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

1 Problem

To prove angles of equilateral triangles are 60° each.

2 Solution

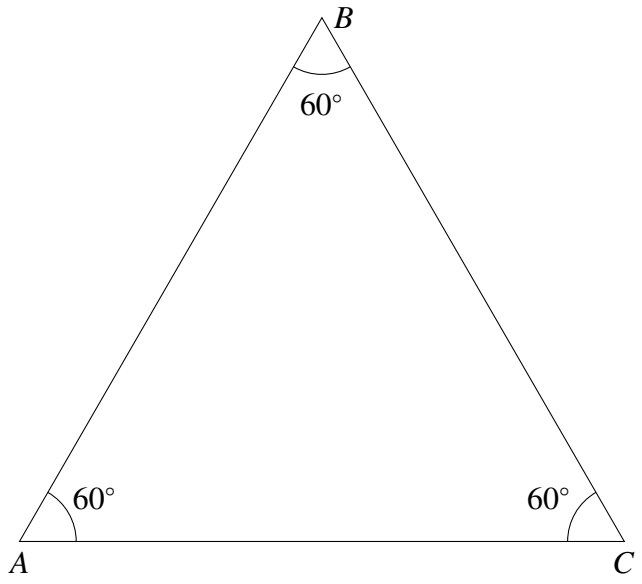

Fig. 1: Equilateral $\triangle ABC$ with A,B and C as vertices

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

$$A = \begin{pmatrix} a_1 \\ a_2 \end{pmatrix} B = \begin{pmatrix} 0 \\ 0 \end{pmatrix} C = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix}$$

In equilateral triangle we have:

$$\|\mathbf{A}-\mathbf{B}\| = \|\mathbf{B}-\mathbf{C}\| = \|\mathbf{A}-\mathbf{C}\| \tag{2.0.1}$$

Taking Inner Product of **BC** and **AC**

$$\begin{aligned} \angle BCA &= \|\mathbf{B}-\mathbf{C}\|^T \|\mathbf{A}-\mathbf{C}\| \\ \angle BCA &= \|\mathbf{B}-\mathbf{C}\|^2 \cos\theta \end{aligned} \tag{2.0.2}$$

Taking Inner Product of **BC** and **AC**

$$\begin{aligned} \angle BAC &= \|\mathbf{B}-\mathbf{A}\|^T \|\mathbf{A}-\mathbf{C}\| \\ \angle BAC &= \|\mathbf{B}-\mathbf{C}\|^2 \cos\theta \end{aligned} \tag{2.0.3}$$

Taking Inner Product of **BC** and **AC**

$$\begin{aligned} \angle ABC &= \|\mathbf{A}-\mathbf{B}\|^T \|\mathbf{B}-\mathbf{C}\| \\ \angle ABC &= \|\mathbf{B}-\mathbf{C}\|^2 \cos\theta \end{aligned} \tag{2.0.4}$$

From 2.0.2,2.0.3 and 2.0.4 we have

$$\angle BCA = \angle ABC = \angle BAC \tag{2.0.5}$$