Assignment 3
CSC236, Fall 2008

1. Read the definition of FindSecond(A) below. Prove that the precondition implies the postcondition. Notice that along the way you should find an appropriate loop invariant and show termination.

```
def FindSecond(A) :
    # Precondition: A is an array of length at least 2, and that contains different
      integer numbers.
    # Postcondition: returns the second highest number in A
     if (A[1] > A[2]) then
         a = A[1]; b = A[2];
     else
         a = A[2]; b = A[1]
     endif
     j = 3;
     while (j  <= length(A)) {
       if (A[j] > a)
            b = a; a = A[j];
       else if (A[j] > b)
            b = A[j]
       endif
       j = j + 1
     }
   return b;
```

2. Consider the language L, consisting of strings over the alphabet $\Sigma = \{0,1\}$ that have an even number of 1s. For each of the regular expressions below, either prove they denote L, or else find a counter-example that shows they do not. Your counter-example should either exhibit a string that is in L but not denoted by the regular expression, or else one denoted by the regular expression that is not in L.

   (a) $R_1 = ((01)^*(10^*1)^*)$

   (b) $R_2 = (0 + (10^*1))^*$

   (c) $R_3 = (0^*(10^*1))^*$

   (d) $R_4 = (0^*(10^*1)^*)^*$

3. Prove that any regular expression that doesn't include a Kleene star denotes a finite language.

4. Consider the following languages over alphabet $\{0,1\}$:

   (a) $L_1 = \{x \in \{0,1\}^* : x \text{ does not contain the string } 101\}$

(b) $L_2 = \{xy : x \in \{0\}^*, |y| \text{ is even}\}$

For each of these languages, construct a DFSA that accepts it. Don't forget to prove your construction is correct.