More Practise with Expressions

Purpose:

To gain practice with expression manipulation and `if`-statements in JAVA.

Due Date:

The completed lab assignment is due Friday, October 12 *at the beginning of lecture.* It should be stapled and your name highlighted.

Question and Answer Problems

1. A year in the Gregorian calendar (that is, the calendar currently in use in Canada) is a *leap year* if

   - the year is divisible by 4; and
   - either the year is not divisible by 100 or the year is divisible by 400.

   Write a short program that asks the user for a year, and then tells the user whether or not it is a leap year.

2. The quadratic formula says that the solutions of the equation $a\,x^2 + b\,x + c = 0$ are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1}$$

   Note; If $b^2 < 4ac$ there are no real roots. If $b^2 = 4ac$ the two real roots are equal.

   It is more accurate to compute the roots as follows: Compute the larger root (in absolute value) x_1 using

$$x_1 = \begin{cases} \dfrac{-b - \sqrt{b^2 - 4ac}}{2a} & \text{if } b \geq 0 \\[2ex] \dfrac{-b + \sqrt{b^2 - 4ac}}{2a} & \text{if } b \leq 0 \end{cases}$$

   and then solve for the small root x_2 using

$$x_2 = c/(ax_1). \tag{2}$$

⇒ Write a program that asks the user for *a*, *b*, and *c* and then prints out the real roots if they exist. Your program should print an appropriate error message if there are no roots, and an appropriate warning message if the roots are identical.

When printing out the solution print out *a*, *b*, *c* and the roots neatly using `String.format` or `System.out.printf` appropriately.

⇒ Write a program that compares the results of computing the smaller root using (1) and (2). Be sure to print the two results to high precision.

Determine what *a*, *b*, and *c* should be for the equation $(x - 10^3)(x - 10^{-3}) = 0$, and input those values into your program. Can you explain the results?

3. Write a program that plays a word game with the user.[1] The program should ask the user to enter the following:

- Her or his name
- Her or his age
- The name of a city
- The name of a post-secondary institution
- A profession
- A type of animal
- A pet's name

After the user has entered these items, the program should display the following story, inserting the user's iinput into the appropriate locations:

```
There once was a person named name who lived in a city.  At the age of age,
name went to school at post secondary institute.  Name
graduated and went to work as a profession.
Then, Name adopted a(n) animal named Petname.  They both
lived happily ever after!
```

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[1]This is problem 16 *p.* 108 from *Starting Out with* Java*^{TM}*: *From Control Structures through Objects* (**5**th edition) by Tony Gaddis. Pearson. 2012.