

Matrix Theory (EE5609)

Assignment-1

Prasanth Kumar Duba
EE20RESCH11008

Abstract—This document contains the solution to find the direction vector for a straight line drawn through the given point

Download all python codes from

<https://github.com/EE20RESCH11008/Matrix-Theory/tree/master/Assignment-1/Code>

and latex-tikz codes from

<https://github.com/EE20RESCH11008/Matrix-Theory/tree/master/Assignment-1>

1 PROBLEM

Find the direction in which a straight line must be drawn through the point \mathbf{B} so that its point of intersection with the line may be the distance of 3 units from this point, where

$$\mathbf{B} = \begin{pmatrix} -1 \\ 2 \end{pmatrix} \quad (1.0.1)$$

and the line

$$(1 \quad 1)\mathbf{x} = 4 \quad (1.0.2)$$

2 SOLUTION

The given equation of the line in parametric form:

$$\mathbf{x} = \mathbf{A} + \lambda \mathbf{m} \quad (2.0.1)$$

where,

$$\mathbf{A} = \begin{pmatrix} 3 \\ 1 \end{pmatrix} \quad (2.0.2)$$

$$\mathbf{m} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} \quad (2.0.3)$$

If \mathbf{x} be the point of intersection,

$$\|\mathbf{x} - \mathbf{B}\| = 3 \quad (2.0.4)$$

$$\|\mathbf{A} + \lambda \mathbf{m} - \mathbf{B}\| = 3 \quad (2.0.5)$$

$$(\mathbf{A} + \lambda \mathbf{m} - \mathbf{B})^T (\mathbf{A} + \lambda \mathbf{m} - \mathbf{B}) = 9 \quad (2.0.6)$$

$$[(\mathbf{A} - \mathbf{B})^T \mathbf{m} = \mathbf{m}^T (\mathbf{A} - \mathbf{B})] \quad (2.0.7)$$

$$\|\mathbf{m}\|^2 \lambda^2 + [2(\mathbf{A} - \mathbf{B})^T \mathbf{m}] \lambda + \|\mathbf{A} - \mathbf{B}\|^2 = 9 \quad (2.0.8)$$

$$2\lambda^2 + 10\lambda + 8 = 0 \quad (2.0.9)$$

$$\lambda = -4 \quad \text{or} \quad \lambda = -1 \quad (2.0.10)$$

The point of intersection,

$$\therefore \mathbf{x} = \begin{pmatrix} -1 \\ 5 \end{pmatrix} \text{ or } \begin{pmatrix} 2 \\ 2 \end{pmatrix} \quad (2.0.11)$$

The direction vector,

$$\mathbf{v} = \mathbf{B} - \mathbf{x} \quad (2.0.12)$$

$$\mathbf{v} = \begin{pmatrix} 0 \\ -3 \end{pmatrix} \text{ or } \begin{pmatrix} -3 \\ 0 \end{pmatrix} \quad (2.0.13)$$

