

Linear Algebra - Worksheet

Read this article before beginning the exercises: [Linear Algebra Explained in 4 Pages](#)

This assignment consists of 3 parts:

- Matrix Dimensions
- Vector Operations
- Matrix Operations

After completing the exercises by hand, use Python to check your work.

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 7 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \quad C = \begin{bmatrix} 5 & -1 \\ 9 & 1 \\ 6 & 0 \end{bmatrix} \quad D = \begin{bmatrix} 3 & -2 & -1 \\ 1 & 2 & 3 \end{bmatrix}$$

$$u = \begin{bmatrix} 6 & 2 & -3 & 5 \end{bmatrix} \quad v = \begin{bmatrix} 3 & 5 & -1 & 4 \end{bmatrix} \quad w = \begin{bmatrix} 1 \\ 8 \\ 0 \\ 5 \end{bmatrix}$$

1. Matrix Dimensions

Write the dimensions of each matrix.

1.1) A is $[2 \times 3]$

1.2) B is $[2 \times 2]$

1.3) C is $[3 \times 2]$

1.4) D is $[2 \times 3]$

1.5) u is $[1 \times 4]$

1.6) w is $[4 \times 1]$

2. Vector Operations

Perform the following operations. Assume $\alpha = 6$.

2.1) $\vec{u} + \vec{v} = [6+3, 2+5, -3-1, 5+4] = [9, 7, -4, 9]$

2.2) $\vec{u} - \vec{v} = [6-3, 2-5, -3+1, 5-4] = [3, -3, -2, 1]$

2.3) $\alpha \vec{u} = 6 \times [6, 2, -3, 5] = [36, 12, -18, 30]$

2.4) $\vec{u} \cdot \vec{v} = (6 \times 3) + (2 \times 5) + (-3 \times -1) + (5 \times 4) = 51$

2.5) $\|\vec{u}\| = \sqrt{u \cdot u} = \sqrt{51}$

3. Matrix Operations

Evaluate each of the following expressions, if it is defined; else fill in with "not defined." Do your work by hand on scratch paper.

$$3.1) A + C = \text{not defined.}$$

$$3.2) A - C^T = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 7 & 4 \end{bmatrix} - \begin{bmatrix} 5 & 9 & 6 \\ -1 & 1 & 0 \end{bmatrix} = \begin{bmatrix} -4 & -7 & -3 \\ 3 & 6 & 4 \end{bmatrix}$$

$$3.3) C^T + 3D = \begin{bmatrix} 5 & 9 & 6 \\ -1 & 1 & 0 \end{bmatrix} + 3 \cdot \begin{bmatrix} 3 & -2 & -3 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 5 & 9 & 6 \\ -1 & 1 & 0 \end{bmatrix} + \begin{bmatrix} 9 & -6 & -9 \\ 3 & 6 & 9 \end{bmatrix} = \begin{bmatrix} 14 & 3 & -3 \\ 2 & 7 & 9 \end{bmatrix}$$

$$3.4) BA = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 2 & 7 & 4 \end{bmatrix} = \begin{bmatrix} -1 & -5 & -4 \\ 2 & 7 & 4 \end{bmatrix}$$

$$3.5) BA^T = \text{not defined}$$

Optional

$$3.6) BC = \text{not defined}$$

$$3.7) CB = \begin{bmatrix} 5 & -1 \\ 9 & 1 \\ 6 & 0 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 5 & -6 \\ 9 & -8 \\ 6 & -6 \end{bmatrix}$$

$$3.8) B^4 = (B^2)^2 = \left(\begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \right)^2 = \left(\begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix} \right)^2 =$$

$$3.9) AA^T =$$

$$3.10) D^T D =$$