Brave New World

Homework 1

Due: October 15 at start of lecture

Q1) Recall the *findmin* algorithm, which determines the location of the smallest number in an array A of n numbers:

```
best = 1;
for i=2 to n
{
    if (A[i] < A[best]) then
    {
        best = i;
    }
}
```

Modify this algorithm so that it computes the *average* of the numbers in A (you'll probably want to introduce some new variables). Your answer should be in pseudocode.

Q2) In this problem, we'll study population growth. To make things clearer, let's just consider the growth in the human *female* population. Suppose that, throughout history, each woman has had d daughters, and that d has remained constant over time. What is the size of a woman's nth generation of female descendants? For example, the size of a woman's 1st generation of female descendants (i.e. her female children) is d. Express your answer as a simple formula in terms of d and n.

The number of women in the world in 2001 was about 3 billion. Consider a woman living in the year 1. Assuming a new generation is born every 25 years, what is the largest possible value for d? You can use the google calculator
http://www.google.com/intl/en/help/features.html#calculator
Does this value seem right to you? If it seems off, what explanations could there be for the reason the current population doesn't match the prediction. (Note: Perhaps the first person to study population this way was Thomas Malthus.)

Q3) Write pseudocode that computes the formula you found in Question 2. In other words, given two variables d and n, the pseudocode should calculate the size of a woman's nth generation of female descendants, assuming that every woman has d daughters.

Q4) Estimate the total number of arithmetic operations you have done in your entire life. It doesn't have to be a precise estimate; just come up with a loose upper bound. Explain your reasoning, and list all your assumptions. When in doubt, round up. Now determine how long it would take your laptop to perform the same number of operations, assuming it can perform 100 million operations per second.

Q5) Questions based on *Blown to Bits*, Chapter 3.
http://www.bitsbook.com/wp-content/uploads/2008/12/chapter3.pdf
Write short (at most one paragraph long) answers to each question based on the information in the chapter.

1. What is the difference between the information in an electronic document produced by text processing software (such as Adobe Acrobat) and an electronic document obtained by scanning a printed document?
2. How are graphical images represented in a computer?
3. What is ASCII? How is the letter 'b' represented in ASCII?
4. Why is it that "Which bits mean what in a document format is a multi-billion dollar business"?
5. What is steganography; why and how is it used?
6. What happens to data in deleted files?
7. Why is that back-ups and saved disks we create today will not necessarily be useful in the future?

Q6) Convert 57 from decimal to binary. Convert 100110 from binary to decimal.

Q7) Bonus Problem: Construct an algorithm for finding both the maximum and the minimum of n numbers that does significantly fewer comparisons than the "obvious" algorithm. The obvious algorithm is the one that first finds the maximum (doing n-1 comparisons) and then finds the minimum (doing another n-1 comparisons). How many comparisons does your algorithm do in the worst case?