Numerical Method

Homework-1

Due Date: April 15, 2013 (through Ninova)

Q1) (MATLAB-40 pts) Solve $f(x) = x^3 - 3x + 2$ by implementing and coding the Secant, Newton-Raphson and Bisection methods. Plot the relative errors of each method using initial conditions stated below. Explain the details of the relative error figure, for ex; which one is faster, which one has the best performance etc.

(HINT: the y axis of relative error figure is relative error and the x axis of it is number of iteration)

Initial Conditions:

Bisection method, $x_l = -4 \;\; x_u = -1$

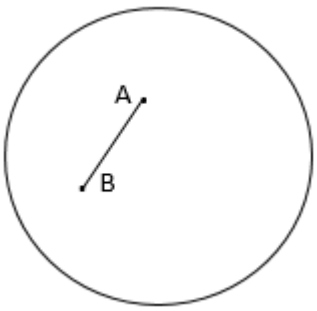
Secant method, $x_1 = -4 \;\; x_2 = -4.1$

Newton-raphson method, $x_1 = -4$

Q2) (MATLAB-40 pts) Plot $f(x) = \sin(x)$ between [0, 2π]. Firstly, select 3 points from $f(x) = \sin(x)$. Find the polynomial functions passing through these points using Direct, Lagrange and Newton's interpolation methods. Increase your number of points with 5, 9, 20 and repeat the procedure. Current interpolation points should contain previous interpolation points. Explain relationship between number of point and the curves.

(HINT: Use only one figure for each method. For example, Lagrange method figure contains 5 curve which are original sin(x), 3 point interpolation, 5 point interpolation, 9 point interpolation and 20 point interpolation. Please be careful selecting points!)

Q3) (MATLAB-20 pts) In the unit circle, select randomly two points and calculate the distance between these two points. What is the approximate mean value of this distance? Plot number of sample and mean distance. x axis is number of samples, y axis is mean distance. Mean distance should be converged.



(HINT: Generate random dataset and apply your algorithm. We do not expect to find exact mean value. Only calculate the approximate value using a dataset large enough. You should decide the size of dataset. Remember that radius of unit circle is 1.)

Q4) (BONUS-10 pts) We know that $\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$. So, what is the value of this integral $\int_{-\infty}^{\infty} e^{-\alpha x^2} dx = ?$

(HINT: Do not evaluate the integral, find solution using unity of x like meter, centimeter etc.) *This question is not related to the course, but it definitely provides some problem solving experience!!*

Some Instructions:

-An e-report should be prepared ***individually***. Handwritten or scanned documents will not be accepted. There is no specific template for the report, it's free-style.

-For Q1, Q2 and Q3, MATLAB codes should also be uploaded.

-Any homework with cheating attempts like **code and/or report similarity** will be graded as -100.