CS 795: Deep Learning

(Thanks to Dr. Reddy at Virginia Tech.)

Homework 2

Due Date: Feb 27th, 2019 (4:30PM) **Total: 100 Points**

Note: All implementations are required to be accomplished and submitted using the *Jupiter notebook (if using Python) or a demo file using other programming languages like Java/C*. Show your results and necessary comments in the notebook. *No handwritten homework is accepted.*

1) Dropout and Activation Functions

1. In homework 1, we have built a deep feedforward neural network with two hidden layers and implemented the stochastic gradient decent (SGD) algorithm to train the network. Based on your codes, replace the 'sigmoid' activation functions with 'relu' and retrain the model. Compare the results with those in homework 1. Use Data provided in HW1.

2. Suppose the dropout rate of neurons for layer 2 is 1/3, which means only two out of three neurons will be kept during the training for each batch, where the batch size is 1. Implement the backpropagation and train the network. Show the performance on the Test Data.

2) Autoencoders

You are free to use any deep learning package for this problem. Pick the first 100 samples for each digit (0-9) from the MNIST data and construct the training dataset for your problem. Using the 1000 images in your training data, build a standard autoencoder (with only one hidden layer) containing N hidden units. You are free to choose the activation functions (Experiment with them if curious).

Data: https://github.com/datapythonista/mnist

a. Varying the values of N (2,5,10), plot the reconstruction error.

b. Pick one of the images and identify it's nearest 50 images in the latent space. Then, report the average values of precision and recall for all the images corresponding to each digit (vary the values of N=2,5,10). Essentially you are computing Leave-One-Out Classification results with a nearest neighbor classifier in the latent space.

c. Compare these results with the results obtained using PCA method. Use the same N values (latent space dimensions in PCA) for both methods and plot the comparison. Why am I asking you to compare to PCA? What is the connection here.

Deliverables:

- Go to courses.gmu.edu (blackboard) and submit a tar file with LastName_HW2.tar.gz
- The folder zipped should contain two folders:
- 1) PDF
    - Contains a typewritten pdf answering the questions above
- 2) src
    - Contains all source code written for the assignment.