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4. Points and Vectors

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Homework0 due Feb 8, 2023 08:59 -03 Completed

A list of n numbers can be thought of as a point or a vector in n -dimensional space. In

of n -dimensional vectors $\begin{bmatrix} a_1 \\ a_2 \\ \vdots \\ a_n \end{bmatrix}$ flexibly as points and as vectors.

Dot Products and Norm

3/3 points (graded)

Notation: In this course, we will use regular letters as symbols for numbers, vectors, matrices, hyperplanes, etc. You will need to distinguish what a letter represents from the context.

Recall the dot product of a pair of vectors a and b :

$$a \cdot b = a_1 b_1 + a_2 b_2 + \cdots + a_n b_n \quad \text{where } a = \begin{bmatrix} a_1 \\ a_2 \\ \vdots \\ a_n \end{bmatrix} \text{ and } b = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{bmatrix}$$

When thinking about a and b as vectors in n -dimensional space, we can also express the dot product as

$$a \cdot b = \|a\| \|b\| \cos \alpha,$$

where α is the angle formed between the vectors a and b in n -dimensional Euclidean space. The length, also known as **norm**, of a :

$$\|a\| = \sqrt{a_1^2 + a_2^2 + \cdots + a_n^2}.$$

What is the length of the vector $\begin{bmatrix} 0.4 \\ 0.3 \end{bmatrix}$?



What is the length of the vector $\begin{bmatrix} -0.15 \\ 0.2 \end{bmatrix}$?

Dot Products and Orthogonality

1/1 point (graded)

Given n -dimensional vectors \mathbf{u} and \mathbf{v} , when is \mathbf{u} orthogonal to \mathbf{v} ? The angle between them is θ ?

☐ when $\theta = 0$

☒ when $\theta = 90^\circ$

☐ when $\theta = 180^\circ$



? STANDARD NOTATION

Submit

You have used 2 of 2 attempts

Unit Vectors

1.0/1 point (graded)

A unit vector is a vector with length 1. The length of a vector is also called its norm.

Given any vector \mathbf{x} , what is the unit vector pointing in the same direction as \mathbf{x} ? Answer in terms of the norm of the vector \mathbf{x} .

(Type \mathbf{x} for the vector \mathbf{x} , and $\text{norm}(\mathbf{x})$ for the norm of the vector \mathbf{x} .)

$\mathbf{x} / \text{norm}(\mathbf{x})$



? STANDARD NOTATION

Submit

You have used 3 of 3 attempts

Projections

What is the signed magnitude of the projection of onto ? More precisely, if \mathbf{a} is a vector in the direction of the correct choice above, find a number such that

(Type **a_1** for , **a_2** for , and **a_3** for . If applicable, you may use function such as notation button.)

$$(a_1^2 - a_2^2 + a_3^2) / \sqrt{a_1^2 + a_2^2 + a_3^2}$$

? STANDARD NOTATION

Submission button: The "submit button" will activate only after you have answered all multiple choices, in this problem.

Submit

You have used 3 of 3 attempts

Discussion

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