Homework 5: Feed-forward Neural Networks

Nitish Shah, Shivam Kumar

March 18 2020

1   Introduction

This assignment will include completing a minimal neural network implementation with back propagation for training.

2   Questions

1. fnn.py has a class for `FNN` which is a feedforward neural network which holds a list of `Layer`s. Study the classes and the utility functions. You need to write `forward` and `backward` methods in the `Layer` class. Use these to write `forwardprop` and `backprop` methods in the `FNN` class.
   Submission: hw5_fnn_<your_roll_number>.py file.

2. Complete the training loop in and use mnist_experiment.py to train a small deep neural network with 2 hidden layers (containing 128 and 32 RELU units each) for handwritten digits recognition using MNIST dataset. The accuracy should be around 99% on the training set and around 97% on the validation and test set. Report the training time, train and validation loss graphs and train and validation accuracy graphs
   Submission: hw5_mnist_experiment_<your_roll_number>.py file
   Report: hw5_mnist_experiment_<your_roll_number>.doc/docx file

   (To demonstrate the effect of learning, 100 randomly selected test images will be shown with true labels (black on top left corner), predictions before training (red on bottom right corner), and predictions after training (blue on bottom left corner). See the figure below as an example. You can see that the predictions improve from random guess to almost perfect. This is already written for you)

3. [**Bonus**] Solve the above problem 2 using `Keras` in Tensorflow 2. Use tensorboard to view and report the graphs. (Use Google Colab. Google Colab will already have a ready to use environment with Tensorflow 2 and tensorboard installed)
   Submission: Link to google collab notebook hw5_mnist_<your_roll_number> file

3 Submission guidelines

1. Keep all the files in a folder (including data) named hw5_<your_roll_number>

2. Complete the assignment and rename the files as given in the questions. Add the report, zip the folder and submit just the zip.

3. The zip should contain all necessary files to run the mnist experiment program.

4. [**IMPORTANT**] Zip the folder and not the files. Please make sure that when you unzip your submission file you get a single folder named hw5_<your_roll_number> (and not all the files inside)

4 Collaboration policy

1. You can discuss anything you want with anyone you want. In fact discussions with other students or TAs to solve doubts or for debugging is highly encouraged.

2. You can use all the resources you have.

3. Do NOT share code with anyone or copy it from any source. The code you submit should be completely your own. Don't even share or copy code snippets with or from other students or from the internet