

Statistical Methods **

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Calendario: 24 ore, Lunedì ore 14.30 - 16.30 e Mercoledì ore 14.30 - 16.30. Prima lezione il 9 novembre 2009. Aula DEI/G (Piano 3, Dipartimento di Ingegneria dell'Informazione, Via Gradenigo 6/a).

Prerequisiti: Basics of Probability Theory and Linear Algebra.

Tipologia di esame: homework assignments and take-home exam.

Aim: The course will present a survey of statistical techniques which are important in applications. The unifying power of the information theoretic point of view will be stressed.

Topics:

Background material. The noiseless source coding theorem will be quickly reviewed in order to introduce the basic notions of entropy and informational divergence (Kullback-Leibler distance) of probability measures. The analytical and geometrical properties of the divergence will be presented.

Divergence minimization problems. Three basic minimization problems will be posed and, on simple examples, it will be shown that they produce the main methods of statistical inference: hypothesis testing, maximum likelihood, maximum entropy.

Multivariate analysis methods. Study of the probabilistic and statistical aspects of the three main methods: Principal Component Analysis (PCA), Canonical Correlations (CC) and Factor Analysis (FA). In the spirit of the course these methods will be derived also via divergence minimization. Time permitting there will be a short introduction to the Nonnegative Matrix Factorization method as an alternative to PCA to deal with problems with positivity constraints.

EM methods. The Expectation-Maximization method was introduced as an algorithm for the computation of Maximum Likelihood (ML) estimator with partial observations (incomplete data). We will present the EM method as an alternating divergence minimization algorithm (à la Csiszár Tusnády) and show its application to the ML estimation of Hidden Markov Models.

The MDL method. The Minimum Description Length method of Rissanen will be presented as a general tool for model complexity estimation.

References: A set of lecture notes and a list of references will be posted on the web site of the course.

** Corso mutuato dalla Scuola di Dottorato in "Ingegneria dell'Informazione"