

# Assignment - 3

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**Abstract**—This is a simple document to learn about vectors and matrices and present it using latex, draw figures using Python, Latex.

Download all and latex-tikz codes from

svn co <https://github.com/arjunjc93/Assignment-2.git>

## 1 VECTORS

(POINTS AND VECTORS BY G V V SHARMA  
EXERCISES-Q.2.26)

1.1. The two adjacent sides of a parallelogram are  $\begin{pmatrix} 2 \\ -4 \\ -5 \end{pmatrix}$  and  $\begin{pmatrix} 1 \\ -2 \\ -3 \end{pmatrix}$ . Find out the unit vector parallel to its diagonal. Also, find its area.

**Solution:**

a) Let

$$\mathbf{A} = \begin{pmatrix} 2 \\ -4 \\ -5 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 1 \\ -2 \\ -3 \end{pmatrix} \quad (1.1.1)$$

be the adjacent sides of the parallelogram.  
Let  $\mathbf{D}$  be the diagonal of the parallelogram.  
Then,

$$\mathbf{D} = \mathbf{A} + \mathbf{B} \quad (1.1.2)$$

$$\mathbf{D} = \begin{pmatrix} 3 \\ -6 \\ -8 \end{pmatrix} \quad (1.1.3)$$

$$\|\mathbf{D}\| = \sqrt{(3)^2 + (-6)^2 + (-8)^2} = \sqrt{109} \quad (1.1.4)$$

Let  $\mathbf{U}$  be the unit vector of  $\mathbf{D}$  which can be found as follows:

$$\mathbf{U} = \frac{\mathbf{D}}{\|\mathbf{D}\|} \quad (1.1.5)$$

Solving the above equation gives the unit vector  $\mathbf{U}$  which is parallel to the diagonal  $\mathbf{D}$ .

$$\therefore \mathbf{U} = \frac{1}{\sqrt{109}} \begin{pmatrix} 3 \\ -6 \\ -8 \end{pmatrix} \quad (1.1.6)$$

The area of the parallelogram is defined as

$$\|\mathbf{A} \times \mathbf{B}\| \quad (1.1.7)$$

where

$$\mathbf{A} \times \mathbf{B} = \begin{pmatrix} 0 & -A_3 & A_2 \\ A_3 & 0 & -A_1 \\ -A_2 & A_1 & 0 \end{pmatrix} \begin{pmatrix} B_1 \\ B_2 \\ B_3 \end{pmatrix} \quad (1.1.8)$$

$$= \begin{pmatrix} 0 & 5 & -4 \\ -5 & 0 & -2 \\ 4 & 2 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ -2 \\ -3 \end{pmatrix} = \begin{pmatrix} -2 \\ 1 \\ 0 \end{pmatrix} \quad (1.1.9)$$

Thus the desired area is

$$\|\mathbf{A} \times \mathbf{B}\| = \sqrt{(-2)^2 + (1)^2 + (0)^2} \quad (1.1.10)$$

$$= \sqrt{5} \quad (1.1.11)$$

