ICFO



ICFO Colloquium Series: Statistical Physics of Generative Diffusion

MARC MEZARD

November 03, 2025
12:00 to 13:00
Auditorium

ABSTRACT:
Generative models, in which one trains an algorithm to generate fake samples ?similar' to those of a data base, is a major new direction developed in machine learning in the recent years. In particular, generative models based on diffusion equations have become the state of the art for image generation. However, the reasons for this spectacular technological success are not well understood, and neither are its limitations. While the theory of stochastic processes asserts that a perfect guidance of the diffusion should lead back to samples of the database, this i¿½condensationi¿½ phenomenon is avoided in practice by the i¿½imperfectioni¿½ of the algorithms used in machine l
arning. After an introduction to this topic, the talk will explain how statistical physics concep
s allow to analyze generative diffusion in the high-dimensional limit, where data are for

ed by a large number of va

BIO:
Marc Mezard is a Professor of Theoretical Physics. He studied physics at Ecole normale superieure in Paris and obtained his PhD in 1984. Hired at CNRS in Paris, he was Research Director in Universite Paris Sud starting in 2012. In 2022 he became Director of Ecole normale superieure, and then joined Bocconi University as a professor, in the newly create department of computational sciences. His work focuses on statistical physics of disorder d systems, with applications in various fields like information theory, computer scienc , machine learning, biophysic
. Mezard is interested in the emergent phenomena in complex systems with many interacti g i¿½atomsi¿½, (that could be for instance agents on a market, information bits, or mol cules are different or live in different environments.) The statistical physics of disordered s stems that he contributes to develop finds applications in various branches of science - bi logy, economics and finance, information theory, computer science, statistics, signal proce sing. In recent years his research has focused on information processing in neural net orks, machine learning and deep networks. He is particularly interested in the theoretical imp ct of data structure on learning strategies and generalization performance.
Hosted by: Prof. Dr. Maciej Lewenstein