Universidad Ana G. Mendez –Recinto de Gurabo
Department of Engineering
Electrical and Computer Engineering Programs
Numerical Methods with Programming
COMP 411

Project I

Due: Monday, October 30, 2023, at 11:59PM

Source Code

Problem 1: Write a MATLAB program that implements all the nonlinear equations root finding algorithms we discussed in class. The program should display a menu with a list of methods names in addition to an exit option. Once an option is selected, a function of the specified algorithm should be invoked. Each algorithm should ask for its necessary inputs. Remember that Muller, Bairstow and roots only works with polynomials.

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1. Bisection
2. False Position
3. Fixed-Point iteration
4. Newton
5. Secant
6. Modified Secant
7. MATLAB fzero
8. Muller
9. MATLAB roots
10. Exit

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Application Problems

Problem 2:

Aerospace engineers sometimes compute the trajectories of projectiles such as rockets. A related problem deals with the trajectory of a thrown ball. The trajectory of a ball thrown by a right fielder is defined by the (x, y) coordinates as displayed in Fig. 1. The trajectory can be model

$$y = (\tan\theta_0)x - \frac{g}{2v_0^2\cos^2\theta_0}x^2 + y_0$$

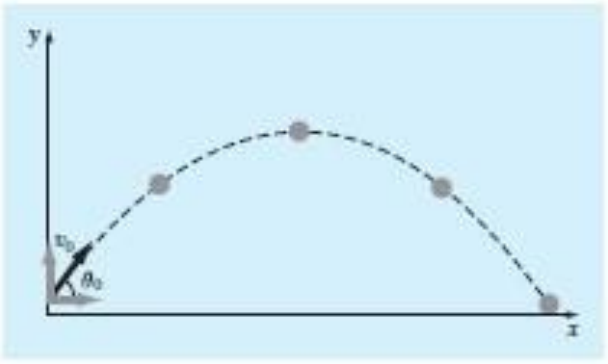

Fig. 1

a. Find the appropriate initial angle θ0, if v0 = 30 m/s, and the distance to the catcher is 90 m. Note that the throw leaves the right fielder's hand at an elevation of 1.8 m and the catcher receives it at 1 m.

Use $\varepsilon_s = 0.01\%$

b. Repeat part a using different initial guesses (3 different values where applicable).
c. Plot a graph of the approximation percentage error for all the used algorithms in part a.
d. Which algorithm is the fastest?

Problem 3: A total charge Q is uniformly distributed around a ringshaped conductor with radius a. A charge q is located at a distance x from the center of the ring (Fig. 2). The force exerted on the charge by the ring is given by

$$F = \frac{1}{4\pi e_0} \frac{qQx}{(x^2 + a^2)^{3/2}}$$

where $e_0 = 8.9 \times 10^{-12}\ \mathrm{C^2/(N\ m^2)}$. Find the distance x where the force is 1.25 N if q and Q are 2×10^{-5} C for a ring with a radius of 0.85 m.

You need to run all codes when possible.

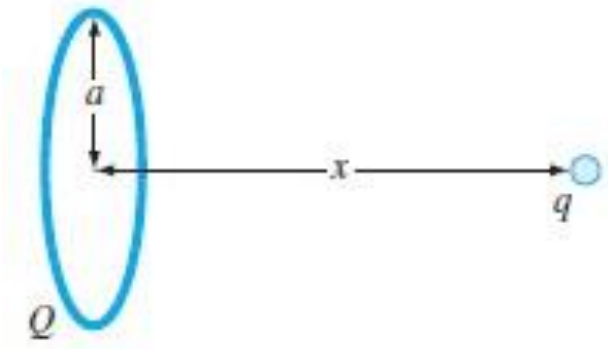

Fig. 2

Problem 4: For fluid flow in pipes, friction is described by a dimensionless number, the Fanning friction factor f. The Fanning friction factor is dependent on a number of parameters related to the size of the pipe and the fluid, which can all be represented by another dimensionless quantity, the Reynolds number Re. A formula that predicts f given Re is the von Karman equation:

$$\frac{1}{\sqrt{f}} = 4\log_{10}\left(\mathrm{Re}\sqrt{f}\right) - 0.4$$

Typical values for the Reynolds number for turbulent flow are 10,000 to 500,000 and for the Fanning friction factor are 0.001 to 0.01. Develop a function to solve for f given a user-supplied value of Re between 2,500 and 1,000,000. Design the function so that it ensures that the absolute error in the result is $E < 0.000005$.