ML Report

**Abstract**

In this section, we will introduce another approach to this problem. There will be a brief introduction, a detailed explanation on the algorithm, and some results.

**Introduction**

After the data is processed, there are a few ways to approach Hand writing recognition. We did a few researches on neural network, and picked a few model for comparison, such as Multidimensional Recursive Neural Network, Deep Belief Net, Deep Boltzmann Machine, and Convolutional Neural Network. After a series of comparison and evaluation, we chose convolutional neural network and deep belief net since they have a great performance on 2D images, yet others are not so good or has excessive power.

**Implementation**

**Convolutional Neural Network**

This attempt is based on Theano, a deep learning toolkit for python, and is written in Python. After pre-processing, the image is cropped and minimized to 50\*50, and we sent them into the first layer. The first layer is a convolutional layer with 100 maps and 3\*3 filter, after that is a layer which does max pooling of 2\*2. Following by 150 maps 3\*3 filter and 2\*2 max-pooling, 200 maps 3\*3 filter, 2\*2 max-pooling, 500 fully connected neurons and 1000 fully connected neurons and lastly a logistic regression neuron.

That will sums up to be:

Input->100C3MP2, 150C3MP2, 200C3MP2, 500FN, 1000FN, LogReg->output

**Deep Belief Net**

We build a 1500, 1000, 500, 300, 200, 5 layered DBN 400 epochs, and pretrained each layer with 100 epochs. Still the result was not as good as expected, they were around 80% on the first phase testing. We failed fast and dumped this method.

**Result**

We’ve tested a few models with different parameters

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| 50C3MP2, 50C3MP2, 50C3MP2, 500FN, LogReg, 200 epochs | 87.26% |
| 50C3MP2, 100C3MP2, 150C3MP2, 500FN, LogReg,400 epochs | 89.44% |
| 100C3MP2, 150C3MP2, 200C3MP2, 500FN, 1000FN, LogReg, 400 epochs | 91.26% |

This model has scored 92.15% at the second phase test.

**Reference**

Alex Graves and J. Schmidhuber Ofﬂine Handwriting Recognition with Multidimensional Recurrent Neural Networks. *In Advances in Neural Information Processing Systems*. 2009.

Dan Ciresan and J. Schmidhuber Multi-Column Deep Neural Networks for Ofﬂine Handwritten Chinese Character Classiﬁcation. *IDSIA / USI-SUPSI Technical Report No. IDSIA-05-13. 2013*