

AI5006 - Assignment 1

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Question :

Find the vector equation of the line passing through the point $\begin{pmatrix} 1 \\ 2 \\ -4 \end{pmatrix}$ and perpendicular to the two lines

$$\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7} \text{ and}$$

$$\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{5}$$

Solution :

Equation of a \vec{l} passing through \vec{a} and parallel to \vec{n} is given by:
 $\vec{l} = \vec{a} + L * \vec{n}$, where L is some constant

Since the line passes through $\begin{pmatrix} 1 \\ 2 \\ -4 \end{pmatrix}$

$$\vec{a} = (i + 2j - 4k)$$

Let \vec{n} be the normal vector to both lines. If \vec{m}_1 and \vec{m}_2 are the direction vectors of the lines, then

$$\vec{m}_1^T \vec{n} = 0$$

$$\vec{m}_2^T \vec{n} = 0$$

$$\text{Let } \vec{n} = \begin{pmatrix} x \\ y \\ z \end{pmatrix} \quad \vec{m}_1 = \begin{pmatrix} 3 \\ -16 \\ 7 \end{pmatrix} \quad \vec{m}_2 = \begin{pmatrix} 3 \\ 8 \\ -5 \end{pmatrix}$$

Since \vec{n} is perpendicular to \vec{m}_1 and \vec{m}_2

$$3x - 16y + 7z = 0$$

$$3x + 8y - 5z = 0$$

Solving the equations $\frac{x}{2} = \frac{y}{3} = \frac{z}{6} = K$

$$x = 2K, y = 3K, z = 6K$$

$$\vec{n} = K * (2i + 3j + 6k)$$

so the equation of \vec{l} is

$$\vec{l} = (i + 2j - 4k) + L * K(2i + 3j + 6k), \text{ where L is any constant}$$

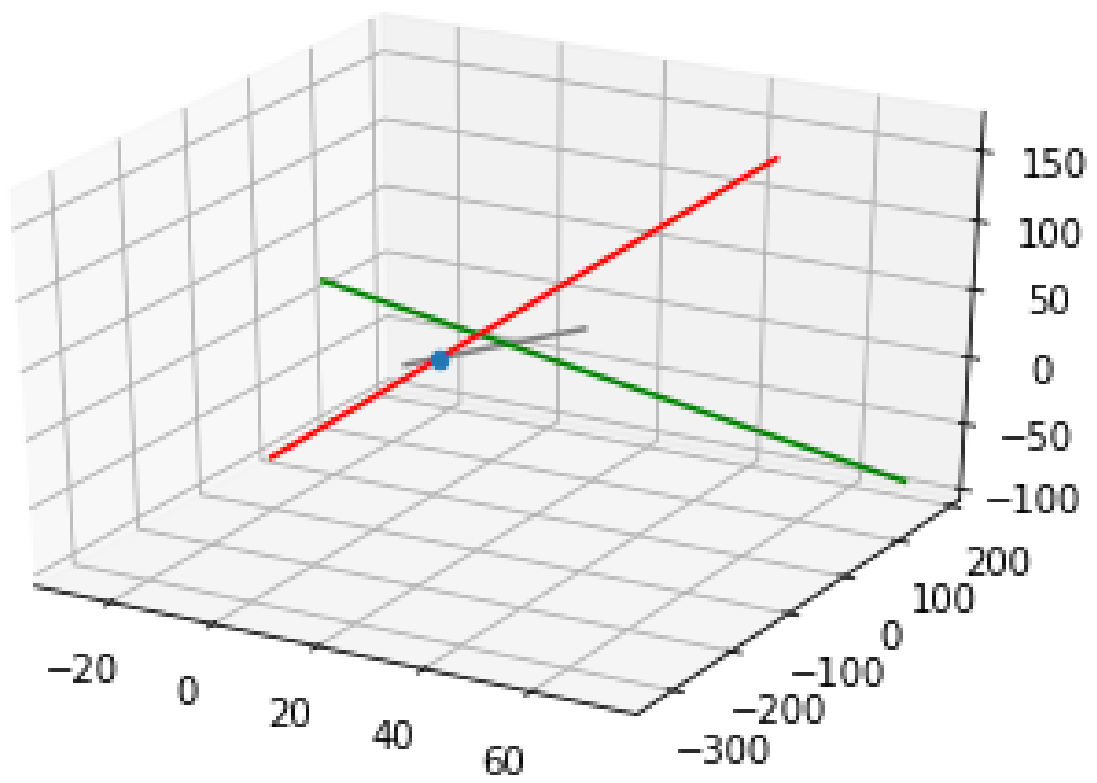


Figure 1: perpendicular