Assignment 2

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

Download all python codes from

```
https://github.com/harshachinta/EE5609−Matrix−
    Theory/tree/master/Assignments/Assignment2/
    code
```

and latex-tikz codes from

```
https://github.com/harshachinta/EE5609−Matrix−
    Theory/tree/master/Assignments/Assignment2
```

1 Problem

Show that the lines

$$\frac{x-5}{7} = \frac{y+2}{-5} = \frac{z}{1}, \tag{1.0.1}$$

$$\frac{x}{1} = \frac{y}{2} = \frac{z}{3} \tag{1.0.2}$$

are perpendicular to each other.

2 Explanation

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

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

Line equation of (2.0.1) can be written as,

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

From (2.0.2), the direction vector is given by

$$\mathbf{d_1} = \begin{pmatrix} 7 \\ -5 \\ 1 \end{pmatrix} \tag{2.0.3}$$

Similarly, let us consider second equation:

$$\frac{x}{1} = \frac{y}{2} = \frac{z}{3} = t \tag{2.0.4}$$

Line equation of (2.0.4) can be written as,

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

From (2.0.5), the direction vector is given by

$$\mathbf{d_2} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \tag{2.0.6}$$

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 equation (2.0.3) and (2.0.6)) is given by:

$$\mathbf{d_1^T d_2} = (7 \times 1) + (-5 \times 2) + (1 \times 3) = 0 \tag{2.0.7}$$

$$\implies \boxed{\mathbf{d_1^T d_2} = 0} \tag{2.0.8}$$

3 Solution

From (2.0.8), as the dot product of direction vectors of the lines is 0 ($\mathbf{d_1^T d_2} = 0$), we can say that the lines are perpendicular to each other.

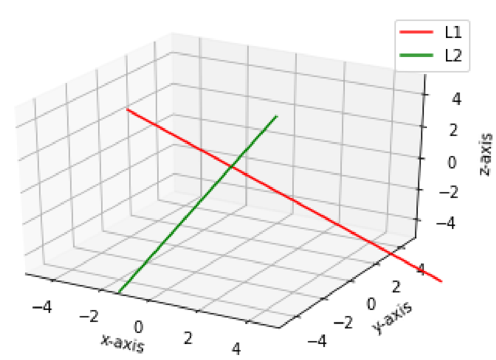

Fig. 1: Lines perpendicular to each other