

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
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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

$$\mathbf{P} = \begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix} \quad (0.1)$$

$$\mathbf{Q} = \begin{pmatrix} 4 \\ 4 \\ -7 \end{pmatrix} \quad (0.2)$$

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

$$\mathbf{Q} - \mathbf{P} = \begin{pmatrix} 4 \\ 4 \\ -7 \end{pmatrix} - \begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix} \quad (0.3)$$

$$\mathbf{Q} - \mathbf{P} = \begin{pmatrix} 4 - 2 \\ 4 - 1 \\ -7 - (-1) \end{pmatrix} \quad (0.4)$$

$$\mathbf{Q} - \mathbf{P} = \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix} \quad (0.5)$$

$$(\mathbf{Q} - \mathbf{P})^T = (2 \quad 3 \quad -6) \quad (0.6)$$

The magnitude of the vector along PQ is

$$\|\mathbf{Q} - \mathbf{P}\| = \sqrt{(\mathbf{Q} - \mathbf{P})^T (\mathbf{Q} - \mathbf{P})} \quad (0.7)$$

$$\|\mathbf{Q} - \mathbf{P}\| = \sqrt{\begin{pmatrix} 2 & 3 & -6 \end{pmatrix} \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix}} \quad (0.8)$$

$$\|\mathbf{Q} - \mathbf{P}\| = \sqrt{(2)^2 + (3)^2 + (-6)^2} \quad (0.9)$$

$$\|\mathbf{Q} - \mathbf{P}\| = \sqrt{4 + 9 + 36} \quad (0.10)$$

$$\|\mathbf{Q} - \mathbf{P}\| = \sqrt{49} \quad (0.11)$$

$$\|\mathbf{Q} - \mathbf{P}\| = 7 \quad (0.12)$$

The unit vector along PQ is

$$\frac{\mathbf{Q} - \mathbf{P}}{\|\mathbf{Q} - \mathbf{P}\|} = \frac{\begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix}}{7} \quad (0.13)$$

$$\frac{\mathbf{Q} - \mathbf{P}}{\|\mathbf{Q} - \mathbf{P}\|} = \frac{1}{7} \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix} \quad (0.14)$$

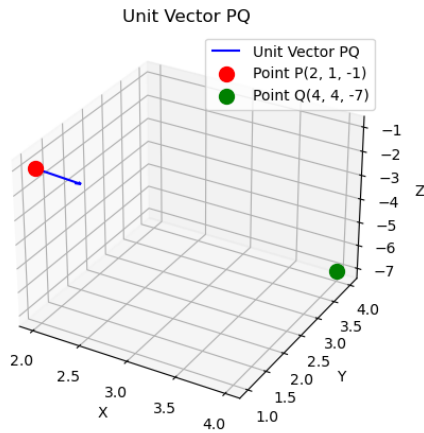


Fig. 0.1: Unit Vector PQ