Neural Network Theory and Applications

Homework Assignment 3
March 29, 2018
Due at April 11, 2018

In this assignment, convolutional neural network (CNN) will be used to deal with multi-class classification problems. CNN is a class of deep, feed-forward artificial neural networks that has successfully been applied to analyzing visual imagery.

Two problems are given below. The dataset used in this homework is the MNIST database (Modified National Institute of Standards and Technology database), which is commonly used for training and testing in the field of machine learning. The dataset can be downloaded from this link. You are supposed to download the following file.

train-images-idx3-ubyte.gz: training set images (9912422 bytes)
train-labels-idx1-ubyte.gz: training set labels (28881 bytes)
t10k-images-idx3-ubyte.gz: test set images (1648877 bytes)
t10k-labels-idx1-ubyte.gz: test set labels (4542 bytes)

The MNIST database contains 60,000 training images and 10,000 testing images. You need to use the training set to build the ten-category classification model and validate it on the test set.

Problem 1:

Solving the ten-class classification problem in the given dataset using feed-forward neural network. You need to finetune your network and only present your best result.

Notice: You can either use tensorflow or other deep learning tools to solve this problem. You can also build your network without using any deep learning tools, which is a better option.

Problem 2:

Solving the ten-class classification problem using CNN.
(a) You need to implement LeNet[1] and use it to solve this problem.
(b) Compare the results and training time with problem 1.
(c) Visualize the deep features which can be extracted before feed-forward layers, and discuss the results.

[1] Lecun Y, Bottou L, Bengio Y, et al. Gradient-based learning applied to document recognition. Proceedings of the IEEE, 1998, 86(11):2278-2324.