# 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) $A$  2x3

1.2) $B$  2x2

1.3) $C$  3x2

1.4) $D$  2x3

1.5) $u$  1x4

1.6) $w$  4x1

---

# 2. Vector Operations

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

2.1) $\vec{u} + \vec{v} = \begin{bmatrix} 9 & 7 & -4 & 9 \end{bmatrix}$

2.2) $\vec{u} - \vec{v} = \begin{bmatrix} 3 & 3 & -2 & 1 \end{bmatrix}$

2.3) $\alpha\vec{u} = \begin{bmatrix} 36 & 12 & -18 & 30 \end{bmatrix}$

2.4) $\vec{u} \cdot \vec{v} = 18 + 10 + 3 + 20 = 51$

2.5) $\|\vec{u}\| = \sqrt{36 + 4 + 9 + 25} = \sqrt{74} = 8.6$

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

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

3.5) $BA^T = $ not defined

## Optional

3.6) $BC = $ Not defined

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

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

3.9) $AA^T = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 7 & 4 \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 2 & 7 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 14 & 28 \\ 28 & 69 \end{bmatrix}$

3.10) $D^T D = \begin{bmatrix} 3 & 1 \\ -2 & 2 \\ -1 & 3 \end{bmatrix}\begin{bmatrix} 3 & -2 & -1 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 10 & -4 & 0 \\ -4 & 8 & 8 \\ 0 & 8 & 10 \end{bmatrix}$