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Design Document: Quadratic Equation Solver

Intro to Problem: The quadratic equation uses the coefficients of a quadratic equation to find the roots of that equation. It is usually used when other methods of finding the roots are not applicable due to format.

The general form is: ($[-b \pm \sqrt{b^2 - 4ac}]$) / 2a , where the quadratic equation follows the format: ax^2 + bx + c .

Variables and Inputs: From this, we can see that a, b, and c must be variables needed in the program. They will also need to be user-input, as they change with every equation.

- a: Variable, requires user input
- b: Variable, requires user input
- c: Variable, requires user input

Necessary Equations:

- Quadratic Formula: required equation, listed above. Used to determine the 2 roots of a quadratic equation by coefficients.
- Linear Formula: required equation, “ x = -c / b “. Used to determine the single root of a linear equation.
- Determinant: required equation, “ b^2 – 4ac “. Used to determine if roots of equation are real or imaginary.

Possible Outputs:

- 2 Roots of input equation: This will be the most common output. Most frequently, this will be two real numbers. There will also be times where the roots are presented in Cartesian form (a + bi), where a is a real number and b is a coefficient for I, indicating an imaginary/complex root. Both roots are either real or imaginary, there cannot be one of each.
- 1 Root of input equation: If the input equation is linear, only one root need be output.

Possible Issues:

- Invalid Equations: Equations of higher power will not function properly, as the program would not have the proper format to solve them. The program needs to have a measure preventing the user from continuing with an equation of higher power than two before any calculation begins.
- Linear Equations: For linear equations, the format would be 0ax^2 + bx + c. As a is in the denominator of the equation, it cannot be zero if the equation is to function properly. However, due to the requirements, it must still be solved, so any equations found to be linear (if a = 0) will need to be routed to a different equation as to not create a division by 0 error. For a linear equation of the format (0ax^2) + bx + c = 0, we can solve for x by converting it into the form: x = -c / b.
- Equations with imaginary roots: As would be expected, problems would arise with complex roots, as Cartesian notation would not be compatible with the output or solving methods of the main equation. For this, there would be a check on the discriminant to determine if the roots are imaginary so that we can format the results properly with a modified codeblock. We can use the fact that, if the discriminant comes out to a negative value then the roots are imaginary, to direct the calculations to the proper section. If implemented properly, there would be no issue if either part of the root, real or imaginary, was negative.