USER MANUAL - FINAL PROJECT

Numerical Analysis

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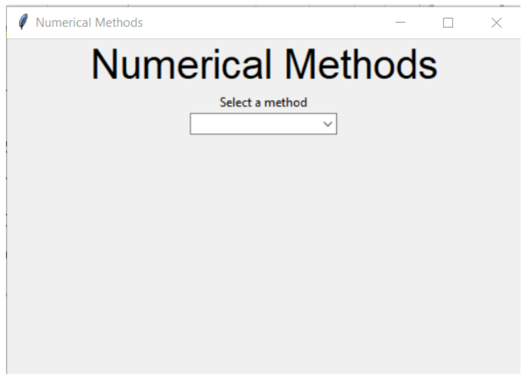
Contenido

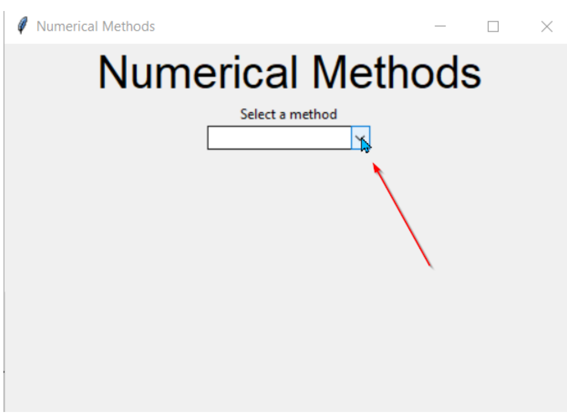
INTRODUCTION

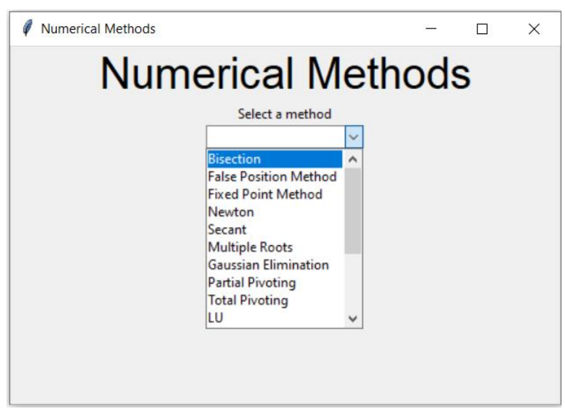
This user manual shows how to manage the graphical interface depending on the selected numerical method, it specifies what the user must enter for each of the methods and how to do it in order to reach the expected result. It shows the parameters to enter and the way in which to do it, such as how to write the functions or matrices in each specific case, the objective of this manual is to make the use of our application easier and more efficient.

1) Main view of the program.



Selecting a specific method:





METHODS

SINGLE-VARIABLE EQUATIONS

GENERAL CONSIDERATIONS

All methods in single-variable equations must follow the following considerations:

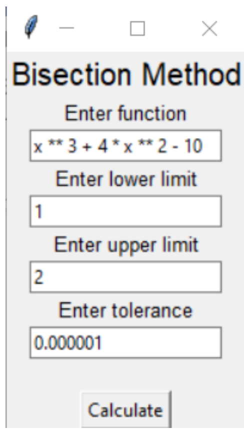
- The user can only enter the variable ‘x’ in the function. No other variable is allowed (a, z, g, etc.).
- If the user wants to enter an **exponential function**, he/she must use the following format:
  np.exp(expression here)
  Example of valid exponential function: *np.exp(-x) + 2*
- Π (PI) must be enter as: *np.pi*
- **Natural logarithm** must be enter as: np.log(expression here)
- Tolerances entered must be between: [0.1 , 0.0000000000000000000000 ... 1]
- Use period (“. “) for decimal numbers
- If it is required to make use of a power within the function to be evaluated, use “**”.
  Example: x**2 for the power x^2

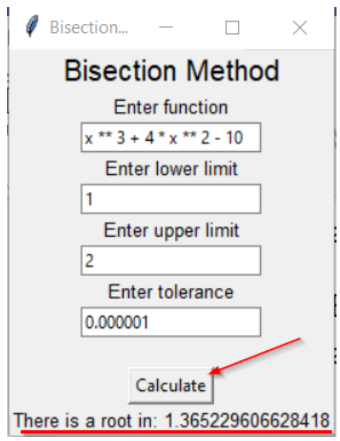
BISECTION

For this method, the user must enter as parameters:

- The function
- The limits of the interval (lower and upper) where the user wants to evaluate the function
- The tolerance.

Example: We want to know if a root exists within the function $x^3 + 4x^2 - 10$, between [1,2] with a tolerance of 0.000001





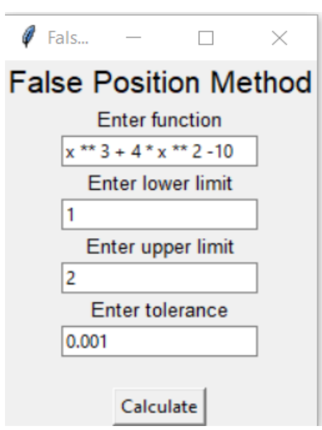
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

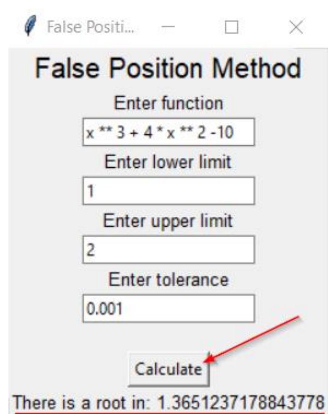
FALSE POSITION

For this method, the user must enter as parameters:

- The function
- The limits of the interval (lower and upper) where the user wants to evaluate the function
- The tolerance.

Example: We want to know if a root exists within the function $x^3 + 4x^2 - 10$, between [1,2] with a tolerance of 0.000001





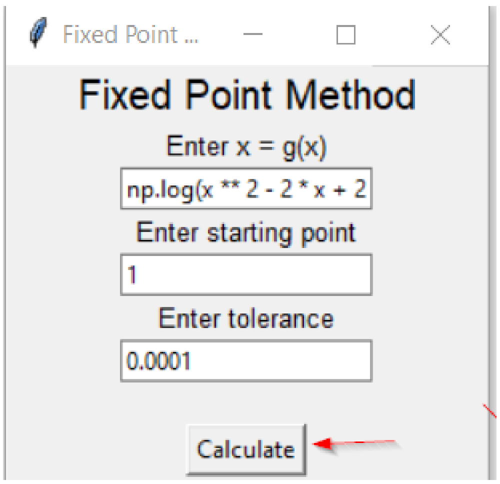
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

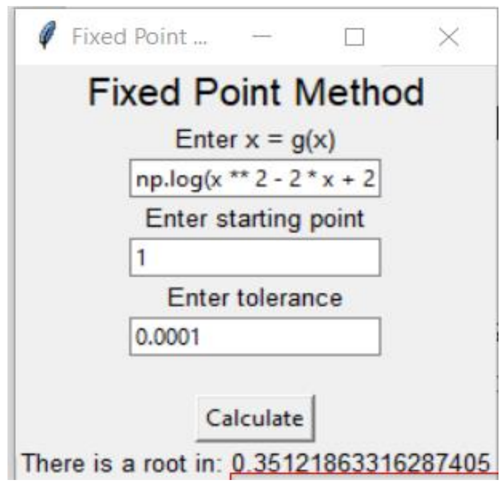
FIXED-POINT ITERATION

For this method, the user must enter as parameters:

- x = g(x)
- The starting point: Random number
- The tolerance

Example: We want to know if a root exists within the function $\ln(x^2 - 2x + 2)$ between [1,2] with a tolerance of 0.000001



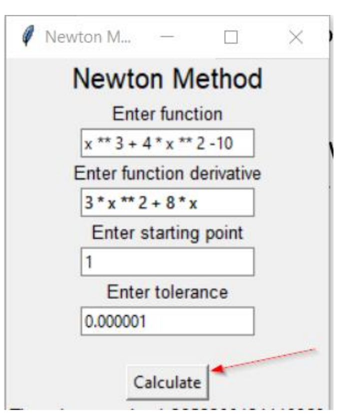


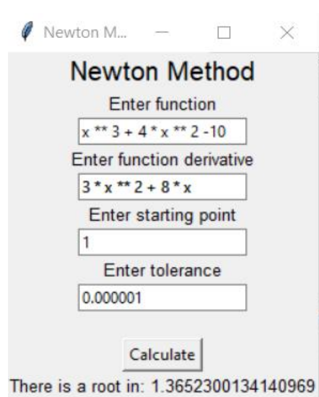
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

NEWTON

For this method, the user must enter as parameters:

- The function
- Function derivative
- Starting point
- The tolerance



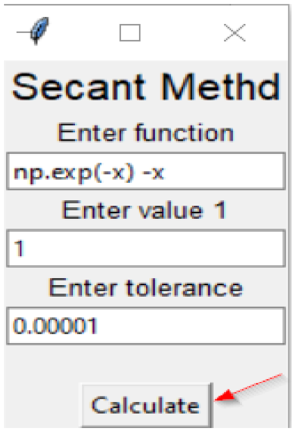


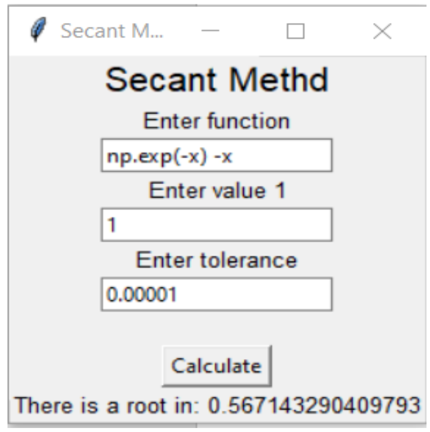
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

SECANT

For this method, the user must enter as parameters:

- The function
- Value 1
- Tolerance





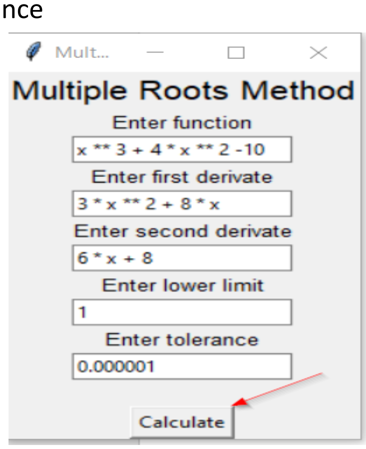
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

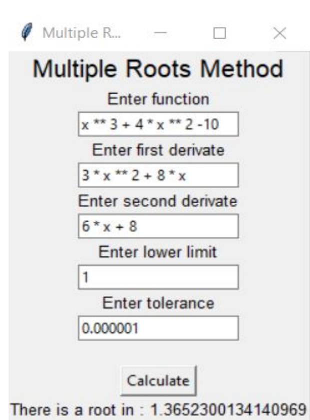
Note: The original method receives two values, but in our implementation only the first one is entered. The second value is calculated by adding the first value plus 4 times the tolerance.

MULTIPLE ROOTS

For this method, the user must enter as parameters:

- The function
- First function derivate
- Second function derivate
- Lower limit
- Tolerance





As you saw before, after clicking the button "Calculate", if all the values are correct, the output is show.

EQUATION SYSTEMS

GENERAL CONSIDERATIONS

All methods of equation systems must follow the following considerations:

For Partial Pivoting, Jacobi and Gauss-Seidel Method:

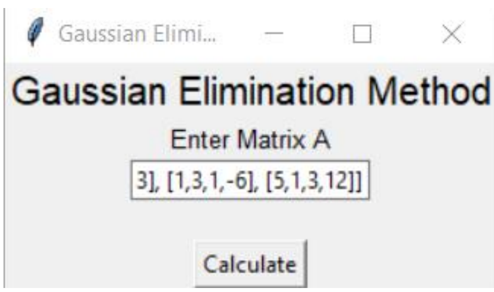
- Same consideration as Gaussian Elimination Method

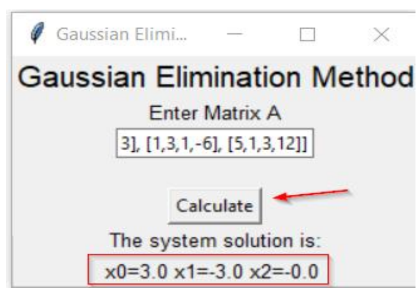
GAUSSIAN ELIMINATION

- In this method the diagonal cannot contain zeros (0) (Just in this method)
- The matrix is delimited by brackets [ ].
- Rows format is: [# . , # . , # .] inside of the matrix brackets.
  - Example of 1 row: [[1., 2., 3.]]
  - Example of 2 rows: [[1., 2., 3.] , [4. , 5. , 6.]]

For this method, the user must enter as parameters:

- The matrix A: The matrix must be Ab matrix. (Matrix and coefficients)
  Example here: [[3, 2, 3, 3], [1, 3, 1, -6], [5, 1, 3, 12]]



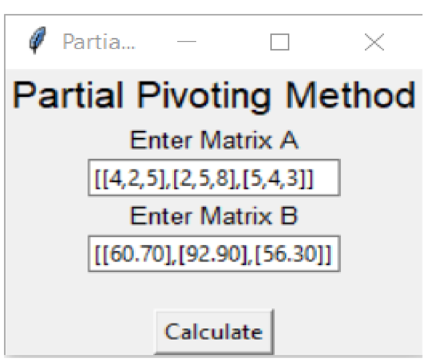


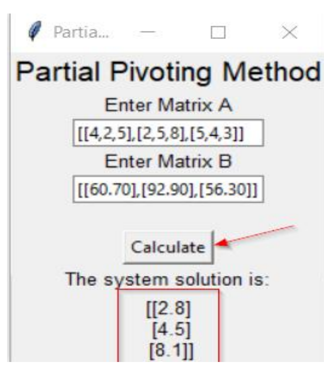
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

PARTIAL PIVOTING

For this method, the user must enter as parameters:

- Matrix A: Square Matrix
- Matrix B: Coefficient matrix





As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

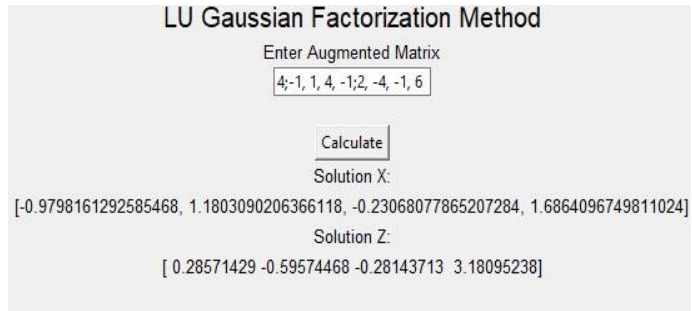
LU FACTORIZATION

For this method, the user must enter as parameters:

- Augmented matrix: The system's augmented matrix includes the independent terms, use commas to separate rows and semicolons to separate columns.
  Example: If you want to enter this matrix augmented,

$$\begin{pmatrix} 7 & 3 & -1 & 2 \\ 3 & 8 & 1 & -4 \\ -1 & 1 & 4 & -1 \\ 2 & -4 & -1 & 6 \end{pmatrix}$$

it must be entered like this 7,3,-1,2;3,8,1,-4;-1,1,4,-1;2,-4,-1,6

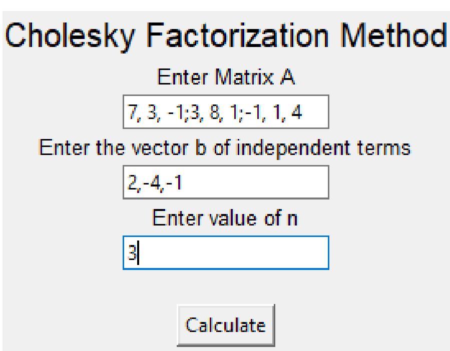


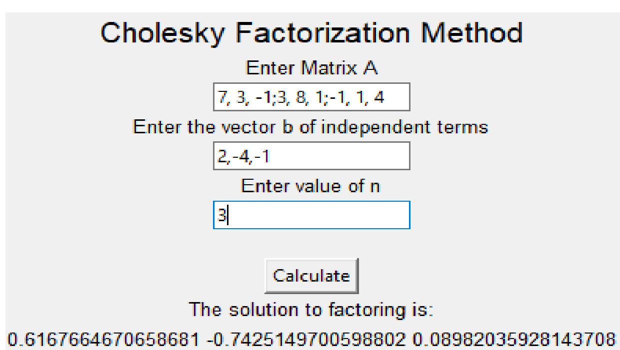
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

CHOLESKY

For this method, the user must enter as parameters:

- Matrix A: Square Matrix
- Matrix B: Coefficient matrix
- Value of n: Size of the square matrix
  Note: Use commas to separate rows and semicolons to separate columns.





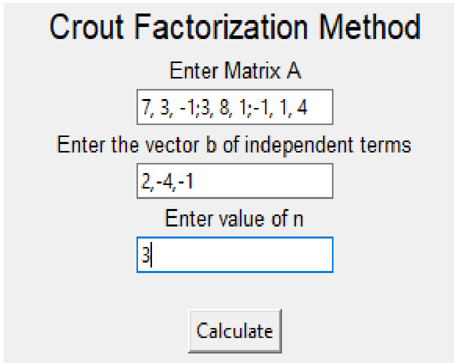
As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

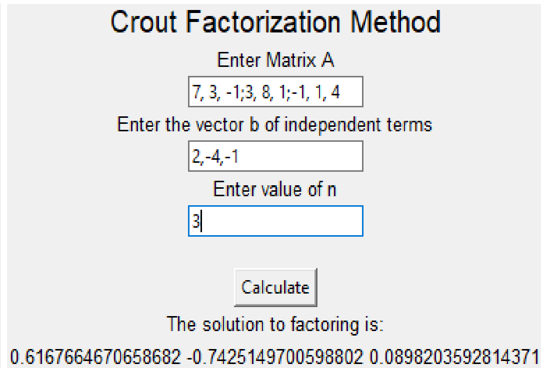
CROUT

For this method, the user must enter as parameters:

- Matrix A: Square Matrix
- Matrix B: Coefficient matrix
- Value of n: Size of the square matrix

  Note: Use commas to separate rows and semicolons to separate columns.





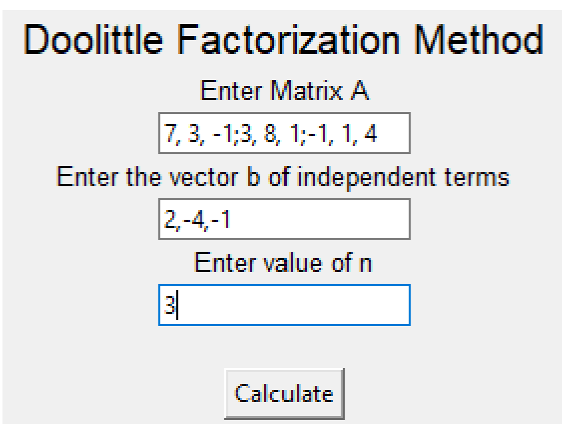
As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown.

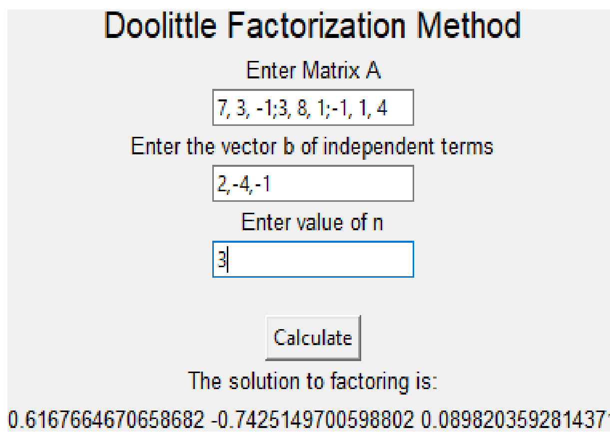
DOOLITTLE

For this method, the user must enter as parameters:

- Matrix A: Square Matrix
- Matrix B: Coefficient matrix
- Value of n: Size of the square matrix

  Note: Use commas to separate rows and semicolons to separate columns.



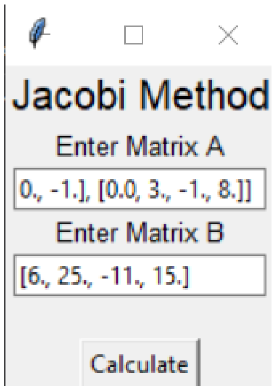


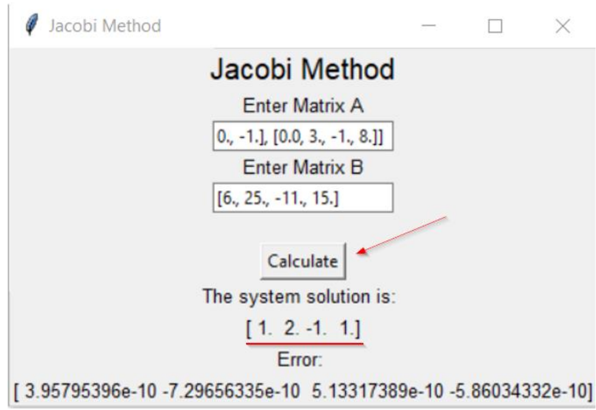
As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown.

JACOBI

For this method, the user must enter as parameters:

- Matrix A: Square Matrix
- Matrix B: Coefficient Matrix



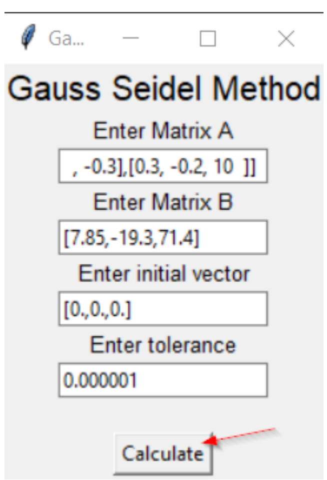


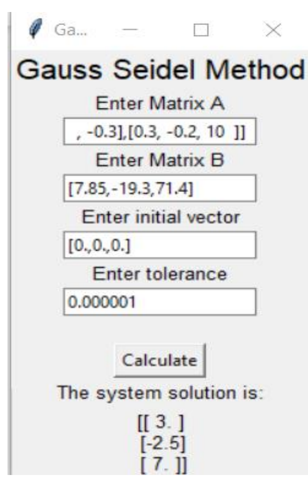
As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown.

GAUSS-SEIDEL

For this method, the user must enter as parameters:

- Matrix A: square matrix
- Matrix B: Coefficient matrix
- Initial vector: Whatever number
- The tolerance





As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown.

INTERPOLATION

GENERAL CONSIDERATIONS

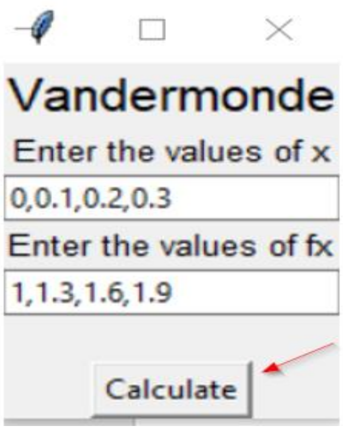
All methods of equation systems must follow the following considerations:

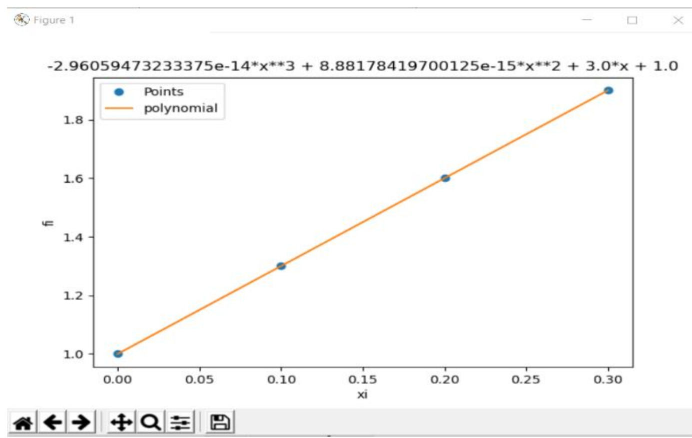
- Use period (“. “) for decimal numbers
- The values of *x* and *fx* must be entered separated by commas

VANDERMONDE

For this method, the user must enter as parameters:

- Values of x:
- Values of fx:



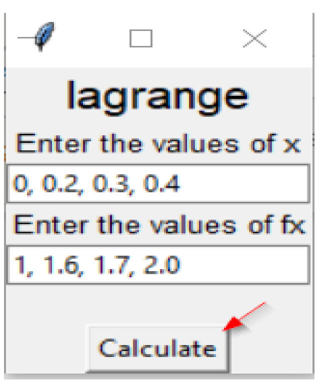


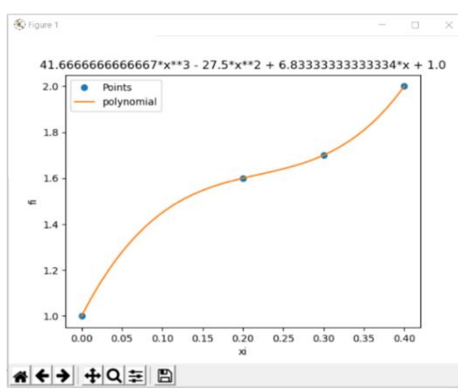
As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown. (Graphic output)

LAGRANGE

For this method, the user must enter as parameters:

- Values of x:
- Values of fx:



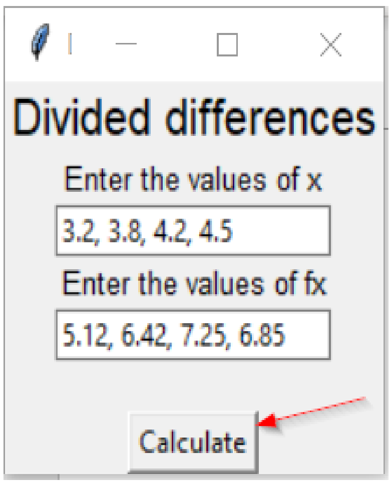


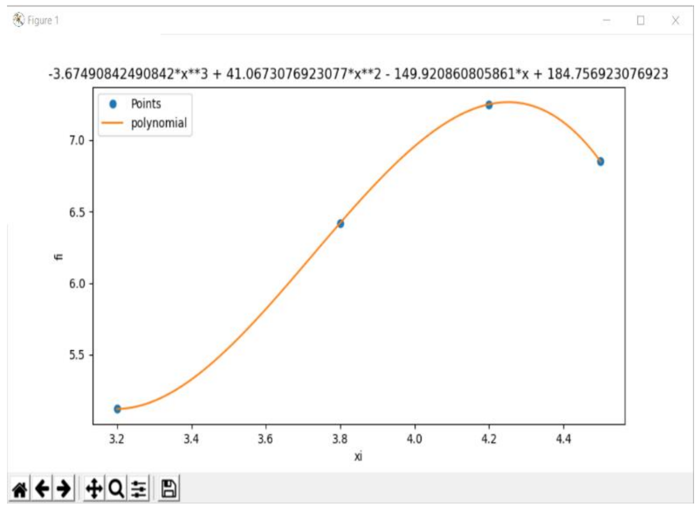
As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown. (Graphic output)

DIVIDED DIFFERENCES (NEWTON)

For this method, the user must enter as parameters:

- Values of x:
- Values of fx:





As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.

EXTRAS

GENERAL CONSIDERATIONS

All methods in extras must follow the following considerations:

- The user can only enter the variable 'x' in the function. No other variable is allowed (a, z, g, etc.).
- If the user wants to enter an **exponential function**, he/she must use the following format:

  np.exp(expression here)

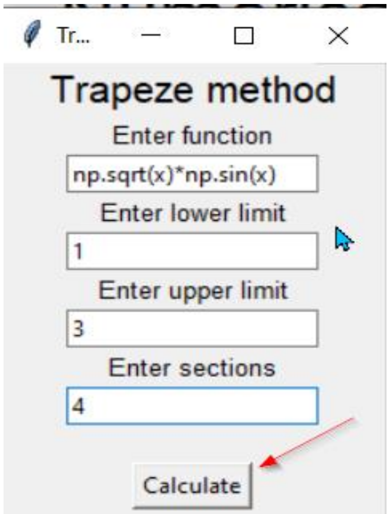
  Example of valid exponential function: *np.exp(-x) + 2*
- Π (PI) must be enter as: *np.pi*
- **Natural logarithm** must be enter as: np.log(expression here)
- Tolerances entered must be between: [0.1 , 0.0000000000000000000000 ... 1]
- Use period (". ") for decimal numbers
- If it is required to make use of a power within the function to be evaluated, use "**".

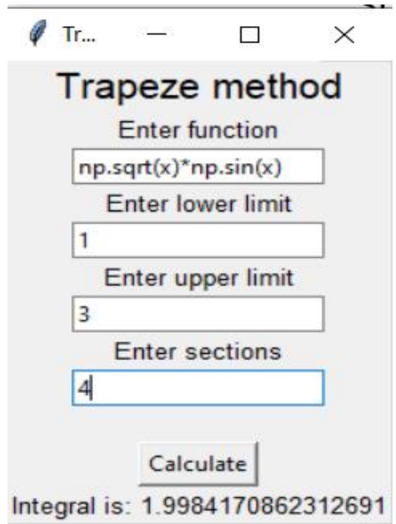
  Example: x**2 for the power x^2

TRAPEZOIDAL RULE

For this method, the user must enter as parameters:

- The function
- Lower and upper limit
- Sections



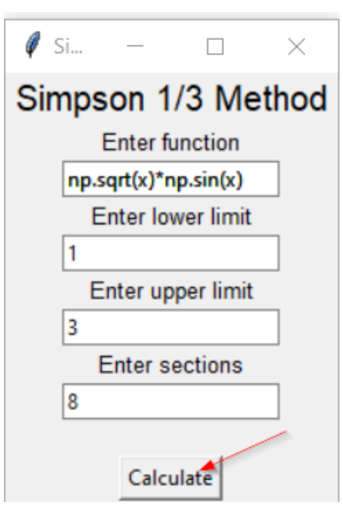


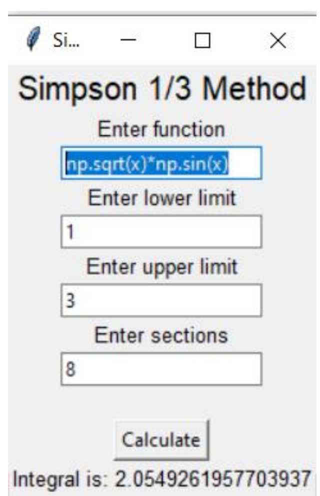
As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown.

SIMPSON 1/3

For this method, the user must enter as parameters:

- The function
- Lower and upper limit
- Sections: Must be pair



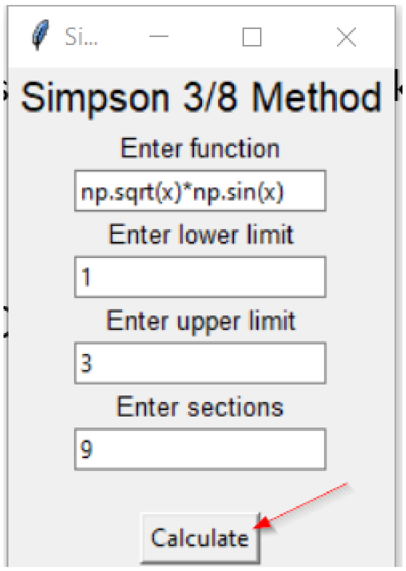


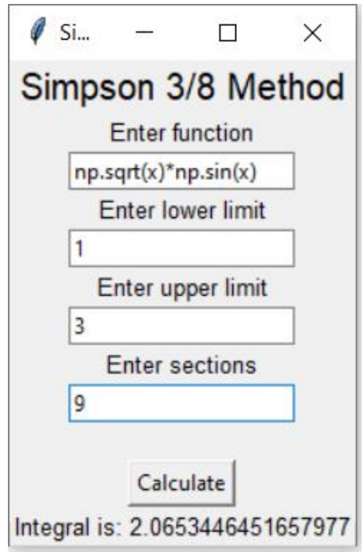
As you saw before, after clicking the button “Calculate”, if all the values are correct, the output is shown.

SIMPSON 3/8

For this method, the user must enter as parameters:

- The function
- Lower and upper limit
- Sections: Must be an odd number multiple of 3





As you saw before, after clicking the button "Calculate", if all the values are correct, the output is shown.