

MS-382
Java Program #1
Simple Expressions

Date Assigned: Monday, December 4, 2006
Date Due: Wednesday, December 13, 2006

The purpose of the assignment is to be able to translate simple expressions into correct Java expressions. The program should find the two roots to the following quadratic equation:

$$x^2 - 8x + 15 = 0$$

In general, any quadratic equation of the form:

$$Ax^2 + Bx + C = 0$$

where A , B , and C are constants in the equation (called the coefficients), can be solved by using the quadratic formula, which follows:

$$\frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

Write a program that solves the above quadratic equation using the quadratic formula. First write your program with “hard coded” values for the 3 coefficients above and print out your answers. Then, rewrite your program so that it prompts the user to input the values of A , B , and C . Be careful that the discriminant (i.e. the term underneath the square root sign) is always non-negative (≥ 0). Use the functions intrinsic to the language to compute squares and square roots (i.e. $Math.pow(x, y)$ and $Math.sqrt(x)$). Be sure to print both roots of the equation.

Note: The formula only yields real-valued answers when the quantity

$$B^2 - 4AC$$

is non-negative. The above quantity is called the discriminant of the quadratic formula. When you test your program with other values for A , B , and C , make sure the discriminant is not negative (a negative discriminant indicates complex roots, which is beyond the scope of this assignment).

When you are finished with your assignment, your well-commented program source files can be emailed to bleasing@msoe.edu, along with a written report that discusses how you went about meeting the objectives of the assignment. The report serves as ‘external documentation’ for your work (which is done by the program itself). The report can be in Word .doc format or Acrobat .pdf format (or .txt format, as a last resort). The report should discuss your design used to solve the problem and show how you tested your work to be sure that it is correct.

Development Strategy: Don't try to do the whole program at once; that's too difficult and will just waste time and lead to much frustration. Rather, do the work in "stages" or "phases of development".

Phase 1

In the first stage, simply "hard-code" the values 1, -8, and 15 into the formula above and output the two roots to the console. Once this is working to your satisfaction, add input capabilities to your program by prompting the user to enter values for A, B, and C; store these inputs into variables; and compute and output the new roots to the user's quadratic equation. This can lead to problems, since the discriminant (see above) must be non-negative for the answers to be correct (i.e. non-complex roots). Don't worry about complex roots for now; we'll take care of this in the third phase shortly.

Phase 2

For the second phase, just have some test cases that you've worked out beforehand that you know are correct and test those inputs on your program. You should get the correct answers as output from your program. These are called "test cases" and you should include the test case description, the expected output, and the actual output from your program in your written report.

Phase 3

In the third phase of development that takes care of the problem of the negative discriminant. Add an 'if' statement to your program that only computes the roots if the discriminant is non-negative (simply output an error message if the values for A, B, and C yield a negative discriminant). Once this logic is added to your program, test it to be certain that it always gives accurate answers.

Phase 4

If you're able to get the required three elements of the assignment working, then try to add a loop that lets the user solve several quadratic equations in one session. Also you might try representing complex numbers in your Java program.