

EE5609: Matrix Theory

Assignment-2

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Abstract—This document contains a solution for proving the determinant of the given matrix is zero.

Download the python codes from

<https://github.com/pavanmanesh/EE5609/blob/master/Assignment2/codes>

and latex-tikz codes from

<https://github.com/pavanmanesh/EE5609/tree/master/Assignment2>

Let A be the given matrix and x be a vector where x is

$$\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \quad (3.0.4)$$

From (2.0.1), we can write the augmented form in this way:

$$\begin{pmatrix} -a & 0 & -c & 0 \\ 0 & a & -b & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \quad (3.0.5)$$

upon solving the above , the value of x:

$$\mathbf{x} = \begin{pmatrix} -\frac{c}{a}x_3 \\ \frac{b}{a}x_3 \\ x_3 \end{pmatrix} \quad (3.0.6)$$

$$\mathbf{x} = \begin{pmatrix} -\frac{c}{a} \\ \frac{b}{a} \\ 1 \end{pmatrix} x_3 \quad (3.0.7)$$

1 PROBLEM

$$\begin{vmatrix} 0 & a & -b \\ -a & 0 & c \\ b & c & 0 \end{vmatrix} = 0 \quad (1.0.1)$$

2 THEOREM FOR HOMOGENEOUS SYSTEMS

Theorem used for solving this problem:

$$A\mathbf{x} = \mathbf{0} \quad (2.0.1)$$

has a nontrivial solution if and only if $|A| = 0$ (i.e., A is singular).

There exists a nontrivial solution for the given matrix. From the theorem (2.0.1), the determinant is equal to 0.

3 SOLUTION

Converting A into reduced echelon form:

$$\begin{pmatrix} 0 & a & -b \\ -a & 0 & -c \\ b & c & 0 \end{pmatrix} \xrightarrow{R_1 \leftrightarrow R_2} \begin{pmatrix} -a & 0 & -c \\ 0 & a & -b \\ b & c & 0 \end{pmatrix} \quad (3.0.1)$$

$$\xrightarrow{R_3 \leftarrow a \times R_3 + b \times R_1} \begin{pmatrix} -a & 0 & -c \\ 0 & a & -b \\ 0 & ac & -bc \end{pmatrix} \quad (3.0.2)$$

$$\xrightarrow{R_3 \leftarrow R_3 - c \times R_2} \begin{pmatrix} -a & 0 & -c \\ 0 & a & -b \\ 0 & 0 & 0 \end{pmatrix} \quad (3.0.3)$$