Computer Science 400

Practice Exam

Today's Date
36 points (0% of final grade)
Instructors: Florian Heimerl, Ashley Samuelson, and Young Wu

Name: _____ **Student ID #**: _____
(ALL UPPERCASE LETTERS)

NetID (email): _____@wisc.edu

Circle your Lecture:

Lec001 MWF 11:00AM (Florian)	Lec002 MWF 1:00PM (Florian)	Lec003 MWF 1:20PM (Ashley)	Lec010 Tu 5:30PM (Young)

INSTRUCTIONS:

1. Enter your Name, StudentID#, NetID, and Lecture Section on this exam booklet **AND** on your bubble sheet.
2. On your bubble sheet, fill in the bubble corresponding to **Version X**.
3. Notice that the back of your bubble sheet contains RBT Images for you to reference during this exam.

This exam contains two parts and is worth a total of 36 points.
Part I contains **12** Multiple Choice Questions worth 2 points each, for a total of **24** points possible.
Part II contains **3** Short Answer Questions that are worth a total of **12** points possible.
You will have 45 Minutes to complete the exam.
Be sure to carefully read through every question completely.

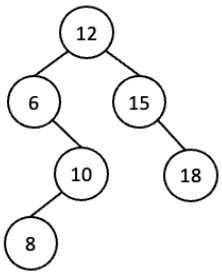
I certify that I will keep my answers covered so that they may not be viewed by another student during the exam or prior to completion of their exam. I also certify that I will not view or in any way use another's work or any unauthorized devices. I understand that I may not make any type of copy of any portion of this exam without express permission from my instructor. I understand that being caught allowing another to view my work or being caught viewing another's work are both violations of this agreement and that either may result in an automatic failure of the exam, the course, and additional consequences in accordance with the Department of Computer Sciences, the College of Letters and Sciences, and/or the University of Wisconsin - Madison.

Signature: _____

Turn off and put away your cell phone, calculator, smart watches, smart glasses, smart pencils, etc. now and wait for the proctor to signal the start of the exam.

Part I: Multiple Choice (12 Questions, 2 points each)

1. Consider rotating the nodes containing 6 and 10 in the binary search tree that is diagramed to the right. Which of the following statements will be true about the resulting tree?

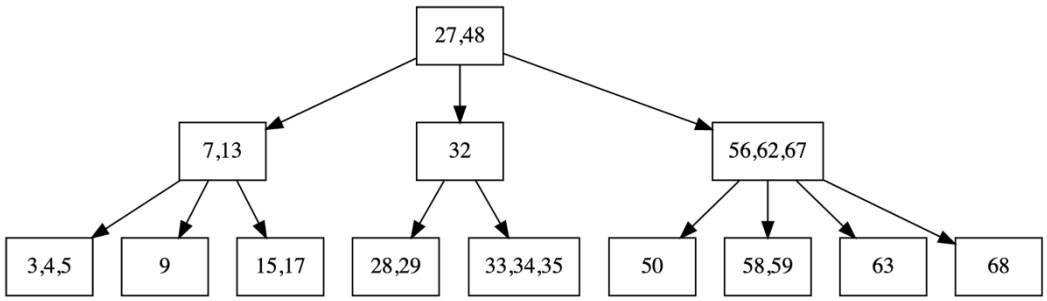


   A. 8 will be a **LEFT** child, and the height of the resulting tree will be **SMALLER**
   B. 8 will be a **LEFT** child, and the height of the resulting tree will be **THE SAME**
   C. 8 will be a **LEFT** child, and the height of the resulting tree will be **LARGER**
   D. 8 will be a **RIGHT** child, and the height of the resulting tree will be **SMALLER**
   E. 8 will be a **RIGHT** child, and the height of the resulting tree will be **THE SAME**

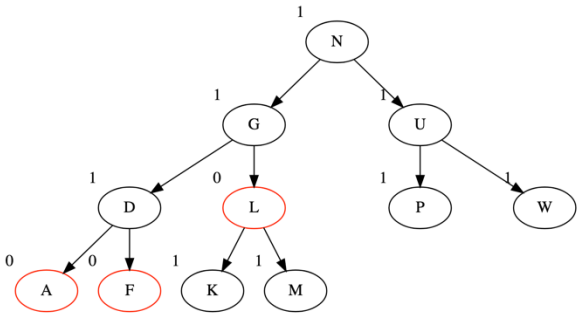
2. Which of the following commands could potentially change your working directory to be a sibling directory of the working directory?
   A. `cd a/../`
   B. `cd b/../../`
   C. `cd ../c/`
   D. `cd ../../d`
   E. `cd ../e/../`

3. Trace through inserting the number 34.5 into the 2-3-4 tree below. After this insertion, which value(s) below will 34.5 share a node with?

   A. 32
   B. 34
   C. 35
   D. 32,34
   E. 27,48



4. How many rotations are used throughout the removal of the value K from the red-black tree depicted to the right? Red nodes in this tree are marked with a 0 and black nodes are marked with a 1 on top of the node.

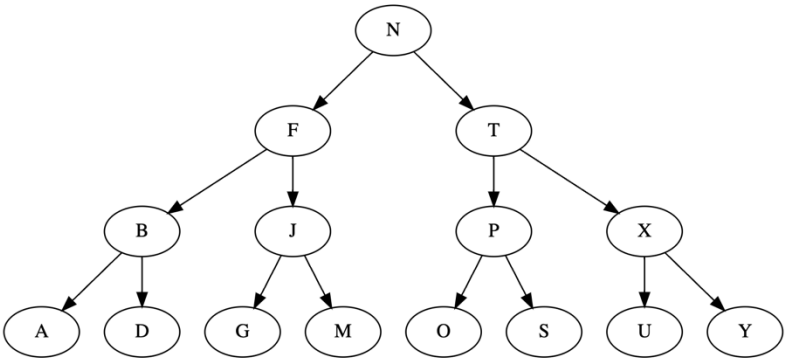


   A. 0
   B. 1
   C. 2
   D. 3
   E. 4

5. Which of the following commands can be used to check which files have been added to staging, and are ready to be added to the next commit?
   A. git log
   A. git commit
   B. git status
   C. git add
   D. git checkout

6. Suppose that J is a red node with a red parent in the following tree, and that outside of this one violation the rest of the following tree conforms to all Red-Black Tree properties (the colors are just omitted from this diagram). Which of the following nodes would you need to know the color of to determine the appropriate case and algorithm to begin resolving this violation?

   A. T
   B. M
   C. N
   D. G
   E. B



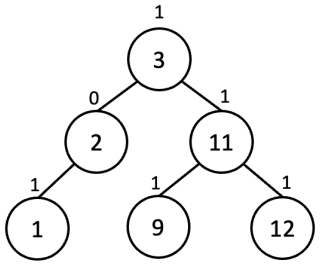
7. Which of the following tests is best categorized as a unit test?
   A. A test that runs a backend for Project 1 with an AVL tree implementation to check if the backend returns the expected data from a dataset stored in the tree.
   B. A test that passes two unrelated nodes into the rotate method of the BinarySearchTree of Project 1 to test if the method throws an exception.
   C. A test that runs a frontend with a backend for Project 1 to test if the frontend lists the songs for a given range from the dataset read in by the backend.

8. Consider running "make all" in the directory below. Which of the following files do you expect to see created as a result of running this command?

```
[student@exam] (1)$ ls -l
total 1
-rw-rw-r-- 1 student student 69 Mar 18 17:30 Makefile
-rw-rw-r-- 1 student student  0 Mar 18 17:31 X
-rw-rw-r-- 1 student student  0 Mar 18 17:32 Y
-rw-rw-r-- 1 student student  0 Mar 18 17:33 Z
[student@exam] (2)$ cat Makefile
all: W X Z
      ls
W:
      touch A
X: Y
      touch B
Z: Y
      touch C
```

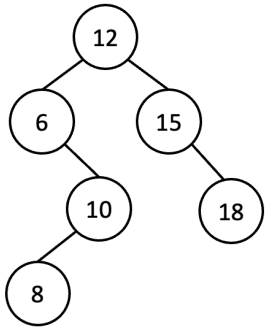
   A. A, B, C
   B. A, B
   C. A, C
   D. B, C
   E. Only B

9. [True of False] The following tree is a valid Red-Black Tree. Red nodes in this tree are marked with a 0 and black nodes are marked with a 1 on top of the node.



A. True
B. False

10. [True or False] The following tree is a balanced AVL tree.



A. True
B. False

11. [True or False] The JUnit test runner will report two passing tests from the following Test class.

```
public class Tester {
   @Test public void test1() { }
   @Test public void test2() { Assertions.assertTrue(true); }
}
```

A. True
B. False

12. Which or the following lambda expressions can be used to implement the Comparable<T> interface?

```
public interface Comparable<T> {
        public int compareTo(T other);
}
```

A. (x) -> System.out.println(-1)
B. (x) -> x
C. () -> 16
D. (x) -> 3

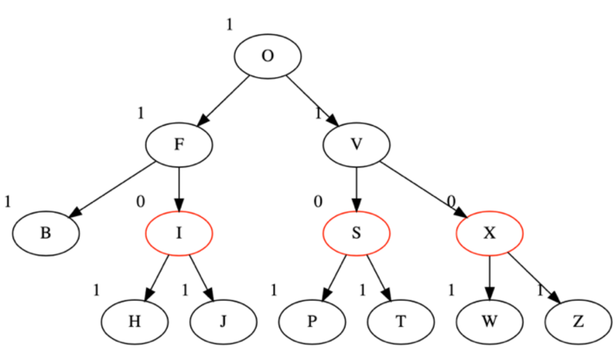
Double-check that you have answered all 12 questions on your SCANTRON bubble sheet.
The last remaining pages of this exam contain Part II Short Answer.

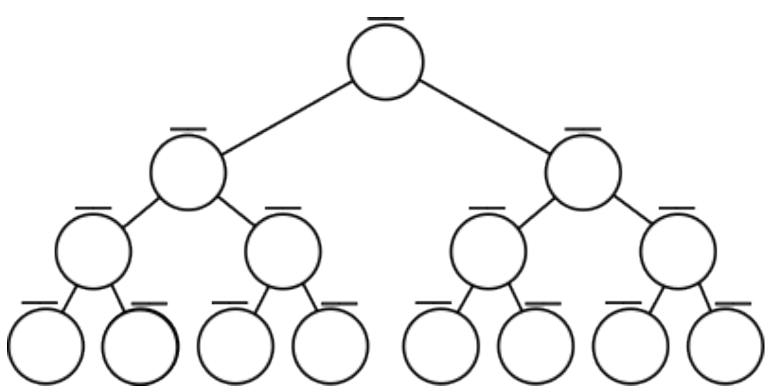
Part II Short Answer (3 Questions, 4 points each)

13. Complete the final case of the rotation implementation below, to rotate the specified child and parent nodes. Note that this is simpler than P101 both 1) because nodes do not have parent references that need updating, and 2) because you are only implementing this one very specific case: where a child is the left child of its parent, and that parent is a left child of its parent, and all three references are non-null.

```
protected static class Node<T> {
   public Node<T> leftChild;
   public Node<T> rightChild;
   public boolean isLeftChild() { /* implementation details omitted */ }
}

public void rotate(Node<T> child, Node<T> parent, Node<T> grandParent) {

   // only implement the following case for this method:
   if( child.isLeftChild() && parent.isLeftChild() ) {
   // note that child, parent, and grandparent are all non-null in this case

       ________________________________________________________________

       ________________________________________________________________

       ________________________________________________________________

       ________________________________________________________________

       ________________________________________________________________

       ________________________________________________________________
   }
}
```

14. Remove the letter B from the following red-black tree, and then draw the resulting tree into the provided blanks. Leave blanks for empty node positions in the resulting tree empty. Mark the color of each node with a 0 on top of red nodes and a 1 on top of black nodes.





15. Fill in the two blank lines below to indicate what output you expect to see displayed in response to the previous bash commands in this session.

```
student@cs400:~/midterm$ ls
fileA  fileB  folder1/  folder2/
student@cs400:~/midterm$ ls folder1
fileC
student@cs400:~/midterm$ ls folder2
fileD
student@cs400:~/midterm$ mv folder2/fileD folder1/fileE
student@cs400:~/midterm$ cp folder1/fileC ../fileF
student@cs400:~/midterm$ rm fileA
rm: remove regular file 'fileA'? y
student@cs400:~/midterm$ cd folder1
student@cs400:~/midterm/folder1$ ls
```

_____

```
student@cs400:~/midterm/folder1$ ls ..
```

_____

Double-check that you have answered all 12 questions on your MULTIPLE CHOICE bubble sheet, in addition to all 3 SHORT ANSWER questions. When done, turn in both your Exam Booklet and Bubble Sheet answers to one of the TA Proctors in your room. Please have your UW ID ready.