Paperwork on Degree Project: Machine Learning Based Fault Prediction for Real-time Scheduling on Shop-floor

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Overview

Deep belief nets(DBNs) are probabilistic generative models that are composed of multiple layers of stochastic, latent variables. The latent variables typically have binary values and are often called hidden units or feature detectors. The top two layers have undirected, symmetric connections between them and form an associative memory. The lower layers receive top-down, directed connections from the layer above. The states of the units in the lowest layer represent a data vector.(Geoffrey E. Hinton (2009) Deep belief networks. Scholarpedia, 4(5):5947.)[1] DBN can be viewed as a composition of simple, unsupervised networks like restricted Boltzmann machines(RBMs) or auto-encoders. In the structure of DBN, each sub-network's hidden layer serves as the visible layer for the next. This structure leads to a layer-by-layer fast training process.
Deep belief nets have been widely used for image and video sequence recognition, as well as fault diagnosis and prediction in other fields. For example, Yan Liu et al. developed a discriminative DBN for visual data classification which outperforms both representative semi-supervised classifiers and existing deep learning techniques(Pattern Recognition)[2]. Hai B. Huang et al. combined regression-based DBN with SVM and performed sound quality prediction of vehicle interior noise with their model where the result shows the combined model outperforms four conventional machine learning methods multiple linear regression(MLR), back-propagation neural network(BPNN), general regression neural network(GRNN) and SVM(Applied Acoustic)[3]. Furao Shen et al. used DBN for exchange rate forecasting in finance and found their model better than typical forecasting methods such as feed forward neural network (FFNN)(Neurocomputing)[4]. De-long Feng et al. developed a DBN model for fault-diagnosis simulation study of gas turbine engine(Frontiers of Information Technology and Electronic Engineering)[5].

Algorithm Details

Overall, fast training, high model complexity, require large amount of training data. Capable of learning complex patterns. Problem in fine tuning.
Step 1:
...
Step n: equations

References

[1] Hassan K Khalil. *Nonlinear systems.* Prentice Hall, Upper Saddle river, 3. edition, 2002. ISBN 0-13-067389-7.

[2] Tobias Oetiker, Hubert Partl, Irene Hyna, and Elisabeth Schlegl. *The Not So Short Introduction to LaTeX 2ε.* Oetiker, OETIKER+PARTNER AG, Aarweg 15, 4600 Olten, Switzerland, 2008. http://www.ctan.org/info/lshort/.

[3] Shankar Sastry. *Nonlinear systems: analysis, stability, and control*, volume 10. Springer, New York, N.Y., 1999. ISBN 0-387-98513-1.