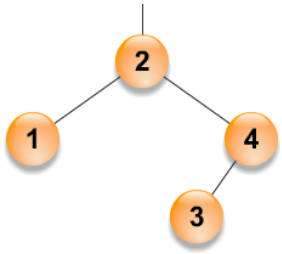
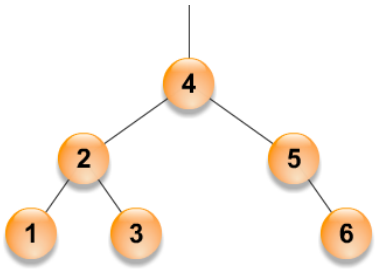
Final Exam Supplementary Practice

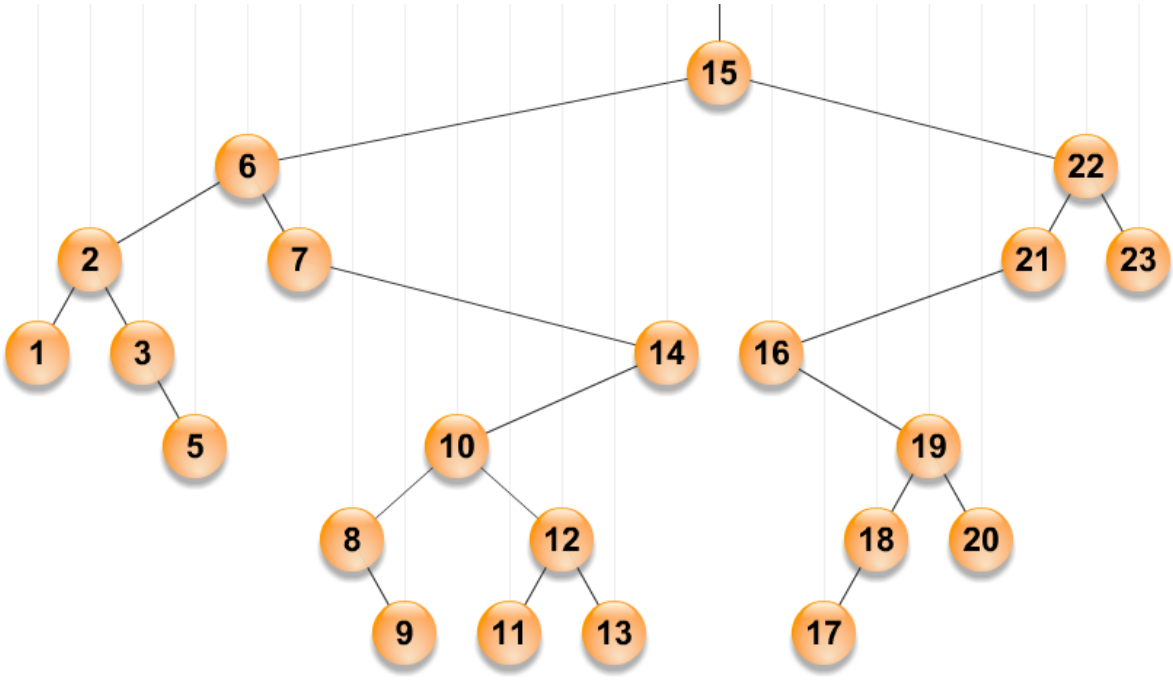
1. (4 points) Consider the trees below. ***Draw*** the tree after removing the desired node, following the algorithm we discussed in class.
   a. Remove node 4.



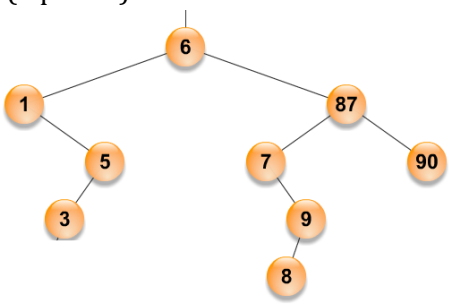
   b. Remove node 5.



   c. Remove node 15



2. (4 points) Re-draw the tree …



   a. After a left-rotation rooted at 6.

   b. After a right-rotation rooted at 87.

   c. After part b, followed by a left-rotation at 6

3. (3 points) Hashtables.
   a. ***Explain*** how, if we don't keep a cached `size` instance variable, you can determine the number of elements in a hashtable that uses chaining.

   b. ***Write*** the big-O runtime of the algorithm you described in a. ***Explain*** your choice

4. (1 point) ***Define*** load factor

5. (3 points) ***Write*** the asymptotic (Big-O) runtime …
    a. … for a HashMap that uses chaining and caches the size, of …
        i. isEmpty()
        ii. put(k,v)
        iii. remove(k)
    b. …for a TreeMap that is balanced, of …
        i. isEmpty()
        ii. put(k,v)
        iii. remove(k)
6. (3 points) ***Write*** the Big-O runtime of the following methods for …
    a. Java's TreeMap class (You can assume the tree is balanced, and don't need to account for the cost of balancing the tree.)
        i. clear()
        ii. contains(k)
        iii. put(k,v)
    b. Java's HashMap class, where *c* is the capacity and *n* is the number of elements currently stored in the dataset. Assume the load factor is reasonably low.
        i. clear()
        ii. contains(k)
        iii. put(k,v)
7. (2 points) ***Explain*** why remove(k,v) is O(1) for a HashMap that has a low load factor.

8. (4 points) Write a hashCode method for a Person class which has a firstName and lastName variable. Write an equals method, too.

```
public int hashCode() {


}

public boolean equals(Object other) {




}
```

9. (4 points) Write the one interface that is best for the given application from these options: Set, Map, Stack, Queue, and List. ***Explain*** your answer.
    a. Processing print jobs in the order they are received.

    b. Finding an object describing a user with the lastname "Jones"

    c. Evaluating a postfix traversal of an expression tree (e.g. 5 4 * 8 2 / 2 3 * + +)

    d. Determining if a word is in the dictionary or not.

10. (3 points)
    a. Draw an expression tree for the postfix expression in Problem 9. c.

    b. Write the in-order traversal of the tree

    c. Write the pre-order traversal of the tree

11. (3 points)
    e. Describe one feature of a primitive array that an ArrayList does not provide.

    f. Describe two features of an ArrayList that the primitive array does not provide.