Exercise 1: Linear Algebra Recap

Lecture Information Processing and Communication

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Submit solutions until Tuesday 2022-04-26, by uploading to your group's exercise folder on cs.uol.de. You may submit your solutions in groups of at most two students.

Note: For the first exercise, submissions are accepted until 12:00 noon Wednesday 2022-04-28 and you may also send them by email.

1. Definition of operations on vectors

Assume that you are given two column vectors $\mathbf{u}$ and $\mathbf{v}$. Give the equation for computing each of the different types of vector products listed below. If two or more are identical, give the equation only once.

(a) inner product, (b) dot product, (c) Hadamard product, (d) tensor product, (e) cross product, (g) dyadic product, (h) outer product, (i) scalar product.

2. Norm and distance

(a) Define the term "norm" of a vector and give three examples of specific vector-norms.

(b) Define the term "distance" of two vectors and relate it to the "norm".

(c) Define the "Frobenius norm" of a matrix $\mathbf{A}$. State the definition using (c1) a double sum and (c2) the trace operator and show that both definitions are equivalent.

3. Projection

Assume that you are given two column vectors $\mathbf{u}$ and $\mathbf{v}$. Define the projection of the vectors.