Midterm (CSCI 4310/6323,Spring 2021)

Instructor: Dr. Bin Fu

Due 10:30pm March 26, 2021 (Friday). Download the word file and type your solution under each problem at the same file. Your submission need to be at word file instead of PDF so that it is easy to grade. Submit your word file to blackboard. If there is any problem to upload to blackboard, send your midterm to bin.fu@utrgv.edu with Subject: Algorithm Midterm--First Name Last Name.

Name: ID:

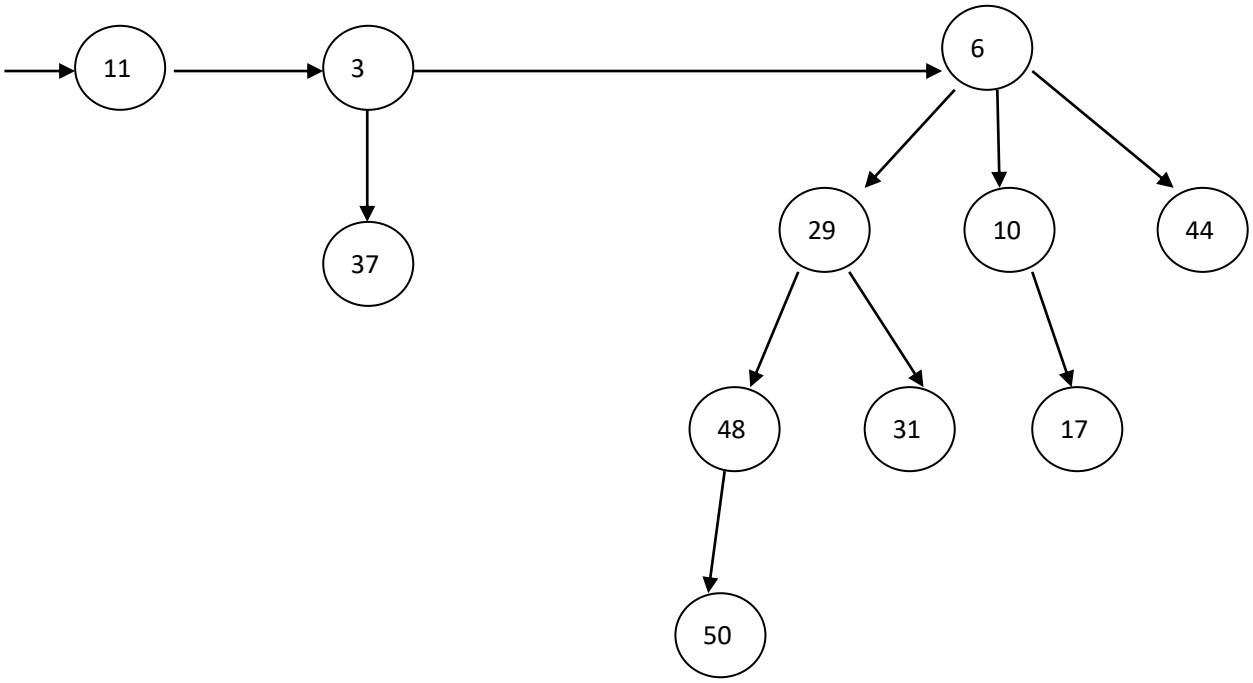
1. Solve the recursive equations with big-O notation.

   a) $T(n) = 4T(n/2) + n^3$ with T(1)=1.

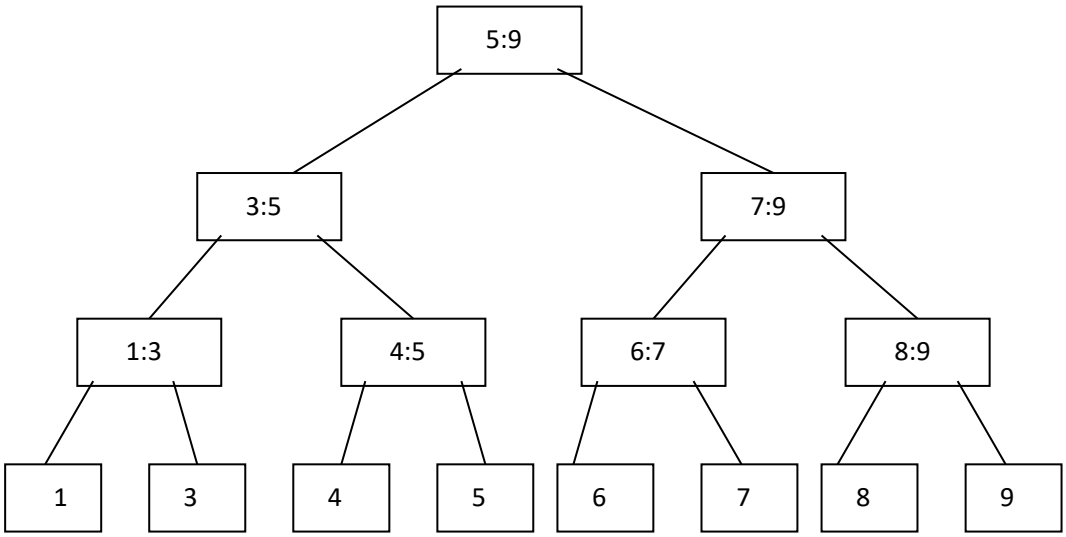
   b) How many lines, as a function of n, does the following program print? Write a recurrence and solve it. You many assume n is a power of 2.

```
function f(n)
    If (n>1)
    {       Print.line("still going");
            f(n/2); f(n/2); f(n/2);
     }
```

2. Generate the union for the following two bionomial heaps.



3. Delete the element 7 in a 2-3 tree, and show how the new 2-3 is formed.



4. An array A[1…n] is said to have a majority element if more than half of its entries are the same. Given an array, the task is to design an efficient algorithm to tell whether the array has majority element, and, if so, to find that element.

(a) Show how to solve this problem in O(n log n) time via a divide and conquer method.

(b) Can you give a linear time O(n) algorithm?

5. An interval [a, b] covers a point c if c is in [a, b] (In other words, $a \leq c \leq b$). Develop an algorithm such that given a list of intervals, and a list of points in x-axis, it gives a least number of intervals from the given list to cover all points in the input list. For example, assume that the input list of intervals is [1,5], [2,3], and [7, 12], and the input list of points is 1,3, 4, 8, 10. The points in the input list can be covered by [1,5] and [7, 12] in the interval list of the input. Please design a dynamic programming algorithm, and give its time complexity. Clearly show your recursion.