MAT224: Project

- **Project due date: April 15**
- **Work in groups of 6 maximum.**
- **Only Octave (or MATLAB) is allowed.**
- **Submit the files (programming files and a file containing the figures with your comments) electronically via Moodle all in one zipped file. Note that your programme will be checked and executed.**
- **The name of the submitted file has to contain a name and ID of one of the group members**
- **Names of group members have to appear within the programming files**
- **No name will be added after submission**

Part I: Finds Roots using bisection and Newton methods.

The goal of this work is to estimate the values of π and e with a high accuracy by solving

$$\sin(x) = 0 \quad \text{and} \quad \ln(x) = 1$$

1. Write a program for the bisection method. Compute successive estimates till the error as a tolerance in function (ETF) is smaller than 10^{-6}. Print in a file, the final iteration number, the numerical solution and the corresponding error.

    (1**pts**)

2. Write a program for the Newton's method. Starting from the initial guesses used for the bisection method, compute successive estimates till the error ETF is smaller than 10^{-6}. Print in a file, the final iteration number, the numerical solution and the corresponding error.   (**2pt**)

3. Plot the curves of solutions (in one figure) for both Newton and Bisection.
    (**1pt**)

4. Plot the curves of errors for both Newton and Bisection. Compare the two methods in terms of speed and accuracy.   (**1pt**)

Put all your results in word file and comment them.

Part II: Lorenz attractor

The goal of this part is to capture the Lorenz attractor.

Consider the Laurence 3D dynamical system

$$\begin{cases} \dfrac{dx(t)}{dt} = \sigma\big(y(t) - x(t)\big) \\ \dfrac{dy(t)}{dt} = x(t)\big(\rho - z(t)\big) - y(t) \\ \dfrac{dz(t)}{dt} = x(t)y(t) - \beta z(t) \end{cases}$$

Where σ, ρ, β are parameters

1. Write a program to solve the system using the Euler explicit method. **(2pts)**
2. Make simulations for different values of σ, ρ, β and different initial values. Graph the 3D trajectories showing the Lorenz attractor and the chaotic character of the system. **(2pts)**
3. Put all results in the same file used for Part I, with comments. **(1pts)**

What to submit:

1. The bisection and Newton and Lorenz codes (with group names inside)
2. The asci file containing the final results (iteration, solution, error)
3. Word file containing
   a. Plotted graphs of Bisection and Newton solutions (in one figure) and ETF curves (in one figure) + comments.
   b. Plotted graphs for Lorenz systems solutions (for different initial values and for different parameters σ, ρ, β. Comments.

- **Use the provided word template.**
- **Put all files in a single directory and submit is as a single zipped file (use standard tool for zipping). Name the zipped file by: nameID (use the name of one of the group)**
- **Don't copy programs from internet, I need to see your work.**

Note: Marks will be deducted for uncommented and non-running codes (codes with bugs) (programs), and non-respect of submission requirements.