Assignment 1

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***Abstract*—This document illustrates scalar and vector products of two vectors**

Download python code from :

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

Problem

Find scalar and vector products of the two vectors

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

Solution :

Scalar product :

$$a \,.\, b \;=\; \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} \;.\; \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} \;=\; (a_1 \times b_1 \;+\; a_2 \times b_2 \;+\; a_3 \times b_3)$$

Substituting $a_1 = 3,\ a_2 = -4,\ a_3 = 5\ and\ b_1 = -2,\ b_2 = 1,\ b_3 = -3$

$$= \begin{bmatrix} 3 \\ -4 \\ 5 \end{bmatrix} \;.\; \begin{bmatrix} -2 \\ 1 \\ -3 \end{bmatrix}$$

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

$$= -25$$

Vector product :

The vector cross product also can be expressed as the product of a skew−symmetric matrix and a vector

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

Substituting $a_1 = 3,\ a_2 = -4,\ a_3 = 5\ and\ b_1 = -2,\ b_2 = 1,\ b_3 = -3$

$$a \;\times\; b \;=\; \begin{bmatrix} 0 & -5 & -4 \\ 5 & 0 & -3 \\ 4 & 3 & 0 \end{bmatrix} \begin{bmatrix} -2 \\ 1 \\ -3 \end{bmatrix}$$

$$= \begin{bmatrix} (0 \times -2) \;+\; (-5 \times 1) \;+\; (-4 \times -3) \\ (5 \times -2) \;+\; (0 \times 1) \;+\; (-3 \times -3) \\ (4 \times -2) \;+\; (3 \times 1) \;+ (0 \times -3) \end{bmatrix} \;=\; \begin{bmatrix} 7 \\ -1 \\ -5 \end{bmatrix}$$