MATH 3043, Numerical Analysis I
Fall 2020

Lab 9

This lab will have you implementing Gaussian elimination with pivoting to solve linear systems.

Solutions must be submitted on Canvas by **November 15** at **11:59 PM**. Please submit a single script file `Lab9Lastname.m` and the corresponding published file `Lab9Lastname.pdf` (for example, my submitted files would be `Lab9Zumbrum.m` and `Lab9Zumbrum.pdf`). Each solution should

- be contained in a separate cell which includes the problem number and short problem description,
- run independent of other cells,
- be adequately commented.

1. Write a local function `x = GPP(A,b)` that accepts the coefficient matrix `A` and the right-hand side vector `b` for a linear system, implements Gaussian elimination with partial pivoting, and outputs the solution vector `x`.

   Use the function to solve the linear system

$$\begin{aligned} 2x_1 &+ x_3 - x_4 = 6 \\ 6x_1 + 3x_2 &+ 2x_3 - x_4 = 15 \\ 4x_1 + 3x_2 - 2x_3 &+ 3x_4 = 3 \\ -2x_1 - 6x_2 + 2x_3 &- 14x_4 = 12. \end{aligned}$$

2. Write a local function `x = GSPP(A,b)` that accepts the coefficient matrix `A` and the right-hand side vector `b` for a linear system, implements Gaussian elimination with scaled partial pivoting, and outputs the solution vector `x`.

   Use the function to solve the linear system

$$\begin{aligned} \pi x_1 - ex_2 + \sqrt{2}x_3 - \sqrt{3}x_4 &= \sqrt{11} \\ \pi x_1 + ex_2 - e^2 x_3 + \tfrac{3}{7}x_4 &= 0 \\ \sqrt{5}x_1 - \sqrt{6}x_2 + x_3 - \sqrt{2}x_4 &= \pi \\ \pi^3 x_1 + e^2 x_2 - \sqrt{7}x_3 + \tfrac{1}{9}x_4 &= \sqrt{2}. \end{aligned}$$

Note: For the selection of pivot elements in each method, output if a row swap was performed (including the rows swapped) or not.