Assignment 1

Depp Learning  
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# Build, Train, and Validate CNN Model

## f.3. Display (print) a summary of the model using summary(). Draw a diagram illustrating the structure of the neural network model, making note of the size of each layer (# of neurons) and number of weights in each layer. 4.

A diagram of a layer structure

Description automatically generated

# Test and analyze the model

## g.1. Display (plot) the Training Vs Validation Accuracy of the CNN Model as a line graph using matplotlib. Provide proper axis labels, title and a legend. Use different line color's for training and validation accuracy. **Compare and analyze the training and validation accuracy in your report**

A graph of training and validation accuracy

Description automatically generated As shown in the plot, the model quickly learns to classify the training data, reaching approximately 89.99% accuracy by the 8th epoch (epoch 7). The validation and training curves are almost aligned in the final epoch, indicating that the model is generalizing well. In other words, the model is correctly classifying nearly 90% of both the training and validation data, demonstrating that overfitting is not an issue.

## g.2. Evaluate the cnn model with the test dataset using Tensorflow's evaluate() and display (Print) the test accuracy. **Compare and discuss the test accuracy to the validation accuracy in your report**

A screenshot of a computer screen

Description automatically generated The image on the right shows that the test accuracy is also very close to the training and validation accuracy, further confirming the model's strong performance and generalization.

## g.6. Analyze and discuss the prediction probability distribution in your report

As shown in the image below, the model assigns the highest probability to the true label for each picture, meaning the predictions are correct. While we are displaying only 4 samples here, and all predictions happen to be correct, we know from the earlier accuracy test that in about 11.2% of cases, the model will assign the highest probability to the wrong class.

A collage of different types of clothing

Description automatically generated

## A graph of a diagram Description automatically generated with medium confidenceg.8. Analyze and discuss the confusion matrix in your report

Once again, the confusion matrix confirms that the model is highly accurate, as seen by the large values along the main diagonal. However, it appears that category 6 (Shirt) is the most challenging to classify correctly, with the lowest number of true labels predicted accurately. Specifically, the model frequently misclassifies this category:

1. **136 times** as category 0 (T-shirt/top)
2. **90 times** as category 2 (Pullover)
3. **30 times** as category 3 (Dress)
4. **66 times** as category 4 (Coat)

This misclassification pattern also occurs in reverse:

1. Category 0 (T-shirt/top) is misclassified as 6 (Shirt) **81 times**.
2. Category 2 (Pullover) is misclassified as 6 (Shirt) **66 times**.
3. Category 3 (Dress) is misclassified as 6 (Shirt) **31 times**.
4. Category 4 (Coat) is misclassified as 6 (Shirt) **82 times**.

Out of 1000 examples for category 6 (Shirt), only **659 are correctly predicted**, resulting in an accuracy of approximately **65.9%**. This is significantly lower than the overall accuracy of the model on the test data, which is around **88%**.

On the other hand, category 8 (Bags) and category 1 (Trousers) are easily recognized, with accuracies above **97%**. This is likely because, in the MNIST\_Fashion dataset, there are no items that closely resemble trousers (like shorts) or bags (like suitcases), making them easier for the model to classify.

# Build,Train,Validate,Test and Analyze RNN Model

## h.f. Build, Train, and Validate CNN Model

### h.f.3. Display (print) a summary of the model using summary(). Draw a diagram illustrating the structure of the neural network model, making note of the size of each layer (# of neurons) and number of weights in each layer. 4.

As we can see this model is simpler, have less layers, neurons and weights.

A blue rectangular sign with white text

Description automatically generated

### h.g.1. Display (plot) the Training Vs Validation Accuracy of the CNN Model as a line graph using matplotlib. Provide proper axis labels, title and a legend. Use different line color's for training and validation accuracy. **Compare and analyze the training and validation accuracy in your report**

A graph of training and validation accuracy

Description automatically generated As shown in the plot, this model also quickly learns to classify the training data, reaching approximately 87.23% accuracy by the 8th epoch (epoch 7). The validation and training curves are almost aligned in the final epoch, indicating that the model is generalizing well. In other words, the model is correctly classifying nearly 88% of both the training and validation data, demonstrating that overfitting is not an issue.

The overall accuracy of for this model is slightly lower than using CNN.

### h.g.2. Evaluate the cnn model with the test dataset using Tensorflow's evaluate() and display (Print) the test accuracy. **Compare and discuss the test accuracy to the validation accuracy in your report**

A screenshot of a computer program

Description automatically generatedThe image on the right shows that the test accuracy is also very close to the training and validation accuracy, further confirming the model's strong performance and generalization.

### h.g.6. Analyze and discuss the prediction probability distribution in your report

As shown in the image below, the model assigns the highest probability to the true label for each picture, meaning the predictions are correct. While we are displaying only 4 samples here, and all predictions happen to be correct, we know from the earlier accuracy test that in about 13.8% of cases, the model will assign the highest probability to the wrong class. If we compare these results with the ones from CNN, we can see that in general CNN is more ‘confident’ about its predictions, assigning higher probabilities to the correct class compared to the RNN.

A collage of different types of clothing

Description automatically generated

### A graph of a diagram Description automatically generated with medium confidenceh.g.8. Analyze and discuss the confusion matrix in your report

Once again, the confusion matrix confirms that the model is highly and similar to the ones made about the CNN applies here.

# Conclusion

Both neural networks performed well on this task; however, the CNN trained significantly faster than the RNN and achieved slightly better accuracy. On the other hand, the RNN is much simpler, with fewer layers, neurons, and parameters.