MATH 5510 – Numerical Analysis September 2, 2016

Assignment 1

1. Write three programs that accept as inputs $(x_1, ..., x_n)$, $(f_1, ..., f_n)$, and $z \in \mathbb{R}^m$ and return $P(f|x_1, ..., x_n)(z)$, where the interpolating polynomial $P(f|x_1, ..., x_n)$ is computed using

   - the monomial basis (and evaluated using Horners scheme)
   - the Lagrange basis
   - the Newton basis (and evaluated using Horners scheme).

   Use your program to interpolate the error function `erf`, which is defined by

   $$\text{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-s^2} ds$$

   and which can be evaluated using the Matlab function `erf`, at the points $1, 1.2, 1.4, ..., 3$. Plot the error between `erf` and the interpolating polynomial $P(f|x_1, ..., x_n)$ computed with each of your three programs at $z = (0 : 0.01 : 4)$. Based on your results, would you recommend using polynomial interpolation to approximate `erf` at points outside $[1, 3]$?

   Plot the error between the interpolation polynomial computed using the monomial basis and the Newton basis and plot the error between the interpolation polynomial computed using the Lagrange basis and the Newton basis. Which method introduces the largest error in computing the interpolation polynomial.