Processing and comparing of data streams using machine learning

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From many different approaches of machine learning, multilayered self-teaching neural networks (a.k.a. Deep Belief Networks) using the unsupervised learning approach are gaining popularity nowadays. They used to be not accepted and largely ignored by most of the experts in machine learning community for almost 40 years. One of the reasons was simply because of too little computational power of available technology at the time.

However, today it is already producing interesting results for example in computer vision. One of the successful projects using unsupervised learning of neural networks was recognition of human face based on many snapshots from videos on youtube.com. This model was trained in 2012 for three days on 1000 computers with 16000 cores altogether. [1]

There are several strategies for learning multilayer neural networks. Five of them are listed here [2]:

1. Denial
2. Analogy with evolution
3. Procrastination
4. Backpropagarion
5. "Wake-sleep" algorithm

The most effective learning turned out to be the combination of strategies number 3, 4 and 5. Strategy number 3 called procrastination is about usage of hidden layers. Neural networks with one hidden layer use this layer to find the patterns and features in the input layer. These features are much more useful for deciding on how the output will look like than just the raw input data.

Multilayered neural networks take this approach to higher levels of abstraction. First hidden layer finds the features in the input layer, the second hidden layer finds the

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patterns and features of the features in the first hidden layer and so on. This approach is also a bit closer to how our brain works with multiple levels of abstraction.

The problem with multilayered neural networks is that the usually very powerful backpropagation algorithm which is our strategy number 4, doesn't work here as it is losing power with every layer. This is where unsupervised learning using strategy number 3 comes useful to pre-train the hidden layers one by one separately to find the patterns and features in layer underneath [2]. After this stage of unsupervised learning the backpropagation algorithm is once again useful to fine-tune the model.

Fifth strategy "Wake-sleep" algorithm is about usage of both passes through neural network for unsupervised learning, from bottom layer up to the top and from top layer down to the bottom. Bottom-up pass ("wake" phase) is about recognizing the output based on input. The binary states of units in adjacent layers will be used in the "sleep" phase to train generative phase with top-down pass, which is about generating the input based on output. The binary states can be now used in training recognition weights. In "Wake-sleep" algorithm we initialize the weights with small random values and then we alternate between these two passes of learning [2].

Our goal is to find methods and new ways of training to utilize the potential of multilayered neural networks and unsupervised learning to process and compare large streams of unlabeled data. We want to focus on data from eye tracker and simple sound recordings like long pronunciations of single letter for example letter "r".

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References

[1] Quoc V. Le et al.: Building high-level features using large scale unsupervised learning. In Proc. of the 29th International Conference on Machine Learning, ICML 2012, Omnipress, pp. 81-88.

[2] Hinton, G. E.: To recognize shapes, first learn to generate images, In P. Cisek, T. Drew and J. Kalaska (Eds.), Computational Neuroscience: Theoretical Insights into Brain Function. Elsevier, 2007