Linear Algebra
Assignment 5 MATH 2318 (Fall 2022)

Deadline: Saturday October 8th, 11:59pm.

Policy to turn in assignment:

- Assignment should be submitted via BlackBoard.
- Student needs to turn in their assignment as a single PDF file.
- No email or late submission will be accepted.

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4 points 1. Let $T : \mathbb{R}^2 \to \mathbb{R}^2$ be a linear transformation that first reflects points through the x_1-axis, and then reflects points through the line $x_2 = x_1$. Find the standard matrix of T. Draw a picture to support your claims.

3 points 2. Let $T : \mathbb{R}^3 \to \mathbb{R}^2$ be a linear transformation defined by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}\right) = \begin{bmatrix} x_1 - 5x_2 + 4x_3 \\ x_2 - 6x_3 \end{bmatrix}$$

Determine if T is onto and/or one-to-one. *Hint*: Find A, the standard matrix of T, and study the number of solutions of $A\vec{x} = \vec{b}$ for any $\vec{b} \in \mathbb{R}^2$.

6 points 3. Let $A = \begin{bmatrix} 2 & 0 & -1 \\ 4 & -5 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 7 & -5 & 1 \\ 1 & -4 & -3 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$. Compute the following

a) $CA - 3B$.

b) $A^TC + B^T$.

3 points 4. For each of the following, determine if the statement is true or false. Provide a short reasoning (one or two sentences).

a) Let $T : \mathbb{R}^n \to \mathbb{R}^m$ be a linear transformation. If $m > n$, then T cannot be onto.

b) Let $T : \mathbb{R}^n \to \mathbb{R}^m$ be a linear transformation. If $n > m$, then T cannot be one-to-one.

c) Let T be a linear transformation. If $T(\vec{x}) = \vec{0}$, then $\vec{x} = \vec{0}$.