Contributions to Deep Learning Models

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Abstract

Deep Learning is a new area of Machine Learning research which aims to create computational models that learn several representations of the data using deep architectures. These methods have become very popular over the last few years due to the remarkable results obtained in speech recognition, visual object recognition, object detection, natural language processing, etc.

The goal of this thesis is to present some contributions to the Deep Learning framework, particularly focused on computer vision problems dealing with images. These contributions can be summarized in two novel methods proposed: a new regularization technique for Restricted Boltzmann Machines called Mask Selective Regularization (MSR), and a powerful discriminative network called Local Deep Neural Network (Local-DNN). On the one hand, the MSR method is based on taking advantage of the benefits of the L_2 and the L_1 regularizations techniques. Both regularizations are applied dynamically on the parameters of the RBM according to the state of the model during training and the topology of the input space. On the other hand, the Local-DNN model is based on two key concepts: local features and deep architectures. Similar to the convolutional networks, the Local-DNN model learns from local regions in the input image using a deep neural network. The network aims to classify each local feature according to the label of the sample to which it belongs, and all of these local contributions are taken into account during testing using a simple voting scheme.

The methods proposed throughout the thesis have been evaluated in several experiments using various image datasets. The results obtained show the great performance of these approaches, particularly on gender recognition using face images, where the Local-DNN improves other state-of-the-art results.