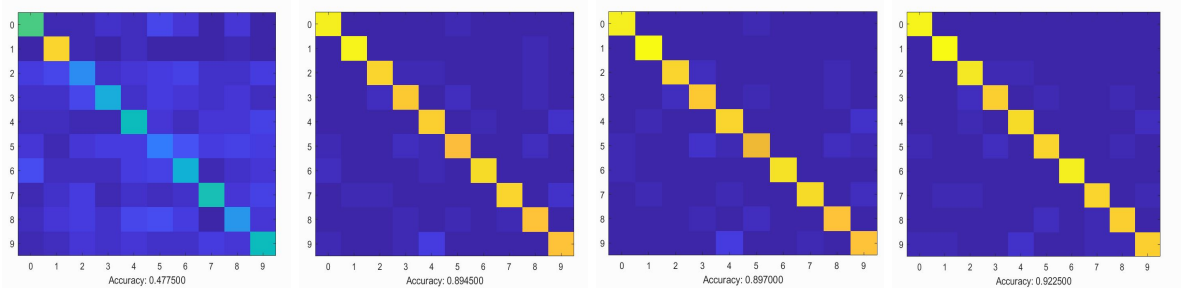

(a) Confusion Matrix for SLP_linear (b) Confusion Matrix for SLP (c) Confusion Matrix for MLP (d) Confusion Matrix for CNN

Summary-Homework:4

The problem is to build a neural network to recognize hand-written digits in the MNIST dataset. Four different types of neural networks have been constructed. They are : Single Layer Perceptron with Euclidean Loss, SIngle Layer Perceptron with Softmax Cross Entropy Loss and ReLu non-linearity, Multiple Layer Perceptron with one hidden layer containing 30 units and a Convolutional Neural network with a 3X3 filter, a maxpooling layer, a flattening layer and a Fully Connected Layer.

To this end I wrote codes in MATLAB compatible with the given specifications. The trained weights for the various networks have also been uploaded. As anticipated, the network with the introduction of Softmax Loss function gives a better accuracy of 89.45% as opposed to 47.75% in Single Layer Perceptron because it clamps the output to a range between 0 and 1. The training parameters used are: Learning Rate = 0.01 and Decay Rate = 0.5 for single layer perceptron and Learning Rate = 0.2 and Decay Rate = 0.9 for SIngle Layer Perceptron Model with ReLu and Softmax.The accuracy obtained for MultiLayer Perceptron is even better(89.70%) due to the introduction of a hidden layer consisting of 30 units which leads to better training. The training parameters used are: Learning Rate = 0.05 and Decay Rate = 0.75 for multi layer perceptron.The Convolutional Neural Network gives the best results among the lot with an accuracy of 92.25% because it the preserves the spatial structure of the image which the previous three networks do not.The training parameters used are: Learning Rate = 0.10 and Decay Rate = 0.8.

FOr all these models, a decay interval of 1000 iterations and a batch size of 30 has been used. Also the models have been trained for 10000 iterations using Stochastic Gradient Descent as the optimization method. The confusion matrices have been plotted for the four networks.