

Matrix theory - Assignment1

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Abstract—This document illustrates scalar and vector products of 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/>

3 SOLUTION

3.1 Scalar product

$$\mathbf{a}^T \mathbf{b} = \begin{pmatrix} 3 & -4 & 5 \end{pmatrix} \begin{pmatrix} -2 \\ 1 \\ -3 \end{pmatrix} \quad (3.1.1)$$

$$= (3 \times -2) + (-4 \times 1) + (5 \times -3) \quad (3.1.2)$$

$$= -25 \quad (3.1.3)$$

3.2 Vector product

1 PROBLEM

Find scalar and vector products of the two vectors

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

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 0 & 5 & -4 \\ 5 & 0 & -3 \\ -(-4) & 3 & 0 \end{pmatrix} \begin{pmatrix} -2 \\ 1 \\ 3 \end{pmatrix} \quad (3.2.1)$$

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} (0 \times -2) + (-5 \times 1) + (-4 \times -3) \\ (5 \times -2) + (0 \times 1) + (-3 \times -3) \\ (4 \times -2) + (3 \times 1) + (0 \times -3) \end{pmatrix} \quad (3.2.2)$$

2 CONSTRUCTION

2.1 Scalar product

Scalar product of two vectors \mathbf{a} and \mathbf{b} is defined as

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 7 \\ -1 \\ 5 \end{pmatrix} \quad (3.2.3)$$

$$\mathbf{a}^T \mathbf{b} = \begin{pmatrix} a_1 & a_2 & \dots & a_n \end{pmatrix} \begin{pmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{pmatrix} = a_1 b_1 + a_2 b_2 + \dots + a_n b_n \quad (2.1.1)$$

2.2 Vector product

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

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} 0 & a_3 & a_2 \\ a_3 & 0 & -a_1 \\ -a_2 & a_1 & 0 \end{pmatrix} \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix} \quad (2.2.1)$$