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

2 Explanation

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

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

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

3 Solution

Solution Approach 1 :

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

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

$x = A^{-1}.b$

$$x = \begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix}^{-1} \cdot \begin{pmatrix} -74 \\ -604 \end{pmatrix}$$

Adjoint of a given matrix A = $\begin{pmatrix}152 & 378\\ 378 & 158\end{pmatrix}$

Multiply by 1/Determinant of Matrix A with the adjoint in order to get the final result

$$x = \begin{pmatrix}2.01534475 & 1.03815998\end{pmatrix}$$

Solution Approach 2:

Using Row Reduction Method approach:

Augmented Matrix is : $\begin{pmatrix} 158 & -378|-74 \\ -378 & 152|-604 \end{pmatrix}$

Step1-Multiply Row1 by 378 and Row2 by 152:

$$\begin{pmatrix} 59724 & -142884|-27972 \\ -59724 & 24016|-95432 \end{pmatrix}$$

Step2-Add row1 and row2 in row2:

$$\begin{pmatrix} 59724 & -142884|-27972 \\ 0 & -118868|-123404 \end{pmatrix}$$

Step3-row1 is row1*118868 - row2*142884:

$$\begin{pmatrix} 7099272432 & 0|1.43*10^{1}0 \\ 0 & -118868|-123404 \end{pmatrix}$$

Step4-row1 is row1/7099272432 and row2 is row2/-118868:

$$\begin{pmatrix} 1 & 0|2.0153 \\ 0 & 1|1.03816 \end{pmatrix}$$

Step5-Final value of x:

$$x = \begin{pmatrix}2.01534475 & 1.03815998\end{pmatrix}$$

Solution Approach 3 :

Augmented Matrix is : Ax = b

Assuming R = $\begin{pmatrix}0 & -1\\ 1 & 0\end{pmatrix}$
Now,multiply R on both sides, we get :

$RAx = Rb$

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

After multiplication of matrix:

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

Now, multiply the matrix A on both sides,we get:

$ARAx = ARb$

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

Now, after multiplication of above matrices:

$$\begin{pmatrix}0 & 118,868\\ -118,868 & 0\end{pmatrix} x = \begin{pmatrix}123404\\ -239560\end{pmatrix}$$

Now, both the rows is row/118,868:

$$\begin{pmatrix}0 & 1\\ -1 & 0\end{pmatrix} x = \begin{pmatrix}1.03815998\\ -2.01534475\end{pmatrix}$$

So, final result is :

$$x = \begin{pmatrix}2.01534475 & 1.03815998\end{pmatrix}$$