ELL784: Introduction to Machine Learning
Due Date: August 26, 2024, 11:59pm

August 20, 2024

Assignment 2	Marks:

In real-world scenarios, we often know very little about the actual test data, making it crucial to ensure that any accuracy achieved is not merely by chance. Therefore, we will apply techniques such as hyperparameter tuning and validation, as discussed in class, to ensure the robustness of our model. Here are the detailed tasks:

1. Train your ANN for the classification of handwritten images in the MNIST dataset (0-9). Choose the number of layers and neurons accordingly. Plot and report the loss functions and accuracies for training, validation, and the test set. Use methods discussed in class (tuning and validation) to tune hyper parameters. Use one hot encoding for the class labels.

2. Consider the same MNIST dataset to build a tree-type growing neural network. Each node learns a one layer neural network that tries to classify samples correctly. Child nodes are added to correct for misclassified samples. Plot the loss functions and accuracies for training, validation, and testing as the network grows. (Bonus points if you are able to achieve 100% accuracy).

3. Suggest ways of determining when to stop training so that generlization is improved.

4. Bonus points for inovative ways of handling class imbalance at later tree nodes.

5. Try to visualize what each node has learnt.

Notes:

- Please try all questions *yourself.* Ask one of the TAs or me, offline or in the class, in case you have doubts.

- You should submit your code as a zip file (links directing to the code will not be evaluated).

- Include a report (pdf) file that includes a brief description of each question, explaining what you did. Include any observations and/or plots required by the question in this report.

- We plan to run a plagiarism test for suspicious submissions. Any cheating will result in a zero on the assignment, a penalty of -10 points, and possibly much stricter penalties (including a fail grade and/or a DISCO).

- This assignment is supposed to be done individually.