

day11 quadratic formula

Due: Wednesday 9/13/23

Your job today is to write a program that implements the quadratic formula. If you have already learned this in math class, awesome. If you haven't yet, this Python program will help you when you do get there; it solves any quadratic equation.

Here is the formula:

$$\text{For any quadratic equation } ax^2 + bx + c = 0, \text{ the solutions can be found using: } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The quadratic formula can be a bit tricky to type out in Python. To save you time and struggle, here are the calculations (Copy and paste them into your program if you want to save time.)

```
d = b**2-4*a*c
x1=(-b+d**.5)/(2*a)
x2=(-b-d**.5)/(2*a)
```

x1 and x2 are the two solutions. These lines give you the two answers of any quadratic equation if you put the correct numbers into a, b, and c.

The $d = b^2 - 4ac$ part is called the "discriminant". It tells us how many of what type of solutions the equation has, depending upon if it's positive, negative or zero.

You will check if d is **positive**. If it is, the equation has two solutions. If d is **negative**, it has no real solutions, and if d is **equal to zero**, the equation has one solution that repeats twice. You'll check this with an if/elif/else statement.

Another way to say this same information is here:

- For some equations the answers x1 and x2 will be the same. That happens when $b^2 - 4ac$ is equal to 0.
- For some equations the answers are different. This happens when $b^2 - 4ac$ is a positive number.
- Some equations have what are called complex solutions. These aren't regular "real" numbers. You learn about these in Math 3, but don't worry about understanding them if you haven't worked with them. If $b^2 - 4ac$ is a negative number we're going to say there are "no real solutions."

The details of today's assignment are on the next page.

Today's assignment is to make your program do the following:

- Make a new repl, name it "Day11 quadratic".
- Put a comment at the top of your program with your name and the date.
- Welcome the user and say what is going to happen (that is, that we're solving quadratic equations.)
- Start a while True: loop
- Ask the user for integer inputs a, b, and c
- Add this line: $d = b^2 - 4 * a * c$
- Add these lines:
 $x1 = (-b + d^{.5}) / (2 * a)$
 $x2 = (-b - d^{.5}) / (2 * a)$
Make sure they are both tabbed in at the same level in your while True: loop
- Use an "if/elif/else" statement to check if d is zero, positive, or negative, then do the following:
 - If d is zero say there is one repeated solution and give the single solution **once** (you can print x1 or x2 for this, as they are the same in this situation.)
 - If d is positive say there are two solutions, then print both x1 and x2.
 - If d is negative say that there are no real solutions and do NOT print any solutions out. If you see answers printing out that have a j in them (like 2+3j) then d is negative and you should not be printing the solutions. The j means the answer is complex. I'm asking you to not print complex answers in today's program
- Finally, ask the user if they would like to do another, then repeat if they do.

Use the bullet list above to make sure you have completed everything I have asked you to do. Spelling, neatness, and accuracy count on this program.

When you think you are finished, check your program by running the four equations below. These equations will help you verify that your program is working properly. You have to run all four tests to be sure you did the program correctly:

$$2x^2 - 5x - 3 = 0 \quad a = 2, b = -5, c = -3 \text{ should give you } 3.0 \text{ and } -0.5$$

$$x^2 + 3x + 1 = 0 \quad a = 1, b = 3, c = 1 \text{ should give you } -0.3819660112501051 \text{ and } -2.618033988749895$$

$$x^2 + 4x + 4 = 0 \quad a = 1, b = 4, c = 4 \text{ should give you } -2.0 \text{ as a single repeated solution}$$

$$x^2 + 3x + 20 = 0 \quad a = 1, b = 3, c = 20 \text{ should say no real solutions}$$

Run these tests, or comparable ones, and then copy the output from the console by highlighting the output and then right clicking on it and choosing Copy (Control-C does not work).

Go to repl and scroll to the end of your program. After the last line of your program type a few blank lines, then put in three quotes "", then one more blank line, then paste the output from your sample run, then add a new blank line and put in three more quotes. Python treats that entire block as a comment now.

To get full credit on this assignment you must not only code it, but test it and include the output of your tests, showing that it all works, at the bottom as instructed here. If you have questions please check with me.

If you finish early, please continue adding things, per notes on the next page.

Additions:

1. Add a line that reports the axis of symmetry. This is the center of the graph if you graph the parabola defined by the equation. You can find that using this formula:

$$\text{axis} = -b / (2 * a)$$

Print out the axis of symmetry like this:

$$\text{Axis of symmetry: } x = 2$$

2. Find and print the vertex of the parabola. The vertex is a point (x , y) where x is the axis of symmetry value (the variable axis from the previous item) and y is the result you get when you plug axis in for x in the main equation:

$$y = a * x * x + b * x + c$$

Print out the vertex like this:

$$\text{Vertex: } (4 , 6)$$

3. Add an if/else statement to report either the maximum value of the equation or the minimum value of the equation. The maximum value is the y value from the previous item if the a variable is negative. The minimum value is the y value from the previous item if the a variable is positive. You can just do a check to see if a is < 0, and if it is, report the maximum value like this:

Maximum value: 6

And then do an else and report the y value as the minimum.

Here are some graphs of parabolas to show you what I'm talking about.

