Mean field theory in Inverse Problems: from Bayesian sampling to overparameterization of networks

Qin Li
University of Wisconsin-Madison, USA
qinli@math.wisc.edu

Bayesian sampling and neural networks are seemingly two different machine learning areas, but they both deal with systems with many particles. In sampling, one evolves a large number of samples (particles) to match a target distribution function, and in optimizing over-parameterized neural networks, one can view neurons particles that feed each other information in the DNN flow. These perspectives allow us to employ mean-field theory, a powerful tool that translates dynamics of many particle system into a partial differential equation (PDE), so rich PDE analysis techniques can be used to understand both the convergence of sampling methods and the zero-loss property of over-parameterization of ResNets. I would like to showcase the use of mean-field theory in these two machine learning areas, and I'd also love to hear feedbacks from the audience on other possible applications.

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