

# Vector Assignment

Gautam Singh

**Abstract**—This document contains the solution to Question 17 of Exercise 2 in Chapter 10 of the class 12 NCERT textbook.

- 1) Show that the points  $\mathbf{A}, \mathbf{B}, \mathbf{C}$  with position vectors  $\mathbf{A} = \begin{pmatrix} 3 \\ -4 \\ -4 \end{pmatrix}$ ,  $\mathbf{B} = \begin{pmatrix} 2 \\ -1 \\ 1 \end{pmatrix}$ ,  $\mathbf{C} = \begin{pmatrix} 1 \\ -3 \\ -5 \end{pmatrix}$  form the vertices of a right angled triangle.

**Solution:** We write the direction vectors of the three sides as

$$\mathbf{c} = \mathbf{B} - \mathbf{A} = \begin{pmatrix} -1 \\ 3 \\ 5 \end{pmatrix} \quad (1)$$

$$\mathbf{a} = \mathbf{C} - \mathbf{B} = \begin{pmatrix} -1 \\ -2 \\ -6 \end{pmatrix} \quad (2)$$

$$\mathbf{b} = \mathbf{C} - \mathbf{A} = \begin{pmatrix} -2 \\ 1 \\ -1 \end{pmatrix} \quad (3)$$

Taking the inner product of each pair of vectors,

$$\mathbf{c}^\top \mathbf{a} = -35 \quad (4)$$

$$\mathbf{a}^\top \mathbf{b} = 6 \quad (5)$$

$$\mathbf{b}^\top \mathbf{c} = 0 \quad (6)$$

From (6),  $\mathbf{b}^\top \mathbf{c} = 0$ , which implies that  $\mathbf{b} \perp \mathbf{c}$ . Hence,  $\triangle ABC$  is right angled at A. The Python code `codes/perp.py` verifies the answer.