## 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

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

 $\vec{\mathbf{l}} = \vec{\mathbf{a}} + L * \vec{\mathbf{n}}$ , where L is some constant Since the line passes through  $\begin{pmatrix} 1 \\ 2 \\ -4 \end{pmatrix}$ 

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

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

$$\vec{\mathbf{m_1}}^T \vec{\mathbf{n}} = 0$$

$$\vec{\mathbf{m_2}}^T \vec{\mathbf{n}} = 0$$
Let  $\vec{\mathbf{n}} = \begin{pmatrix} x \\ y \\ z \end{pmatrix}$ 

$$\vec{\mathbf{m_1}} = \begin{pmatrix} 3 \\ -16 \\ 7 \end{pmatrix}$$

$$\vec{\mathbf{m_2}} = \begin{pmatrix} 3 \\ 8 \\ -5 \end{pmatrix}$$

Since  $\vec{n}$  is perpendicular to  $\vec{m_1}$  and  $\vec{m_2}$ 

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

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

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

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

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

so the equation of  $\vec{l}$  is

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

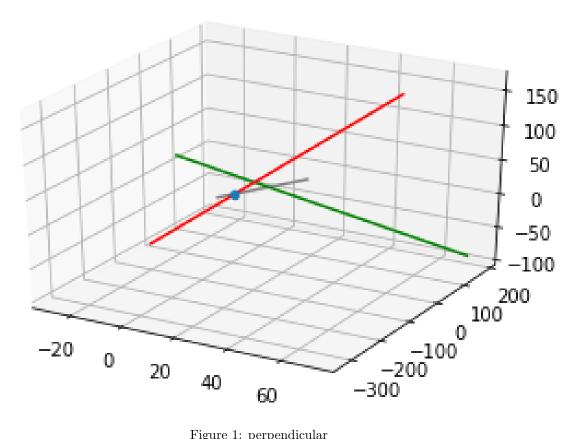


Figure 1: perpendicular