# Matrix Theory (EE5609) Assignment 1

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***Abstract*—This document contains the solution to find a unit vector perpendicular to two vectors**

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## 1 Problem

Find a unit vector perpendicular to each of the vectors a+b and a-b, where

$$a = \begin{pmatrix} 3 \\ 2 \\ 2 \end{pmatrix}, b = \begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix} \tag{1.0.1}$$

## 2 Solution

Let A = a+b and B = a-b

$$A = \begin{pmatrix} 3 \\ 2 \\ 2 \end{pmatrix} + \begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix} = \begin{pmatrix} 4 \\ 4 \\ 0 \end{pmatrix} \tag{2.0.1}$$

$$B = \begin{pmatrix} 3 \\ 2 \\ 2 \end{pmatrix} - \begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix} = \begin{pmatrix} 2 \\ 0 \\ 4 \end{pmatrix} \tag{2.0.2}$$

Let C be a vector Perpendicular to A and B which can be found by the cross product of A and B

$$C = A \times B \tag{2.0.3}$$

$$C = \begin{vmatrix} i & j & k \\ 4 & 4 & 0 \\ 2 & 0 & 4 \end{vmatrix} \tag{2.0.4}$$

$$\therefore C = \begin{pmatrix} 16 \\ -16 \\ -8 \end{pmatrix} \tag{2.0.5}$$

$$||C|| = \sqrt{16^2 + (-16)^2 - 8^2} = 24 \tag{2.0.6}$$

Let u be the unit vector of C which can be found as follows:

$$u = \frac{C}{||C||} \tag{2.0.7}$$

Solving the above equation gives the unit vector u which is perpendicular to vectors A and B

$$\boxed{u = \frac{1}{3}\begin{pmatrix} 2 \\ -2 \\ 1 \end{pmatrix}} \tag{2.0.8}$$