EE5609: Matrix Theory Assignment-9

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***Abstract*—This document proves the given function is Linear Transformation**

Download the latex-tikz codes from

https://github.com/pranaya14014/EE5609/tree/master/Assignment9

1 PROBLEM

$$\mathbf{T}\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} x_2 \\ x_1 \end{pmatrix} \tag{1.0.1}$$

Does function $\mathbf{T}$ from $\mathbb{R}^2$ into $\mathbb{R}^2$ is Linear Transformation.

2 SOLUTION

Let,

$$\mathbf{x}, \mathbf{y} \in \mathbb{R}^2 \tag{2.0.1}$$

Using transformation on $\mathbf{T}$,

$$\mathbf{T}(\mathbf{x}) = \mathbf{A}\mathbf{x} \tag{2.0.2}$$

From (1.0.1) we get,

$$\mathbf{A} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \tag{2.0.3}$$

With c being a scalar,

$$\mathbf{T}(c\mathbf{x}+\mathbf{y}) = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}(c\mathbf{x}+\mathbf{y}) \tag{2.0.4}$$

$$= \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} c\mathbf{x} + \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\mathbf{y} \tag{2.0.5}$$

$$= \begin{pmatrix} 0 & c \\ c & 0 \end{pmatrix}\mathbf{x} + \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\mathbf{y} \tag{2.0.6}$$

$$= c\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\mathbf{x} + \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\mathbf{y} \tag{2.0.7}$$

From (2.0.7) we can say,

$$\mathbf{T}(c\mathbf{x}+\mathbf{y}) = c\mathbf{T}(\mathbf{x}) + \mathbf{T}(\mathbf{y}) \tag{2.0.8}$$

Hence from (2.0.8) we can say $\mathbf{T}$ is a Linear Transformation from $\mathbb{R}^2$ to $\mathbb{R}^2$