Project 4 Questions

Q6: We will implement these steps in code using numpy. We provide a code stencil `main.py` which loads one of two datasets: MINST and the scene recognition dataset from Project 3. We also provide two models: a neural network, and then a neural network whose logits are used as input to an SVM classifier. Please look at the comments in `main.py` for the arguments to pass in to the program for each condition. The neural network model is defined in `model.py`, and the parts we must implement are marked with TODO comments.

1. What do these numbers tell us about the capacity of the network, the complexity of the two problems, the value of training, and the value of the two different classification approaches?

   The data provided below tells us that the capacity of the neural network on MNIST is much smaller than that of SceneRec. Thus, we can conclude that hand writing recognition is much simpler task than scene recognition, which makes sense because there are less factors to consider for classification. Thus, the program works better with less parameters. Because scene rec has so many different features, there are not enough parameters to look at all the factors in a scene.

   The complexity of the two problems is proportional to the capacity of the network. Thus, with more parameters, the more complex the network should be. Based on the data gathered, we know that the NN algorithm is really good on the MNIST data because it is not complex enough to be accurate on ScenRec. A scene would be have too many features for this NN to recognize.

   Having a high value of training is important since it allows the neural network to become more accurate on its test data. As we can see in the data, from epoch 0-9 on the MNIST data set, we see a slight increase in epoch accuracy. On the SceneRec data set, we see a more dramatic increase of epoch accuracy. Thus, this demonstrates how vital having a high value of training to increase accuracy on data sets.

   The NN vs the NN+SVM approaches did not have much difference in accuracy; however, NN+SVM usually preformed a bit higher than NN. Specifically, NN+SVM had a larger difference in accuracy over NN for SceneRec. The data shows that NN+SVM is barely improves accuracy for data sets that are more complex than the optimal use for the NN.

2. How well did each model perform on each dataset? Please use this table to structure your response.

- NN on MNIST: 89% (highest accuracy)
    - Epoch 0 loss: 167028.49
      Accuracy: 89%
    - Epoch 9 loss: 132162.60
      Accuracy: 88%
- NN+SVM on MNIST: 89% (highest accuracy)
    - Epoch 0 loss: 169861.22
      Accuracy: 89%
    - Epoch 9 loss: 130294.3
      Accuracy: 89%
- NN on SceneRec: 18% (highest accuracy)
    - Epoch 0 loss: 30500.26
      Accuracy: 15%
    - Epoch 9 loss: 23342.03
      Accuracy: 18%
- NN+SVM on SceneRec: 26% (highest accuracy)
    - Epoch 0 loss: 30633.37
      Accuracy: 26%
    - Epoch 9 loss: 23622.14
      Accuracy: 22%