CS 797O: Neural Nets and Deep Learning
Unit 4: Extra Credit Assignment
Convolutional Neural Network

Abu Tyeb Azad
WSU ID: Q688C867

May 9, 2023

1 Given Basic Configuration

No. of Convolution Layers Used = 1
No. of Dense Layers Used = 2
No. of Training Epochs = 10
Training time = 64.24 seconds (in colab gpu)

1.1 Network Flow

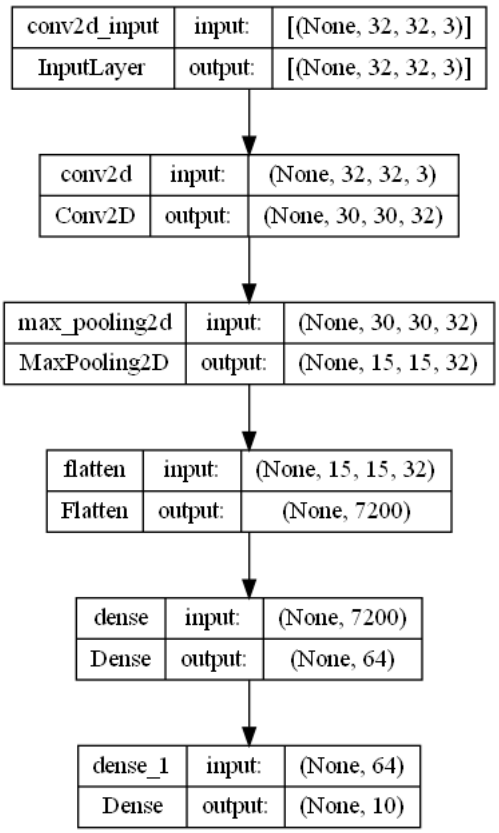

Figure 1: Given Basic CNN Model

1.2 Accuracy

Training Accuracy = 0.727
Validation Accuracy = 0.6367

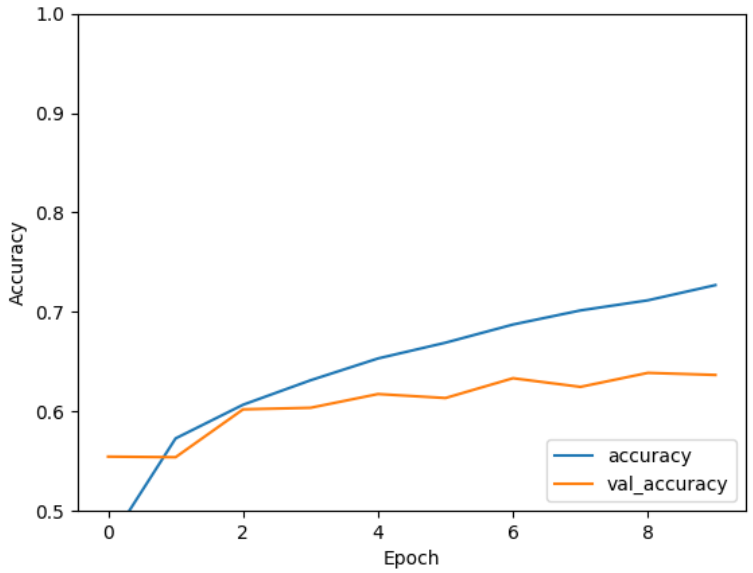

Figure 2: Accuracy of Given Basic Model

1.3 Loss

Training Loss = 0.7907
Validation Loss = 1.084

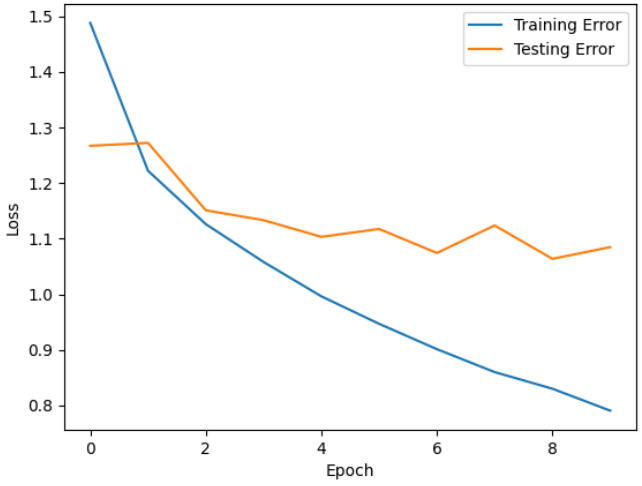

Figure 3: Loss Curve of Given Basic Model

2 Given Modified Configuration 1

No. of Convolution Layers Used = 2 (increased from 1)
No. of Dense Layers Used = 2
No. of Training Epochs = 10
Training time = 53.84 seconds (in colab gpu)

2.1 Network Flow

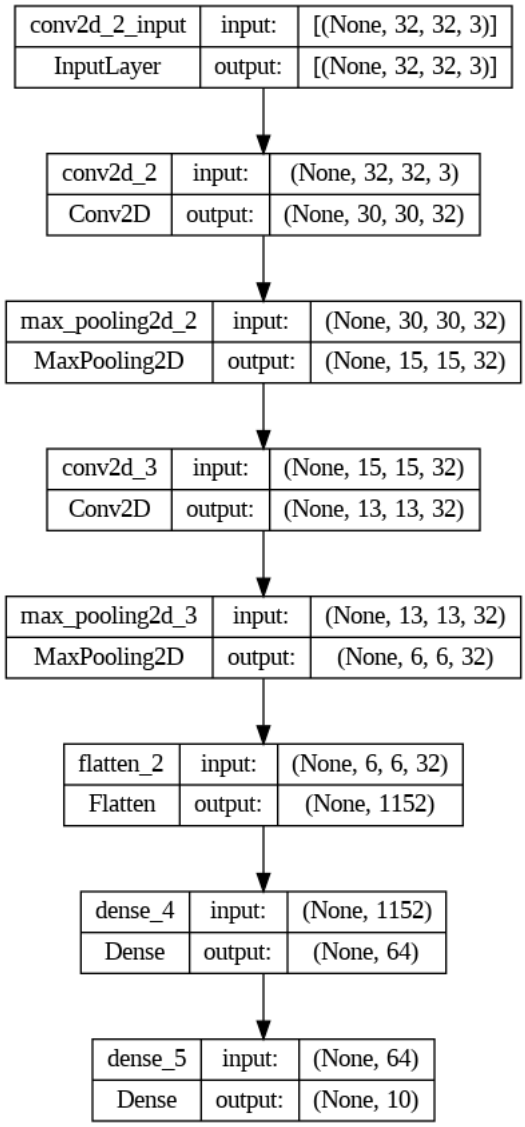

Figure 4: Given Modified CNN Model

2.2 Accuracy

Training Accuracy = 0.7195
Validation Accuracy = 0.6438

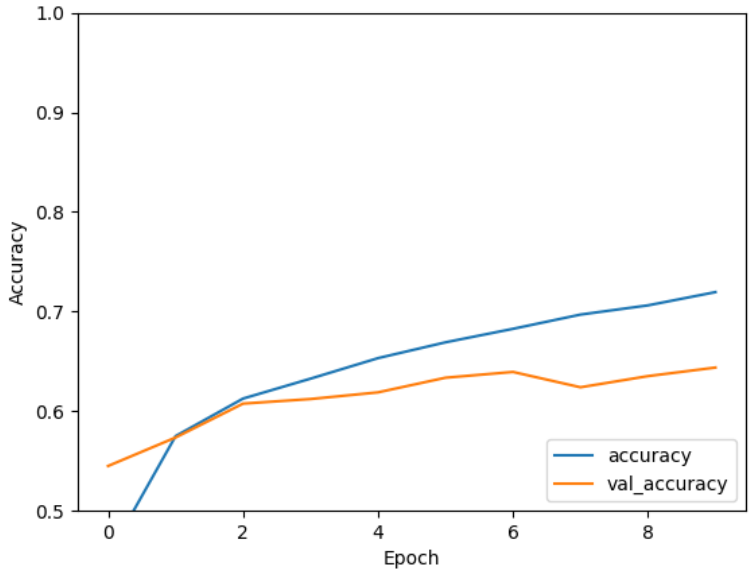

Figure 5: Accuracy of Given Modified Model for 10 Epochs

2.3 Loss

Training Loss = 0.8072
Validation Loss = 1.0576

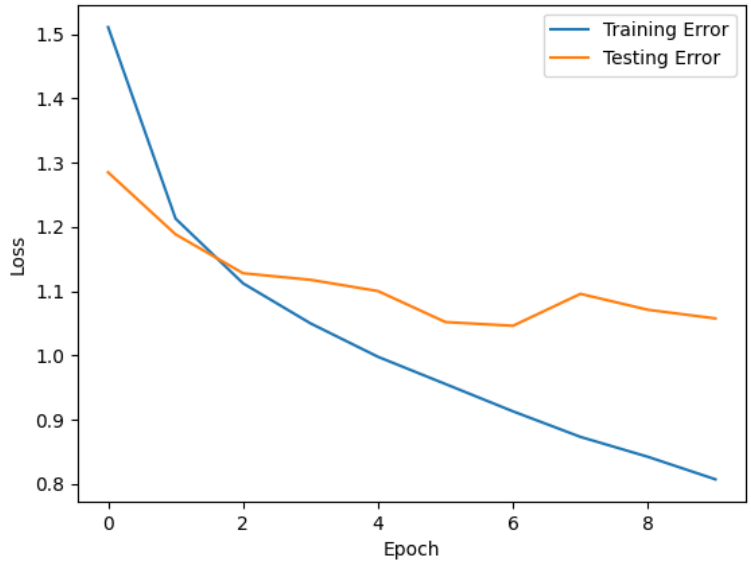

Figure 6: Loss Curve of Given Modified Model for 10 Epochs

3 Given Modified Configuration 2

No. of Convolution Layers Used = 2 (increased from 1)
No. of Dense Layers Used = 2
No. of Training Epochs = 12 (increased from 10)
Training time = 73.30 seconds (in colab gpu)

3.1 Network Flow

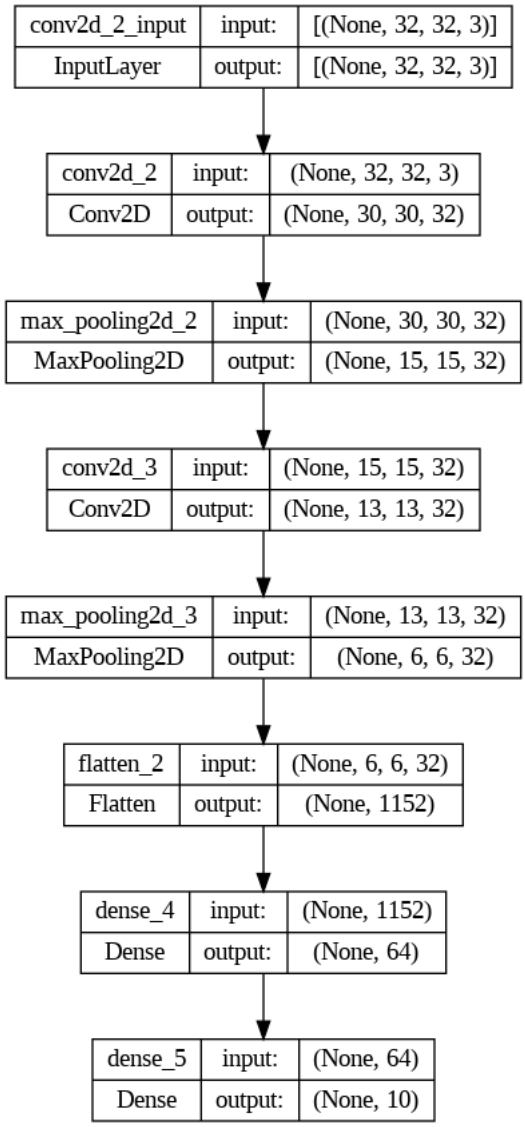

Figure 7: Given Modified CNN Model

3.2 Accuracy

Training Accuracy = 0.7732
Validation Accuracy = 0.6983

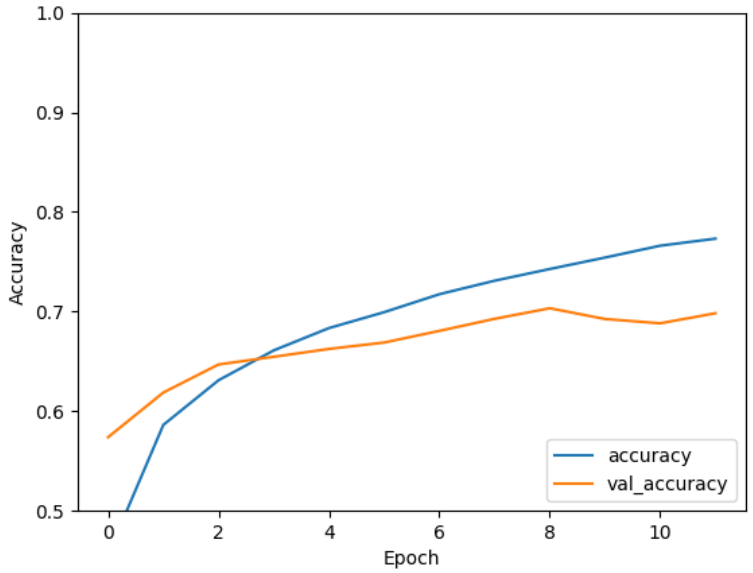

Figure 8: Accuracy of Given Modified Model for 12 Epochs

3.3 Loss

Training Loss = 0.6433
Validation Loss = 0.92095

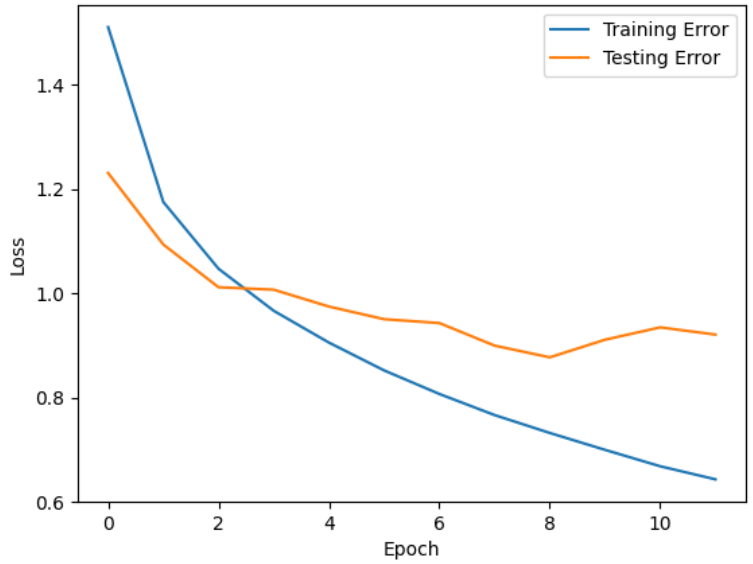

Figure 9: Loss Curve of Given Modified Model for 12 Epochs

4 Custom Configuration 1

No. of Convolution Layers Used = 3 (increased from 2, no. of filters=64)
No. of Dense Layers Used = 2
No. of Training Epochs = 12 (not changed)
Training time = 81.31 seconds (in colab gpu)

4.1 Network Flow

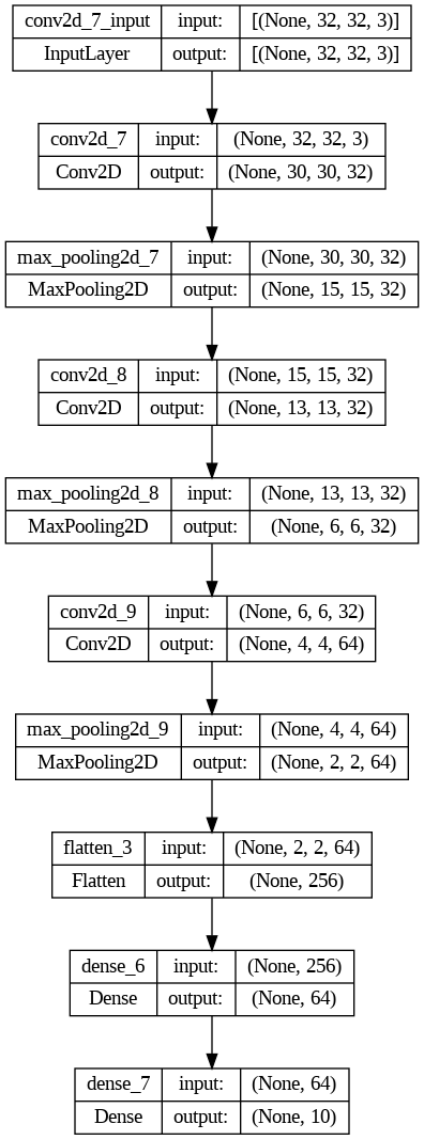

Figure 10: Custom Model 1

4.2 Accuracy

Training Accuracy = 0.7583
Validation Accuracy = 0.7058

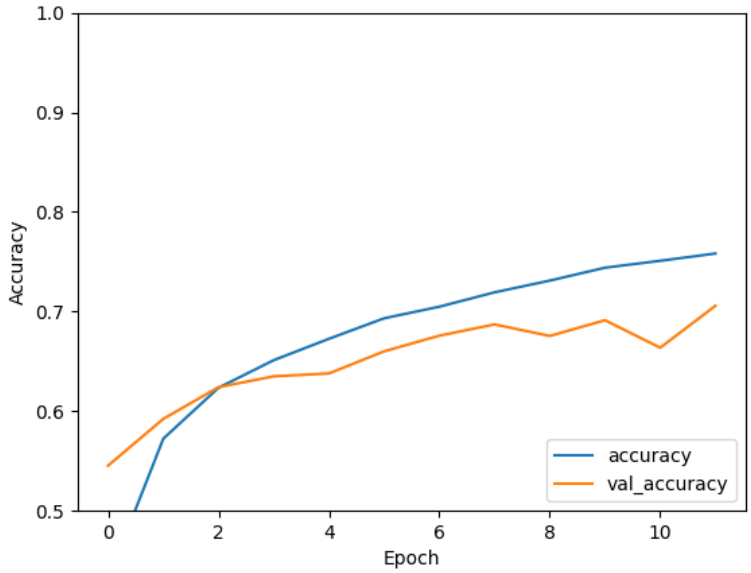

Figure 11: Accuracy of Custom Model for 12 Epochs

4.3 Loss

Training Loss = 0.6844
Validation Loss = 0.8774

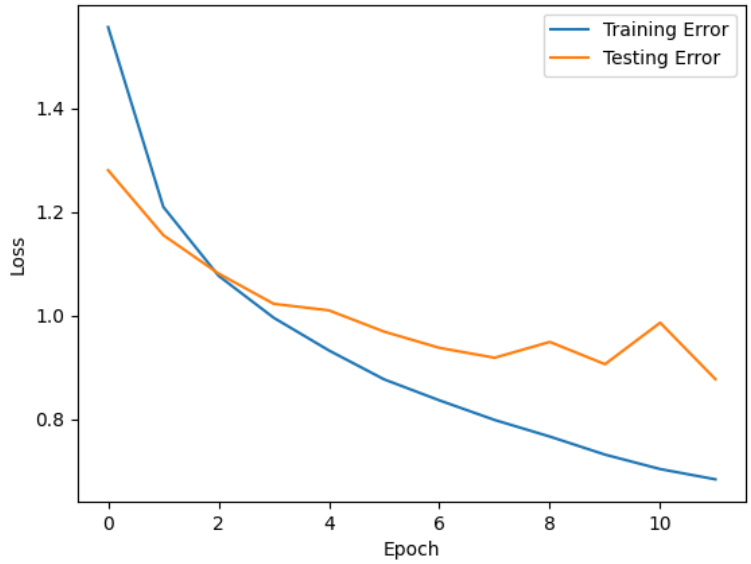

Figure 12: Loss Curve of Custom Model for 12 Epochs

5 Custom Configuration 2

No. of Convolution Layers Used = 3 (increased from 2, no. of filters=64)
No. of Dense Layers Used = 2
No. of Training Epochs = 15 (increased from 12)
Training time = 111.03 seconds (in colab gpu)

5.1 Network Flow

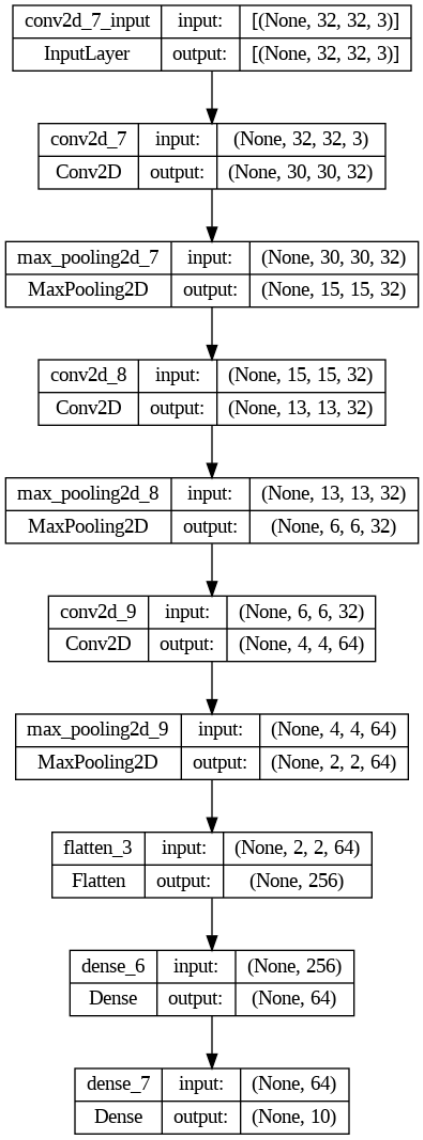

Figure 13: Custom Model 1

5.2 Accuracy

Training Accuracy = 0.7766
Validation Accuracy = 0.7009

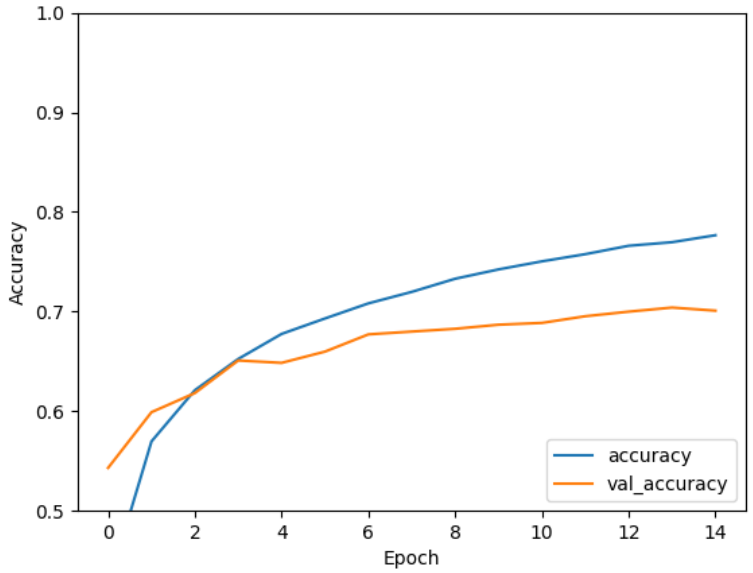

Figure 14: Accuracy of Custom Model for 15 Epochs

5.3 Loss

Training Loss = 0.6318
Validation Loss = 0.9045

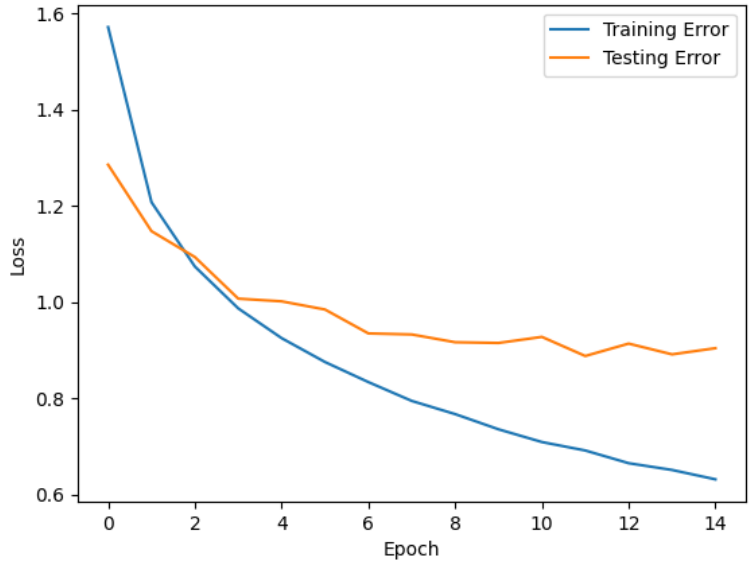

Figure 15: Loss Curve of Custom Model for 15 Epochs

6 Analysis

I have changed the CNN architecture by adding another convolution layer with 64 filters/kernels of size 3x3. Then trained the customized model for 12 and 15 epochs respectively (2 different configurations). Both configurations (epoch = 12 and 15) improves training performance (higher accuracy, lower training error). The 1st configuration (epoch=12), in addition to improving training performance, reduces the validation error (generalization error). But the 2nd configuration (epoch = 15) increases the validation error (the generalization gap increases), which means the model is not generalizing well. If we observe the loss curve in Figure 15, the loss seems to increase around 13 epochs. Most likely, during that point, the model starts to overfit on training data. To improve the performance, I have tried to add more layers, both dense (fully-connected layers) and convolution ones, but the generalization error did not decrease. So we can gather more data so that the model do not overfit and generalize well. Or we can keep the the amount of data the same but in that case we need to decrease the training epochs while ensuring that the model does not underfit.