

# 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](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](https://github.com/priya6971/matrix_theory_EE5609/tree/master/school/tree/master/training/design)

## 1 PROBLEM

Solve the following pair of linear equation

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

## 2 EXPLANATION

Let the matrix is A and b is the vector.

So,  $Ax = b$  Then we can calculate  $x = A^{-1}.b$

$$A = \begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} \quad (2.0.1)$$

$$b = \begin{pmatrix} -74 \\ -604 \end{pmatrix} \quad (2.0.2)$$

## 3 SOLUTION

$$A = \begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} \quad (3.0.1)$$

$$b = \begin{pmatrix} -74 \\ -604 \end{pmatrix} \quad (3.0.2)$$

Augmented Matrix is :  $Ax = b$

$$R = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \quad (3.0.3)$$

Now, multiply R on both sides, we get :

$$RAX = Rb$$

$$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} x = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} -74 \\ -604 \end{pmatrix} \quad (3.0.4)$$

After multiplication of matrix:

$$\begin{pmatrix} 378 & -152 \\ -158 & -378 \end{pmatrix} x = \begin{pmatrix} 604 \\ -74 \end{pmatrix} \quad (3.0.5)$$

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

$$ARAX = ARb$$

$$\begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} \begin{pmatrix} 378 & -152 \\ -158 & -378 \end{pmatrix} x = \begin{pmatrix} 158 & -378 \\ -378 & 152 \end{pmatrix} \begin{pmatrix} 604 \\ -74 \end{pmatrix} \quad (3.0.6)$$

Now, after multiplication of above matrices:

$$\begin{pmatrix} 0 & 118,868 \\ -118,868 & 0 \end{pmatrix} x = \begin{pmatrix} 123404 \\ -239560 \end{pmatrix} \quad (3.0.7)$$

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

$$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} x = \begin{pmatrix} 30851/29717 \\ -59890/29717 \end{pmatrix} \quad (3.0.8)$$

As we know  $EE^{-1} = I$ ,

Now inverse of the below matrix is:

$$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \quad (3.0.9)$$

Now multiply with the inverse of the Matrix in order to get the identity Matrix :

$$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} x = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 30851/29717 \\ -59890/29717 \end{pmatrix} \quad (3.0.10)$$

So, final matrix is after matrix multiplication:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} x = \begin{pmatrix} 59890/29717 \\ 30851/29717 \end{pmatrix} \quad (3.0.11)$$

So, final result is :

$$x = \begin{pmatrix} 59890/29717 & 30851/29717 \end{pmatrix} \quad (3.0.12)$$