

# Matrix Theory (EE5609) Assignment 1

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**Abstract**—This assignment solves a problem on checking whether two lines are parallel or perpendicular.

Below is the link to python code solution of this problem

## 1 PROBLEM STATEMENT

Show that the line through the points  $\begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix}$  and  $\begin{pmatrix} 3 \\ 4 \\ -2 \end{pmatrix}$  is parallel to the line through the points  $\begin{pmatrix} 0 \\ 3 \\ 2 \end{pmatrix}$  and  $\begin{pmatrix} 3 \\ 5 \\ 6 \end{pmatrix}$ .

## 2 THEORY

The direction ratios  $a_1, b_1, c_1$  for a line through the points  $\begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix}$  and  $\begin{pmatrix} x_2 \\ y_2 \\ z_2 \end{pmatrix}$  are given by

$$a_1 = x_2 - x_1 \quad (2.0.1)$$

$$b_1 = y_2 - y_1 \quad (2.0.2)$$

$$c_1 = z_2 - z_1 \quad (2.0.3)$$

For two lines having direction ratios  $a_1, b_1, c_1$  and  $a_2, b_2, c_2$  respectively, they will be parallel if

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2} \quad (2.0.4)$$

And the two lines will be perpendicular if

$$a_1 a_2 + b_1 b_2 + c_1 c_2 = 0 \quad (2.0.5)$$

## 3 SOLUTION

From the theory, the direction ratios for the line through the points  $\begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix}$  and  $\begin{pmatrix} 3 \\ 4 \\ -2 \end{pmatrix}$  are  $a_1 = 2, b_1 = 5, c_1 = -4$  (using equations 2.0.1, 2.0.2, 2.0.3).

Similarly, the direction ratios for the line through the points  $\begin{pmatrix} 0 \\ 3 \\ 2 \end{pmatrix}$  and  $\begin{pmatrix} 3 \\ 5 \\ 6 \end{pmatrix}$  are  $a_2 = 3, b_2 = 2, c_2 = 4$  (using equations 2.0.1, 2.0.2, 2.0.3).

To check if the two lines are parallel, we put the values of the direction ratios of the two lines in equation 2.0.4,

$$\frac{2}{3} \neq \frac{5}{2} \neq \frac{-4}{4}$$

which does not satisfy equation 2.0.4, hence proved that the lines are **not parallel**.

Again to check if the two lines are perpendicular, we put the values of the direction ratios of the two lines in equation 2.0.5,

$$2 \cdot 3 + 5 \cdot 2 + (-4) \cdot 4 = 0$$

which satisfies the equation 2.0.5, hence the lines are **perpendicular** to each other.

**Python Code:** The python code for the above solution can be found at - [https://github.com/Arko98/EE5609/blob/master/Assignment\\_1/Solution\\_1.py](https://github.com/Arko98/EE5609/blob/master/Assignment_1/Solution_1.py)