

Francesco Camilli: Matrix factorization with neural networks of associative memory

Matrix factorization is an important and challenging mathematical problem encountered in the context of dictionary learning, recommendation systems and machine learning. The study of its Bayes-optimal limits, namely the insurmountable bounds provided by information theory, presents several obstacles that are still hard to overcome. In this talk, I will abandon Bayes-optimality, in favor of an alternative procedure, called "decimation". Decimation is shown to map matrix factorization into a sequence of neural network models of associative memory, of which the Hopfield model is a celebrated example. Each of these networks turn out to depend on the order parameters of the previous ones, that are in turn linked to their retrieval performances. Although sub-optimal in general, decimation has the benefit of completely analyzable performances. Finally, I will exhibit an "oracle" algorithm based on the ground-state search of a neural network, which shows performances that match the theoretical prediction.

Based on: Camilli, Francesco, and Marc Mézard. "Matrix factorization with neural networks." arXiv preprint arXiv:2212.02105 (2022).