Using Supervised Machine Learning to Extract the Entanglement Entropy from Measurements on a Many-Particle Interacting Disordered Wire

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Entanglement, which expresses non-local correlations in quantum mechanics, is the fascinating concept behind much of toady`s aspiration towards quantum technologies. Nevertheless, directly measuring the entanglement of a many-particle system is very challenging. We shall present a proposal to use an artificial intelligence system based on supervised machine learning by a convolution neural network (CNN) to infer the entanglement from a measurable observable for a disordered interacting quantum many-particle system. Several structures of neural networks are tested and a deep CNN akin to structures used for image and speech recognition will be shown the best performance. After training on a set of 500 realizations of disorder, the network is applied on 200 new realizations and its results for the entanglement entropy (EE) where compared to a direct calculation of the EE. Excellent agreement was found, except for several rare region which in a previous study were identified as belonging to an inclusion of a different quantum phase associated with the Griffiths phase.