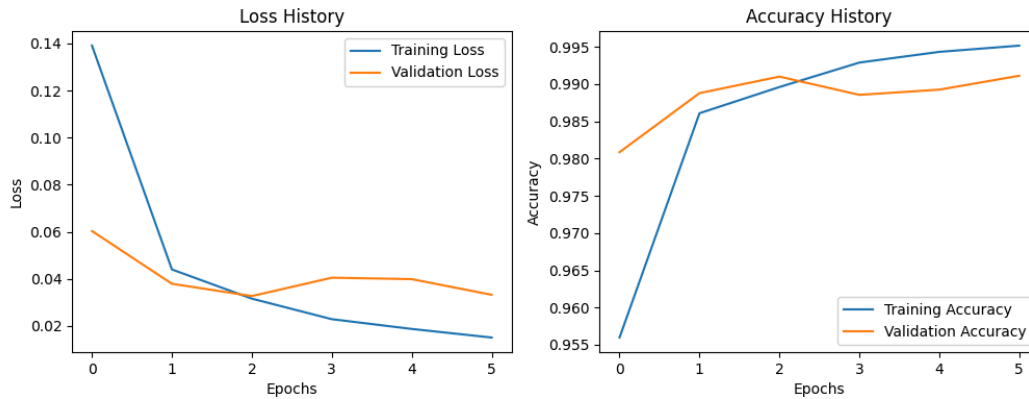# DAMA61 - Final Exam - Exercise 2

Output:

Random Forest Validation Score: 0.9676854876341577
Random Forest Test Score: 0.9669
Random Forest Confusion Matrix:
```
[[ 968    0    0    0    0    2    5    1    4    0]
 [   0 1124    1    3    2    2    2    0    1    0]
 [   5    1  994    6    1    1    3   11   10    0]
 [   0    0   11  972    0    7    0    9    8    3]
 [   0    0    2    0  948    0    5    3    4   20]
 [   5    1    2   13    4  854    7    1    5    0]
 [   5    3    0    0    3    3  940    0    4    0]
 [   1    5   20    2    2    0    0  985    4    9]
 [   2    0    3   10    6    9    4    3  926   11]
 [   6    7    0   12   12    1    1    3    9  958]]
```
CNN Test Accuracy: 0.9919000267982483
CNN Confusion Matrix:
```
[[ 974    0    1    0    0    0    4    1    0    0]
 [   0 1133    0    0    0    0    1    1    0    0]
 [   1    5 1022    0    1    0    0    3    0    0]
 [   0    0    1 1004    0    3    0    2    0    0]
 [   0    0    0    0  977    0    1    0    0    4]
 [   2    0    0    5    0  883    1    0    1    0]
 [   3    3    0    1    1    0  950    0    0    0]
 [   0    2    2    0    0    0    0 1022    1    1]
 [   0    0    3    0    0    0    0    1  967    3]
 [   1    1    0    3    4    4    0    6    3  987]]
```
Random Forest Confusion Matrix:
```
[[ 968    0    0    0    0    2    5    1    4    0]
 [   0 1124    1    3    2    2    2    0    1    0]
```

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```
[   5    1  994    6    1    1    3   11   10    0]
[   0    0   11  972    0    7    0    9    8    3]
[   0    0    2    0  948    0    5    3    4   20]
[   5    1    2   13    4  854    7    1    5    0]
[   5    3    0    0    3    3  940    0    4    0]
[   1    5   20    2    2    0    0  985    4    9]
[   2    0    3   10    6    9    4    3  926   11]
[   6    7    0   12   12    1    1    3    9  958]]
```

CNN Confusion Matrix:

```
[[ 974    0    1    0    0    0    4    1    0    0]
[   0 1133    0    0    0    0    1    1    0    0]
[   1    5 1022    0    1    0    0    3    0    0]
[   0    0    1 1004    0    3    0    2    0    0]
[   0    0    0    0  977    0    1    0    0    4]
[   2    0    0    5    0  883    1    0    1    0]
[   3    3    0    1    1    0  950    0    0    0]
[   0    2    2    0    0    0    0 1022    1    1]
[   0    0    3    0    0    0    0    1  967    3]
[   1    1    0    3    4    4    0    6    3  987]]
```

Comments:

The Random Forest classifier achieved a validation score of approximately 0.968 and a test score of approximately 0.967. The confusion matrix for the test set shows that the Random Forest classifier performed well, but some misclassifications occurred, mostly in classes where the digits might be similar in appearance.

The history plots for loss and accuracy show that the training and validation loss decreased significantly in the initial epochs, while accuracy increased. The validation accuracy plateaued, which is expected due to early stopping, preventing overfitting.

The CNN model achieved a test accuracy of approximately 0.992, which is higher than the Random Forest classifier. The confusion matrix for the CNN model indicates very few misclassifications, showing its superior performance over the Random Forest classifier in this task.

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The conclusion is that the CNN model outperforms the Random Forest classifier in terms of accuracy and confusion matrix, suggesting it is better suited for image classification tasks like MNIST.