# 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/subhasishsaikia22/EE5609-
    Matrix-theory
```

and latex-tikz codes from

```
https://github.com/subhasishsaikia22/EE5609-
    Matrix-theory
```

## 1 Problem

Show that the lines with the directional vectors

$$\begin{pmatrix}12\\-3\\-4\end{pmatrix}, \quad \begin{pmatrix}4\\12\\3\end{pmatrix} \quad and \quad \begin{pmatrix}3\\-4\\12\end{pmatrix} \tag{1.0.1}$$

are mutually perpendicular.

## 2 Explanation

When two vectors are perpendicular to each other,their inner product is zero. Let

$$\mathbf{A} = \begin{pmatrix}12\\-3\\-4\end{pmatrix} \tag{2.0.1}$$

$$\mathbf{B} = \begin{pmatrix}4\\12\\3\end{pmatrix} \tag{2.0.2}$$

$$\mathbf{C} = \begin{pmatrix}3\\-4\\12\end{pmatrix} \tag{2.0.3}$$

The inner product of $\mathbf{A}$ and $\mathbf{B}$ is

$$\mathbf{A}^T\mathbf{B} = (12 \cdot 4) + (-3 \cdot 12) + (-4 \cdot 3) = 0 \tag{2.0.4}$$

The inner product of $\mathbf{B}$ and $\mathbf{C}$ is

$$\mathbf{B}^T\mathbf{C} = (4 \cdot 3) + (12 \cdot -4) + (3 \cdot 12) = 0 \tag{2.0.5}$$

The inner product of $\mathbf{C}$ and $\mathbf{A}$ is

$$\mathbf{C}^T\mathbf{A} = (3 \cdot 12) + (-4 \cdot -3) + (12 \cdot -4) = 0 \tag{2.0.6}$$

Hence, the three lines with the given directional vectors are mutually perpendicular.