Hoang Ho - 1001654608
CSE 4310-001 Fundamentals of Computer Vision
Assignment 4 - Convolutional Neural Networks
Due May 11, 2022, by 11:59 PM

Assignment 4 – Report

See the README.txt file for details on changing hyperparameters, package installations, and how to run the files.

Hyperparameters

These hyperparameters were used for all models:

Number of target classes = 101

Path to food dataset = "./data/food/"

Batch size = 25

Number of workers = 4

Number of GPUs = 1

Maximum epochs = 8

Learning rate = 1e-3

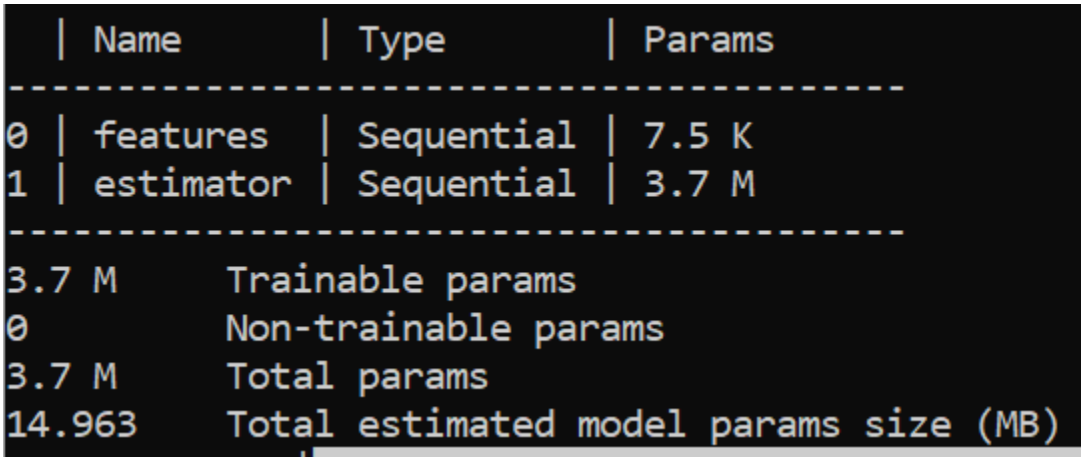
Basic CNN

Chosen Architecture:

The following architecture similar to AlexNet was used:

1. Convolutional layer with 3 input channels, 8 output channels, and kernel size 11
2. ReLU activation function
3. 2D Max pooling with kernel size 2
4. Convolutional layer with 8 input channels, 11 output channels, and kernel size 5
5. ReLU activation function
6. 2D Max pooling with kernel size 3

7. Convolutional layer with 11 input channels, 24 output channels, and kernel size 3
8. ReLU activation function
9. 2D Max pooling with kernel size 2
10. Fully connected layer using 6144 input features and 576 output features
11. ReLU activation function
12. Fully connected layer using 576 input features and 256 output features
13. ReLU activation function
14. Fully connected layer using 256 input features and 128 output features
15. ReLU activation function
16. Fully connected layer using 128 input features and 101 output features



```
  | Name      | Type       | Params
-----------------------------------------
0 | features  | Sequential | 7.5 K
1 | estimator | Sequential | 3.7 M
-----------------------------------------
3.7 M     Trainable params
0         Non-trainable params
3.7 M     Total params
14.963    Total estimated model params size (MB)
```

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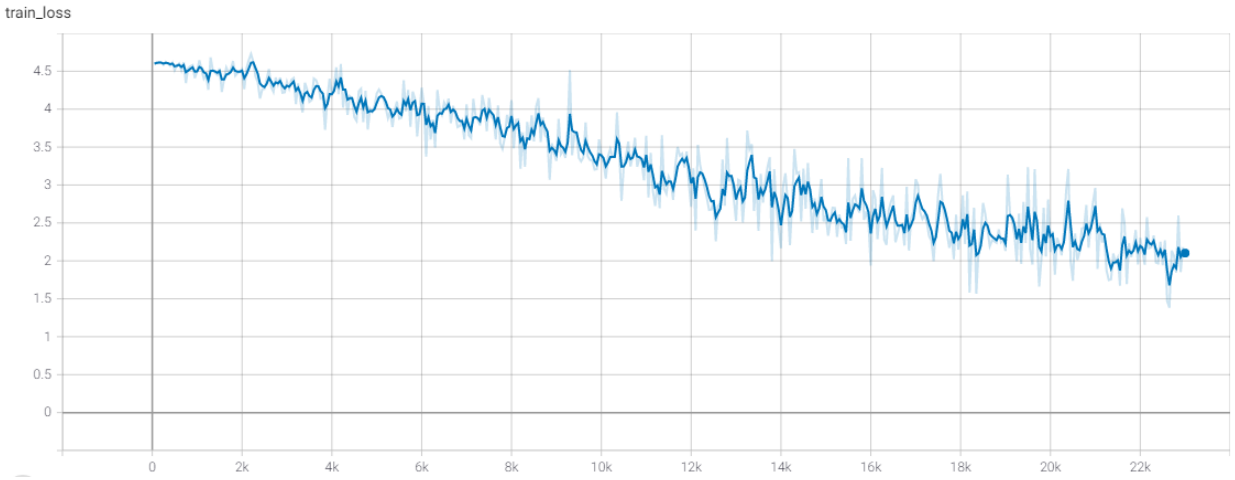
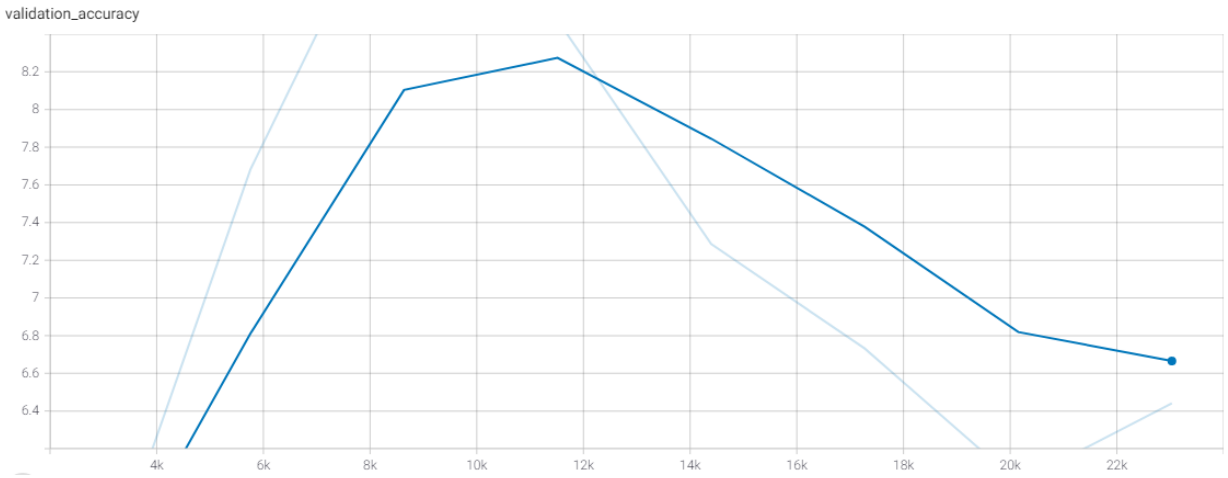
Training Loss:



Validation Accuracy:



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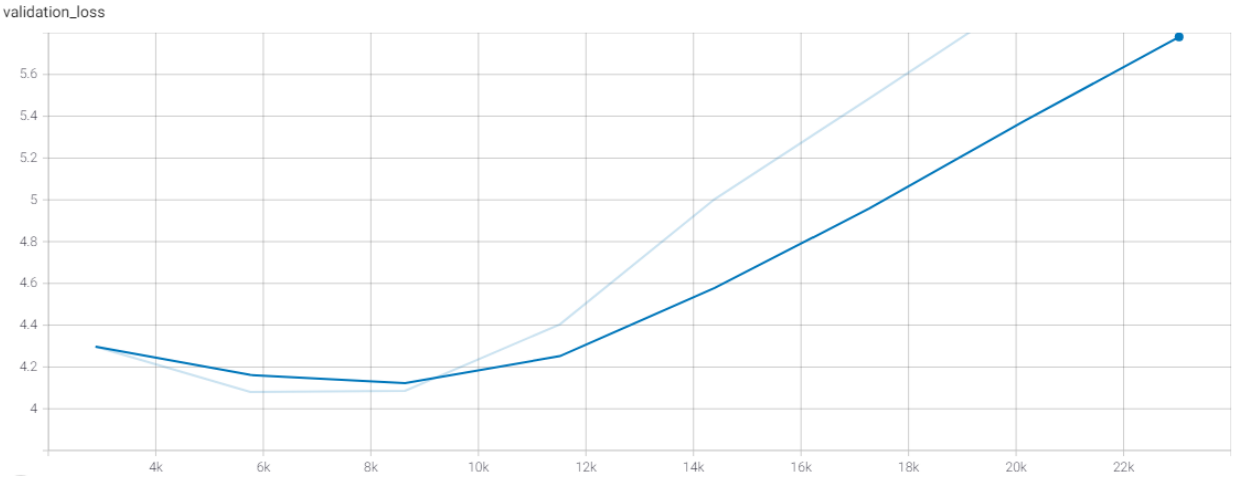
Validation Loss:



Final Test Accuracy:

Test metric	DataLoader 0
test_accuracy	6.526732444763184
test_loss	6.179446697235107

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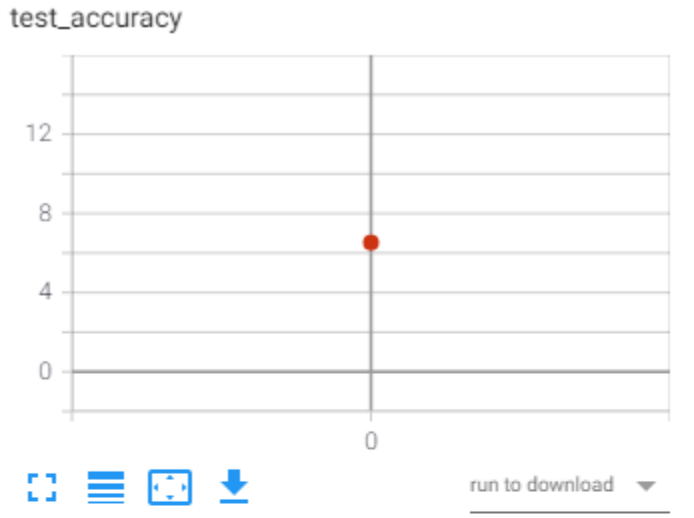
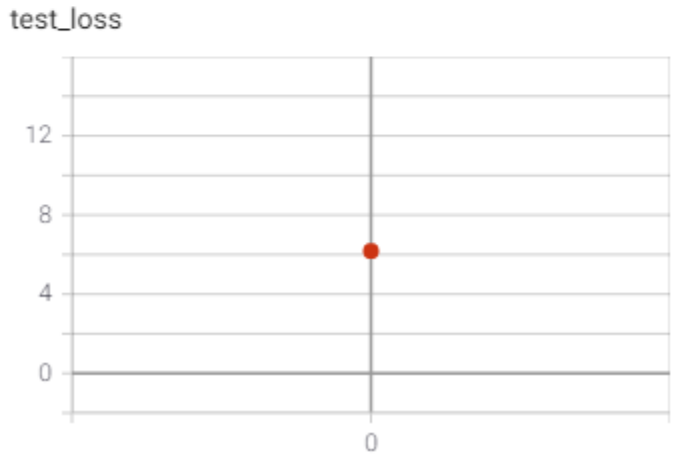


test_loss



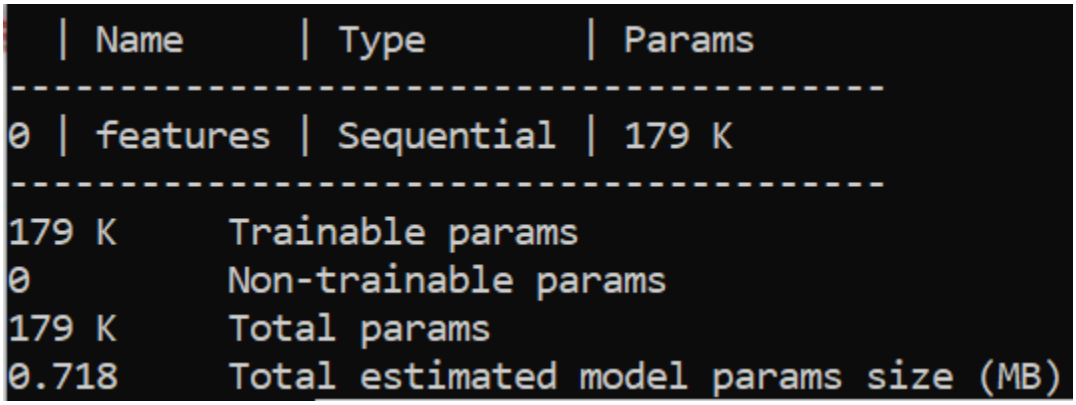
All Convolutional Net

Chosen Architecture:

The following architecture was used:

1. Convolutional layer with 3 input channels, 8 output channels, and kernel size 3

2. ReLU activation function
3. Convolutional layer with 8 input channels, 32 output channels, kernel size 3, and strides 2
4. ReLU activation function
5. Convolutional layer with 32 input channels, 64 output channels, kernel size 5, and strides 2
6. ReLU activation function
7. Convolutional layer with 64 input channels, 128 output channels, kernel size 3
8. ReLU activation function
9. Convolutional layer with 128 input channels, 101 output channels, kernel size 2



Here we see the total number of parameters in the all convolutional model is 179,000 parameters. In the basic CNN used in the previous section, the total number of parameters was 3.7 million parameters.

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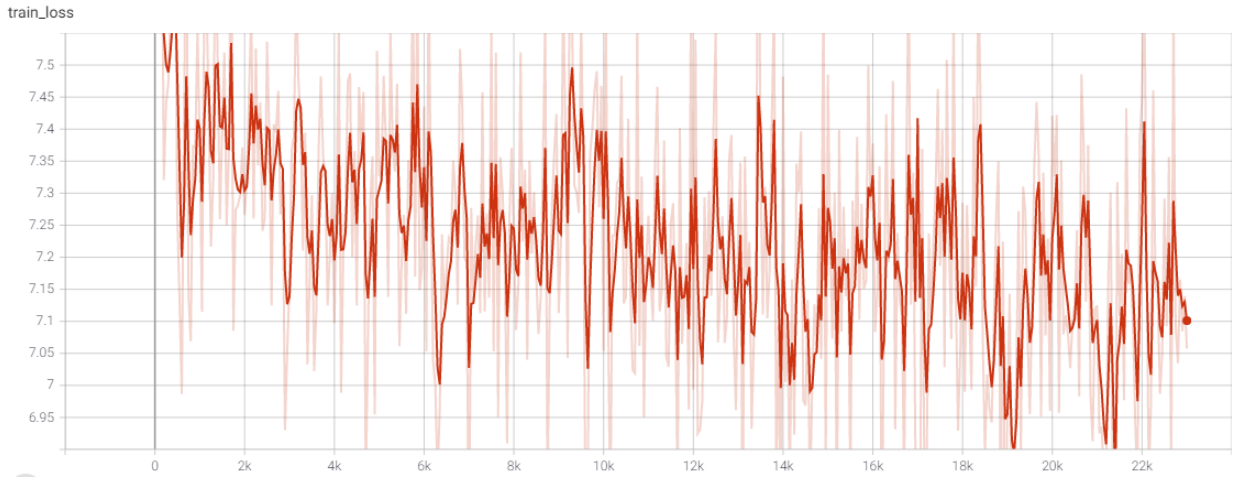
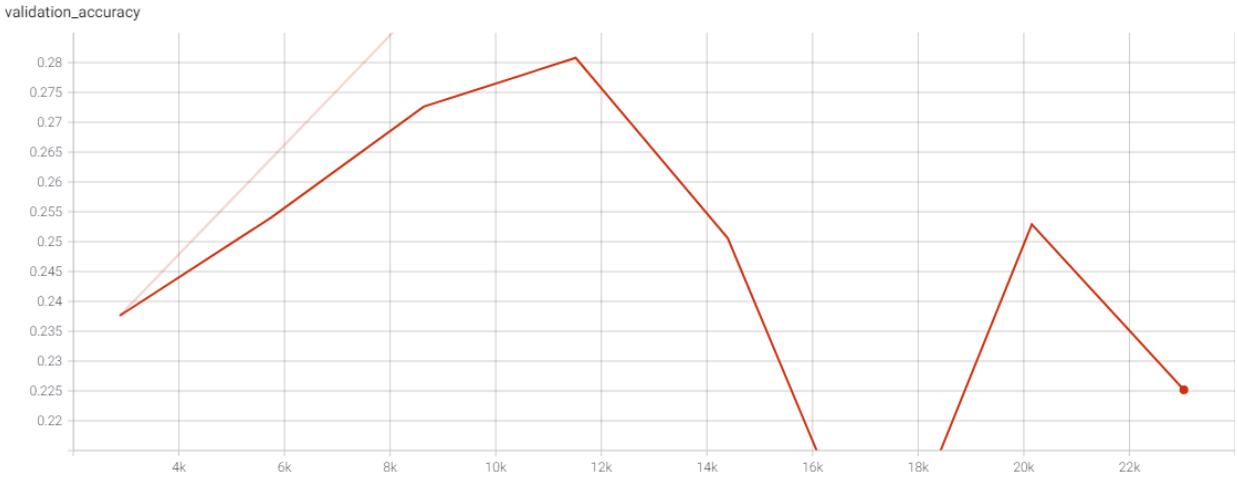
Training Loss:



Validation Accuracy:



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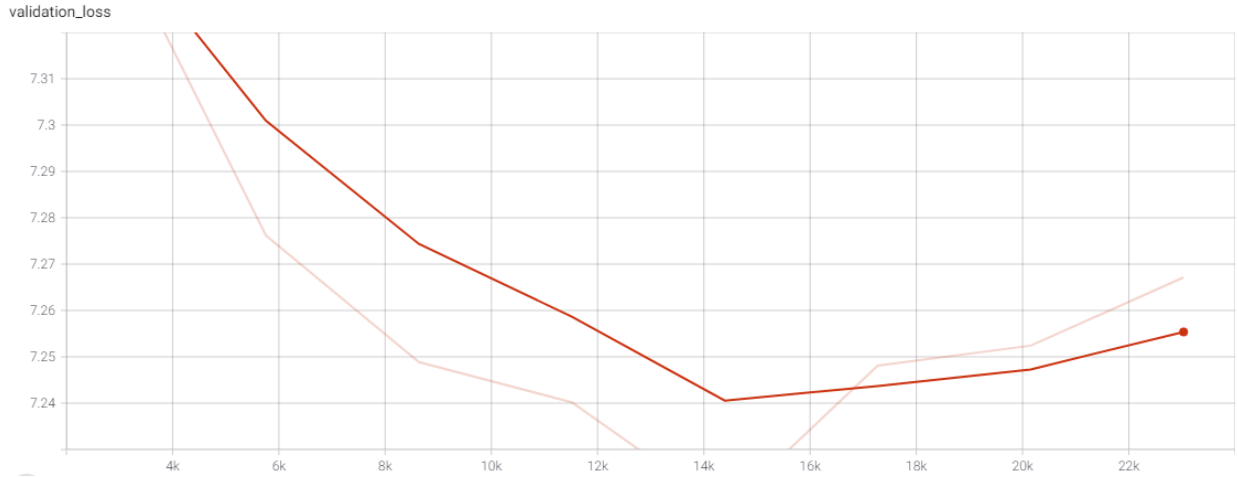
Validation Loss:



Final Test Accuracy:

Test metric	DataLoader 0
test_accuracy	0.3405940532684326
test_loss	7.237005710601807

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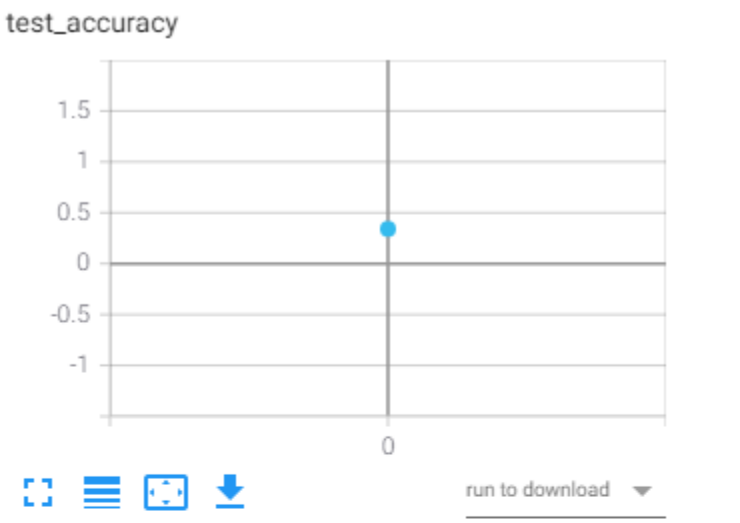
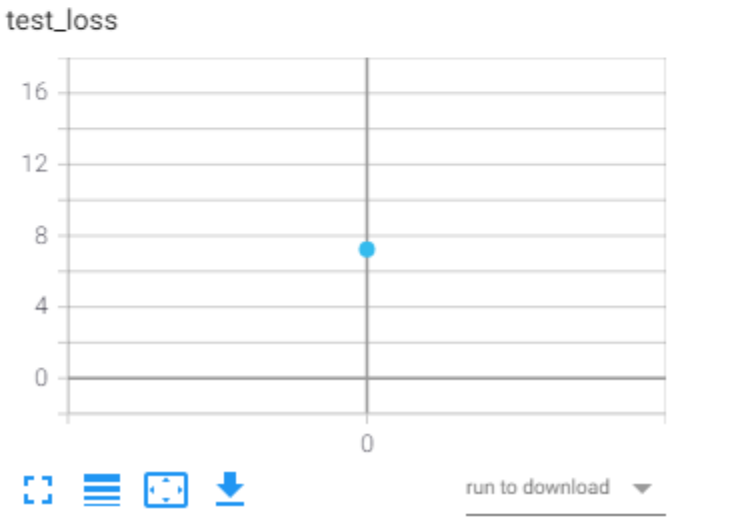


test_loss



Regularization

Chosen Model:

BasicCNN model

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Additions:

Added two dropouts after the 2nd and 3rd fully connected layer

New Architecture:

1. Convolutional layer with 3 input channels, 8 output channels, and kernel size 11
2. ReLU activation function
3. 2D Max pooling with kernel size 2
4. Convolutional layer with 8 input channels, 11 output channels, and kernel size 5
5. ReLU activation function
6. 2D Max pooling with kernel size 3
7. Convolutional layer with 11 input channels, 24 output channels, and kernel size 3
8. ReLU activation function
9. 2D Max pooling with kernel size 2
10. Fully connected layer using 6144 input features and 576 output features
11. ReLU activation function
12. Fully connected layer using 576 input features and 256 output features
13. ReLU activation function
14. Dropout
15. Fully connected layer using 256 input features and 128 output features
16. ReLU activation function
17. Dropout
18. Fully connected layer using 128 input features and 101 output features

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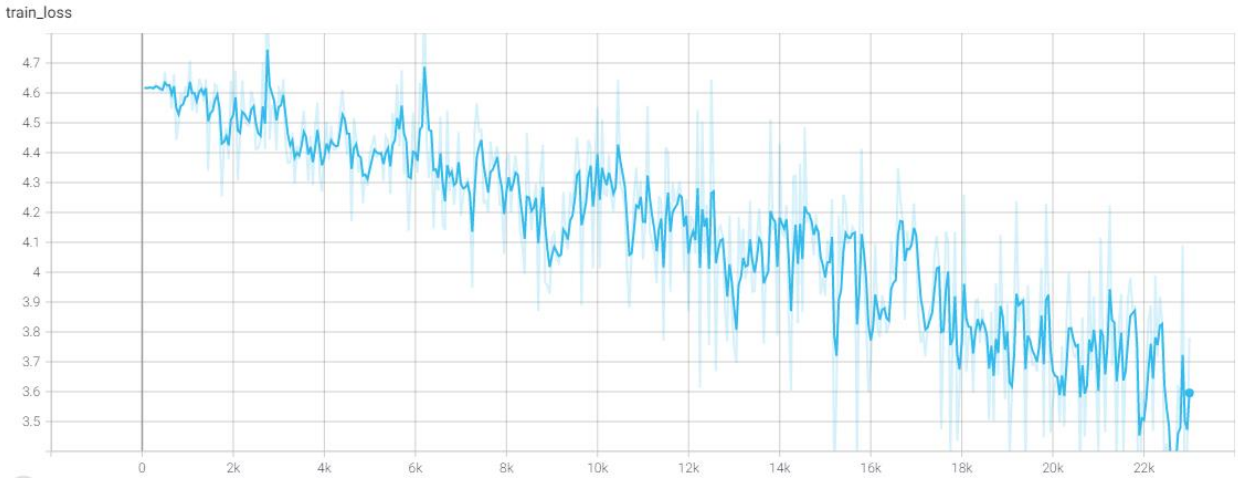
```
  | Name      | Type       | Params
-----------------------------------------
0 | features  | Sequential | 7.5 K
1 | estimator | Sequential | 3.7 M
-----------------------------------------
3.7 M     Trainable params
0         Non-trainable params
3.7 M     Total params
14.963    Total estimated model params size (MB)
```

Training Loss:



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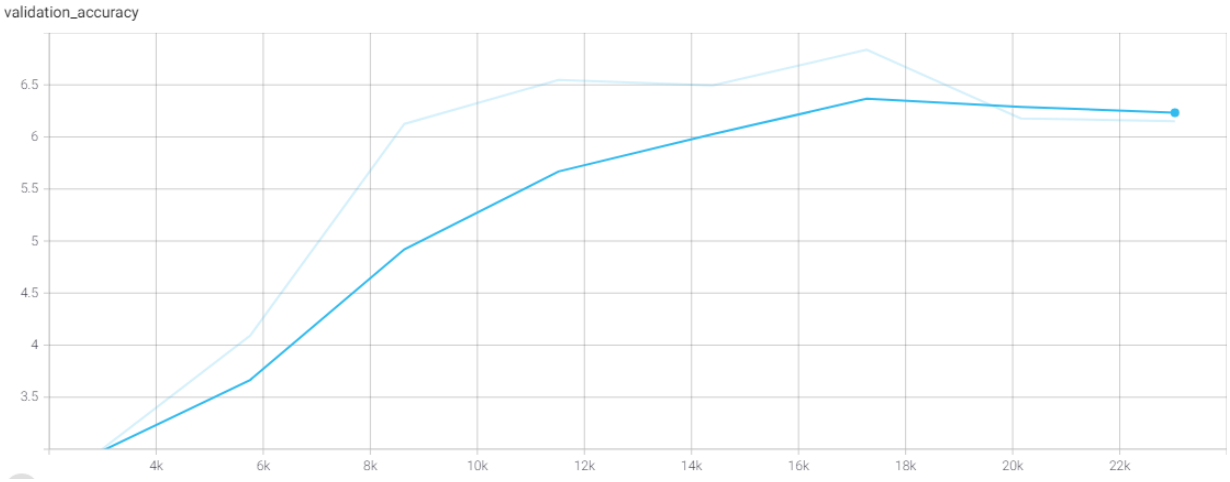
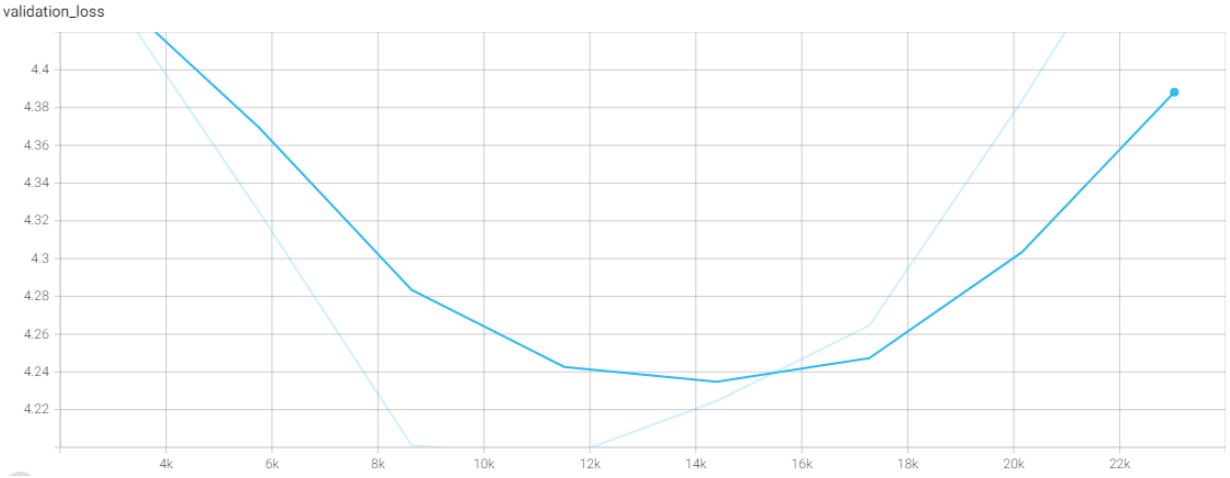
Validation Accuracy:



Validation Loss:



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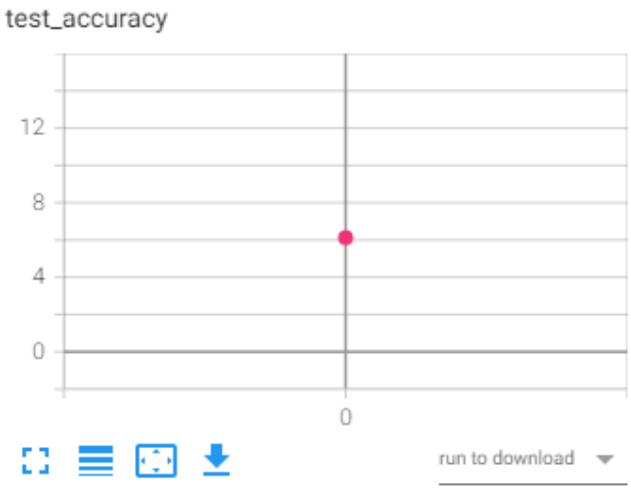
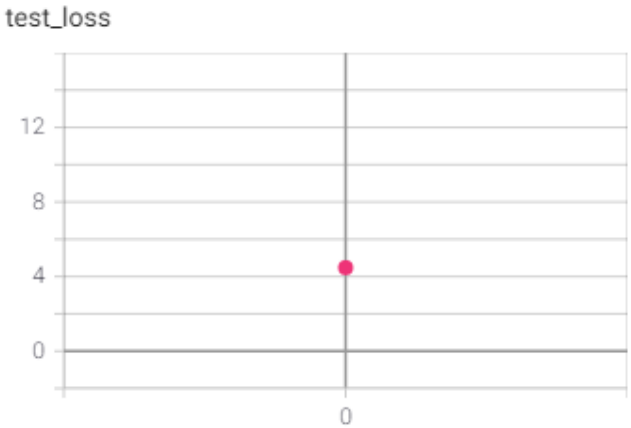
Final Test Accuracy:

Test metric	DataLoader 0
test_accuracy	6.118812084197998
test_loss	4.475569248199463



test_loss



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Transfer Learning

Pre-trained model used:

GoogLeNet which is 22 layers deep, 27 layers when pooling layers are included.

Image of full architecture can be found here.

Changes:

Excluded the last layer. Added linear layer with the number of filters the layer before the last layer as the input features and the target classes (101) as the output feature.

```
  | Name      | Type       | Params
-----------------------------------------
0 | features  | Sequential | 5.6 M
1 | estimator | Linear     | 103 K
-----------------------------------------
5.7 M     Trainable params
0         Non-trainable params
5.7 M     Total params
22.814    Total estimated model params size (MB)
```

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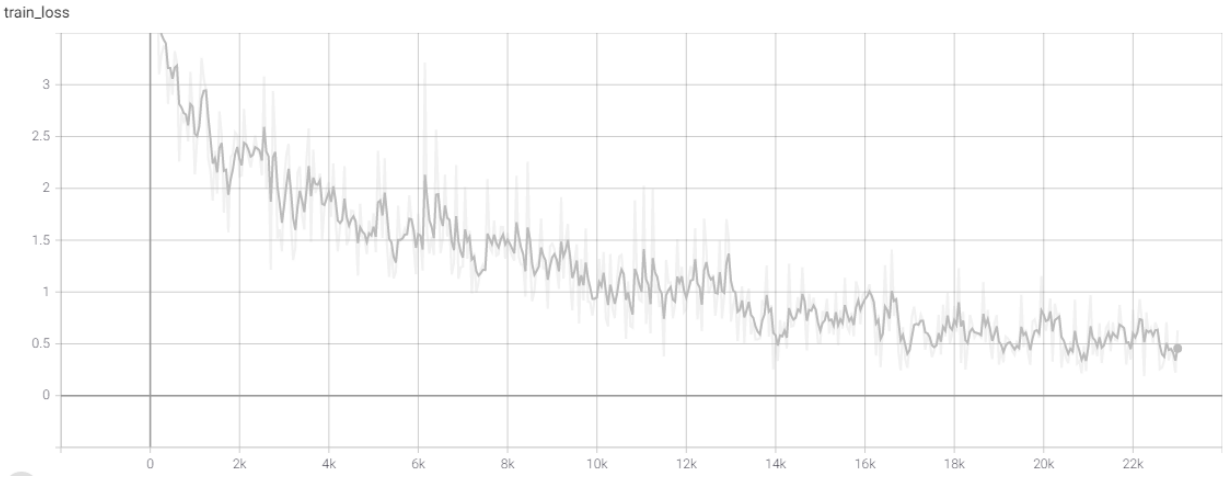
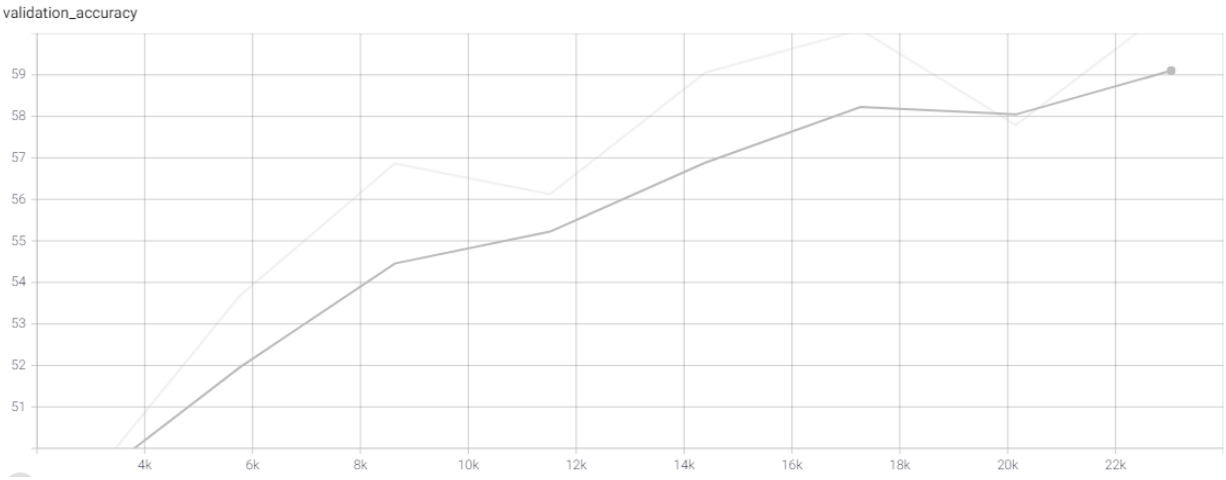
Training Loss:



Validation Accuracy:



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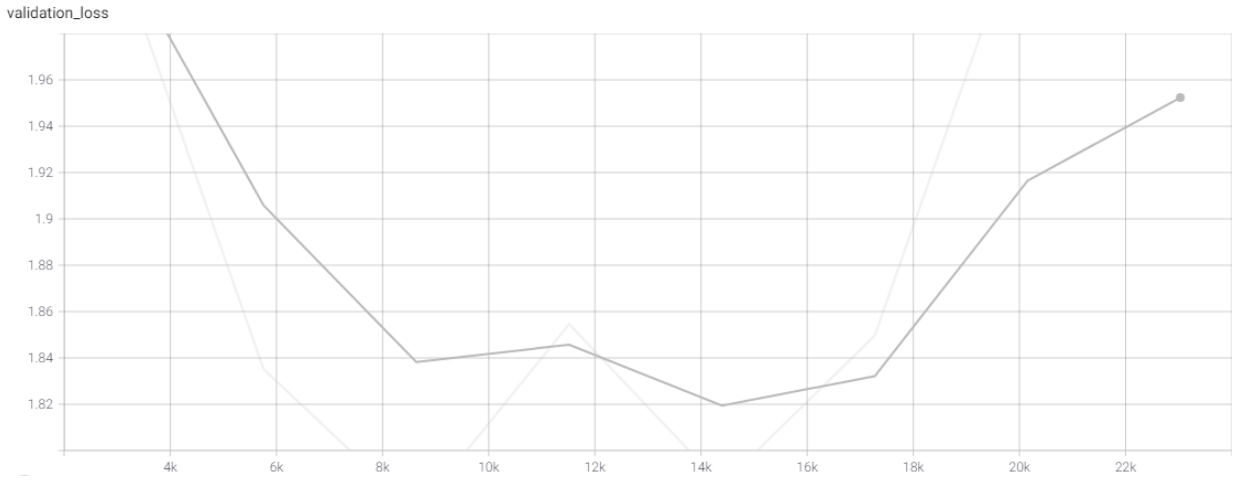
Validation Loss:



Final Test Accuracy:

Test metric	DataLoader 0
test_accuracy	66.2336654663086
test_loss	1.5928475856781006

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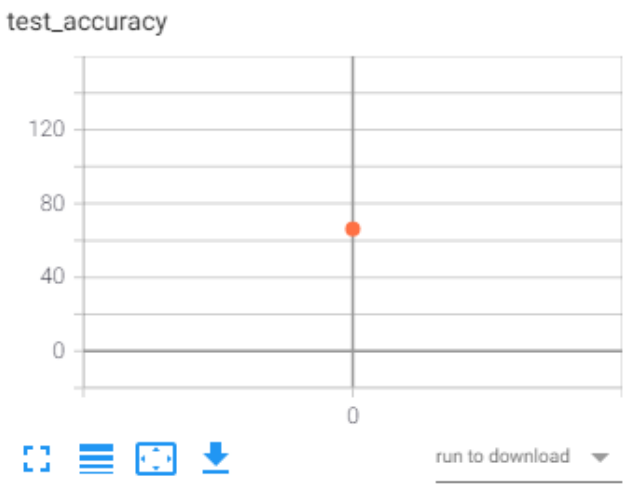

test_loss