INF283 - Compulsory Assignment 1

Submission deadline: October 13, 2017

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Automatic recognition of handwritten digits

In this exercise you will train an Artificial Neural Network (AKA Multi-Layer Perceptron) to recognise hand-written digits. You will have at your disposal a data set of normalised scans of hand-written digits, which you can download from MittUIB (file: `handwriting.csv`). You are expected to develop a network which will generalize with an accuracy of more than 80%. Parts of the data set has been withheld in order to check this.

This is an individual assignment, you may ask for help and advice, but you will write your own answer and code. Please note clearly any collaboration. The grade will be Fail/Pass, and passing is a requirement for taking the final exam.

The data set

`handwriting.csv` is a comma separated data file with unlabeled rows and columns. It has been obtained from normalised image scans of handwritten digits, where the ink-density in a grid overlaid on the scan has been recorded in 62 grid variables, corresponding the 62 first columns in the data file. The ink-density has been recored with floating point values in the range [0,1]. The last column of the data file contains the target attribute, the intended digit, encoded as integers in the range [0,9].

Task 1. Classifying digits

Design a neural network (a.k.a.) multi-layer perceptron to classify digits based on the supplied data, you may use the code by Marsland (i.e. the textbook), available at:

https://seat.massey.ac.nz/personal/s.r.marsland/Code/Ch4/mlp.py

Describe your network in your report, including the following elements:

1. The input layer
2. The output layer and the output activation functions
3. The choice of error (loss, cost) function
4. The number size of the hidden layer

At regular intervals during training, the program should emit statistics on accuracy. Decide a suitable training regime (including training, validation, and testing data) and implement it. Train your model using various parameters for momentum and learning rate, and describe your results, including a graph of the performance during training, as well as an estimate of your model's final classification accuracy on previously unseen instances.

Task 2 - Select one of: A) Multiple hidden layers

Modify the code so that the network now includes several hidden layers. Run the training process again, and describe differences in the results. Can you get better accuracy with fewer nodes? What happens to training time?

Or: B) Autoencoder

Modify your network to function as an autoencoder network. Train it on the handwriting input data. Describe your training regime and network architecture including choice of activation functions as above, and your reasoning behind it. Which representations and categories did the network learn?

Submission

Create a zip archive containing your source code for Task 1 and either Task 2A *or* 2B, and a PDF report with your answers to the questions, and submit it to MittUIB by October 13. Mark each page of your report clearly with your name.