Assignment-13

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Abstract—**In this document, we find whether the given function T from $\mathbf{R}^2$ into $\mathbf{R}^2$ is a linear transformation or not.**

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1 PROBLEM STATEMENT

Verify whether $T(x_1, x_2) = (x_1 - x_2, 0)$ is a linear transformation or not.

2 SOLUTION

Let $\mathbf{V}$ and $\mathbf{W}$ be the vector spaces. The function $T : \mathbf{V} \to \mathbf{W}$ is called a linear transformation of $\mathbf{V}$ into $\mathbf{W}$ if for all $\mathbf{u}$ and $\mathbf{v}$ in $\mathbf{V}$ and for any scalar k in field $\mathbf{F}$,

$$T(k\mathbf{u} + \mathbf{v}) = kT(\mathbf{u}) + T(\mathbf{v}) \qquad (2.0.1)$$

Given,

$$T\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix}\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} \qquad (2.0.2)$$

Consider,

$$T(k\mathbf{x} + \mathbf{y}) = \begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix}(k\mathbf{x} + \mathbf{y}) \qquad (2.0.3)$$

$$= \begin{pmatrix} k & -k \\ 0 & 0 \end{pmatrix}\mathbf{x} + \begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix}\mathbf{y} \qquad (2.0.4)$$

$$= k\begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix}\mathbf{x} + \begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix}\mathbf{y} \qquad (2.0.5)$$

$$T(\mathbf{x} + \mathbf{y}) = kT(\mathbf{x}) + T(\mathbf{y}) \qquad (2.0.6)$$

Therefore, the given function T is a linear transformation.