Homework 2: FORTRAN

This homework is due Friday, Feb. 3 at the beginning of the lecture (1:10 PM). Each weekday that the homework is late you lose 10% of the possible points. This will be the late policy on homeworks from now on.

1. (10 points) Write a FORTRAN program to solve quadratic equations (that is, equations of the form $ax^2 + bx + c = 0$). Your program will take as input a series of lines, each of which contains three real literals (such as `3.1459E-2`) separated by commas. You can use the following READ statement

   ```
         READ 10,A,B,C
   10    FORMAT (3F15.0)
   ```

   to read in three reals separated by commas into the variables `A`, `B` and `C`, respectively. If `A`, `B` and `C` are all zero, your program should halt. Otherwise, you should print out a line containing the roots of the quadratic equation $\mathtt{A}x^2 + \mathtt{B}x + \mathtt{C} = 0$. You can print out two real roots on a line using a statement such as

   ```
         PRINT 20,ROOT1,ROOT2
   20    FORMAT (2E14.6E3)
   ```

   and you can print out two complex roots using a statement such as:

   ```
         PRINT 30,REALP1,IMAGP1,REALP2,IMAGP2
   30    FORMAT (2(E14.6E3, 1H+, E13.6E3, 1Hi))
   ```

   Turn in a listing of your program and also mail it to `matthews` (on Zaphod or atanasoff). Also turn in the results of running your program on the test data found in the file:

   `/users/class/cs342/public/quad-test.in`

   that is on Zaphod.

2. (4 points) Do exercise 2-13 on page 58 in the text.

3. (4 points.) Do exercise 2-14 on page 58 in the text.

4. This question concerns the problems of aliasing in FORTRAN programs.

   (a) (2 points) What principles of good design are violated by the COMMON facility in FORTRAN?

   (b) (6 points) What changes would you make to the definition of FORTRAN to make its COMMON facility conform to the principles of good design? Briefly explain the changes you would make and how your changes are justified on the basis of the principles of good design.

5. (10 points) Consider the following FORTRAN program.

```
      INTEGER AGE, WEIGHT, COUNTER, BEAUTY
      REAL PI, R2, R3, X, Y, Z

      AGE = 10
      WEIGHT = 20
      R2 = 3.4

      DO 100 COUNTER=1, AGE+2, 1
            PI = 3.1415
            IF (COUNTER .GT. 0) GOTO 110
            R2 = R2+PI
110         I2 = R2**2
            I3 = R2+0
            BEAUTY = AGE+WEIGHT
            X = 4*R2+PI
            Y = 4*R2+PI
            Z = 4*R2+PI
100   CONTINUE
C     ... code to print values of all variables goes here...
      END
```

Optimize the above program by writing a functionally equivalent FORTRAN program that is more time-efficient than the above (when both your program and the above are compiled by a FORTRAN compiler that does not do any optimizations itself). Use all the optimization techniques discussed in class that apply.