# Assignment - 3

Arjun Jayachandran
MD/2020/702

***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

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

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

$$\mathbf{D} = \mathbf{A} + \mathbf{B} \tag{1.1.2}$$

$$\mathbf{D} = \begin{pmatrix}3\\-6\\-8\end{pmatrix} \tag{1.1.3}$$

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

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

$$\mathbf{U} = \frac{\mathbf{D}}{\|\mathbf{D}\|} \tag{1.1.5}$$

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

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

The area of the parallelogram is defined as

$$\|\mathbf{A} \times \mathbf{B}\| \tag{1.1.7}$$

where

$$\mathbf{A} \times \mathbf{B} = \begin{pmatrix}0 & -A_3 & A_2\\ A_3 & 0 & -A_1\\ -A_2 & A_1 & 0\end{pmatrix}\begin{pmatrix}B_1\\B_2\\B3\end{pmatrix} \tag{1.1.8}$$

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

Thus the desired area is

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

$$= \sqrt{5} \tag{1.1.11}$$