

Assignment 4

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Geometry

Abstract—This documnet contains the solution to prove angles of a equilateral triangles are 60 degrees through Linear Algebra .

Download all python codes from

https://github.com/shivangi-975/EE5609-Matrix_Theory/tree/master/Assignment4/Codes

Download latex-tikz codes from

https://github.com/shivangi-975/EE5609-Matrix_Theory/blob/master/Assignment4/Assignment4.tex

$$\mathbf{B}^T \mathbf{C} = (\sqrt{x_2^2 + y_2^2} \sqrt{x_3^2 + y_3^2}) \cos \theta = (x_1^2 + y_1^2) \cos \theta \quad (2.0.6)$$

$$\mathbf{C}^T \mathbf{A} = (\sqrt{x_3^2 + y_3^2} \sqrt{x_1^2 + y_1^2}) \cos \theta = (x_1^2 + y_1^2) \cos \theta \quad (2.0.7)$$

From 2.0.5 2.0.6 and 2.0.7 we have

$$\mathbf{A}^T \mathbf{B} = \mathbf{B}^T \mathbf{C} = \mathbf{C}^T \mathbf{A} \quad (2.0.8)$$

1 PROBLEM

To prove angles of equilateral triangles are 60° each.

2 SOLUTION

Considering A,B and C as the vertices of triangle:

$\mathbf{A} = \begin{pmatrix} x_1 \\ y_1 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} x_2 \\ y_2 \end{pmatrix}$ $\mathbf{C} = \begin{pmatrix} x_3 \\ y_3 \end{pmatrix}$ Expressing each side in terms of norm we have:

$$\|\mathbf{A}\| = \sqrt{x_1^2 + y_1^2} \quad (2.0.1)$$

$$\|\mathbf{B}\| = \sqrt{x_2^2 + y_2^2} \quad (2.0.2)$$

$$\|\mathbf{C}\| = \sqrt{x_3^2 + y_3^2} \quad (2.0.3)$$

we know for equilateral triangle all sides are equal,Hence we have:

$$\|\mathbf{A}\| = \|\mathbf{B}\| = \|\mathbf{C}\| \quad (2.0.4)$$

Now taking inner product we have:

$$\mathbf{A}^T \mathbf{B} = (\sqrt{x_1^2 + y_1^2} \sqrt{x_2^2 + y_2^2}) \cos \theta = (x_1^2 + y_1^2) \cos \theta \quad (2.0.5)$$