*Assigned: 8-28-24*

*Due Date: 9-13-24*

CS 6210: Introduction to Scientific Computing

*Assignment 1*

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1. Modify your program to use the Vandermonde matrix to calculate an interpolating polynomial to exp(x) on [0,2] with 6,11,21,41,81,161,321 and 641 points and to evaluate the accuracy at 1001 sample points using the infinity and 2 norms. Use both evenly spaced points and Chebyshev spaced points x(i) on [-1,1] mapped to [0,2] as given by x(i) = 1 –cos(π(i-1)/(n-1)) for i = 1,…,n. Comment on and describe how the accuracy changes with the choice and number of points.
2. Extend the program to use the Matlab routines bary and baryweights that use Lagrange polynomial interpolation . Again comment on how the accuracy varies with the different choice of 6,11,21,41,81,161,321 and 641 points, both Chebyshev and evenly spaced. Note that not all the codes work well for all choices of points
3. Further extend your program to use the Matlab cubic spline routine PCHIP and the matlab spline troolbox routines with say 6th or 8th order splines, with both even and Chebyshev points. Again use both sets of points and comment on the outcome. Is the choice of points so critical for the spline routine as it was for the Lagrange polynomials?
4. Using the matlab timing functions tic and toc, time the 4 different methods with the required points and plot them. How do these timing results compare to each other? Did you see what you expected? On a different graph plot the infinity error norms for the different point sets. Note in order to show and explain your results you may have to exclude certain data points when one or more methods blows up. This may happen with polynomials on a large evenly spaced mesh for reasons we have discussed in class.
5. Provide a summary that explains which method provides the fastest answer and is the most accurate and robust for both methods,
   * Source code for all programs that you write, thoroughly documented.
     + Include a README file describing how to compile and run your code.
   * Your report should be in PDF format and should stand on its own.
     + It should describe the methods used, explain your results and contain figures.
     + It should also answer any questions asked above.
     + It should cite any sources used for information, including source code and collaborators.