Matrix Theory Assignment 8

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***Abstract*—This problem demonstrate a method to find weather given transformation is linear or not.**

All the codes for the figure in this document can be found at

https://github.com/Ritesh622/Assignment_EE5609/tree/master/Assignment_8

1 Problem

Find weather given functions $\mathbf{T}$ from $\mathbb{R}^2$ into $\mathbb{R}^2$ are linear transformations or not

$$\mathbf{T}(x_1, x_2) = ({x_1}^2, x_2) \tag{1.0.1}$$

2 solution

Let

$$\mathbf{T}(1,0) = \begin{pmatrix}1\\1\end{pmatrix}\begin{pmatrix}1 & 0\end{pmatrix}\begin{pmatrix}1 & 0\\0 & 1\end{pmatrix} \tag{2.0.1}$$

$$\implies \mathbf{T}(1,0) = (1,0) \tag{2.0.2}$$

$$\mathbf{T}(-1,0) = \begin{pmatrix}1\\1\end{pmatrix}\begin{pmatrix}-1 & 0\end{pmatrix}\begin{pmatrix}-1 & 0\\0 & 1\end{pmatrix} \tag{2.0.3}$$

$$\implies \mathbf{T}(-1,0) = (1,0) \tag{2.0.4}$$

If $\mathbf{T}$ were a linear transformation then we would have

$$\mathbf{T}((1,0)) = (1,0) \tag{2.0.5}$$

$$\implies \mathbf{T}(-1\,(1,0)) = -1.\mathbf{T}(1,0) \tag{2.0.6}$$

$$\implies -1.(1,0) = (-1,0) \tag{2.0.7}$$

which is a contradiction, since

$$\mathbf{T}((-1,0)) = (1,0) \tag{2.0.8}$$

$$(1,0) \neq (-1,0)\,. \tag{2.0.9}$$

Hence non-linear transformation.