Contribution ID: **8** Type: **not specified**

Inferring effective couplings with Restricted Boltzmann Machines

Wednesday, 28 June 2023 15:30 (25 minutes)

Restricted Boltzmann Machines (RBMs) are stochastic neural networks, known for learning a latent representation of the data and generating statistically similar new data. From the statistical physicist's point of view, an RBM is a highly familiar object: a disordered Ising spin Hamiltonian, in which the spins are distributed on a bipartite lattice. Such energy function can be expanded as an Ising-like Hamiltonian with interaction terms up to any desired order. In this work, we used RBMs to face a generalized Ising problem. First, we generated spin configurations with a generalized Ising Hamiltonian and used such configurations to train an RBM. Then, we inferred the coupling tensor of the effective Ising model learned in each case. It is shown that there is a direct equivalence between the RBM parameters and the interactions of the generalized Ising model. Moreover, considering that previous attempts to solve the inverse Ising model with RBMs were limited to 2-body interactions, our work extends such previous approaches as we demonstrate that RBMs can indeed capture high-order correlations.

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