Implementing constrastive divergence algorithm for learning Restricted Boltzmann Machines

1 Description

Restricted Boltzmann Machines (RBMs) are probabilistic generative neural networks that use an energy model to define the probability of the states. They can be used for density estimation and to learn a latent representation of a given problem. However, the methods used to learn the parameters of an RBM are more complex than those commonly used for learning multi-layer perceptrons. These learning algorithms usually require Markov Chain Monte Carlo sampling methods. Contrastive divergence [1, 2, 3] is one of the methods applied to learn RBMs.

2 Objectives

The goal of the project is to implement in Python the Contrastive Divergence algorithm to learn an RBM from data. The description of methods used to learn RBMs presented in [2] could be a starting point for understanding and implement it. The project should: 1) Implement the Contrastive Divergence method. 2) Test the implemented algorithm in learning an RBM from a dataset (e.g., MNIST dataset). 3) Evaluate the quality of the RBM and/or the information captured by the latent variables.

As in other projects, a report should describe the characteristics of the design, implementation, and results. A Jupyter notebook should include calls to the implemented function that illustrate the way it works.

3 Suggestions

- Check the brief description of RBMs given in the application paper [3].
- Analyze detailed presentation of RBM learning algorithms given in [2].

References

[1] Miguel A Carreira-Perpinan and Geoffrey E Hinton. On contrastive divergence learning. In *Aistats*, volume 10, pages 33–40. Citeseer, 2005.

[2] Asja Fischer and Christian Igel. Training restricted Boltzmann machines: An introduction. *Pattern Recognition*, 47(1):25–39, 2014.

[3] Ruslan Salakhutdinov, Andriy Mnih, and Geoffrey Hinton. Restricted Boltzmann machines for collaborative filtering. In *Proceedings of the 24th international conference on Machine learning*, pages 791–798. ACM, 2007.