Assignment 4

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Download latex-tikz codes from

https://github.com/Bharat437/Matrix_Theory/tree/master/Assignment4

1 Question

(Geometry,1.10) Q. Using cosine formula in an equilateral triangle, show that $\cos 60^\circ = \frac{1}{2}$.

2 Explanation

Consider an equilateral $\triangle ABC$ as shown in below figure:

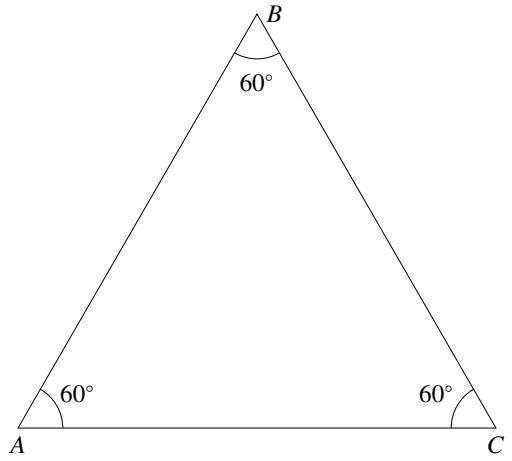

Fig. 1: Equilateral $\triangle ABC$

In equilateral triangle, all sides have equal length. Lets consider coordinates of points as A(0,0),B($\frac{1}{2}$,$\frac{\sqrt{3}}{2}$),C(1,0) such that each side has length equal to 1 and forms an equilateral triangle.

Direction vector of AC and AB is given as below

$$\mathbf{m}_{AC} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \tag{2.0.1}$$

$$\mathbf{m}_{AB} = \begin{pmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix} \tag{2.0.2}$$

We can say that line AB is obtained by rotating line AC by +60°. Using rotation matrix, we can obtain direction vector of AB as below.

$$\begin{pmatrix} \cos 60^\circ & -\sin 60^\circ \\ \sin 60^\circ & \cos 60^\circ \end{pmatrix} \mathbf{m}_{AC} = \mathbf{m}_{AB} \tag{2.0.3}$$

$$\implies \begin{pmatrix} \cos 60^\circ & -\sin 60^\circ \\ \sin 60^\circ & \cos 60^\circ \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix} \tag{2.0.4}$$

$$\implies \begin{pmatrix} \cos 60^\circ \\ \sin 60^\circ \end{pmatrix} = \begin{pmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix} \tag{2.0.5}$$

$$\cos 60^\circ = \frac{1}{2} \tag{2.0.6}$$

Hence proved.