LINEAR ALGEBRA II FOR PHYSICS

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FS 2023

Program

(1) Linear ODEs and Diagonalization of Endomorphisms.
   (a) Differential equations: linear ODEs with constant coefficients; systems of linear ODEs with constant coefficients; the matrix exponential and its evaluation.
   (b) Diagonalization of matrices.
   (c) Diagonalization of endomorphisms. In particular: the spectral decomposition; the infinite-dimensional case.
   (d) Trigonalization.
(2) Inner Products.
   (a) The dot product.
   (b) Inner product spaces.
   (c) The norm.
   (d) Square-integrable continuous functions and square-summable sequences.
   (e) Orthogonality: the orthogonal projection; the Gram–Schmidt process; orthogonal complements. Sylvester's criterion.
   (f) Orthogonal operators: isometries; the orthogonal groups; symmetric and skew-symmetric operators.
(3) Hermitian products.
   (a) The standard hermitian product on $\mathbb{C}^n$.
   (b) Hermitian spaces. In particular: nondegeneracy and Dirac's notation; the adjoint of an operator.
   (c) The norm.
   (d) Orthogonality: the orthogonal projection; the Gram–Schmidt process; orthogonal complements. Sylvester's criterion.
   (e) Unitary operators: the unitary groups; self-adjoint and anti-self-adjoint operators.
   (f) Diagonalization of normal matrices; in particular, unitary, self-adjoint, and real symmetric matrices.
   (g) Simultaneous diagonalization.
   (h) Normal form of orthogonal matrices.
   (i) Properties of the exponential map to unitary and to orthogonal matrices.
   (j) Normal form of real symmetric bilinear forms.