

Assignment 1

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AI20MTECH11001

Abstract—This document explains the properties of a unit vector and how to find out if two vectors are perpendicular, using an example of three mutually perpendicular unit vectors

Download all python codes from

<https://github.com/ZeeShan-IITH/IITH-EE5609/new/master/codes>

and latex-tikz codes from

<https://github.com/ZeeShan-IITH/IITH-EE5609>

I. PROBLEM

show that each of the given three vectors is a unit vector

$$\frac{1}{7} \begin{pmatrix} 2 \\ 3 \\ 6 \end{pmatrix}, \frac{1}{7} \begin{pmatrix} 3 \\ -6 \\ 2 \end{pmatrix}, \frac{1}{7} \begin{pmatrix} 6 \\ 2 \\ -3 \end{pmatrix}.$$

II. EXPLANATION

A unit vector is a vector of unit magnitude. let

$$\vec{a} = \frac{1}{7} \begin{pmatrix} 2 \\ 3 \\ 6 \end{pmatrix}, \vec{b} = \frac{1}{7} \begin{pmatrix} 3 \\ -6 \\ 2 \end{pmatrix}, \vec{c} = \frac{1}{7} \begin{pmatrix} 6 \\ 2 \\ -3 \end{pmatrix}$$

$$\|\vec{a}\| = \frac{1}{7} \sqrt{2^2 + 3^2 + 6^2} = 1$$

$$\|\vec{b}\| = \frac{1}{7} \sqrt{3^2 + (-6)^2 + 2^2} = 1$$

$$\|\vec{c}\| = \frac{1}{7} \sqrt{6^2 + 2^2 + (-3)^2} = 1$$

III. PROBLEM

Also show that the three vectors are mutually perpendicular to each other

IV. EXPLANATION

When two vectors are perpendicular to each other their dot product is zero.

The dot product of \vec{a} and \vec{b} is

$$\vec{a}^T \vec{b} = \frac{1}{7} \cdot \frac{1}{7} (2 \cdot 3 + 3 \cdot (-6) + 6 \cdot 2) = 0$$

The dot product of \vec{b} and \vec{c} is

$$\vec{b}^T \vec{c} = \frac{1}{7} \cdot \frac{1}{7} (3 \cdot 6 + (-6) \cdot 2 + 2 \cdot (-3)) = 0$$

The dot product of \vec{c} and \vec{a} is

$$\vec{c}^T \vec{a} = \frac{1}{7} \cdot \frac{1}{7} (6 \cdot 2 + 2 \cdot 3 + (-3) \cdot 6) = 0$$