Proposal: A simple PCANet-CNN for Image classification

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Abstract

In this paper, we are going to propose a simple deep learning architecture for image classification which is based on the PCANet [1]. In the proposed architecture, we extend the PCANet by connecting it with a convolutional network [2], and the convolutional filters can be learned from back propagation. We will test the proposed deep network in various tasks such as objection recognition, digit recognition and face verification.

1 Motivation and Overview

This work is mainly motivated by the PCANet, which served as a simple but competitive deep learning baseline. Typically the deep learning networks (DNN) contains stacked trainable stages and is then followed by a supervised loss function. Each stage comprises a fully-connected layer or convolutional layer together followed by a nonlinear neuron function. DNN usually needs time-consuming training via back propagation.

In contrast, PCANet comprises only very basic data processing components. The multi-stage filters are learned by a simple principal component analysis, and no linear operation is involved until its very last layer, where binary hashing and histogram are employed to compute the features. Thus, back propagation is not needed for parameters updating and this results in a very efficient model training. The architecture of PCANet is shown in Figure 1.

Our goal is to design a novel deep learning architecture, which starts with a PCANet, without binary hashing and histogram, and then followed by a convolutional network and a supervised loss such as SVM loss or cross entropy loss. Our idea is as follows: the first two stages of PCANet already have learned a very good representation of each image, however, the binary hashing and histogram may lose some information. Therefore, we followed it with convolutional layer(s) and hope it can retain as much information as possible, thereby lead to a better performance. Since the input features of the convolutional layer(s) are well learned (by PCANet), so we guess it will not take too much time to train the these convolutional filters. However, we haven't decided the architecture of convolutional layers yet, but the number of convolutional layers would not exceed 2.

2 Datasets

We will evaluate our new deep network in various tasks, and compare the results with the PCANet proposed in [1]. The potential tasks include:

- Objection recognition on CIFAR10 dataset
- Digit recognition on MNIST dataset
- Face Verification on LFW dataset

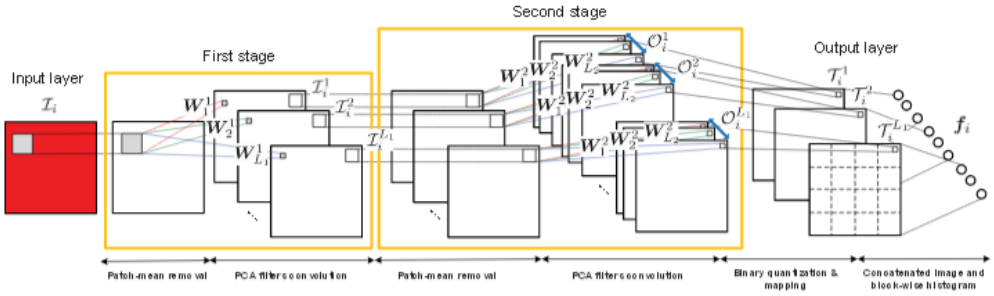

Fig. 2. The detailed block diagram of the proposed (two-stage) PCANet.

Figure 1: The Architecture of PCANet

References

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[2] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "Imagenet classification with deep convolutional neural networks," in *Advances in neural information processing systems*, pp. 1097–1105, 2012.