Assignment 1 - Part 1

Objective:

The aim of this assignment is to compare and analyze the behavior of the different numerical methods studied in class: Bisection, False-position, Fixed point, Newton-Raphson, Secant and Bierge-Vieta.

Description:

You are required to implement a root finder program which takes the following as input: -
1- The equation as free text.
2- The technique to use as a drop down list or buttons.
3- Its required parameters (e.g. interval for the bisection method).
** Also, you should implement a general algorithm that takes as an input the equation to solve and outputs its roots (You must indicate: why you chose this algorithm and compare it with one of the above methods).

Specification:

- The program must contain the following features: -

1- An interactive GUI that enables the user to enter equations containing different functions such as: {poly, exp, cos, sin…}.
2- Reading from files must be available (all the inputs are available in the same file).
3- Differentiation and Parsing is your task (you are encourage to use MATLAB built-in functions).
4- A way to choose a method to solve the given equation (Preferably a drop down list or buttons), also a way to choose to use all the methods and provide text boxes to enter the parameters for each method.
5- A plot of the function with the boundary functions in case of bisection and false position, $g(x)$ with $y = x$ in case of fixed point, $f'(x)$ in the remaining cases (see the lectures slides).
6- A way to enter the precision and the max number of iterations otherwise default values are used,
   Default Max Iterations = 50, Default Epsilon = 0.00001;
7- The answer for the chosen method indicating the number of iterations, execution time, all iterations, approximate root, and precision.
8- You need to output the above results in a file, preferably in a tabular format.
9- Compute the theoretical bound of the error for the methods using the formulas in the lectures.
10- In the case of using all the methods, you need to plot the following curves: -
   i. Curve between the number of iterations and the theoretical error bound for all the methods in the same graph.
   ii. Curve between the number of iterations and the obtained root value at this iteration for all the methods in the same graph.

- The final report should contain: -

1- Flowchart or pseudo-code for each method and the general algorithm.

2- Explain your general algorithm and the reason behind your decisions along with the data structures used.

3- Analysis for the behavior of different examples using the analysis template, and your conclusion about the behavior of each method (at least three examples).

4- Problematic functions and the reason for their misbehavior and your suggestions (if exists).

5- Sample runs and snapshots from your GUI.

Bonus:

- Single step mode simulation showing the iterations on the drawn function for one method of choice.

Assignment 1 - Part 2

Objective:

The aim of this assignment is to compare and analyze the behavior of numerical methods studied in class: Gaussian-elimination, LU decomposition, Gaussian-Jordan and Gauss-Seidel.

Description:

You are required to implement a program for solving systems of linear equations, which takes as an input *the equations*, *the technique to use* and *its required parameters*.

Specification:

- The program must contain the following features: -

1- An interactive GUI that enables the user to enter a set of linear equations.
2- Reading from files must be available as well (all the inputs are available in the same file).
3- A way to choose a method to solve the given equation (Preferably a drop down list or buttons), also a way to choose to use all the methods and provide text boxes to enter the parameters for each method.
4- A way to enter the precision and the max number of iterations otherwise default values are used,
    Default Max Iterations = 50, Default Epsilon = 0.00001;
5- The answer for the chosen method indicating the number of iterations, execution time, all iterations' approximate root and precision.
6- You need to output the above results in a file preferably in a tabular format.
7- In the case of using all the methods, you need to plot the following curve for every variable separately: -
    i. Curve between the number of iterations and the obtained root value at this iteration for all the methods in the same graph.

- The final report should contain: -

1- Flowchart or pseudo-code for each method and the general algorithm.
2- Explain your general algorithm and the reason behind your decisions along with the data structures used.
3- Analysis for the behavior of different examples using the analysis template, and your conclusion about the behavior of each method (at least three examples).
4- Problematic functions and the reason for their misbehavior and your suggestions (if exists).
5- Sample runs and snapshots from your GUI.

Deliverables:

- You should work in groups of **5** at maximum.
- Deadline for the assignment is **11th May 2017 @11:59 pm**.
- Submit your work by sending an e-mail to: omar.salaheldine@gmail.com

  with the subject: [**Numerical Assignment**].

  Make sure to include your full names and IDs in the mail body.
- Any detected copies will be severely penalized (**Negative Marks**).