Assignment1

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***Abstract*—This document explains the concept of collinear and whether the triangle formed by given 3 points is right angled triangle or not.**

Download all python codes from https://github.com/cs19resch11004/5600/hari

Download all Latex-tikz codes from https://github.com/cs19resch11004/5600/hari

I. Problem

Without using the Pythagoras theorem, show that $\begin{pmatrix}4\\4\end{pmatrix}$, $\begin{pmatrix}3\\5\end{pmatrix}$ and $\begin{pmatrix}-1\\-1\end{pmatrix}$ are the vertices of a right angled triangle?

II. Solution

The direction vectors of $\vec{A}-\vec{B}$, $\vec{A}-\vec{C}$ and $\vec{B}-\vec{C}$ are

$$\vec{A}-\vec{B}=\begin{pmatrix}-1\\1\end{pmatrix} \tag{1}$$

$$\vec{A}-\vec{C}=\begin{pmatrix}-5\\-5\end{pmatrix} \tag{2}$$

$$\vec{B}-\vec{C}=\begin{pmatrix}-4\\-6\end{pmatrix} \tag{3}$$

1)

$$(\vec{A}-\vec{B})^T(\vec{B}-\vec{C})=\begin{pmatrix}-1\\1\end{pmatrix}\begin{pmatrix}-4\\-6\end{pmatrix}=-2 \tag{4}$$

$$(\vec{A}-\vec{B})^T(\vec{B}-\vec{C})=-2\neq 0 \tag{5}$$

Sides $\vec{A}-\vec{B}$ and $\vec{B}-\vec{C}$ of triangle are not perpendicular.

2)

$$(\vec{A}-\vec{C})^T(\vec{B}-\vec{C})=\begin{pmatrix}-5\\-5\end{pmatrix}\begin{pmatrix}-4\\-6\end{pmatrix}=50 \tag{6}$$

$$(\vec{A}-\vec{C})^T(\vec{B}-\vec{C})=50\neq 0 \tag{7}$$

Sides $\vec{A}-\vec{C}$ and $\vec{B}-\vec{C}$ of triangle are not perpendicular.

3)

$$(\vec{A}-\vec{B})^T(\vec{A}-\vec{C})=\begin{pmatrix}-1\\1\end{pmatrix}\begin{pmatrix}-5\\-5\end{pmatrix}=0 \tag{8}$$

$$(\vec{A}-\vec{B})^T(\vec{A}-\vec{C})=0 \tag{9}$$

Sides $\vec{A}-\vec{B}$ and $\vec{A}-\vec{C}$ of triangle are perpendicular to each other and the right angle at vertex $\begin{pmatrix}4\\4\end{pmatrix}$, and the following figure represents the triangle formed by given points $\vec{A}$, $\vec{B}$ and $\vec{C}$.