Computer Science 477/677 Fall 2014

University of Nevada, Las Vegas Computer Science 477/677 Fall 2013

Practice for Examination on September 30, 2014

Name:_____

No books, notes, scratch paper, or calculators. Use pen or pencil, any color. Use the rest of this page and the backs of the pages for scratch paper. If you need more scratch paper, it will be provided.

The entire test is 155 points.

1. True or False. [5 points each]

   (a) _____ Computers are so fast today that complexity theory is only of theoretical, but not practical, interest.

   (b) _____ If any problem can be precisely formulated in a mathematical way, there is an algorithm that solves it.

2. Fill in the blanks. [5 points each blank.]

   (a) In hash tables, the most popular way to solve collision is by _____.

   (b) What is the **only** difference between the abstract data types *queue* and *stack*?

   _____

   (c) Name a well-known divide-and-conquer searching algorithms.

   _____

3. Solve each of the following recurrences, giving the answer in terms of O, Θ, or Ω, whichever is most appropriate [10 points each].

   (a) $T(n) < T(n-2) + n^2$

(b) $F(n) >= F(\sqrt{n}) + \lg n$

(c) $G(n) \geq G(n-1) + \lg n$

(d) $F(n) = 4F(n/2) + n^2$.

(e) $H(n) \leq 2H(\sqrt{n}) + O(\log n)$.

(f) $K(n) = K(n - \sqrt{n}) + 1$.

(g) $F(n) = 4F\left(\frac{3n}{4}\right) + n^5$ (No, you don't need a calculator.)

4. [15 points] Consider the following procedure:

```
void george(int n)
 {
 & int m = n;
 & while (m > 1)
 &  {
 &    for (int i = 1; i < m; i++)
 &     cout << "I cannot tell a lie.  I chopped down the cherry tree." << endl;
 &    m = m/2;
 &  }
 }
```

Consider the question of how many lines of output the execution of `george(n)` would produce. Write down an appropriate recurrence for this question, and give an asymptotic solution in terms of `n`, using either O, Ω, or Θ, whichever is most appropriate.

5. Give a **mathematically correct** definition of the statement, "$f(n) = \Omega(n^3)$." (If you write more than 15 words, your answer is probably wrong. I will take off points if you give an example, or write anything else that is unnecessary.) [15 points]

6. Show that $n = \Omega(\log n)$. Write down the complete proof.

7. Show that $\sqrt{n} = O(n)$. Write down the complete proof.