

1. Linear Algebra (ces trois parties peuvent être traitées ensemble -> Linear Algebra in a broad sense)

Definitions of matrices, vectors and linear systems

Solutions of linear systems of equations: direct methods* (Gauss/Cholesky factorisations).

Vectors spaces, rank, linear independence.

Linear mappings and matrices, basis change, images and kernels.

2. Analytic Geometry

Norms on finite dimensional spaces and dot products, lengths and distances.

Angles, orthogonality.

Orthogonal matrices, projections.

3. Matrix Decomposition

Determinant and trace.

Eigenvalues, eigenvectors, eigendecompositions.

Singular value decompositions, low rank approximation of matrices.

Pour ces 3 parties il faut viser 12h environ (6h cours + 6h TD)

4. Vector calculus (les deux parties qui suivent on peut les traiter ensemble -> mathematical tools for optimisation)

Univariate functions: differentiation, Taylor series decomposition

Partial derivatives and operators for multivariate functions.

Chain rule for partial derivatives, Jacobian matrices and tensors

Gradients of matrix functions, gradients in a deep network.

5. Optimisation

Minimisation of an univariate function

Gradient descent method, stochastic gradient descent

Constrained optimisation, Lagrangian.

Convex optimisation, convex functions.

Linear and quadratic programming.

Pour ces 3 parties il faut viser 6h environ (3h cours + 3h TD)

En Janvier (avant ou au tout debut du second semestre par exemple) on peut completer avec les 2 parties restantes.

6. Probability and statistics

Random variables, Probability distributions (discrete and continuous variables), basic properties

Expected value and variance. Covariance and correlation. Change of variables,

Population, samples. Median mean, confidence intervals.

Central limit theorem.

Multivariate statistics.

Ici on est un peu obligé de dédier 6h (3h cours+ 3h TD) -> il y a beaucoup de concepts et

definitions différentes.

7. Laplace transform

Basic properties of the Laplace transforms

Inverse of Laplace transform

Decomposition in partial fractions for the computation of Laplace transform.

Solutions of ODEs with constant coefficients using Laplace transform

Il serait raisonnable de dédier encore 6h environ pour cette dernière partie