

# Assignment 2

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**Abstract**—This document explains the concept of finding if two different lines are perpendicular to each other.

Download latex-tikz codes from

<https://github.com/harshachinta/EE5609-Matrix-Theory/tree/master/Assignments/Assignment2>

## 1 PROBLEM

Show that the lines

$$\frac{x-5}{7} = \frac{y+2}{-5} = \frac{z}{1},$$

$$\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$$

are perpendicular to each other.

## 2 EXPLANATION

Let us consider a parameter  $t$ .  
Considering the first equation:

$$\frac{x-5}{7} = \frac{y+2}{-5} = \frac{z}{1} = t \quad (2.0.1)$$

Line equation of 2.0.1 can be written as,

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 7t+5 \\ 5t-2 \\ t \end{pmatrix} = \begin{pmatrix} 5 \\ 2 \\ 0 \end{pmatrix} + t \begin{pmatrix} 7 \\ -5 \\ 1 \end{pmatrix} \quad (2.0.2)$$

From 2.0.2, the direction vector is given by

$$\mathbf{d}_1 = \begin{pmatrix} 7 \\ -5 \\ 1 \end{pmatrix} \quad (2.0.3)$$

Similarly, let us consider second equation:

$$\frac{x}{1} = \frac{y}{2} = \frac{z}{3} = t \quad (2.0.4)$$

Line equation of 2.0.4 can be written as,

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = t \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \quad (2.0.5)$$

From 2.0.5, the direction vector is given by

$$\mathbf{d}_2 = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \quad (2.0.6)$$

Two lines are perpendicular to each other when the dot product of their direction vectors is 0.

Dot product of direction vectors  $\mathbf{d}_1$  and  $\mathbf{d}_2$  (from eq 2.0.3 and 2.0.6) is given by:

$$\mathbf{d}_1^T \mathbf{d}_2 = (7 \times 1) + (-5 \times 2) + (1 \times 3) = 0 \quad (2.0.7)$$

$$\Rightarrow \boxed{\mathbf{d}_1^T \mathbf{d}_2 = 0} \quad (2.0.8)$$

## 3 SOLUTION

From 2.0.8, as the dot product of direction vectors of the lines is 0 ( $\mathbf{d}_1^T \mathbf{d}_2 = 0$ ), we can say that the lines are perpendicular to each other.