Contribution ID: **109** Type: **not specified**

Unsupervised Identification of phase transition on the Lattice

Tuesday 27 August 2019 15:30 (30 minutes)

Machine learning (ML) has been recently used as a very effective tool for the study and prediction of data in various fields of physics, from statistical physics to theoretical high energy physics. We investigate the use of deep learning autoencoders for the unsupervised recognition of phase transitions in physical systems formulated on a lattice. We use spin configurations produced for the 2-dimensional ferromagnetic Ising model in zero external magnetic field. We study numerically the relation between one latent dimension to the critical temperature T_c. The autoencoder reveals the two phases, one for which the spins are ordered and the other for which spins are disordered, reflecting the restoration of the Z_2 symmetry as the temperature increases. For the our largest volume, the transition between the two phases occurs very close to the analytically extracted critical temperature. We identify as a quasi-order parameter the absolute average latent dimension enabling us to predict the critical temperature.

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Session Classification: Workshop on Lattice and Condensed Matter Physics