

7.4.27

EE25BTECH11020 - Darsh Pankaj Gajare

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Question:

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The triangle PQR is inscribed in the circle $x^2 + y^2 = 25$. If \mathbf{Q} and \mathbf{R} have co-ordinates $(3, 4)$ and $(-4, 3)$ respectively then $\angle QPR$ is equal to

(A) $\frac{\pi}{2}$

(B) $\frac{\pi}{3}$

(C) $\frac{\pi}{4}$

(D) $\frac{\pi}{6}$

Solution:

Table

Q	$\begin{pmatrix} 3 \\ 4 \end{pmatrix}$
R	$\begin{pmatrix} -4 \\ 3 \end{pmatrix}$

$$\mathbf{x}^\top \mathbf{x} = 25$$

(0.1)

The given points (position vectors) are

$$\mathbf{q} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}, \quad \mathbf{r} = \begin{pmatrix} -4 \\ 3 \end{pmatrix} \quad (0.2)$$

Verify they lie on the circle:

$$\mathbf{q}^\top \mathbf{q} = 3^2 + 4^2 = 25, \quad (0.3)$$

$$\mathbf{r}^\top \mathbf{r} = (-4)^2 + 3^2 = 25. \quad (0.4)$$

Compute the inner product (matrix/dot product):

$$\mathbf{q}^\top \mathbf{r} = \begin{pmatrix} 3 & 4 \end{pmatrix} \begin{pmatrix} -4 \\ 3 \end{pmatrix} \quad (0.5)$$

$$= 3 \cdot (-4) + 4 \cdot 3 = -12 + 12 = 0. \quad (0.6)$$

Compute norms (using matrix notation) and the central angle θ :

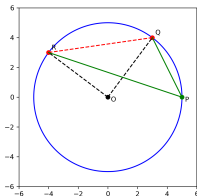
$$\|\mathbf{q}\| = \sqrt{\mathbf{q}^\top \mathbf{q}} = 5, \quad \|\mathbf{r}\| = \sqrt{\mathbf{r}^\top \mathbf{r}} = 5, \quad (0.7)$$

$$\cos \theta = \frac{\mathbf{q}^\top \mathbf{r}}{\|\mathbf{q}\| \|\mathbf{r}\|} = \frac{0}{5 \cdot 5} = 0 \quad (0.8)$$

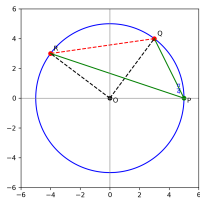
$$\Rightarrow \theta = \frac{\pi}{2}. \quad (0.9)$$

Since $\angle QPR$ is the angle subtended at the circumference by chord QR , it equals half the central angle:

$$\angle QPR = \frac{\theta}{2} = \frac{\pi}{4}. \quad (0.10)$$



Plot using C libraries



Plot using Python