Numerical Methods (CS 357)

Worksheet

Part 1. Permutation Matrices

Create a permutation `P` matrix that takes the vector $x = [0, 1, 2, 3, 4]^T$ to $Px = [1, 3, 4, 0, 2]$.

```
import numpy as np
P = np.zeros((5,5))

P[   ,0] = 1
P[   ,1] = 1
P[   ,2] = 1
P[   ,3] = 1
P[   ,4] = 1

print(P.dot(x))
```

Part 2. Pivoted LU

Factor the matrix

$$A = \begin{bmatrix} 0 & 2 & 1 \\ 1 & 1 & 3 \\ 2 & 4 & 4 \end{bmatrix}$$

into a permutation matrix P, a lower triangular matrix L, and an upper triangular matrix U. Here are a few reminders about the process (so that you don't have to go look these up):

- Original factorization: $M_2 P_2 M_1 P_1 U = A$
- $L_2 = M_2$
- $L_1 = P_2 M_1 P_2^{-1}$
- $L = L_1^{-1} L_2^{-1}$

- $P = P_2 P_1$

```
import numpy as np

P = np.zeros((3,3), dtype=np.float64)
P[   , 0] = 1
P[   , 1] = 1
P[   , 2] = 1

L = np.array([
    [1, 0, 0],
    [ , 1, 0],
    [ ,  , 1],
    ])

U = np.array([
    [ ,  ,  ],
    [0,  ,  ],
    [0, 0,  ],
    ])

print(P.dot(A)-L.dot(U))
```