A Few Words on Deep Learning

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STATS 780/CSE 780

Introduction

- This is the first in a series of a selected topics to be covered between this "lecture" and the end of term.
- In each case, the idea is to make you aware of an idea and to provide you with a path forward if you want to learn more.
- Now, a few words on deep learning and (restricted) Boltzman machines.

Deep Learning

- Imagine a neural network with many layers (a deep belief network).
- This is an example of deep learning.
- However, how to learn the network is not trivial.
- After last week's lecture on neural networks, you may have read about backpropagation.
- Traditional backpropagation is not effective for deep learning (cf. Hinton, 2006).

(Restricted) Boltzman Machine

- "A Boltzmann machine is a network of symmetrically coupled stochastic binary units" (Salakhutdinov and Hinton, 2009).
- The network contains visible units and hidden units.
- There are three types of interaction: visible-to-visible; visible-to-hidden; hidden-to-hidden.
- We can compute the energy of a state and, in turn, work out probabilities.
- If there are no visible-to-visible or hidden-to-hidden interactions, we have a restricted Boltzman machine (RBM; Smolensky, 1986).

Comments

- Deep learning can be thought of as a hierarchical approach.
- If you want to learn more, I suggest looking at Ruslan Salakhutdinov's website: `http://www.cs.cmu.edu/~rsalakhu/`.
- Geoff Hinton's site is also a great resource: `http://www.cs.toronto.edu/~hinton/`.
- Canada was (and still is, but perhaps to a lesser extent) at the leading edge of work on deep learning.

Refernces

- Salakhutdinov, R. and Hinton, G. (2009). Deep Boltzmann machines. *Proceedings of the 12th International Conference on Artificial Intelligence and Statistics (AISTATS) 2009, Clearwater Beach, Florida, USA.*
- Smolensky, P. (1986). Information processing in dynamical systems: Foundations of harmony theory. In Rumelhart, D. E. and McClelland, J. L., eds, Parallel Distributed Processing, vol. 1, ch. 6, pp. 194–281. MIT Press, Cambridge.