COE 301 / ICS 233 – Computer Organization

MIPS Programming Assignment 3, Term 171

Due date: Wednesday 21/03/2018 at 11:59 PM (Late submission = 0 points)

The roots of a quadratic equation $ax^2 + bx + c = 0$ can be found as $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Paraphrasing Wikipedia: The expression underneath the square root sign, $\Delta = b^2 - 4ac$, is called the ***discriminant***. Based on the discriminant, a quadratic equation with real coefficients can have two distinct real roots, duplicate real roots, or two distinct complex roots. The three cases are as follows:

1. If the discriminant is **positive**, then there are two distinct real roots at
$$\frac{-b + \sqrt{\Delta}}{2a} \text{ and } \frac{-b - \sqrt{\Delta}}{2a}$$
2. If the discriminant is **zero**, then there are duplicate real roots at
$$\frac{-b}{2a}$$
3. If the discriminant is **negative**, then are two distinct (non-real) complex roots at
$$\left(\frac{-b}{2a} + i\frac{\sqrt{-\Delta}}{2a}\right) \text{ and } \left(\frac{-b}{2a} - i\frac{\sqrt{-\Delta}}{2a}\right) \text{ where } i = \sqrt{-1}$$

Write a MIPS code that will find the roots of the quadratic equation $ax^2 + bx + c = 0$, where a, b, and c are entered by the user as **integer** values. Once read, these integer values should be stored in **`$a0`**, **`$a1`**, and **`$a2`**, respectively. The main code should call a procedure **`roots`** that computes the roots of the quadratic equation as **double-precision** floating point numbers. The **`roots`** procedure should return the ***real*** part of the roots in the **`($f1$f0)`** and the **`($f3$f2)`** pairs. If there are ***imaginary*** parts to the roots (i.e., the part that is multiplied by $i = \sqrt{-1}$), then they should be returned by the **`roots`** procedure in the **`($f5$f4)`** and the **`($f7$f6)`** pairs. A zero value in the **`($f5$f4)`** and the **`($f7$f6)`** pairs signify that the roots do **not** have an ***imaginary*** part (i.e., the roots are ***real***). After returning from the **`roots`** procedure call, the main code should print the results by first printing the nature of the roots (i.e., two ***distinct real*** roots, ***duplicate real*** roots, or two ***distinct complex*** roots), then printing the values of the roots. Print each root value as two parts; ***real*** and ***imaginary***. To verify your code, compare your results with the results obtained by an online quadratic equation solver (example: https://www.mathsisfun.com/quadratic-equation-solver.html).

Submission Guidelines:

All submissions should be done through Blackboard. Submit the source code of the program. Make sure that your program is well written and documented. The program will be graded according to its correctness and documentation. It is your responsibility to make sure that the program works. A program that does not assemble or run will receive zero on correctness. **Copying programming assignment is not allowed. This is individual work. Detected copies will get zero grades. This includes the one who wrote the program and the one who copied it.**

Grading Scheme:

Dividing the code to main code and a procedure and passing parameters properly	**[3 points]**
Reading a, b, and c of the quadratic equation from the user	**[1 point]**
Properly computing the roots	**[6 points]**
Printing the nature of the roots	**[2 points]**
Printing the values of the roots	**[2 points]**
Program readability and comments	**[1 point]**
Total	**[15 points]**