COMP 5214 PA1 Report

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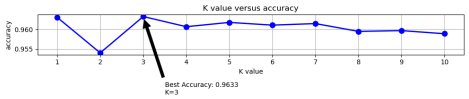
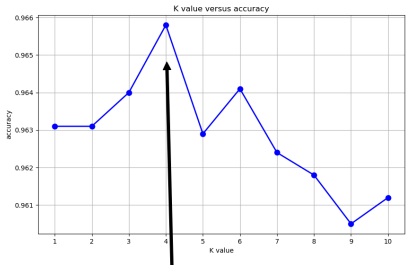
1 K-Nearest Neighbors (KNN)

In this section, we implement KNN classification with two different tie-breaking strategies. The default scikit-learn implementation resolves ties by selecting the first appearing class. We modified the prediction function to break ties using the smallest aggregated sum of absolute differences (SAD). For both methods, the accuracy of find the nearest neighbor is 0.9631. The optimal K values were found to be 3 and 4 for the default and modified methods respectively.

The highest accuracy achieved using the modified tie-breaking strategy was 0.9658. Figure 1a and fig. 1b demonstrate the relationship between K values and classification accuracy for both methods.



(a) Default tie-breaking (first appearing class)



(b) Modified tie-breaking (smallest aggregated SAD)

Figure 1: KNN classification accuracy with different tie-breaking strategies

2 Multilayer Perceptron (MLP)

We evaluated MLP performance with varying numbers of neurons in a single hidden layer. As shown in table 1, the classification accuracy improves with increasing network capacity until reaching 64 neurons, after which performance gains become marginal.

Table 1: MLP performance with different hidden layer configurations

Neurons in Hidden Layer	**Accuracy (%)**
4	72.06
8	91.20
16	95.59
32	96.90
64	97.66
128	97.73
256	97.93

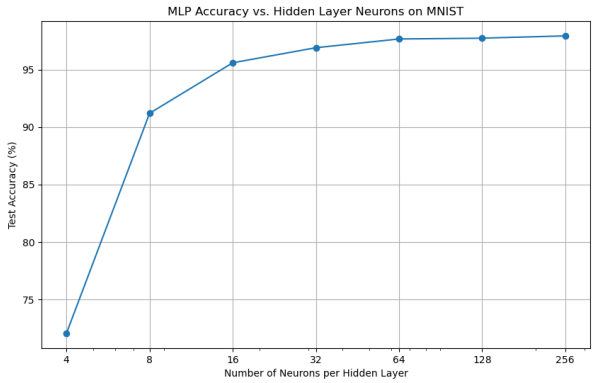
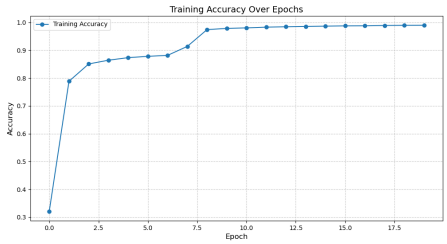


Figure 2: MLP classification accuracy vs. hidden layer size

3 Convolutional Neural Network (CNN)

Implementing the LeNet-5 architecture achieved 99.13% test accuracy, demonstrating CNNs' superior performance for image classification compared to MLPs. Figure 3 shows the training progression over 20 epochs.



(a) Training accuracy progression

(b) Training loss progression

Figure 3: LeNet-5 training performance metrics

4 Convolutional Attention Network (CAN)

Our CAN implementation's performance is 99.25% accuracy. Figure 4 illustrates how feature channel count affects model performance.

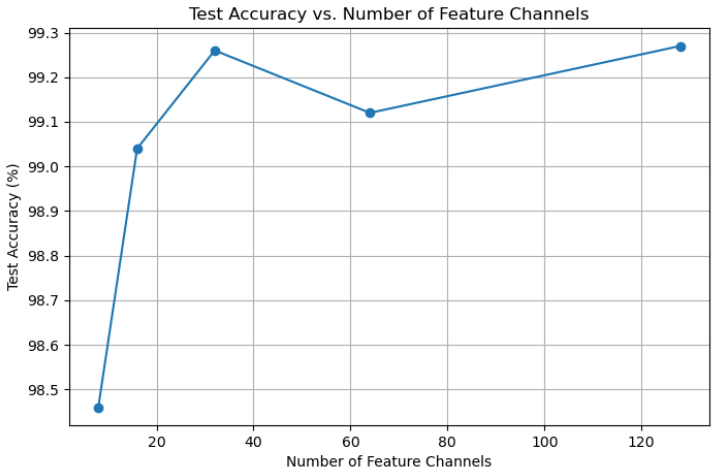


Figure 4: CAN performance vs. number of feature channels