Matrix theory Assignment 11

K R Sai Pranav

***Abstract*—This document contains the concept of sub space.**

Download all python codes from

https://github.com/saipranavkr/EE5609/codes

and latex-tikz codes from

https://github.com/saipranavkr/EE5609

1 Problem

Find the range, rank, null space, and nullity for the zero transformation and the identity transformation on a finite-dimensional space V.

2 Solution

Suppose vector space $\mathbf{V}$ has dimension n. Table 0 provides the properties of range, rank, null space and nullity of zero and identity transformation on a vector space $\mathbf{V}$

3 Example

Let T_0, T_I be the zero and identity transformation on the vector space $\mathbf{V}$ of dimension 2. Let,

$$\mathbf{v} = \begin{pmatrix} v_1 \\ v_2 \end{pmatrix}$$

be a vector in $\mathbf{V}$. Now,

$$T_0\mathbf{v} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{3.0.1}$$

From (3.0.1) we can tell that, it has range of $\{0\}$, Rank of Zero, Null space as $\mathbf{V}$ and nullity as 2(The dimension of $\mathbf{V}$) Now,

$$T_I\mathbf{v} = \begin{pmatrix} v_1 \\ v_2 \end{pmatrix} \tag{3.0.2}$$

From (3.0.2) we can tell that, it has range of $\mathbf{V}$, Rank of 2, Null space as $\{0\}$ and nullity as 0(The dimension of zero subspace). Because identity transformation is the transformation $T_I : \mathbf{R}_n \rightarrow \mathbf{R}_n$ defined by $T_I(x) = x$ for every vector x

$\mathbf{v}^T = \begin{pmatrix} v_1 & v_2 & \cdots & v_n \end{pmatrix}$		
Properties	**Zero Transformation**	**Identity Transformation**
Transformation	$T_0\mathbf{v} = \begin{pmatrix} 0 \\ 0 \\ \vdots \\ 0 \end{pmatrix}$	$T_I\mathbf{v} = \begin{pmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{pmatrix}$
Range	Zero subspace $\{0\}$	whole vector space $\mathbf{V}$
Rank	Zero	n
Null space	whole vector space $\mathbf{V}$	Zero subspace $\{0\}$
Nullity	whole vector space $\mathbf{V}$ $\implies n$	Zero subspace $\{0\}$ $\implies 0$

TABLE 0: Properties of Zero and Identity transformation