Assignment 05: Vectors and Matrices
Assigned: 19th November 2019
Due: 6th December 2019 at 5 PM
Note: Please upload your solution as an ipynb file to the Canvas page.

The purpose of this assignment is to develop your skills in using Numpy arrays and doing vector and matrix operations.

1. Let A be a 4 x 4 matrix and B a 2 x 1 matrix. The symbol $\cdot$ represents a dot product. Using the shape of the matrix as a guide, indicate if the following expressions are valid or not.

   (a) $A + B$

   (b) $A \cdot B$

   (c) $A \cdot A$

   (d) $B \cdot B$

   (e) $B^T \cdot B \cdot A$

2. Using the following matrices and vectors. Compute the following.

$$A = \begin{bmatrix} 1 & 4 & -2 \\ 4 & 8 & 6 \\ -2 & 6 & 12 \end{bmatrix}$$
$$B = \begin{bmatrix} 6 & 2 & -2 \\ 4 & 8 & 3 \\ -1 & 6 & 9 \end{bmatrix}$$
$$c = [6, -4, 3]$$
$$d = [3, -1, 5]$$

   (a) $A - A^T$

   (b) $A \cdot B$

   (c) $8A - 4B$

   (d) $B^T \cdot B$

   (e) $c^T \cdot B$

   (f) $A \cdot B \cdot c \cdot d^T$

   (g) $c \times d$

   (h) Inverse A^{-1} and check if $A * A^{-1} = I$

3. Find a a unit vector (i.e., vector of magnitude equal to 1) that is perpendicular to both c and d. Hint: *use the cross product definition.*

4. Using array slicing on matrix A

$$A = \begin{bmatrix} 4.0 & 7.0 & -2.43 & 67.1 \\ -4.0 & 64.0 & 54.7 & -3.33 \\ 2.43 & 23.2 & 3.64 & 4.11 \\ 1.2 & 2.5 & -113.2 & 323.22 \end{bmatrix}$$

(a) Extract the third column as a 1D array

(b) Extract the first two rows as a 2D sub-array

(c) Extract the bottom-right 2×2 block as a 2D sub-array

(d) Sum the last column