Analysis of impact of Convolutional Neural Network structure on the performance

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Dataset – CIFAR10

- 60000 32x32 colour images in 10 classes, with 6000 images per class
- Classes:
  - Airplane
  - Automobie
  - Bird
  - Cat
  - Deer
  - Dog
  - Frog
  - Horse
  - Ship
  - Truck






Dataset preparation

1. Normalize pixel values from range 0… 255 to 0 … 1
2. Convert category number (0 … 9) to a 10 element vector with "1" at a position of category number

2

0
0
1
0
0
0
0
0
0
0

Tools

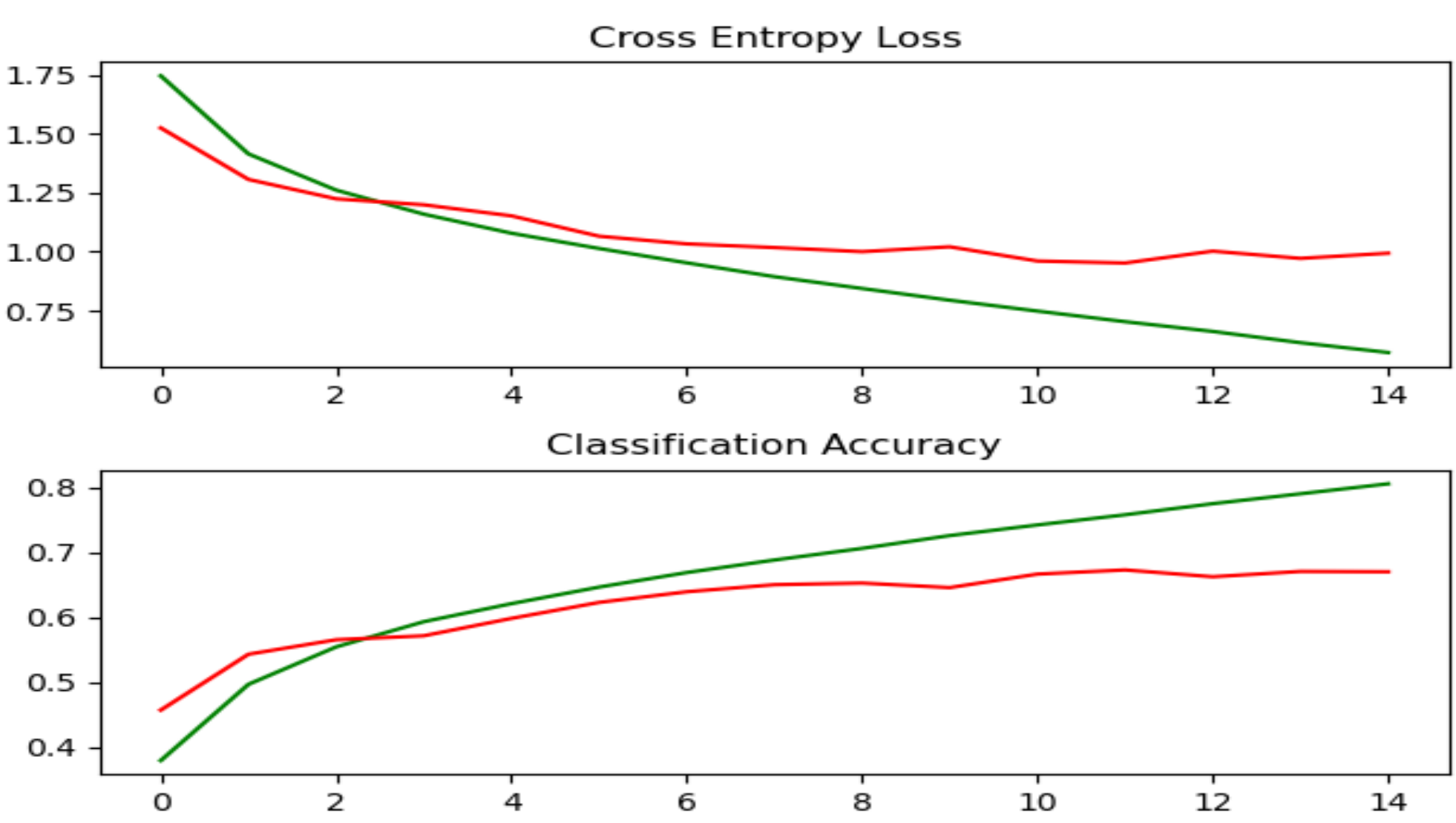
- Python
- Tensorflow
- Keras

Tests

- 6 layers (2 conv, 1 pooling, 1 flatten, 2 full)
- 9 layers (4 conv, 2 pooling, 1 flatten, 2 full)
- 12 layers (6 conv, 3 pooling, 1 flatten, 2 full)
- 6, 9, 12 + dropout layers
- 6, 9, 12 + weight decay
- 6, 9, 12 + dropout layers + weight decay

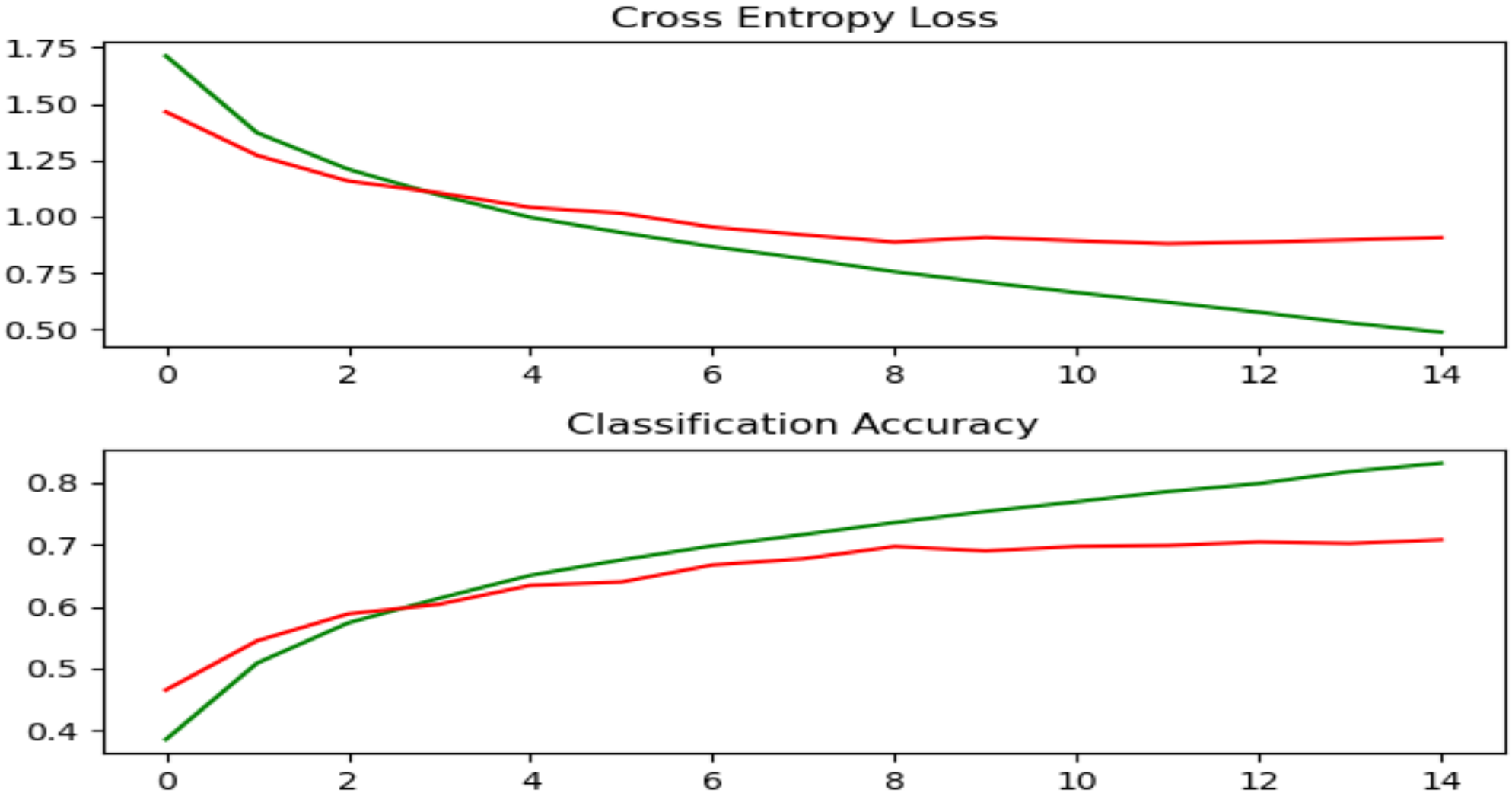
Results

6 layers



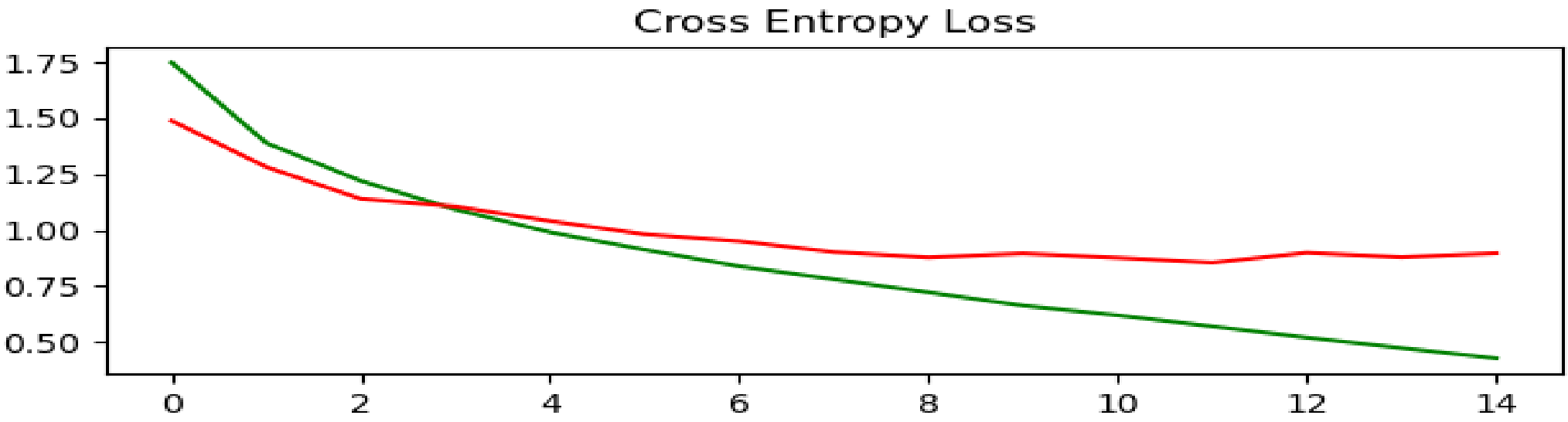
Results

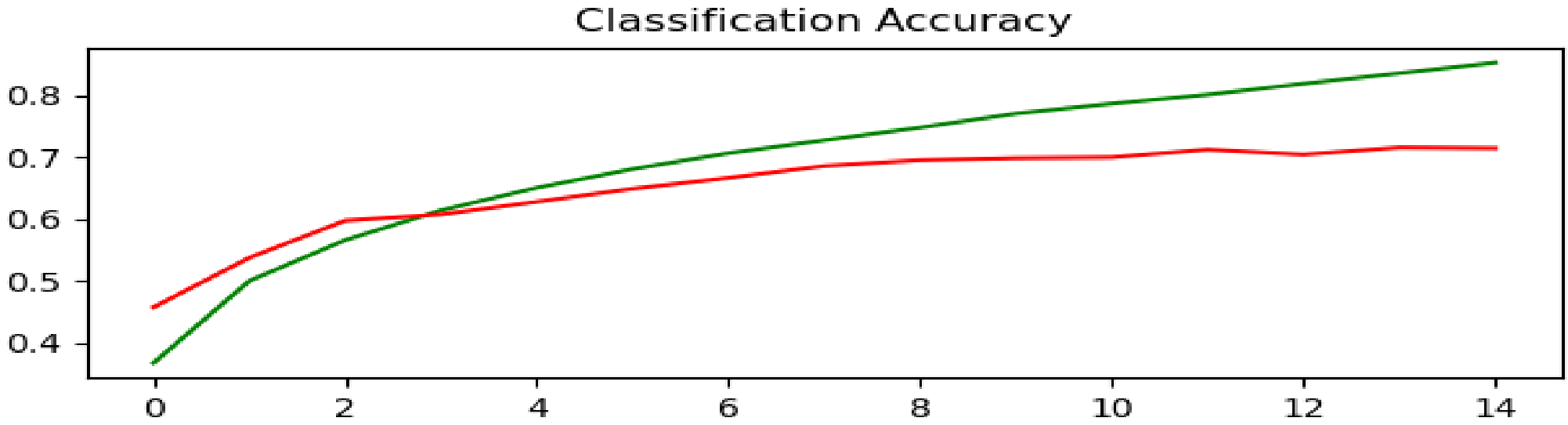
9 layers



Results

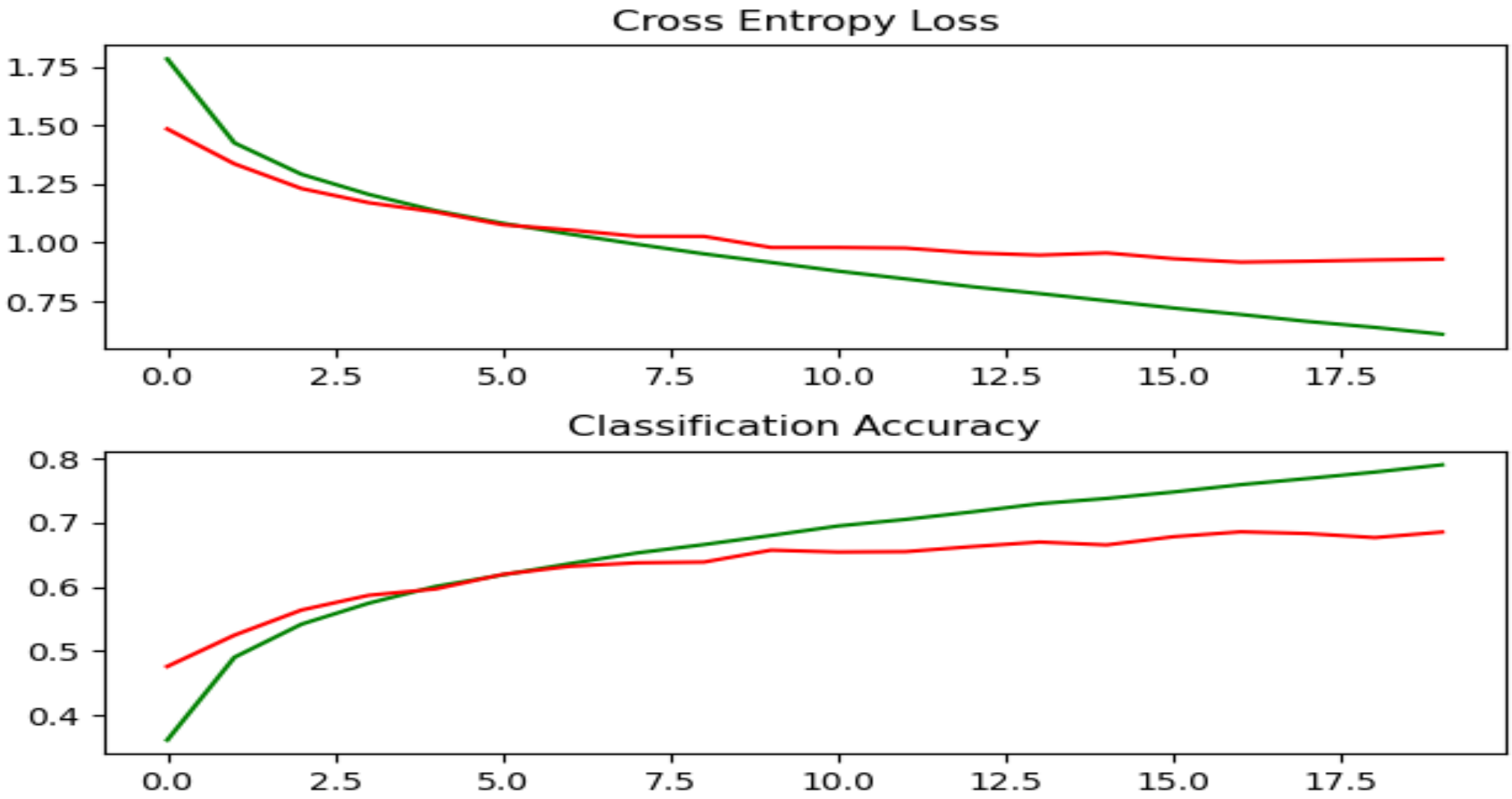
12 layers





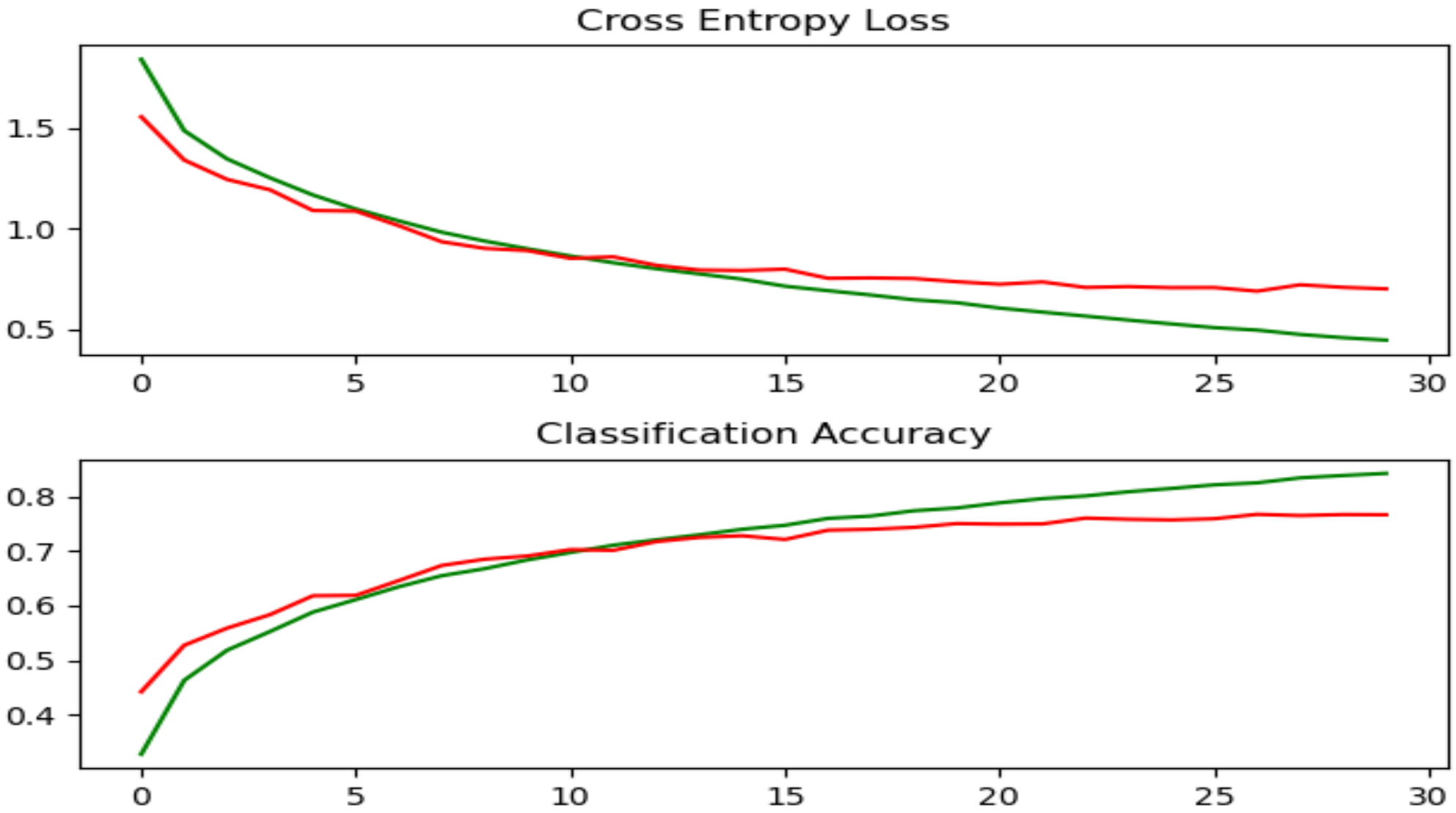
Results

6 layers + 1 dropout layer



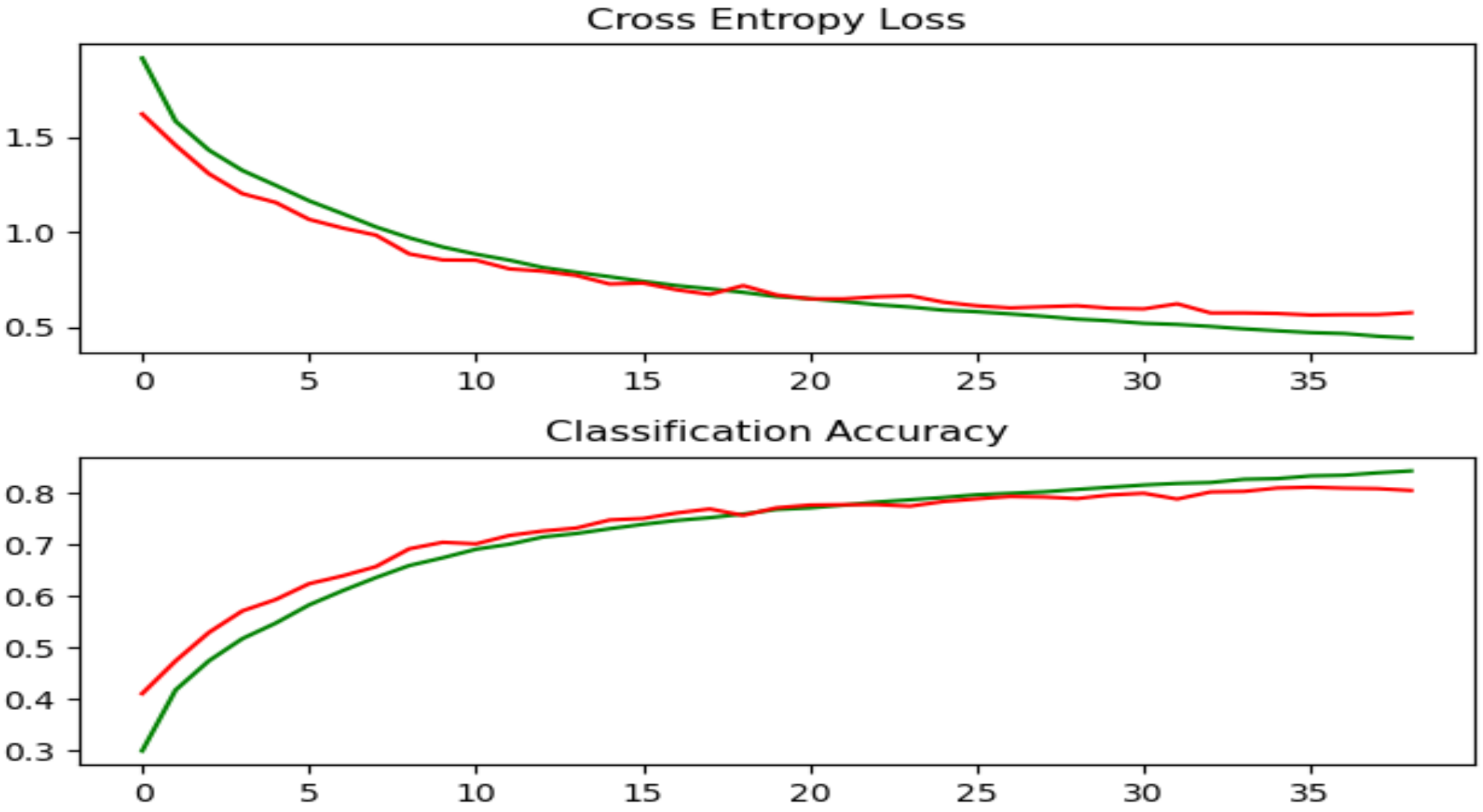
Results

9 layers + 2 dropout layers



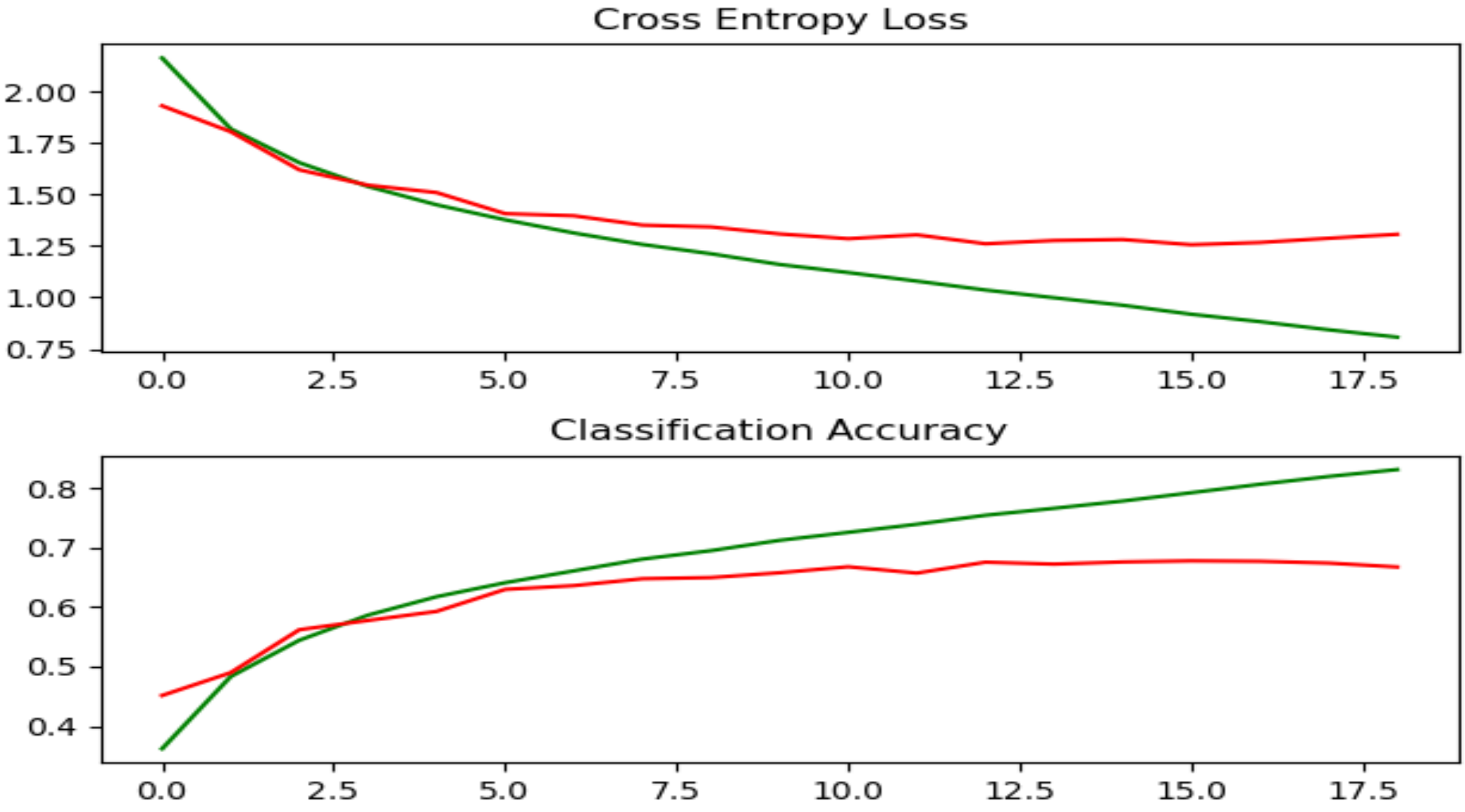
Results

12 layers + 3 dropout layers



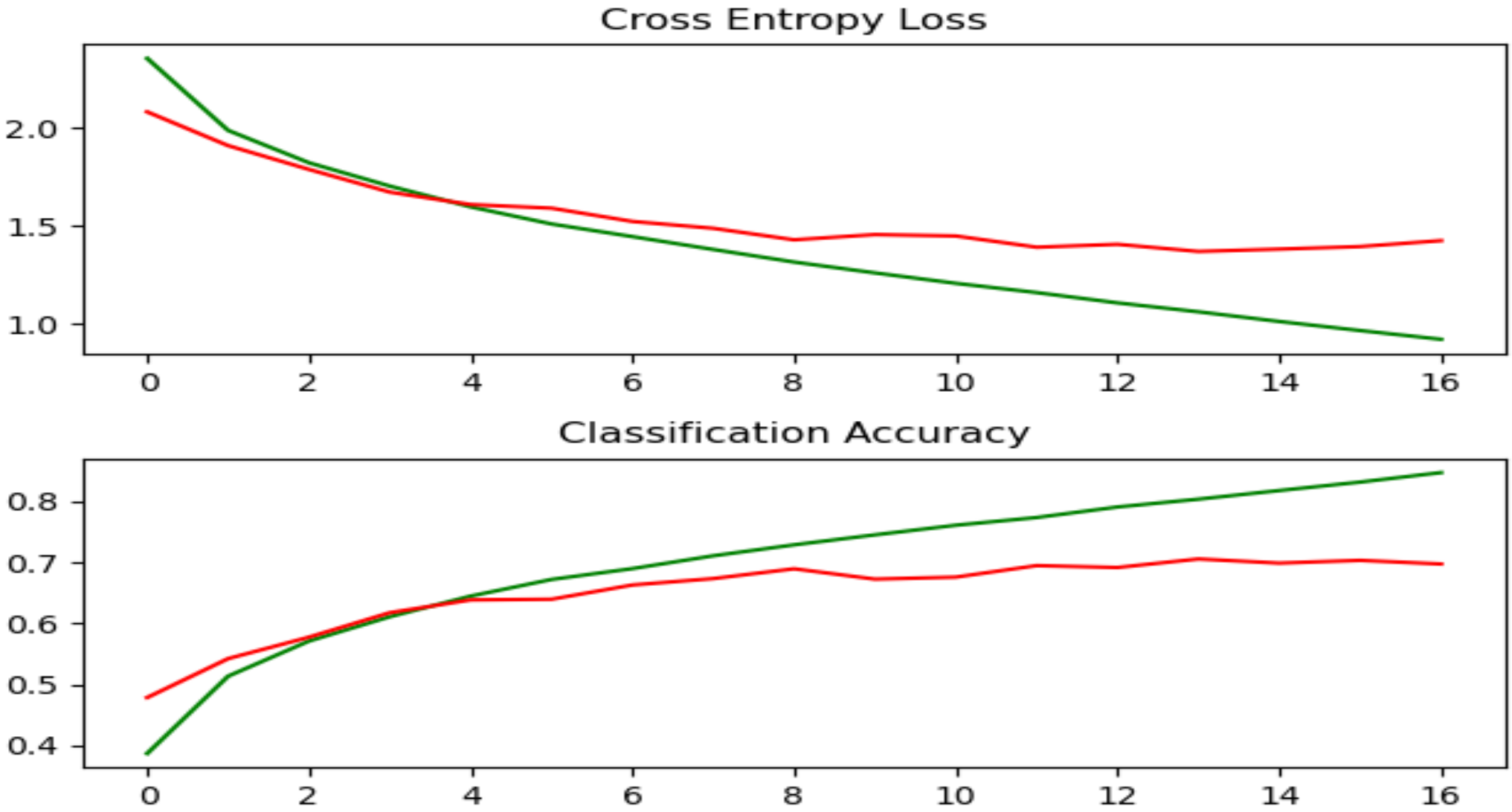
Results

6 layers + weight decay



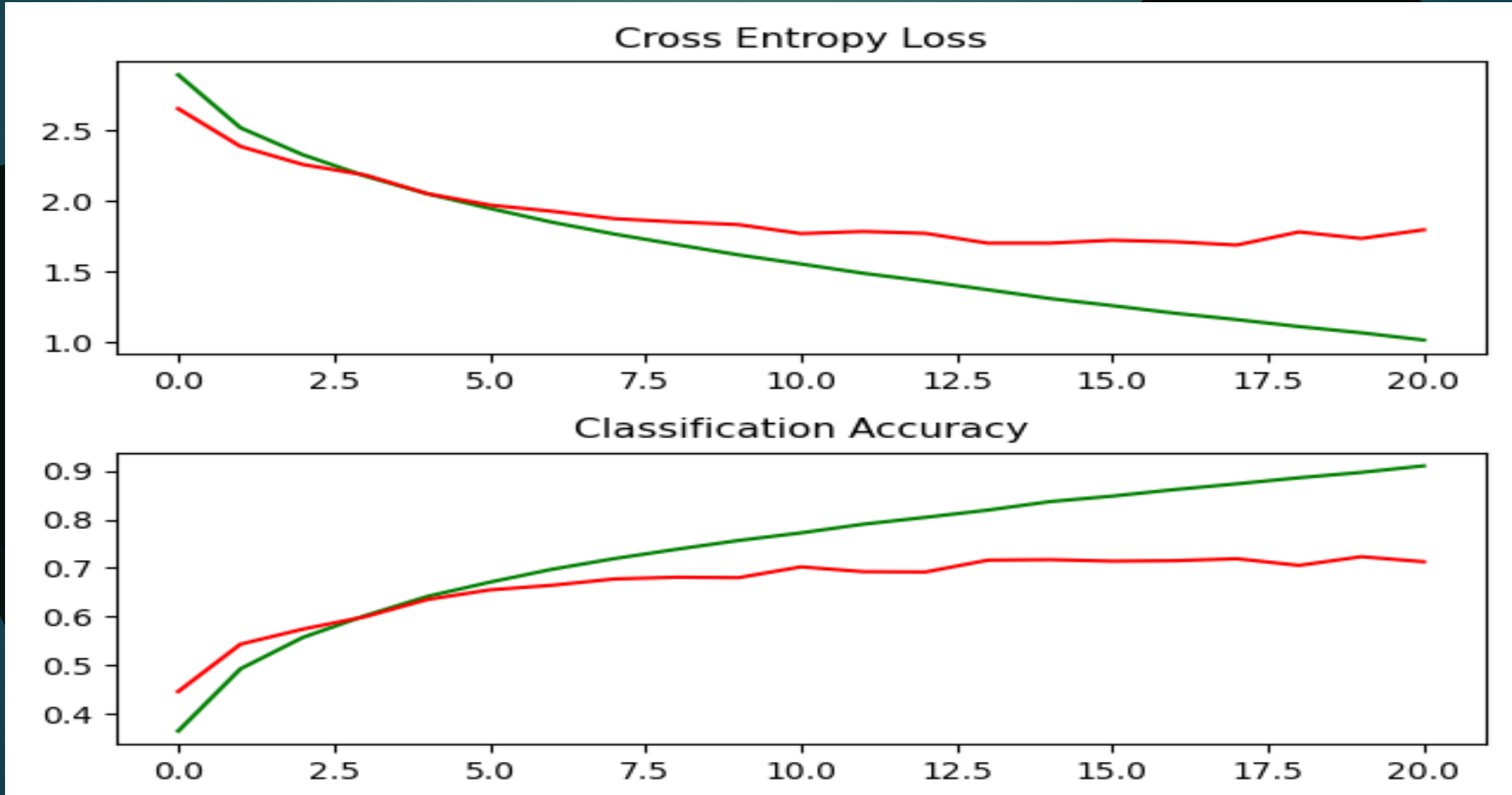
Results

9 layers + weight decay



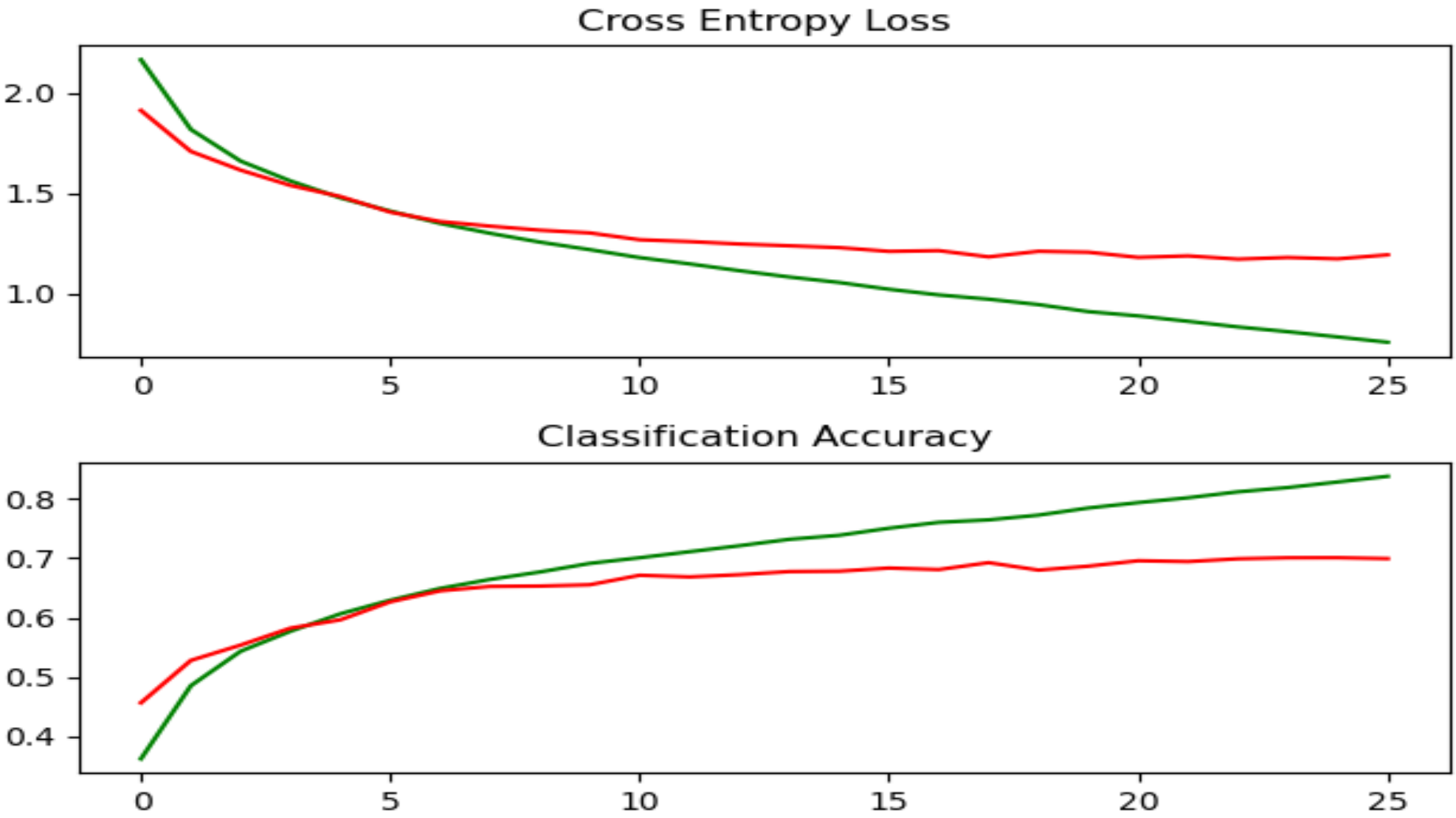
Results

12 layers + weight decay



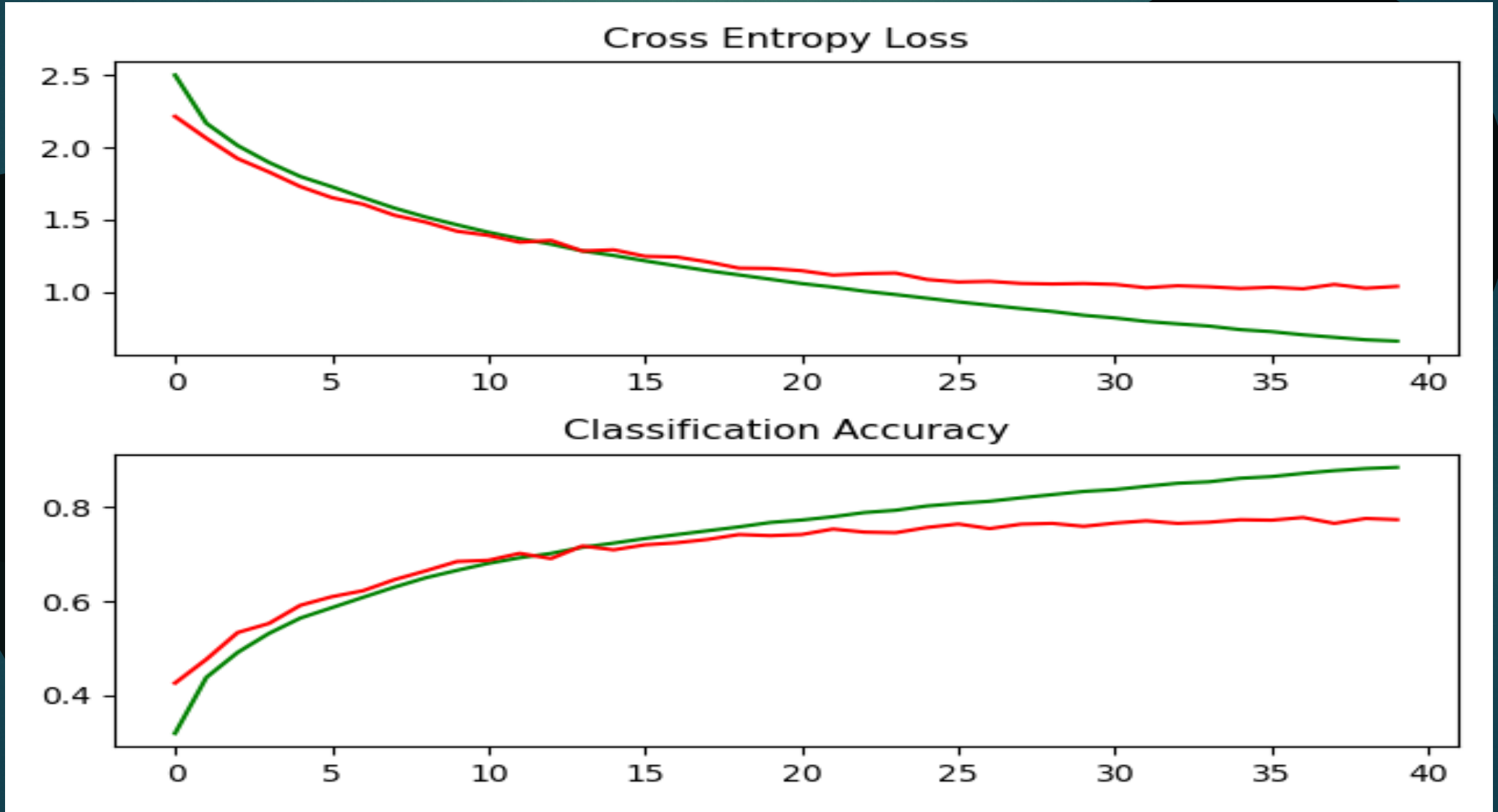
Results

6 layers + 1 dropout layer + weight decay



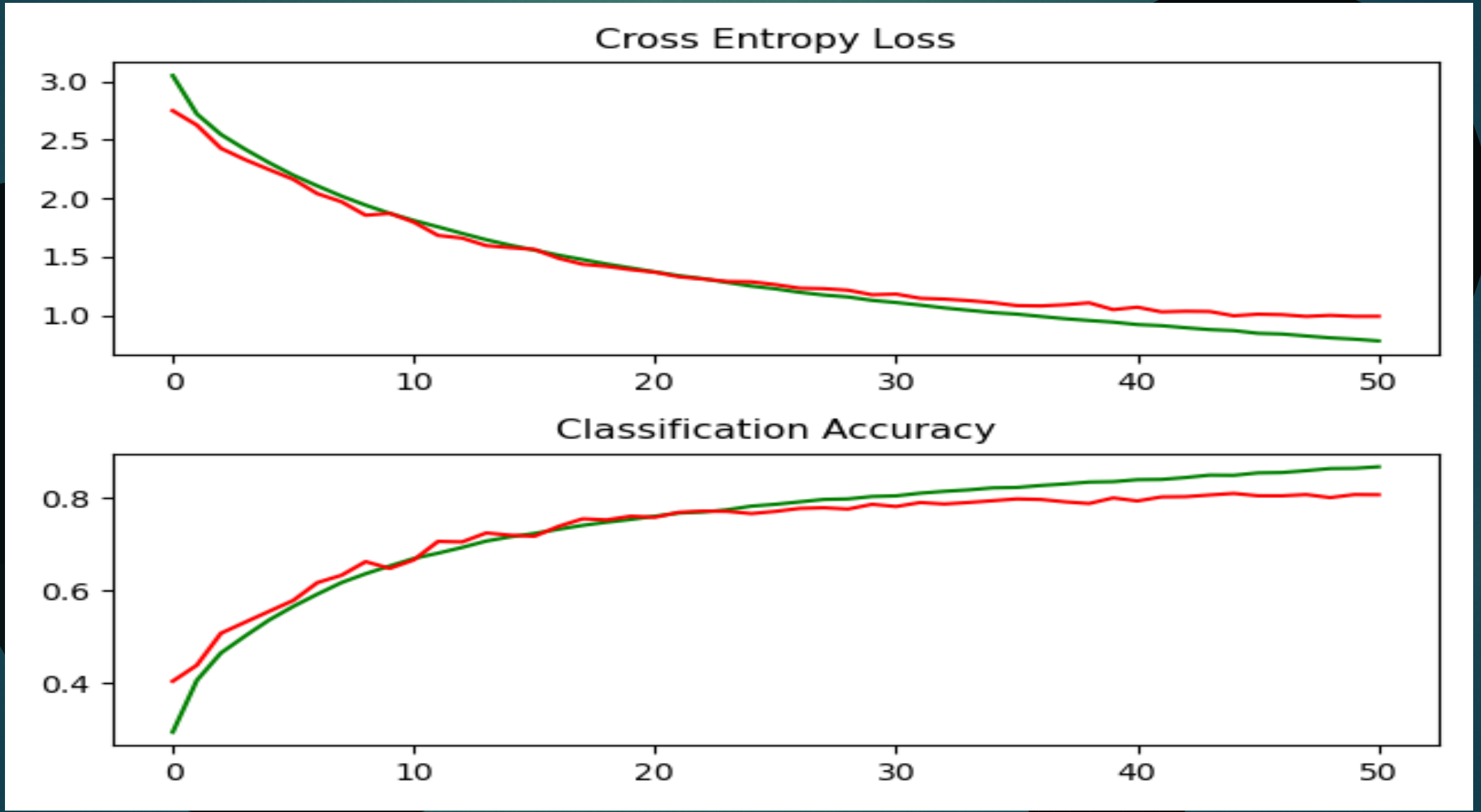
Results

9 layers + 2 dropout layers+ weight decay



Results

12 layers + 3 dropout layers + weight decay



Model	accuracy	loss	epochs
6 layer	0.6679	0.9858	15/100
9 layer	0.7059	0.8938	14/100
12 layer	0.7327	0.8934	16/100
6 layer + dropout	0.6999	0.9124	23/100
9 layer + dropout	0,7633	0.7181	31/100
12 layer + dropout	0.7869	0.6221	33/100
6 layer + weight decay	0.6706	1.2931	18/100
9 layer + weight decay	0.7204	1.3494	18/100
12 layer + weight decay	0.7306	1.6685	19/100
6 layer + dropout + weight decay	0.7011	1.2005	27/100
9 layer + dropout + weight decay	0.7736	1.0429	38/100
12 layer + dropout + weight decay	0.8136	0.9434	71/100

Conclusions

- Deeper networks have better accuracy, but take longer to train
- Deeper networks give diminishing returns, each layer added increases the accuracy by smaller amount
- Effect of weight decay is rather small
- Effect of dropout layers is noticeable
- Combination of dropout layers and weight decay offers significant inprovement over basic models

What's next?

- Data Agumentation
- Batch Normalizaion
- Etc.
- Experiments