

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. EXPLANATION

Initially we will test whether given 3 points are collinear or not. If they are non-collinear then we will check whether the triangle formed by given 3 points is right angled triangle or not by using one of the following 2 methods.

1. Direction vector based method
2. Slope method

In this document we are going to use Direction vector based method.

Let A, B and C are 3 non-collinear points, then we will test, whether any two of the following Direction vectors \vec{AB} and \vec{AC} or \vec{AB} and \vec{BC} or \vec{AC} and \vec{BC} are perpendicular to each other or not by using DOT PRODUCT.

III. SOLUTION

The direction vectors of AB, AC and BC are

$$\begin{aligned}\vec{AB} &= \begin{pmatrix} -1 \\ 1 \end{pmatrix} \\ \vec{AC} &= \begin{pmatrix} -5 \\ -5 \end{pmatrix} \\ \vec{BC} &= \begin{pmatrix} -4 \\ -6 \end{pmatrix}\end{aligned}$$

Testing of \vec{AB} and \vec{BC} are perpendicular to each other or not?

DOT PRODUCT of \vec{AB} and \vec{BC} is,

$$\begin{pmatrix} -1 \\ 1 \end{pmatrix}^T \cdot \begin{pmatrix} -4 \\ -6 \end{pmatrix} = -2 \quad (1)$$

$$\vec{AB} \cdot \vec{BC} = -2 \neq 0$$

Sides AB and BC of triangle are not perpendicular.

Testing of \vec{AC} and \vec{BC} are perpendicular to each other or not?

DOT PRODUCT of \vec{AC} and \vec{BC} is,

$$\begin{pmatrix} -5 \\ -5 \end{pmatrix}^T \cdot \begin{pmatrix} -4 \\ -6 \end{pmatrix} = 50 \quad (2)$$

$$\vec{AC} \cdot \vec{BC} = 50 \neq 0$$

Sides AC and BC of triangle are not perpendicular.

Testing of \vec{AB} and \vec{AC} are perpendicular to each other or not?

DOT PRODUCT of \vec{AB} and \vec{AC} is,

$$\begin{pmatrix} -1 \\ 1 \end{pmatrix}^T \cdot \begin{pmatrix} -5 \\ -5 \end{pmatrix} = 0 \quad (3)$$

$$\vec{AB} \cdot \vec{AC}, \text{ which is } 0$$

Sides AB and AC of triangle are perpendicular to each other. So Triangle ABC is right angled triangle and right angle at vertex $\begin{pmatrix} 4 \\ 4 \end{pmatrix}$.