GA_6: Matrix Methods

ME 273 | Spring Semester 2018

Mission:

Your mission, should you choose to accept it, is to provide thorough answers/solutions to each of the Exercises, including numerical values and graphs where appropriate. Also provide any code that you used to produce the results shown in your solutions to the Exercises. It is imperative that the code you include be commented in detail with your own, original content. Detailed comments are the main way to uniquely identify your individual effort. Please embed all the components of your solutions to the Exercises and your computer code into one document, and turn in a single pdf electronically. Anything beyond a single pdf for your submission will be utterly rejected!

Exercises

1 Gauss Elimination

Consider the following system of linear equations.

$$\begin{aligned} 27.6x_1 - 123.5x_2 - 97.8x_3 &= -11 \\ 45.5x_1 + 100.3x_2 + 2.1x_3 &= 744.3 \\ 1.2x_1 + 67.3x_2 + 99.4x_3 &= 7.7 \end{aligned} \tag{1}$$

Solve the system for x_1, x_2, and x_3 using Gauss elimination. You will, unfortunately, have to write the solution out by hand (with the aid of a calculator!); but, the good news: this is the only assignment in ME273 this semester that requires an good 'ol fashioned pencil and paper effort! Since Hon. Prof. wants you to submit a pdf of your GA report, can you create a digital copy of your solution for this exercises and include it in your single pdf?

2 Cramer's Rule

Express the system of equations in the form

$$\overleftrightarrow{A}\,\overrightarrow{x} = \overrightarrow{b}\,. \tag{2}$$

Solve the system of equations above using Cramer's Rule. Write the solution as a script and describe the output in your report.

3 Inverse of $\overleftrightarrow{A}$

Use the inverse of $\overleftrightarrow{A}$ to calculate the solution vector $\overrightarrow{x}$ for the system of equations. Include this inverse calculation in the same script you created for Exercise 2.

4 Optimized MATLAB Solution

Calculate the solution vector via the optimized MATLAB solution for a system of equations. Compare the results of each of these methods and comment appropriately. Include this calculation in the same script you created for Exercises 2 and 3.

5 Large Matrix

Create a large matrix $\overleftrightarrow{A}$ comprised of elements randomly generated from -100 to +100, and a corresponding vector $\overrightarrow{b}$, whose elements are also randomly generated in the same range. Calculate the solution vector $\overrightarrow{x}$ for this system of equations via the matrix inverse method and the optimized MATLAB method, and compare the results. "Large" means a matrix sufficiently large to require at least a few minutes of run time. To make the comparison, define another matrix that calculates the difference between the two solutions, and output the minimum and maximum of this difference matrix. Comment on the result.