Part B (Matlab Tutorial)

Exercise 2: With the matrices and vectors,

$$A = \begin{pmatrix} 10 & -3 \\ 4 & 2 \end{pmatrix}, B = \begin{pmatrix} 1 & 0 \\ -1 & 2 \end{pmatrix}, v = \begin{pmatrix} 1 \\ 2 \end{pmatrix}, w = \begin{pmatrix} 1 \\ 1 \end{pmatrix},$$

compute the following both by hand and in MATLAB. For the MATLAB computations use the diary command to record your session.

a. $v^T w$

Solution:

$$\begin{aligned} v^T w &= \begin{pmatrix} 1 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \\ &= (1 * 1) + (1 * 2), \\ &= 3. \end{aligned}$$

b. vw^T

Solution:

$$\begin{aligned} vw^T &= \begin{pmatrix} 1 \\ 2 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \\ &= \begin{pmatrix} 1 * 1 & 1 * 1 \\ 2 * 1 & 2 * 1 \end{pmatrix}, \\ &= \begin{pmatrix} 1 & 1 \\ 2 & 2 \end{pmatrix}. \end{aligned}$$

c. Av

Solution:

$$\begin{aligned} Av &= \begin{pmatrix} 10 & -3 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \\ &= \begin{pmatrix} (10 * 1) + (-3 * 2) \\ (4 * 1) + (2 * 2) \end{pmatrix}, \\ &= \begin{pmatrix} 4 \\ 8 \end{pmatrix}. \end{aligned}$$

d. $A^T v$

Solution:

$$\begin{aligned} A^T v &= \begin{pmatrix} 10 & 4 \\ -3 & 2 \end{pmatrix}\begin{pmatrix} 1 \\ 2 \end{pmatrix}, \\ &= \begin{pmatrix} (10 * 1) + (4 * 2) \\ (-3 * 1) + (2 * 2) \end{pmatrix}, \\ &= \begin{pmatrix} 18 \\ 1 \end{pmatrix}. \end{aligned}$$

e. AB

Solution:

$$\begin{aligned} AB &= \begin{pmatrix} 10 & -3 \\ 4 & 2 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ -1 & 2 \end{pmatrix}, \\ &= \begin{pmatrix} (10 * 1) + (-3 * -1) & (10 * 0) + (-3 * 2) \\ (4 * 1) + (2 * -1) & (4 * 0) + (2 * 2) \end{pmatrix}, \\ &= \begin{pmatrix} 13 & -6 \\ 2 & 4 \end{pmatrix}. \end{aligned}$$

f. BA

Solution:

$$\begin{aligned} BA &= \begin{pmatrix} 1 & 0 \\ -1 & 2 \end{pmatrix}\begin{pmatrix} 10 & -3 \\ 4 & 2 \end{pmatrix}, \\ &= \begin{pmatrix} (1 * 10) + (0 * 4) & (1 * -3) + (0 * 2) \\ (-1 * 10) + (2 * 4) & (-1 * -3) + (2 * 2) \end{pmatrix}, \\ &= \begin{pmatrix} 10 & -3 \\ -2 & 7 \end{pmatrix}. \end{aligned}$$

g. A^2

Solution:

$$\begin{aligned} AA &= \begin{pmatrix} 10 & -3 \\ 4 & 2 \end{pmatrix}\begin{pmatrix} 10 & -3 \\ 4 & 2 \end{pmatrix}, \\ &= \begin{pmatrix} (10*10)+(-3*4) & (10*-3)+(-3*2) \\ (4*10)+(2*8) & (4*-3)+(2*2) \end{pmatrix}, \\ &= \begin{pmatrix} 88 & -36 \\ 48 & -8 \end{pmatrix}. \end{aligned}$$

h. $By = w$

Solution:

$$\begin{aligned} By &= w \\ \begin{pmatrix} 1 & 0 \\ -1 & 2 \end{pmatrix}\begin{pmatrix} y_1 \\ y_2 \end{pmatrix} &= \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \\ \begin{pmatrix} y_1 \\ y_2 \end{pmatrix} &= \frac{1}{(1*2)-(0*-1)}\begin{pmatrix} 2 & 0 \\ 1 & 1 \end{pmatrix}\begin{pmatrix} 1 \\ 1 \end{pmatrix} \\ \begin{pmatrix} y_1 \\ y_2 \end{pmatrix} &= \begin{pmatrix} 1 & 0 \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}\begin{pmatrix} 1 \\ 1 \end{pmatrix} \\ \begin{pmatrix} y_1 \\ y_2 \end{pmatrix} &= \begin{pmatrix} 1 \\ 1 \end{pmatrix} \end{aligned}$$

i. $Ax = v$

Solution:

$$\begin{aligned} Ax &= v \\ \begin{pmatrix} 10 & -3 \\ 4 & 2 \end{pmatrix}\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} &= \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \\ \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} &= \frac{1}{(10*2)-(-3*4)}\begin{pmatrix} 2 & 3 \\ -4 & 10 \end{pmatrix}\begin{pmatrix} 1 \\ 2 \end{pmatrix} \\ \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} &= \begin{pmatrix} \frac{2}{32} & \frac{3}{32} \\ \frac{-4}{32} & \frac{10}{32} \end{pmatrix}\begin{pmatrix} 1 \\ 2 \end{pmatrix} \\ \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} &= \begin{pmatrix} \frac{1}{4} \\ \frac{1}{2} \end{pmatrix} \end{aligned}$$

Exercise 4: Use MATLAB to print a table of values x, $sinx$, and $cosx$, for,

$$x = 0, \frac{\pi}{6}, \frac{2\pi}{6}, \ldots, 2\pi$$

Solution:

Exercise 5: Solution:

Exercise 7: Solution:

Exercise 9: Solution: