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**Richer, Restricted Boltzmann
Machines**

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Abstract

In machine learning encoding prior knowledge about a task can be essential to the techniques ability to perform well on said task.(Big mental leap here....) This report explores and evaluates a novel approach to modelling data that is caused by two, independent sources. The theory has been proposed by Frean, Marcus and Marsland, Stephen, leveraging the popular Restricted Boltzmann Machine as a model for a source and a Sigmoid Belief Network as the way for these complex causes to combine. A new algorithm is presented under the dynamics of this model that allow independent representations of multi-cause data to be represented given a multi-cause input.

Contents

Deep Belief networks are powerful models that have proven to achieve state of the art performance in many domains. For instance, image classification, dimensionality reduction, natural language recognition, Document classification, Semantic Analysis.

DBNs capture non-linear interactions between low level features, in the context of image classification the lower layers should capture image filters.

Despite a DBNs expressiveness, there is no way to extract these interactions. If an input has multiple sources then the complex combination is instead learnt, the network has no mechanism for extracting multiple causes. This is the motivation for this project, to be able to separate the sources of data in a new model.

Restricted Boltzmann Machines are two layer, fully connected, unsupervised neural networks. DBNs are constructed by stacking RBMs. Being the building block of the powerful DBN, RBMs are a natural starting point for representing multiple sources. RBMs make the assumption that the features of the input data are dependant in the prior, as they are independant in the posterior. The latter makes them tractable to use in practice, but also means they model/encode a single representation. Again using the example of images, an input image will map to a single representation, again there is a lack of mechanism for modelling sources that are acting independantly.

The Sigmoid Belief Network, the parameterized version of a Bayesian/Belief network appears as a natural choice for modelling independant sources in that it makes a polar assumption to the RBM; – Warning Semicolon Use – Every feature has an independant cause. The sigmoid belief networks assumption could capture data that has multiple source, but this is intractable in practice.

Bibliography