1-Vector Arithmetic

EE1030:Matrix Theory

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Question:1.11.2
Unit vector along PQ, where coordinates of **P** and **Q** respectively are (2, 1, -1) and (4, 4, -7), is (12, 2023)
Solution:

Vertex	Coordinates
P	$\begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix}$
Q	$\begin{pmatrix} 4 \\ 4 \\ -7 \end{pmatrix}$

Table 1.11.2.1 0: Vertex and its coordinates

The vector along PQ is **Q** - **P**

$$\mathbf{Q}-\mathbf{P} = \begin{pmatrix} 4 \\ 4 \\ -7 \end{pmatrix} - \begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix} \tag{0.1}$$

$$\mathbf{Q}-\mathbf{P} = \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix} \tag{0.2}$$

$$(\mathbf{Q}-\mathbf{P})^{\mathsf{T}} = \begin{pmatrix} 2 & 3 & -6 \end{pmatrix} \tag{0.3}$$

The magnitude of the vector along PQ is

$$\|\mathbf{Q}-\mathbf{P}\| = \sqrt{(\mathbf{Q}-\mathbf{P})^{\mathsf{T}}(\mathbf{Q}-\mathbf{P})} \tag{0.4}$$

$$\|\mathbf{Q}-\mathbf{P}\| = \sqrt{\begin{pmatrix} 2 & 3 & -6 \end{pmatrix}\begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix}} \tag{0.5}$$

$$\|\mathbf{Q}-\mathbf{P}\| = \sqrt{(2)^2+(3)^2+(-6)^2} \tag{0.6}$$

$$\|\mathbf{Q}-\mathbf{P}\| = 7 \tag{0.7}$$

The unit vector along PQ is

$$\frac{\mathbf{Q}-\mathbf{P}}{\|\mathbf{Q}-\mathbf{P}\|} = \frac{\begin{pmatrix}2\\3\\-6\end{pmatrix}}{7} \tag{0.8}$$

$$\frac{\mathbf{Q}-\mathbf{P}}{\|\mathbf{Q}-\mathbf{P}\|} = \frac{1}{7}\begin{pmatrix}2\\3\\-6\end{pmatrix} \tag{0.9}$$

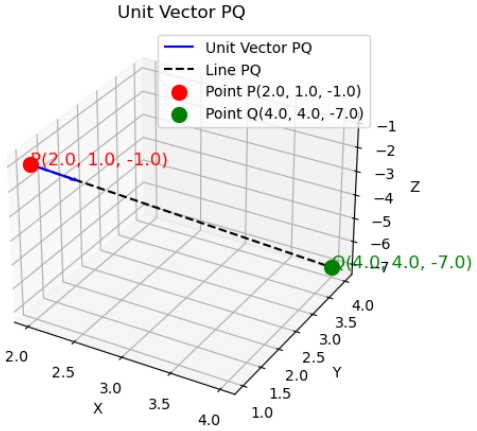

Fig. 0.1: Unit Vector PQ