EE2160 CAD Laboratory - Python Exercise 2

Matrix Algebra

1. Create a Python program that generates a random matrix based on the following user inputs obtained during run-time:

   - matrix dimensions
   - probability distribution
   - matrix structure - identity, diagonal, bi-diagonal, block diagonal, symmetric, skew-symmetric, Toeplitz, circulant, sparse, stochastic, and doubly stochastic
   - if block diagonal or sparse, input block-sizes or sparsity factor (number of non-zero elements), respectively

   Write the generated matrices to a file.

2. Create a Python program that reads matrices from a file and does the following:

   (a) Matrix – addition, multiplication, Kronecker product, Hadamard product, pseudo-inverse

   (b) Computation of – determinant, rank, Eigen values, Eigen vectors

   (c) Computation of p-norm, where the value of $p > 1$ is given by the user

   Append the results to the file containing the matrices.

3. Create a Python program that reads a matrix $\mathbf{A}$ and vector $\mathbf{b}$ from a file and computes:

   (a) $\mathbf{x}$ that solves $\mathbf{Ax} = \mathbf{b}$

   (b) if not solvable, then gives an error message

   (c) if there are many solutions, then gives the least squares solution