CS 4320: Machine Learning

Assignment: Neural Network Classification of Images

In this assignment you will explore the use of convolution neural networks and other neural network architectures to classify images. The data set, Typeface MNIST, is a collection of grayscale images of the digits 0-9 rendered with 2,990 different fonts. The classifier will be judged on its accuracy in predicting the digit from the image.

This is an exploratory assignment. You are required to train *many* different network architectures on this data set, and compare the resulting accuracy of the trained network with the structure of the network.

Required Steps

- Download the data.
- Download the starter code.
- Unpack the data and split it 80%/20%, for training/testing.
- Further split the training data 70%/30%, for training-fit/validation.
- Repeatedly
  - Configure a network architecture, record its structure and number of parameters.
  - Fit the network using the training-fit data.
  - Measure the network accuracy on the training-fit and validation data; record them.
  - Make notes on your observations of connections between network architecture and accuracy.
- Identify the network architectures with the smallest number of parameters that can obtain validation accuracy of at least: 0.90, 0.95, 0.97, and 0.99. (Numbers as displayed by the `score` function of the starter code).
- *AFTER* all exploration has completed and the 4 different networks have been selected, measure their accuracy on the test data.
- Write a report that includes:
  - A description of the data.
  - An outline of any code changes made (besides network architecture.)
  - A description of each of the 4 different architectures with fewest parameters that meet the accuracy cutoffs.
  - A table with the training-fit, validation, and test accuracy scores for each of the 4 different architectures.
  - A discussion of your observations on the functionality of convolution layers, pooling layers, and dense layers for this particular problem. This will probably include some discussion of hyper-parameter settings for these layer types.
  - Conclusions with your advice to future image classification network designers.
- Commit and push your code in the git repository.
- Submit the report (as PDF) to Canvas.