Assignment 1

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***Abstract*—This document solves a problem from Lines and Planes,where we solve the given pair of linear equations.**

Download all python codes from

https://github.com/priya6971/matrix_theory_EE5609/tree/master/school/tree/master/training/design/codes

and latex-tikz codes from

https://github.com/priya6971/matrix_theory_EE5609/tree/master/school/tree/master/training/design

1 Problem

Solve the following pair of linear equation

$$\begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} x = \begin{pmatrix} -74 \\ -604 \end{pmatrix} \tag{1.0.1}$$

2 Explanation

Let the matrix is A and b is the vector. So,Ax = b Then we can calculate x = A^{-1} . b

$$\mathbf{A} = \begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} \tag{2.0.1}$$

$$\mathbf{b} = \begin{pmatrix} -74 \\ -604 \end{pmatrix} \tag{2.0.2}$$

3 Solution

$$\mathbf{A} = \begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} \tag{3.0.1}$$

$$\mathbf{b} = \begin{pmatrix} -74 \\ -604 \end{pmatrix} \tag{3.0.2}$$

$$\mathbf{R} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \tag{3.0.3}$$

$$\mathbf{RARAx} = \mathbf{RARb} \tag{3.0.4}$$

$$\mathbf{RARA} = \mathbf{kI} \tag{3.0.5}$$

I is the Identity Matrix and k is the constant which is equal to 118868 which is shown below

$$\mathbf{kIx} = \mathbf{RARb} \tag{3.0.6}$$

$$\mathbf{kx} = \mathbf{RARb} \tag{3.0.7}$$

Finally divide the LHS and RHS by constant k in order to get the value of x. Now as we know

$$\mathbf{Ax} = \mathbf{b} \tag{3.0.8}$$

$$\mathbf{x} = \mathrm{A}^{-1} \text{ . b} \tag{3.0.9}$$

$$\mathrm{A}^{-1} = \mathrm{RAR} \tag{3.0.10}$$

So, by putting the values of R,A and b in equation 3.0.4 we can easily find out the value of x as follows: Matrix Multiplication of RA is :

$$\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}\begin{pmatrix} 158 & -378 \\ -378 & -152 \end{pmatrix} = \begin{pmatrix} 378 & -152 \\ 158 & -378 \end{pmatrix} \tag{3.0.11}$$

Now, using above resultant matrix RA we can evaluate RARA x = RAR b

$$\begin{pmatrix} 378 & -152 \\ 158 & -378 \end{pmatrix}\begin{pmatrix} 378 & -152 \\ 158 & -378 \end{pmatrix} x = \begin{pmatrix} 378 & -152 \\ 158 & -378 \end{pmatrix}\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}\begin{pmatrix} -74 \\ -604 \end{pmatrix} \tag{3.0.12}$$

After doing matrix multiplication in LHS and RHS,

$$\begin{pmatrix} 118868 & 0 \\ 0 & 118868 \end{pmatrix} x = \begin{pmatrix} 239560 \\ 123404 \end{pmatrix} \tag{3.0.13}$$

Now, divide both the rows by 118868:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} x = \begin{pmatrix} 239560/118868 \\ 123404/118868 \end{pmatrix} \tag{3.0.14}$$

After further calculations in the fractional result:

$$x = \begin{pmatrix} 59890/29717 \\ 30851/29717 \end{pmatrix} \qquad (3.0.15)$$