Program 2022-23

1. Finite numbers:
    - Absolute and relative errors
    - Normalized scientific representation (to compute)
    - IEEE single and double precision
    - Absolute and relative representation errors of real numbers in floating point arithmetic
    - Machine precision
    - Sum and subtraction of finite numbers (in basis 10) (to compute)
2. Linear algebra (ch.2,3,4 -not all the pages- MML)
    - Norms of vectors and matrices (to compute)
    - Linear independence of vectors and rank of a matrix. (to compute)
    - Orthogonality. Orthogonal matrices (to compute)
    - Symmetric and positive definite matrices (compute the eigenvalues and eigenvectors of 2x2 matrices)
    - LU and Cholesky decomposition (you are not required to factorize a matrix)
    - Conditioning of a linear system
    - Linear mappings. Matrix representation
    - Affine spaces and subspaces.
    - Orthogonal projections onto subspace of dimension one and onto a general subspace
    - Eigenvalues and eigenvectors (definitions).
    - Singular Vale Decomposition (SVD).
    - Relation between the singular values of A and the eigenvalues of A^TA.
    - Matrix approximation with svd.

3. Vector Calculus
    - Partial derivatives, gradient and hessian (to compute)
    - The chain rule for vector functions f:R^D → R (to compute)
    - The jacobian (to compute)
    - Automatic differentiation (to compute)

4. Optimization
    - Definitions of local and global minima.
    - Optimality conditions.
    - Iterative methods, convergence rate

- Gradient based descent methods: computation of the direction and of the steplength.

5. Probability and statistics.
    - Sample space, event, probability, Random Variable.
    - Probability Mass Function and probability density function. Poisson and normal distributions.
    - Bivariate probability functions.
    - Sum and product rules. Bayes theorem.
    - Statistics of RV: expectation, mean, covariance, variance, standard deviation, correlation.
    - Population statistics.
    - Statistics and conditional independence.
    - Models as deterministic functions. Empirical risk. Regularization. Examples in the book.
    - Models as probabilistic functions. Examples in the book.
    - Maximum likelihood estimate (MLE) and Maximum a posteriori estimate (MAP).