

Numerical Analysis

CSCE 440/840

Final Project

Fall 2017

This project can be done as a group project with two students in a group.

1. **(15 points) Data Collection:** Select any topic that you are interested in. Regarding this topic find some suitable data. This could be any data of your own, or published data from a book or journal, or some data downloaded from any website. The size of the data should be neither too small nor too large. Cite the source of your data and give the webpage if it is from the Internet.
2. **(100 points) Experimental Comparison of Numerical Algorithms:** Implement (in MATLAB or another high-level programming language) at least two alternative algorithms to process your data. You can select algorithms from any of the following groups (as suitable to your data):
 - (a) **Polynomial root finding methods.** (These include the Bisection Method, Newton's Method, and the Secant Method.)
 - (b) **Function interpolation methods.** (These include Lagrange Interpolation Method, Newton's Interpolation Method, Piecewise Linear Interpolation, Piecewise Linear Approximation, Cubic Spline Interpolation).
 - (c) **Spatial interpolation methods.** (These include Shape Function Interpolation, Inverse Distance Weighting, and Bezier Interpolation.)
 - (d) **Numerical integration methods.** (These include the Upper and Lower Bound Sum of Rectangles Methods, the Trapezoid Method, Simpson's Method, Romberg's Method, and the Monte Carlo Method.) In the comparison, compare the accuracy using the same number of intervals and/or the computational complexity.
 - (e) **Methods of evaluating systems of linear equations.** (These include the naive Gaussian Method, and the Partial Pivoting Method.) In the comparison of these methods, give the residual errors and the condition numbers.
 - (f) **Any other pair of numerical algorithms.** (These need to be checked and approved by the instructor.)
3. **(Undergraduates: 35 points, Graduates: 25 points)** Write a summary of the results of your computational experiments (about 200-500 words). Present your findings in a table, bar chart or other visual method. Include in the comparison and discussion any relevant information about accuracy and computational complexity. Include in your summary a statement about which algorithm you would recommend to others.
4. **(Graduates required 10 points, Undergraduate bonus 10 points):** Make a brief (20 minutes) class presentation about your project using powerpoint slides.

Note: The source code submitted should be executed on CSE server. Provide a "README" file that describes the source code for each problem and indicates how to compile and execute each of your programs.