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CS559 – Fundamentals of Machine Learning

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Final Report

For this final project, we were asked to use the MNIST784 dataset to train assorted Machine Learning Classifiers, score them, and compare them. For task #1 we had to choose three non-deep learning models, and I chose Logistic Regression, Decision Tree, and Random Forest. I wrote a description in my Jupiter notebook about why I chose them, and what their strengths and weaknesses are.

A screenshot of a computer

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**Figure 1: Task #1 Explanations**

Additionally, I scored the models two different times, on their training data, and their test data. Linear Regression had the lowest drop in accuracy between the training and tests sets, while Random Forests had the highest Testing score. Decision Tree, while have a 100% accuracy on the training set, had the largest drop and lowest test score with 87.55%

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**Figure 2: Task #1 Classifier Scores**

For Task #2, we had to make a convolutional neural network with a 10-class classification with hidden and deep layers. I had 4 assorted layers, 1 being in the output and 2 Fully Connected (FC) layers and 2 Convolutional Layers (Conv). Overall, we ended with an accuracy of 95.79% on the test data. But how do these classifiers work for our own handwriting?

**A picture containing table

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**Figure 3: CNN Training and Iteration/Testing Accuracies**

For Task #3 we first had to draw out 5x10 digits; 5 for each number from 0-9. I did this online and just screen snipped the image, knowing I would resize later down the line. Here are my digits, iterating from 0 to 9 based on row.

**Text, letter

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**Figure 4: Handwritten Digits**

Originally, I thought these digits would slot in quite well with MNIST and would have a decently high accuracy, but I was mistaken. All classifiers had significantly lower accuracies, almost all by half. As I predicted though, the Convolutional Neural Network we put together in task #2 had the highest accuracy, and I figured this because it is the most flexible to new data, which in this case is my own handwritten digits.

**Table

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**Figure 5: Classifier Scores for My Digits**

Doing my analysis, I can contribute these lower accuracies to a few different reasons. To begin, the images of my own digits aren’t the same format, size, and positioned as they are in most MNIST digit cases. For cases like Decision Trees, where they are based so heavily on training data and have little flexibility for new data, this is huge and is what I contribute towards its lower accuracy. CNN had the highest, as previously mentioned I expected, due to its flexibility to new data. Additionally, and I noticed this while screenshotting my data, there is a small amount of border pixels around most of my digit images, most likely from the original screenshot, which could impact the accuracy, although I’m sure not by much. In the end, computers are impressive at predicting under the right circumstances, but in situations where the environment may not be the same (positioning differences, sizing differences and picture borders), some issues and a lower accuracy may be the outcome.