UNIVERSITÄT LEIPZIG

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Physics Colloquium

Tuesday, 29 June 2021 at 17:00

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The statistical physics of learning revisited: Phase transitions in layered neural networks

The regained interest in artificial neural networks is largely due to the successful application of feed-forward layered networks in a variety of application domains. The successful training of powerful deep networks has become feasible for a number of reasons, including access to large amounts of data and the ever-increasing availability of computational power. One particularly important aspect of network design is the choice of activation functions, which define the response of individual neurons to their actual input. Here, we aim at a systematic understanding of how the actual activation function influences the training and network performance. To this end we formulate and analyse models of large learning networks with high-dimensional input, using approaches borrowed from the statistical physics of disordered systems. We study so-called student/teacher scenarios in formal thermal equilibrium, which represents the outcome of stochastic training process. In particular, we investigate symmetry-breaking phase transitions in the learning process, which result in sudden changes of the network performance with the amount of available training data. We show that the nature of the phase transitions, *e.g.* continuous vs. discontinuous, depends crucially on the activation function.

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