Exercise session on numerical solution of nonlinear equations, 1

October 18, 2021

Exercise 1

Consider the nonlinear equation $f(x) = x^2 - x + 1 - e^{-x} = 0$ for $x \in [-2, 1]$.

a) Plot the function $f(x)$ on the given interval and identify graphically initial guesses for the solutions of the equation;

b) use these guesses to compute approximations of all the solutions employing the MATLAB function `fsolve` with absolute error tolerance given by 10^{-10} and tolerance on the residual given by 10^{-12}.

c) write a MATLAB function implementing the Newton method and compute again the approximations of all the solutions with absolute error tolerance given by 10^{-10}.

Exercise 2

Write MATLAB functions implementing the chord and secant methods and apply both to the problem in exercise 1.

Exercise 3

Write a MATLAB function implementing the bisection method and apply it to the problem in exercise 1. Say if all the solutions can be determined by this method and, if not, explain why.

Exercise 4

Consider the nonlinear equation $e^x - 2x^2 = 0$ for $x \in [-2, 4]$. Determine graphically the number of solutions of the equation. Compute all the solutions of the equation using the bisection, Newton, chord and secant method using an absolute error tolerance equal to 10^{-6} and a tolerance on the residual equal to 10^{-8}. Repeat the exercise using the function `fsolve` and compare the solutions obtained.