

Assignment 1

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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/Zeehan-IITH/IITH-EE5609/new/master/codes>

and latex-tikz codes from

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

1 PROBLEM

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

$$\frac{1}{7} \begin{pmatrix} 2 \\ 3 \\ 6 \end{pmatrix} \quad (1)$$

$$\frac{1}{7} \begin{pmatrix} 3 \\ -6 \\ 2 \end{pmatrix} \quad (2)$$

$$\frac{1}{7} \begin{pmatrix} 6 \\ 2 \\ -3 \end{pmatrix} \quad (3)$$

2 EXPLANATION

A unit vector is a vector of unit magnitude. let

$$\mathbf{A} = \frac{1}{7} \begin{pmatrix} 2 \\ 3 \\ 6 \end{pmatrix}, \mathbf{B} = \frac{1}{7} \begin{pmatrix} 3 \\ -6 \\ 2 \end{pmatrix}, \mathbf{C} = \frac{1}{7} \begin{pmatrix} 6 \\ 2 \\ -3 \end{pmatrix}$$

$$\|\mathbf{A}\| = \frac{1}{7} \sqrt{2^2 + 3^2 + 6^2} = 1 \quad (4)$$

$$\|\mathbf{B}\| = \frac{1}{7} \sqrt{3^2 + (-6)^2 + 2^2} = 1 \quad (5)$$

$$\|\mathbf{C}\| = \frac{1}{7} \sqrt{6^2 + 2^2 + (-3)^2} = 1 \quad (6)$$

3 PROBLEM

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

4 EXPLANATION

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

The dot product of \mathbf{A} and \mathbf{B} is

$$\mathbf{A}^T \mathbf{B} = \frac{1}{7} \cdot \frac{1}{7} (2 \cdot 3 + 3 \cdot -6 + 6 \cdot 2) = 0 \quad (7)$$

The dot product of \mathbf{B} and \mathbf{C} is

$$\mathbf{B}^T \mathbf{C} = \frac{1}{7} \cdot \frac{1}{7} (2 \cdot 3 + 3 \cdot -6 + 6 \cdot 2) = 0 \quad (8)$$

The dot product of \mathbf{C} and \mathbf{A} is

$$\mathbf{C}^T \mathbf{A} = \frac{1}{7} \cdot \frac{1}{7} (6 \cdot 2 + 2 \cdot 3 + -3 \cdot 6) = 0 \quad (9)$$

Hence, the three unit vectors are mutually perpendicular to each other.