1. Matrix Dimensions

Write the dimensions of each matrix.

1.1) A $\mathbb{R}^{2\times3}$

1.2) B $\mathbb{R}^{2\times2}$

1.3) C $\mathbb{R}^{3\times2}$

1.4) D $\mathbb{R}^{2\times3}$

1.5) u $\mathbb{R}^{4}$

1.6) w $\mathbb{R}^{4\times1}$

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2. Vector Operations

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

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

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

2.3) $\alpha\vec{u} =$ $(6\cdot6)\ (6\cdot2)\ (6\cdot-3)\ (6\cdot5)$ $[36\ \ 12\ \ -18\ \ 30]$

2.4) $\vec{u} \cdot \vec{v} =$ $[6\ \ 2\ \ -3\ \ 5] \cdot [3\ \ 5\ \ -1\ \ 4]$ $[18\ \ 10\ \ 3\ \ 20]$

2.5) $\|\vec{u}\| =$ $\sqrt{6^2 + 2^2 + -3^2 + 5^2} = 8.6023$

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

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

3.4) $BA =$ "Not defined"

3.5) $BA^T =$ "Not defined"

Optional

3.6) $BC = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 5 & -1 \\ 9 & 1 \\ 6 & 0 \end{bmatrix} =$ "not defined"

3.7) $CB = \begin{bmatrix} 5 & -1 \\ 9 & 1 \\ 6 & 0 \end{bmatrix} \cdot \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} (5\cdot1)+(-1\cdot-1) & (5\cdot0)+(-1\cdot1) \\ (9\cdot1)+(1\cdot-1) & (9\cdot0)+(1\cdot1) \\ (6\cdot1)+(0\cdot-1) & (6\cdot0)+(0\cdot1) \end{bmatrix} \begin{bmatrix} 5 & -6 \\ 9 & -8 \\ 6 & -6 \end{bmatrix}$

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

3.9) $AA^T =$ $2\times3 \cdot 3\times2 \rightarrow 2\times3 \quad 3\times2 \rightarrow \begin{bmatrix} 14 & 28 \\ 28 & 69 \end{bmatrix}$

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

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.

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

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