Bocconi

Università Commerciale Luigi Bocconi

Department of Decision Sciences

Statistics Seminars

Monte Carlo integration with repulsive point processes

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3-E4-SR03 Via Roentgen 1 Milano

[Streaming via Zoom]

Abstract

Joint work with Adrien Hardy, Ayoub Belhadji, Pierre Chainais

Monte Carlo integration is the workhorse of Bayesian inference, but the mean square error of Monte Carlo estimators decreases slowly, typically as 1/N, where N is the number of integrand evaluations. This becomes a bottleneck in Bayesian applications where evaluating the integrand can take tens of seconds, like in the life sciences, where evaluating the likelihood often requires solving a large system of differential equations. I will present two approaches to faster Monte Carlo rates using interacting particle systems. First, I will show how results from random matrix theory lead to a stochastic version of Gaussian quadrature in any dimension d, with mean square error decreasing as 1/N^{1+1/d}. This quadrature is based on determinantal point processes, which can be argued to be the kernel machine of point processes. Second, I will show how to further take this error rate down assuming the integrand is smooth. In particular, I will give a tight error bound when the integrand belongs to any arbitrary reproducing kernel Hilbert space, using a mixture of determinantal point processes tailored to that space. This mixture is reminiscent of volume sampling, a randomized experimental design used in linear regression.

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