

# Assignment-13

Pooja H  
AI20MTECH14003

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

Therefore, the given function  $T$  is a linear transformation.

Download all latex-tikz codes from

[https://github.com/poojah15/EE5609\\_AI20MTECH14003/tree/master/Assignment\\_13](https://github.com/poojah15/EE5609_AI20MTECH14003/tree/master/Assignment_13)

## 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  $T : \mathbf{V} \rightarrow \mathbf{W}$  is called a linear transformation of  $\mathbf{V}$  into  $\mathbf{W}$  if the following properties are true for all  $\mathbf{u}$  and  $\mathbf{v}$  in  $\mathbf{V}$  and for any scalar  $k$ .

$$T(\mathbf{u} + \mathbf{v}) = T(\mathbf{u}) + T(\mathbf{v}) \quad (2.0.1)$$

$$T(k\mathbf{u}) = kT(\mathbf{u}) \quad (2.0.2)$$

Given,

$$T\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} \quad (2.0.3)$$

Consider,

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

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

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

Also, we need to show that for some constant  $k$ ,  $T(k\mathbf{x}) = kT(\mathbf{x})$ . Consider,

$$T(k\mathbf{x}) = \begin{pmatrix} k & -k \\ 0 & 0 \end{pmatrix} \mathbf{x} \quad (2.0.7)$$

$$= k \begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix} \mathbf{x} \quad (2.0.8)$$

$$T(k\mathbf{x}) = kT(\mathbf{x}) \quad (2.0.9)$$