Homework 4: Review of Linear Algebra

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Problem 4.1. Consider:

$$\mathbf{A} = \begin{bmatrix} 1 & 3 & -2 \\ -3 & 4 & -1 \\ -2 & 0 & 3 \\ 0 & -4 & 4 \end{bmatrix}, \qquad \mathbf{B} = \begin{bmatrix} 3 & -1 & 2 & 4 \\ -2 & 4 & 2 & 1 \\ 1 & 2 & -4 & -3 \end{bmatrix}.$$

Compute $\mathbf{AB}$, $\mathbf{BA}$, $\mathbf{A}^\mathsf{T}\mathbf{B}^\mathsf{T}$, and $\mathbf{B}^\mathsf{T}\mathbf{A}^\mathsf{T}$, where $\cdot^\mathsf{T}$ denotes the *transpose* operator.

Problem 4.2. Consider:

$$\mathbf{x} = \begin{bmatrix} 8 \\ -3 \\ 0 \\ 1 \\ -7 \end{bmatrix}, \qquad \mathbf{y} = \begin{bmatrix} -5 \\ 9 \\ -4 \\ 6 \\ -2 \end{bmatrix}.$$

Compute $\|\mathbf{x} - \mathbf{y}\|_1$ and $\|\mathbf{x} - \mathbf{y}\|_2$.

Problem 4.3. Let

$$\mathbf{U} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 1 & 3 \\ 1 & 4 \end{bmatrix}, \qquad \mathbf{x} = \begin{bmatrix} -1 \\ 0 \\ 2 \\ 5 \end{bmatrix}.$$

Compute the projection of $\mathbf{x}$ onto $\text{span}\{\mathbf{U}\}$.