

Project Report 3

Classification

Arun Sharma

50206920

Overview

In this project we applied logistic classification and 3 layer neural network on MNIST and USPS dataset. We tuned various hyper parameters according to different models in order to achieve optimal result. Also, we applied CNN using tensorflow library on both the dataset which achieve maximum result. In this project, we accomplished task 4 along with task 1, 2 & 3 and concluded in task 4 that No Free Lunch Theorem is applied.

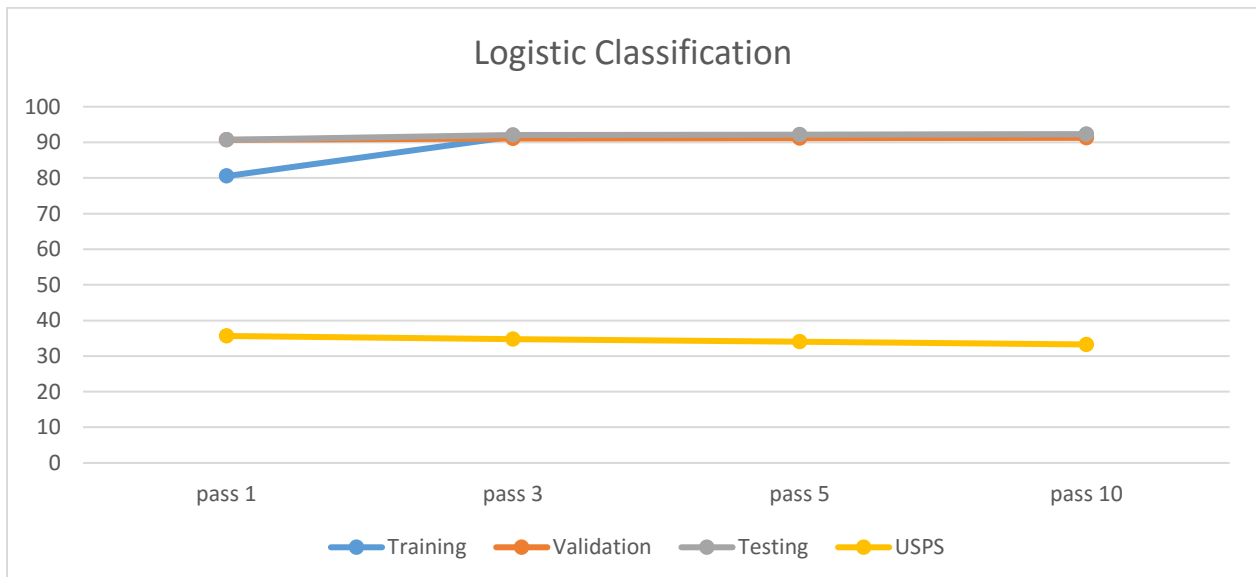
TASK 1 & 4: Logistic Classification

We classified images in MNIST and USPS dataset. The following table is the analysis of MNIST and USPS, where for MNIST we have training, testing and validation, whereas USPS was tested seperately.

	Training	Validation	Testing	USPS
Pass1	80.518	90.7	91.31	35.635
Pass 3	91.646	91.09	92.02	34.71
Pass 5	92.018	91.19	92.11	34.09
Pass 10	92.33	91.26	92.22	33.255

Table of Logistic Classification

Hyper-parameter tuned here is number of epochs. Here passes are number of epochs. As we can see accuracy increases as the number of epochs increases proportionally. But, for the USPS the trained model doesn't work well. Hence No Free Lunch theorem is applied.



Graph for Logistic Classification

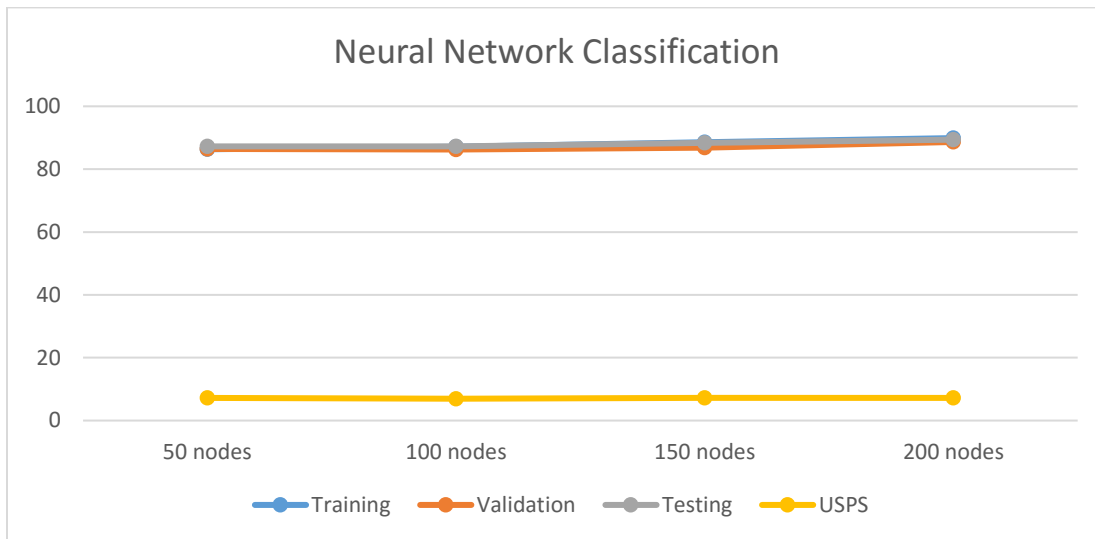
Task 2 & 4: Neural Network

We applied 3 hidden layer neural network on both MNIST and USPS dataset. First we train the model on MNIST dataset, and tuned the hyperparameters such as changing the number of nodes in the hidden layer.

	Training	Validation	Testing	USPS
50 nodes	86.332	86.44	87.25	7.215
100 nodes	87.16	86.26	87.29	6.95
150 nodes	88.562	86.86	88.41	7.225
200 nodes	89.884	88.66	89.39	7.205

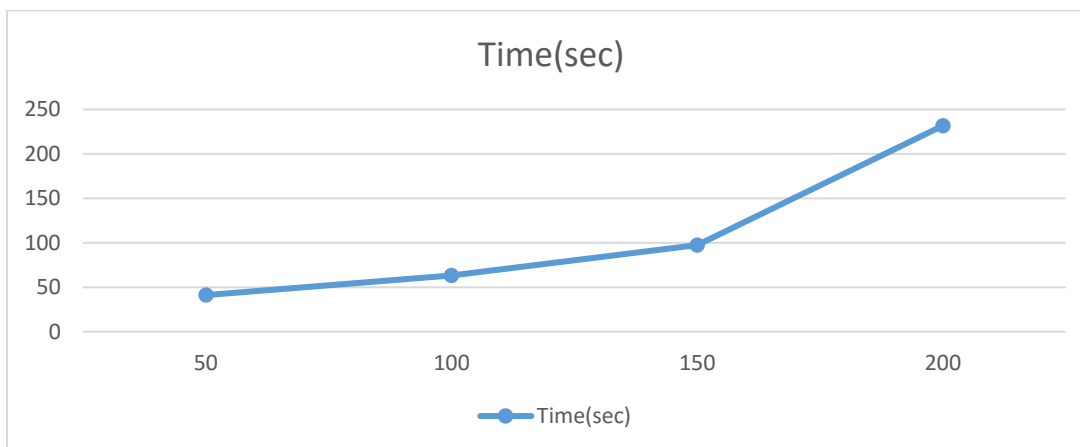
Table for Neural Network

As we can see in the above table as we increase the number of nodes of the hidden layer, accuracy increases proportionally. The below graph represented the table



Graph for Neural Network

But, time complexity increases as the number of nodes in the hidden layer increases.



Time Complexity Graph

Hence at hidden layer = 200, we increase the number of passes or epoch, which leads to more time complexity but the results we drastically improved to 97.286%

	Training	Validation	Testing	USPS
Pass = 5	95.286	91.91	92.78	6.995
Pass = 10	97.502	93.74	93.91	6.92

Again, USPS gives very low accuracy, NO FREE LUNCH THEORUM is applied

Parameters tuned here are Number of Passes/Epochs and Number of hidden layer nodes.

Task 3 & 4: Convolutional Neural Network in MNIST

It is tested in both MNSIT and USPS dataset. Giving optimal performance in MNIST but not up to the mark in USPS. Packages used are cv2 glob and tensorflow.

	Training (approx.)	Testing	Testing USPS
1000 iterations	99.1	96.42	50.975
5000 iteration	99.4	98.46	61.265

Table of CNN on MNIST and USPS

Task 4: Apply the above Trained Models on USPS dataset

We compared USPS dataset on all the trained classification model on MNIST dataset and none of them gives a satisfactory performance. Hence No Free Lunch Theorem is applied overall in this project.

NOTE: Due to computational complexity, CNN is not included in main.py file. Please run cnn.py instead of that. Thank you.