ESO208: Computer Assignment-1

Marks: 100   Due Date: Thursday, August 18, 2016

1. Write a computer program for finding roots of a non-linear equation $f(x)$ using the following methods:
   a. Bisection
   b. False-position
   c. Modified false-position
   d. Newton-Raphson
   e. Secant

   The program should have the following features:

   Input: A user interface for providing – (i) non-linear equation, (ii) option to choose one of the five methods mentioned above, (iii) starting values, and (iv) stopping criteria in form of maximum iterations and maximum relative approximate error (in %).

   Output: (i) Plot of $f(x)$ vs x, (ii) Plot of relative approximate error vs iteration number, and (iii) Roots of the equation.

   Test functions:

   (1)
   $f(x) = 600x^4 - 550x^3 + 200x^2 - 20x - 1 = 0$
   Bracketing Methods: $x_l = 0.1$ $x_u = 1.0$
   Newton-Raphson : $x_0 = 0.5$
   Secant : $x_{-1} = 0.1$ $x_0 = 1.0$
   Maximum iteration : 20
   Maximum relative approximate error (%) : 0.05%

   (2)
   $f(x) = \exp(-x) - x = 0$
   Bracketing Methods: $x_l = 0.0$ $x_u = 1.0$
   Newton-Raphson : $x_0 = 0.5$
   Secant : $x_{-1} = 0.1$ $x_0 = 1.0$
   Maximum iteration : 20
   Maximum relative approximate error (%) : 0.05%

2. Write a computer program for finding roots of a polynomial $f(x)$ using the following methods:
   a. Müller

   b. Bairstow

   Input: A user interface for providing – (i) polynomial, (ii) option to choose one of the two methods, (iii) starting values, and (iv) stopping criteria in form of maximum iterations and maximum relative approximate error (in %).

   Output: (i) Plot $f(x)$ vs x and (ii) Roots of the equation

   Test polynomials:

   (1)
   $$f(x) = 600x^4 - 550x^3 + 200x^2 - 20x - 1 = 0$$
   Müller Method: $x_0 = 0.0$ $x_1 = 0.1$ $x_3 = 0.3$

   Bairstow Method : $r = -1$ $s = -1$

   Maximum iteration : 20

   Maximum relative approximate error (%) : 0.05%

   (2)
   $$f(x) = x^3 + x^2 - 4x - 4 = 0$$
   Müller Method: $x_0 = 0.0$ $x_1 = 0.5$ $x_3 = 1.0$

   Bairstow Method : $r = -1$ $s = -1$

   Maximum iteration : 20

   Maximum relative approximate error (%) : 0.05%

   ## Submission

   Due date: 18th August 12:00 mid-night

   Submit a single zip folder in the Brihaspati server under Assignment-1. The name of the zip-folder should be your roll-number (e.g If your roll no. is 99999, the folder name should be '99999.zip'). The folder should include -

   (i)   All the computer program file(s)

   (ii)   A PDF file of the plots and the solution of the test functions/polynomials (given above). Comment on the convergence and stability of different methods.