CS3114 Spring 2011 Homework Assignment 1
Due Thursday, February 17 at 11pm
50 points

1. Here are some questions that test your working knowledge of how fast computers operate. Is disk drive access time normally measured in milliseconds (thousandths of a second) or microseconds (millionths of a second)? Does your RAM memory access a word in more or less than one microsecond? How many instructions can your CPU execute in one year if the machine is left running at full speed all the time? DO NOT use paper or a calculator to derive your answers.

2. For each of the following pairs of functions, determine whether $f(n)$ is in $O(g(n))$, $g(n)$ is in $O(f(n))$, or $f(n)$ is $\Theta(g(n))$. (Read Section 3.4.5 of the book for help.)

(i) $f(n) = \sqrt{n}$, $g(n) = \log(n^2)$.

(ii) $f(n) = \log(n^2)$, $g(n) = \log n$.

(iii) $f(n) = 2^n$, $g(n) = 10n^2$.

(iv) $f(n) = 2^n$, $g(n) = 3^n$.

3. Give the best *lower* bound that you can for the following code fragment, as a function of the initial value of n.

```
while (n > 1)
  if (ODD(n))
    n = 3 * n + 1;
   else
     n = n / 2;
```

Do you think that the upper bound is likely to be the same as the answer you gave for the lower bound?

4. A typical array-based list implementation stores references to the list data elements. A typical linked list implementation stores in each link node a reference to the data element and a reference to the next link node. Determine the size of a pointer on your machine. Use this and the equation from Section 4.1.3 of the textbook to determine the breakeven point beyond which the array becomes more space efficient than the linked list.

5. A palindrome is a string that reads the same forwards as backwards. Using only a fixed number of stacks and queues, the stack and queue ADT functions, and a fixed number of `int` and `char` variables, write an algorithm to determine if a string is a palindrome. Assume that the string is read from an input stream one character at a time. The algorithm should output TRUE or FALSE as appropriate.