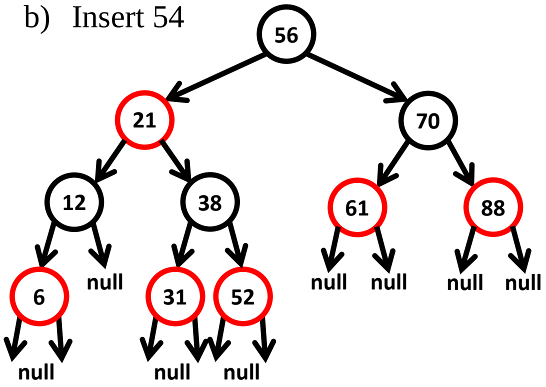
Part 1: Red-Black Trees

1. Draw the completed **Red-Black** Tree after the specified insertion.

   a) Insert 81



   b) Insert 54

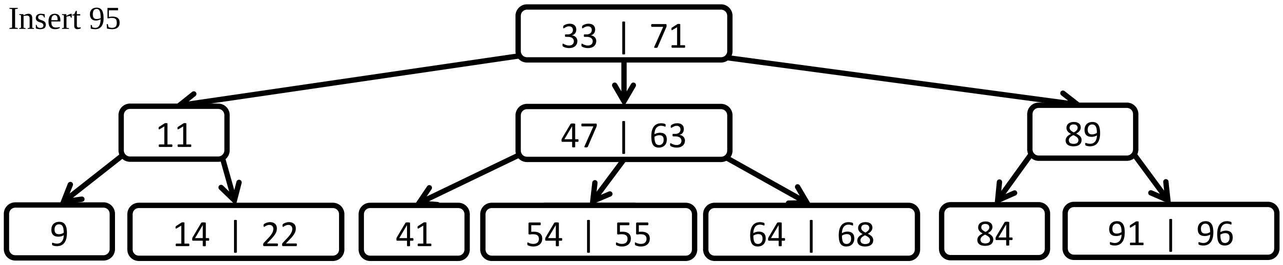


2. Determine a sequence of keys to insert into a BST and a Red-Black Tree such that the height of the BST is less than the height of the Red-Black Tree, or prove that no such sequence is possible.

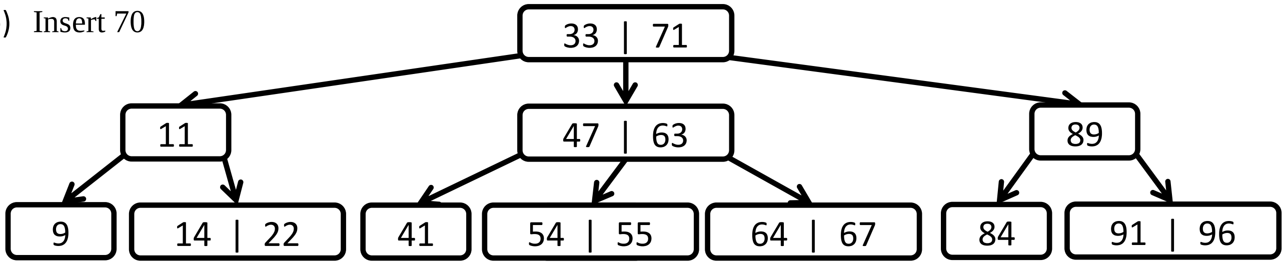
Part 2: B-Trees

3. Draw the completed **2-3 Tree** after each of the specified insertion.

a) Insert 95



b) Insert 70



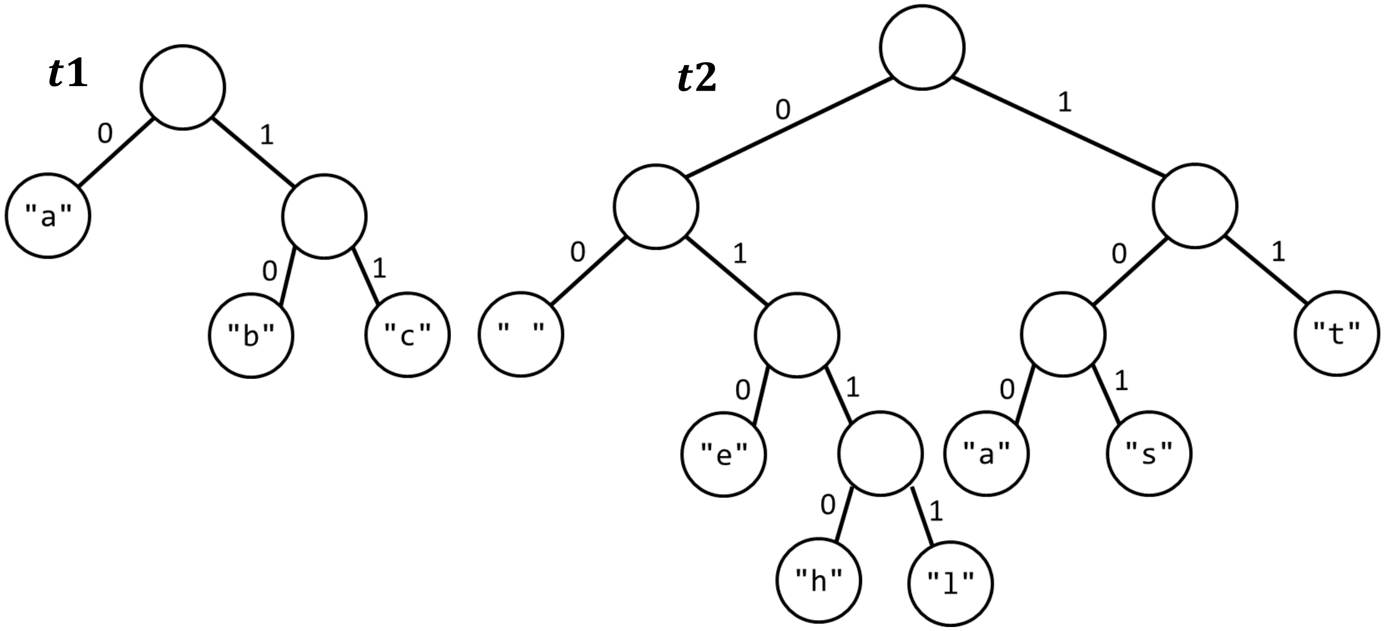
4. Given a B-Tree with $m = 4$, what is the minimum number of elements that could be inserted for which the tree would have a height of 2 (root, plus two levels below). Briefly explain how this scenario would occur (providing example insertions sequence would suffice).

5. Given a B-Tree with $m = 4$, what is the maximum number of elements that could be inserted for which the tree would have a height of 2 (root, plus two levels below). Briefly explain how this scenario would occur (what would the contents of the nodes look like).

Part 3: Implementation

6. For Part 3 you will be decoding bits of data using a Huffman tree, as shown in lecture. Two Huffman trees are provided for you; your task is to implement the decode method so that a textual representation can be obtained from a given input bit string.

   The two Huffman trees are shown below:



Examples:

- In $\boldsymbol{t1}$, the letter b is obtained by a 10 encoding.
- In $\boldsymbol{t2}$, the letter s is obtained by a 101 encoding
- In $\boldsymbol{t2}$, the encoding 1010110010 could be decoded to “she” (101=s, 0110=h, 010=e)

Download the a5_files.zip file containing all of the starter files for this programing component of this assignment. The file can be found in the Resources > Assignments > a5 section on ConneX.

The **`A5Tester.java`** file has tests for the two Huffman trees $t1$ and $t2$ with some example encodings. Once you have completed the decode method, submit the **`HuffmanTree.java`** file.