Titolo: On Restricted Boltzmann Machines (RBMs) with non-linear type architectures and compositional phase.

Abstract: Extracting automatically the complex set of features composing real high-dimensional data is crucial for achieving high performance in machine-learning tasks. Restricted Boltzmann machines (RBMs) are empirically known to be efficient for this purpose and for the automatic generation of good quality data. However different architectures lead to different results in the generative tasks. Fantasy particles obtained by an Hopfield model does not conserve the identity of the original data. While higher dimensional interacting network like ReLU-RBMs are able to encode more informations with a cosequent rising of their generating power. In this work we describe breafly the statistical mechanics results related to the Hopfield network, trying to investigate the reasons of its poor generative efficiency in order to make a compharison with ReLU-RBMs. The theoretichal result will be supported by simulations on the handwritten digits dataset MNIST. Computational results enlight the presence of a "compositional phase" the latter machines experience at the end of their training. These outcames allow us to make an ansatz and investigate this operative regime using the replica analysis of an adequate statistical ensemble of random RBMs. The obtained results can be considered as a guideline to create RBMs being able to interact with complex set of data, maintaining at the same time the important features that characterize generative models.