Lab 10

Ch En 263 – Numerical Tools

Due: 22 Feb. 2024

Instructions

- Complete the exercise(s) below, and submit the following files to Learning Suite:
  - Handwritten portion: scan each page (or take a picture) and combine them into a single pdf named: `LastName_FirstName_Lab10.pdf`
  - Excel portion: submit a workbook named `LastName_FirstName_Lab10.xlsx` where each worksheet tab is named "Problem_1", "Problem_2", etc.
  - Python portion: submit a separate file for each problem named `LastName_FirstName_Lab10_ProblemXX.py` where XX is the problem number.
- Warning: the LS assignment will close promptly at 11:59 pm and late assignments will only receive 50% credit.

Lab Exercises

1. Do the following by hand. Consider the system of linear equations

$$\begin{aligned} -2x_0 + x_1 - 2x_2 &= 1 \\ x_0 + x_1 - x_2 &= -6 \\ x_0 - 2x_1 - x_2 &= -3 \end{aligned}$$

   (a) Find the $\boldsymbol{A}$ matrix and $\boldsymbol{b}$ vector when this problem is written in the form $\boldsymbol{A} \cdot \boldsymbol{x} = \boldsymbol{b}$

   (b) Use Gauss Elimination to solve this problem by hand.

2. You can confirm that your solution to the previous problem is correct by calculating a quantity called the *residual*, which is defined as the norm

$$\epsilon = |\boldsymbol{A} \cdot \boldsymbol{x} - \boldsymbol{b}| \,.$$

   Write a Python function called `residual` that takes arguments of an $n \times n$ matrix `A`, an $n \times 1$ vector `b`, and an $n \times 1$ vector `x` and returns the (scalar) value of the residual. Use loops and arrays to execute the matrix algebra. Use your answer to Problem 1 as a test case to confirm that you have the correct solution for Problem 1 and that your residual code works.