

ME 380
Kinematics and Machine Dynamics
Linear Algebra Worksheet

1. Carry out the following matrix multiplications using the various different techniques we went over in class.

(a) Calculate Ax , where

$$A = \begin{bmatrix} 12 & 17 & -8 & -5 & -6 \\ 3 & 12 & -19 & -3 & -14 \\ -8 & 16 & 14 & -13 & 16 \end{bmatrix}, \quad x = \begin{bmatrix} 3 \\ 3 \\ 2 \\ -1 \\ -1 \end{bmatrix}$$

(b) Calculate AB , where

$$A = \begin{bmatrix} -17 & -7 \\ 4 & -13 \\ 12 & -14 \\ -17 & 7 \end{bmatrix}, \quad B = \begin{bmatrix} -2 & 13 & -12 & 13 & 13 & -1 & 8 \\ -16 & 16 & 17 & -11 & 16 & -13 & -6 \end{bmatrix}$$

2. Solve the following systems of equations using matrix algebra. If more than one solution exist, find all the solutions. If no solution exists, explain why, and find an x such that $\|Ax - b\|$ is minimized.

(a)

$$\begin{aligned} -2x_1 + 18x_2 &= -0.48 \\ 7x_1 - 8x_2 &= 0.04 \end{aligned}$$

(b)

$$\begin{aligned} -13x_1 - 18x_2 - 3x_3 - 17x_4 &= 35 \\ 20x_1 - 6x_2 - 15x_3 - 18x_4 &= -57 \end{aligned}$$

(c)

$$\begin{aligned} 13x_1 - 19x_2 &= 4 \\ -14x_1 + 10x_2 &= -14 \\ -7x_1 + 10x_2 &= 17 \\ 12x_1 - 7x_2 &= 82 \end{aligned}$$

3. Do the following computations

(a) Compute the norm of the vectors $x = [18 \ -11 \ 7]^\top$, $y = [-12 \ -5 \ 20]^\top$.

(b) Compute the angle between the vectors $x = [16 \ 10 \ -10]^\top$, $y = [-17 \ 9 \ -12]^\top$.

(c) Is the following set of vectors independent? If not, why?

$$\begin{aligned}e_1 &= \begin{bmatrix} -5 & \frac{5}{9} & -\frac{35}{9} \end{bmatrix}^\top \\e_2 &= \begin{bmatrix} \frac{25}{9} & \frac{5}{3} & -\frac{5}{9} \end{bmatrix}^\top \\e_3 &= \begin{bmatrix} -\frac{185}{9} & 5 & -\frac{115}{9} \end{bmatrix}^\top\end{aligned}$$