Matrix Theory(EE5609) Assignment 1

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***Abstract*—This Assignment explains the concept of a vector parallel to resultant of two other vectors and finds a vector of given magnitude parallel to resultant vector**

Download all python codes from

https://github.com/anshum0302/EE5609/blob/master/assignment1/solu1.py

and latex-tikz codes from

https://github.com/anshum0302/EE5609/blob/master/assignment1/assign1.tex

1 PROBLEM STATEMENT

Find a vector of magnitude 5 units, and parallel to the resultant of the vectors $\mathbf{a} = \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix}$,$\mathbf{b} = \begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}$.

2 Theory

Resultant $\mathbf{R}$ of two vectors $\mathbf{a}$ and $\mathbf{b}$ is the sum of two vectors.So

$$\mathbf{R} = \mathbf{a} + \mathbf{b} \tag{2.0.1}$$

$$\implies \mathbf{R} = \begin{pmatrix} a1 \\ a2 \\ a3 \end{pmatrix} + \begin{pmatrix} b1 \\ b2 \\ b3 \end{pmatrix} \tag{2.0.2}$$

$$\implies \mathbf{R} = \begin{pmatrix} a1 + b1 \\ a2 + b2 \\ a3 + b3 \end{pmatrix}. \tag{2.0.3}$$

If $\mathbf{R}$ is a vector of magnitude $\|\mathbf{R}\|$ then unit vector in the direction of $\mathbf{R}$ is $\frac{\mathbf{R}}{\|\mathbf{R}\|}$ and vector of magnitude λ parallel to $\mathbf{R}$ is $\frac{\lambda \mathbf{R}}{\|\mathbf{R}\|}$

3 Solution

First find resultant $\mathbf{R}$ of $\mathbf{a} = \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}$

$$\mathbf{R} = \mathbf{a} + \mathbf{b} \tag{3.0.1}$$

$$\implies \mathbf{R} = \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix} \tag{3.0.2}$$

$$\implies \mathbf{R} = \begin{pmatrix} 2+1 \\ 3-2 \\ -1+1 \end{pmatrix} \tag{3.0.3}$$

$$\implies \mathbf{R} = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}. \tag{3.0.4}$$

Magnitude of $\mathbf{R}$ is

$$\|\mathbf{R}\| = \sqrt{3^2 + 1^2 + 0^2} \tag{3.0.5}$$

$$\implies \|\mathbf{R}\| = \sqrt{10} \tag{3.0.6}$$

$$\tag{3.0.7}$$

Then unit vector $\mathbf{r}$ along $\mathbf{R}$ is

$$\mathbf{r} = \frac{\mathbf{R}}{\|\mathbf{R}\|} \tag{3.0.8}$$

$$\implies \mathbf{r} = \frac{1}{\sqrt{10}} \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix} \tag{3.0.9}$$

Then vector of magnitude 5 units parallel to resultant $\mathbf{R}$ is given by

$$\mathbf{u} = 5\mathbf{r} \tag{3.0.10}$$

$$\implies \mathbf{u} = \frac{5}{\sqrt{10}} \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix} \tag{3.0.11}$$

$$\implies \mathbf{u} = \begin{pmatrix} 4.7434 \\ 1.5811 \\ 0 \end{pmatrix} \tag{3.0.12}$$