Exercise 2.5: Visual Applications of Machine Learning

Part 1: Handwritten Numbers

A screenshot of a computer screen

AI-generated content may be incorrect.

There was a 0% Prediction of the correct number, this may be because of the shape of the images which could end up distorted when resized 28x28. However, the model works as it predicted the MSIN very well

A screenshot of a computer code

AI-generated content may be incorrect.

Part 2: Weather Images

Using 16 Epochs this where the results

A screenshot of a computer

AI-generated content may be incorrect.

A graph of loss and loss

AI-generated content may be incorrect.A graph of a graph showing the value of a stock market

AI-generated content may be incorrect.

High validation accuracy means the model is doing well on new data. However, if there's a big difference between training and validation accuracy, the model might be overfitting, meaning it performs great on the training data but not as well on unseen data. The training loss is very low, showing the model has learned the training data well, but the validation loss is higher, indicating it struggles with new data. This suggests the model fits the training data too closely and doesn't generalize well.

A chart of a graph

AI-generated content may be incorrect.

0 = Cloudy

1= Rain

2= Shine

3= Sunrise

The confusion matrix shows that images of "cloudy" and "rain" are often misclassified more than the other two classes. In particular, "cloudy" is often mistaken for "shine" (34 times). The model does a good job with "shine" and "sunrise" images, with very few mistakes. Overall, the model has the most trouble telling apart "cloudy" from "shine" and "rain."

1. **Data Augmentation**: GANs can generate synthetic weather data to augment existing datasets, improving model training and performance, especially in regions with limited historical data.
2. **High-Resolution Forecasting**: By employing GANs for downscaling, we can transform coarse-resolution weather model outputs into high-resolution forecasts, capturing local weather phenomena more accurately.
3. **Uncertainty Quantification**: GANs can be used to model the uncertainty in weather predictions by generating multiple plausible scenarios, helping forecasters understand the range of possible outcomes.

[A Reliable Generative Adversarial Network Approach for Climate Downscaling and Weather Generation - Rampal - 2025 - Journal of Advances in Modeling Earth Systems - Wiley Online Library](https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2024MS004668)