

# Lab 11

Ch En 263 – Numerical Tools

Due: 27 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_Lab11.pdf`
  - Excel portion: submit a workbook named `LastName_FirstName_Lab11.xlsx` where each worksheet tab is named “Problem\_1”, “Problem\_2”, etc.
  - Python portion: submit a separate file for each problem named `LastName_FirstName_Lab11_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. In this problem you will write a Python program to do forward elimination for the system of linear equations:

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

*Note that this is one of the systems you solved for the last homework. This can help you debug your code!*

- (a) Define numpy array variables `A` and `b` and a variable for the number of rows, `n`.
- (b) Write a loop for  $k = 0, 1, \dots, n - 2$  that prints out the diagonal element of each row (except the last one) of the matrix,  $a_{k,k}$ .
- (c) Write a nested loop for  $k = 0, 1, \dots, n - 2$  and  $i = k + 1, k + 2, \dots, n - 1$  that prints out the ratio  $a_{i,k}/a_{k,k}$  where  $i$  are the rows below the  $k^{\text{th}}$  diagonal.
- (d) Write the full forward elimination algorithm using a triple nested loop where the third loop runs over the columns in row  $i$  for  $j = k, k + 1, \dots, n - 1$ . Print the final upper-triangular matrix and modified RHS (right-hand side) vector `b` to the console.