Matrix theory - Assignment1

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***Abstract*—This document illustrates scalar and vector productsof two vectors**

Download all python codes from

https://github.com/shreeprasadbhat/matrixtheory/tree/master/assignment1/codes

and latex-tikz codes from

https://github.com/shreeprasadbhat/matrix−theory/blob/master/assignment1/

1 Problem

Find scalar and vector products of the two vectors

$$\mathbf{a} = \begin{pmatrix} 3 \\ -4 \\ 5 \end{pmatrix}, \ \mathbf{b} = \begin{pmatrix} -2 \\ 1 \\ -3 \end{pmatrix}$$

2 Construction

2.1 Scalar product

$$\mathbf{a}.\mathbf{b} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}^T = \begin{pmatrix} a_1 \times b_1 + a_2 \times b_2 + a_3 \times b_3 \end{pmatrix}$$

2.2 Vector product

Vector product can be expressed as product of a skew-symmetric matrix and vector

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 0 & a_3 & a_2 \\ a_3 & 0 & -a_1 \\ -a_2 & a_1 & 0 \end{pmatrix} \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$$

3 Solution

3.1 Scalar product

$$\mathbf{a}.\mathbf{b} = \begin{pmatrix} 3 \\ -4 \\ 5 \end{pmatrix} \begin{pmatrix} -2 \\ 1 \\ -3 \end{pmatrix}^T$$
$$= \begin{pmatrix} 3 \times -2 \ + \ -4 \times 1 \ + \ 5 \times -3 \end{pmatrix} \ = \ -25$$

3.2 Vector product

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 0 & 5 & -4 \\ 5 & 0 & -3 \\ -(-4) & 3 & 0 \end{pmatrix} \begin{pmatrix} -2 \\ 1 \\ 3 \end{pmatrix}$$

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} (0 \times -2) \ + \ (-5 \times 1) \ + \ (-4 \times -3) \\ (5 \times -2) \ + \ (0 \times 1) \ + \ (-3 \times -3) \\ (4 \times -2) \ + \ (3 \times 1) \ + (0 \times -3) \end{pmatrix}$$

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 7 \\ -1 \\ 5 \end{pmatrix}$$