Linear Algebra 2

Homework 3 – Linear Transformations II

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1. For the following transformations, our task is to find their matrix representation using standard bases, if the transformation is linear.

   (b) $T : \mathbb{R}^2 \to \mathbb{R}^2$ such that $T(x, y) = (2x + |y|, -2y)$

   This transformation is not linear.

   (d) $T : \mathbb{R}^3 \to \mathbb{R}$ such that $T(x, y, z) = y$

   Since T maps from $\mathbb{R}^3$ to $\mathbb{R}$, the matrix must have dimensions such that when mutiplying it by a vector in $\mathbb{R}^3$, the result must be in $\mathbb{R}$. Therefore its dimensions must be three by one. And since we are only interested in the result containing y, we can use the following matrix which multiplies any input vector (x, y, z) as follows.

   $$\begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \times \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} y \end{bmatrix}$$

   (g) $T : \mathbb{C}^2 \to \mathbb{C}^2$ such that $T(z_1, z_2) = (|z_1 + z_2|, z_1 - 2z_2)$ where $\mathbb{C}^2$ is a vector space over $\mathbb{C}$.

   This is not a linear transformation either.