# Title: Scientific Fraculator with Extended Functionality and Expression Simplification

## Overview:

The Fraculator Extended is a Python-based application that provides an extensive set of mathematical and scientific operations, including advanced expression simplification options, Gamma function, fraction-to-decimal and decimal-to-fraction conversions. The calculator supports basic arithmetic operations, trigonometric functions, logarithmic functions, complex numbers, advanced functions, calculus operations such as differentiation and integration, and system of equations solver. The user interface is designed with Tkinter and includes a large display for input and output, as well as various buttons for user interaction.

## Features:

1. Basic arithmetic operations (addition, subtraction, multiplication, division, and exponentiation)

2. Trigonometric functions (sin, cos, tan, and their inverses)

3. Logarithmic functions (natural logarithm and base-10 logarithm)

4. Complex number operations

5. Advanced functions (square root, cube root, factorial)

6. Fractions support

7. Solution of systems of linear equations

8. Differentiation and integration

9. Expression simplification in multiple ways (simplify 1, simplify 2, simplify 3, combinatorial simplify, trigonometric simplify, and expand)

10. Gamma function

11. Fraction-to-decimal and decimal-to-fraction conversions

12. User-friendly interface with large input and output display

13. Customizable variable inputs for x, y, and z

## Implementation Details:

The program is built using Python and Tkinter for the graphical user interface. The application consists of the main window containing the display and buttons, as well as several custom functions to handle mathematical operations.

### 1. Basic Arithmetic Operations:

The calculator supports basic arithmetic operations such as addition, subtraction, multiplication, division, and exponentiation. These operations are implemented using standard Python arithmetic operators.

### 2. Trigonometric Functions:

The calculator includes functions to compute the sine, cosine, tangent, and their inverses using the math library.

### 3. Logarithmic Functions:

The natural logarithm (base e) and base-10 logarithm functions are supported using the math library.

### 4. Complex Number Operations:

The calculator can perform operations on complex numbers, such as addition, subtraction, multiplication, division, and exponentiation. Complex numbers are represented using the ‘i’ or 'j' notation.

### 5. Advanced Functions:

The square root, cube root, and factorial functions are implemented using the math library.

### 6. Fractions Support:

The calculator supports the input and display of fractions using custom functions to format the fractions appropriately.

### 7. Solution of Systems of Linear Equations:

The calculator includes a system of equations solver that uses NumPy's linear algebra module to find the solutions of systems of linear equations.

### 8. Differentiation and Integration:

The calculator supports symbolic differentiation and integration using the SymPy library. Users can input functions and variables, and the calculator will compute the derivatives and integrals symbolically.

### 9. Expression Simplification:

The calculator provides multiple options for expression simplification using the SymPy library, including general simplification, combinatorial simplification, trigonometric simplification, and expansion. Users can select the desired simplification option to obtain the most suitable result for their needs.

### 10. Gamma Function:

The calculator includes the Gamma function, a generalization of the factorial function for non-integer values, using the math library.

### 11. Fraction-to-decimal and Decimal-to-fraction Conversions:

The calculator allows users to convert fractions to decimal numbers and vice versa using custom functions, making it easier to work with different number representations.

### 12. User-friendly Interface:

The user interface is designed using Tkinter and includes a large input and output display area, as well as buttons for various mathematical operations and functions.

### 13. Customizable Variable Inputs:

The calculator allows users to input custom values for x, y, and z, which can then be used in calculations.

### 14. Non-linear equations and systems of equations:

The calculator has the capability to solve non-linear equations and systems of non-linear equations, providing solutions to complex mathematical problems.

## Conclusion:

The Advanced Scientific Calculator with Extended Functionality and Expression Simplification is a powerful and versatile calculator application that provides a comprehensive set of mathematical and scientific functions, including advanced expression simplification options, Gamma function, fraction-to-decimal and decimal-to-fraction conversions, calculus operations, and system of equations solver. Its user-friendly interface and customizable variable inputs make it an excellent tool for solving complex problems and exploring mathematical concepts in-depth.