**Deadlines:**

For all Groups: May 15 2024

**Grading system:**

For every problem you solve you get a score. Your score is your mark for this laboratory.

- 1 problem – 3p

- 2 problem – 3p

- 3 problem – 3p

- 4 problem – 0.5p

- 5 problem – 0.5p

**Introduction:**

Welcome to the first numerical methods lab. Here you will learn some interesting things. The exercises will be solved using Python, Julia, MATLAB or Octave. I have listened to your wishes on how the lab should be so it is built from two parts. The first part is from problem 1-3 and it's pretty easy, maybe only problem 3 is more difficult but it's easy overall it's kind of like homework for these exercises if you do it you get a 9. Problem 4 and 5 are harder and this is for those who know programming well or want to know more and so if you solve these problems too you can get a grade 10.

**1. Bisection method**

Use the bisection method to find a root of the equation ex-x2=0 accurate to 8 decimal places on the interval [-2, 0].

**Restrictions:**

You don't have to use any libraries for this exercise. Exceptions are Numpy and Math libraries

**2. Muller’s method**

Use Muller's method to find a root of the equation x3+2x2+10x-20 = 0  accurate to 8 decimal places, starting with the initial guesses x0 = 0, x1 = 1, and x2 = 2.

**Restrictions:**

You don't have to use any libraries for this exercise. Exceptions are Numpy and Math libraries

**3. Nonlinear equations**

A research team is investigating the behaviour of a nonlinear system. They have formulated a system of nonlinear equations that describe the behaviour of the system. They want to find the roots of the system of equations to better understand the behaviour of the system. Write a program that implements the Newton-Raphson method to find the roots of the system of nonlinear equations. The program should take as input the initial guess, the system of equations, and the desired tolerance. The output should be the roots of the system of equations with an accuracy of at least the specified tolerance value.

**Restrictions:**

You don't have to use any libraries for this exercise. Exceptions are Numpy and Math libraries

**4. Improving algorithm**

You are working for a social media company that is trying to improve its recommendation algorithm. The algorithm involves solving a nonlinear equation of the form f(x) = 0, where f(x) is a function that depends on the user's preferences and other factors. You decide to use the secant method to find the root of the equation because it is faster than the bisection method. However, you realise that the secant method may not always converge to the correct root, especially for certain types of functions. Your task is to implement a modified version of the secant method that is more robust and can handle different types of input data. You decide to use a hybrid approach that combines the secant method with the bisection method. Write a program that implements the hybrid secant-bisection method for finding the root of the nonlinear equation. Your program should be able to handle different types of input data.

**Restrictions:**

You don't have to use any libraries for this exercise. Exceptions are Numpy and Math libraries

**5. Editing images**

UTM creates its own application for image editing. You are working on this graphics project, your part in this project involves rotating and scaling images. Develop a program that can perform affine transformations on images using matrices. Use the NumPy library to implement matrix operations. Write test cases for your program to ensure its accuracy.

**Restrictions:**

You don't have to use any libraries for this exercise. Exceptions are Numpy and Math libraries