

Seminars:



Four two-hour seminars

Monday, March 18th 2024, 15:00 -17:00h
Tuesday, March 19th 2024, 15:00 -17:00h
Wednesday, March 20th 2024, 15:00 -17:00h
Thursday, March 21th 2024, 15:00 -17:00h

Aula B, Dipartimento di Fisica e Chimica Emilio Segrè, Via Archirafi 36

Fundamental elements of statistical inference

Dr. Miguel Ibanez Berganza,

Networks division, IMT Alti Studi, Lucca

Program (optional topics between brackets):

- 1) Phenomenological introduction. The direct and inverse problems. The concepts of spurious correlations, under- and over-fitting, variance and bias errors, Occam's razor. (0.5h)
- 2) The direct problem in examples. Sampling from a multivariate probability distribution: Markov chains and the MCMC method. Inefficiency of uniform MCMC. Relative entropy, variational free energy, and linear response theory. Correlations, cumulants, and interactions. Spurious correlations and the high-temperature expansion. (2h)
- 3) The inverse problem in examples. Bayesian estimators. Inference with Gaussian mixture models. Bayesian inference of correlation matrices. Maximum entropy inference: two examples. Notions on unsupervised neural network learning. (2h)
- 4) Elements of Bayesian model selection. The Bayesian Information Criterion (BIC). A worked example of model selection. [Model selection and Principal Component Analysis.] [The Evidence Lower BOund approximation in ANN learning.] Variational Bayesian calculus and Hierarchical inference. [The predictive coding algorithm.] Elements of probabilistic approaches to cognition and brain function. (3.5h)

Keywords: Statistical inference, Statistical physics, Neural networks, Maximum entropy inference.