Assignment 00010 MNIST proof
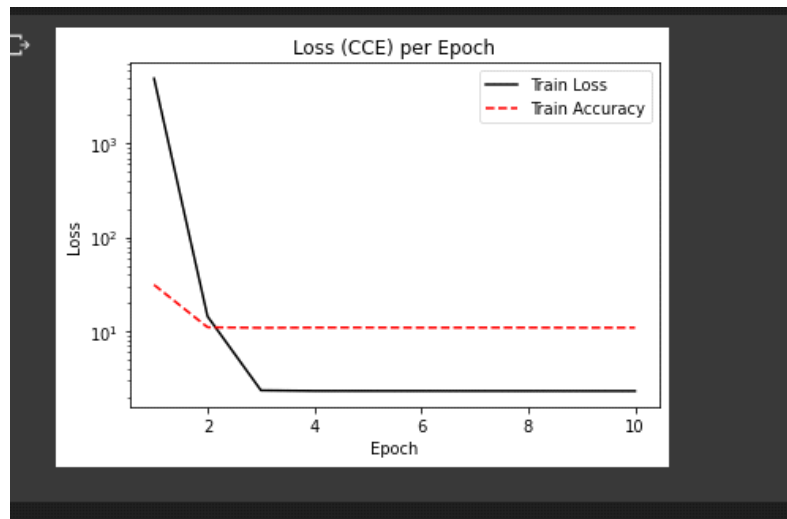
Saturday, February 5, 2022   1:32 PM

Regulizer L2 norm = 0.5
Loss = categorical cros entopy
Batch size= 256 and 128
Hidden layer size 128 and 128
LR=1E-4
Time 800 second

Training

```
Number of Epoch = 1 - Average CCE Lost:= 4904.7728
Training Accuracy = 31.294998168945312
Number of Epoch = 2 - Average CCE Lost:= 14.466035416666667
Training Accuracy = 11.078332901000977
Number of Epoch = 3 - Average CCE Lost:= 2.3596174479166665
Training Accuracy = 10.923333168029785
Number of Epoch = 4 - Average CCE Lost:= 2.3277643229166665
Training Accuracy = 10.991666793823242
Number of Epoch = 5 - Average CCE Lost:= 2.32613203125
Training Accuracy = 11.005000114440918
Number of Epoch = 6 - Average CCE Lost:= 2.32456640625
Training Accuracy = 10.963333129882812
Number of Epoch = 7 - Average CCE Lost:= 2.32316953125
Training Accuracy = 10.983332633972168
Number of Epoch = 8 - Average CCE Lost:= 2.3218903645833335
Training Accuracy = 10.983332633972168
Number of Epoch = 9 - Average CCE Lost:= 2.320640104166667
Training Accuracy = 10.951666831970215
Number of Epoch = 10 - Average CCE Lost:= 2.3194817708333333
Training Accuracy = 10.96833324432373
```
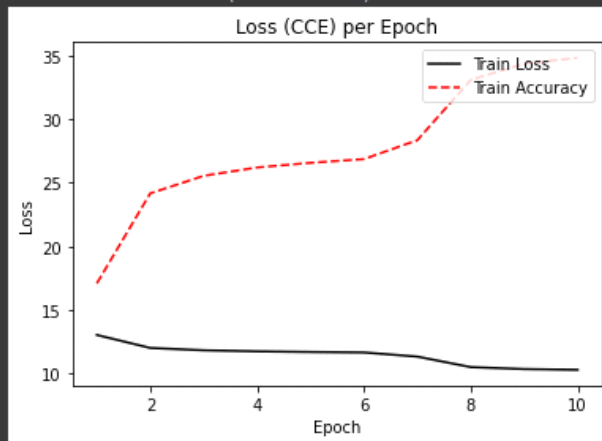

Regulizer L1&L2 norm = 0.01 and 0.01
Loss = categorical cros entopy
Batch size= 256
Hidden layer size 128 and 128
LR=1E-4
Time 800 second

```
Number of Epoch = 1 - Average CCE Lost:= 13.041192708333334
Training Accuracy = 17.093334197998047
Number of Epoch = 2 - Average CCE Lost:= 12.020707291666668
Training Accuracy = 24.17333221435547
Number of Epoch = 3 - Average CCE Lost:= 11.8362625
Training Accuracy = 25.549999237060547
Number of Epoch = 4 - Average CCE Lost:= 11.753988541666667
Training Accuracy = 26.208332061767578
Number of Epoch = 5 - Average CCE Lost:= 11.703176041666667
Training Accuracy = 26.571666717529297
Number of Epoch = 6 - Average CCE Lost:= 11.665883333333333
Training Accuracy = 26.864999771118164
Number of Epoch = 7 - Average CCE Lost:= 11.339109375
Training Accuracy = 28.35333251953125
Number of Epoch = 8 - Average CCE Lost:= 10.513470833333333
Training Accuracy = 33.0966682434082
Number of Epoch = 9 - Average CCE Lost:= 10.361060416666668
Training Accuracy = 34.36000061035156
Number of Epoch = 10 - Average CCE Lost:= 10.300748958333333
Training Accuracy = 34.83000183105469

Total time taken (in seconds): 728.48
```


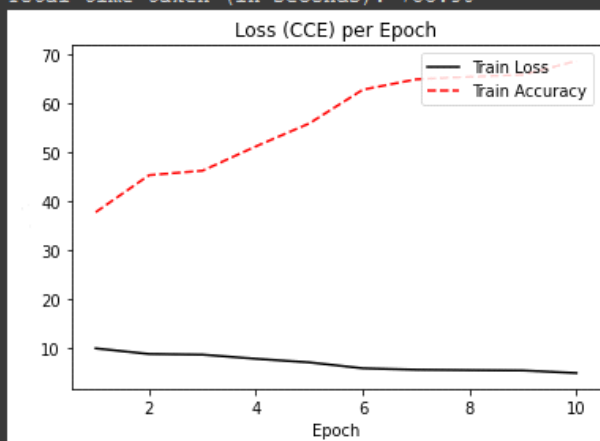Loss (CCE) per Epoch

Accuracy 63.45%
LR=1E-3

```
Number of Epoch = 1 - Average CCE Lost:= 9.821628125
Training Accuracy = 37.69499969482422
Number of Epoch = 2 - Average CCE Lost:= 8.670914583333333
Training Accuracy = 45.27666473388672
Number of Epoch = 3 - Average CCE Lost:= 8.5361203125
Training Accuracy = 46.189998626708984
Number of Epoch = 4 - Average CCE Lost:= 7.688729166666667
Training Accuracy = 51.173336029052734
Number of Epoch = 5 - Average CCE Lost:= 6.952598958333334
Training Accuracy = 55.87333297729492
Number of Epoch = 6 - Average CCE Lost:= 5.742747916666667
Training Accuracy = 62.77333450317383
Number of Epoch = 7 - Average CCE Lost:= 5.4483265625
Training Accuracy = 64.8949966430664
Number of Epoch = 8 - Average CCE Lost:= 5.364228125
Training Accuracy = 65.4183349609375
Number of Epoch = 9 - Average CCE Lost:= 5.2963604166666665
Training Accuracy = 65.81666564941406
Number of Epoch = 10 - Average CCE Lost:= 4.7748651041666665
Training Accuracy = 68.65833282470703

Total time taken (in seconds): 753.90
```


Loss (CCE) per Epoch

```
24
25
```

```
Test CCE: 0.6457
test accuracy = 73.79999542236328
```
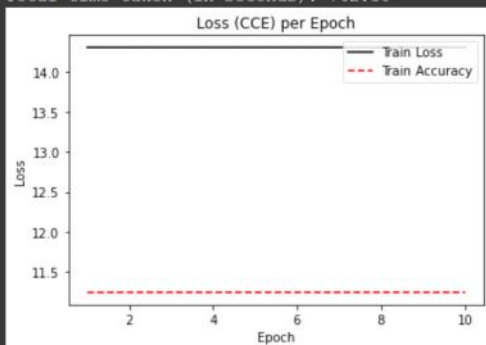
LR=1E-2 Seed is changed to 6273

```
Number of Epoch = 1 - Average CCE Lost:= 14.306622916666667
Training Accuracy = 11.235000610351562
Number of Epoch = 2 - Average CCE Lost:= 14.306480208333333
Training Accuracy = 11.236666679382324
Number of Epoch = 3 - Average CCE Lost:= 14.306479166666668
Training Accuracy = 11.236666679382324
Number of Epoch = 4 - Average CCE Lost:= 14.306480208333333
Training Accuracy = 11.236666679382324
Number of Epoch = 5 - Average CCE Lost:= 14.306480208333333
Training Accuracy = 11.236666679382324
Number of Epoch = 6 - Average CCE Lost:= 14.306480208333333
Training Accuracy = 11.236666679382324
Number of Epoch = 7 - Average CCE Lost:= 14.306479166666668
Training Accuracy = 11.236666679382324
Number of Epoch = 8 - Average CCE Lost:= 14.306479166666668
Training Accuracy = 11.236666679382324
Number of Epoch = 9 - Average CCE Lost:= 14.306480208333333
Training Accuracy = 11.236666679382324
Number of Epoch = 10 - Average CCE Lost:= 14.306480208333333
Training Accuracy = 11.236666679382324

Total time taken (in seconds): 762.38
```


Loss (CCE) per Epoch

```python
1 test_loss_total = tf.Variable(0, dtype=tf.float32)
2 correct_test_prediction = tf.Variable(0, dtype=tf.float32)
3 #test_loss_total = 0.0
4
5 for inputs, outputs in test_ds:
6   preds = mlp_on_default.forward(inputs)
7   #b = mlp_on_default.loss(preds, outputs)
8   test_loss_total = test_loss_total + mlp_on_default.loss(preds, outputs)
9
10
11   for i in range(preds.shape[0]):
12     if tf.argmax(preds[i])== tf.argmax(outputs[i]):
13       correct_test_prediction = correct_test_prediction + 1.0
14
15
16 # a = (test_loss_total.numpy() / X_train.shape[0])
17 # print(X_train.shape[0])
18 # print(test_loss_total.numpy())
19 # print(b)
20 accuracytest = correct_test_prediction/X_test.shape[0]*100
21 print('Test CCE: {:.4f}'.format(np.sum(test_loss_total.numpy()) / X_train.shape[0]))
22 print('test accuracy = {}'.format(accuracytest))
23
24
25
```

```
Test CCE: 2.3814
test accuracy = 11.350000381469727
```
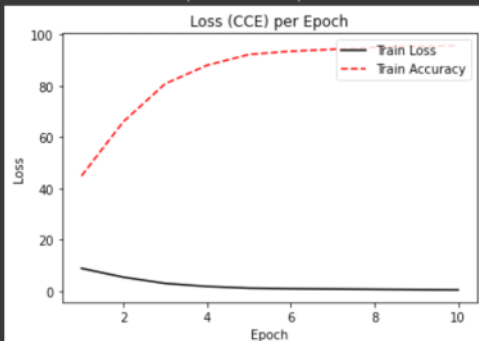
LR=5E-3

```
Number of Epoch = 1 - Average CCE Lost:= 8.782326041666666
Training Accuracy = 44.79666519165039
Number of Epoch = 2 - Average CCE Lost:= 5.344763020833334
Training Accuracy = 65.95166778564453
Number of Epoch = 3 - Average CCE Lost:= 2.92413984375
Training Accuracy = 80.7750015258789
Number of Epoch = 4 - Average CCE Lost:= 1.72414296875
Training Accuracy = 87.96833038330078
Number of Epoch = 5 - Average CCE Lost:= 1.069491015625
Training Accuracy = 92.17333221435547
Number of Epoch = 6 - Average CCE Lost:= 0.8540251302083334
Training Accuracy = 93.44999694824219
Number of Epoch = 7 - Average CCE Lost:= 0.7303628255208333
Training Accuracy = 94.1866683959961
Number of Epoch = 8 - Average CCE Lost:= 0.6146410807291667
Training Accuracy = 94.95499420166016
Number of Epoch = 9 - Average CCE Lost:= 0.49374733072916666
Training Accuracy = 95.43000030517578
Number of Epoch = 10 - Average CCE Lost:= 0.39375423177083335
Training Accuracy = 95.663330078125

Total time taken (in seconds): 766.24
```


Loss (CCE) per Epoch

One Step Inference

```
1  test_loss_total = tf.Variable(0, dtype=tf.float32)
2  correct_test_prediction = tf.Variable(0, dtype=tf.float32)
3  #test_loss_total = 0.0
4
5  for inputs, outputs in test_ds:
6    preds = mlp_on_default.forward(inputs)
7    #b = mlp_on_default.loss(preds, outputs)
8    test_loss_total = test_loss_total + mlp_on_default.loss(preds, outputs)
9
10
11   for i in range(preds.shape[0]):
12     if tf.argmax(preds[i])== tf.argmax(outputs[i]):
13       correct_test_prediction = correct_test_prediction + 1.0
14
15
16 # a = (test_loss_total.numpy() / X_train.shape[0])
17 # print(X_train.shape[0])
18 # print(test_loss_total.numpy())
19 # print(b)
20 accuracytest = correct_test_prediction/X_test.shape[0]*100
21 print('Test CCE: {:.4f}'.format(np.sum(test_loss_total.numpy()) / X_train.shape[0]))
22 print('test accuracy = {}'.format(accuracytest))
23
24
25
```

```
Test CCE: 0.0696
test accuracy = 95.01000213623047
```

Seed #1 5678
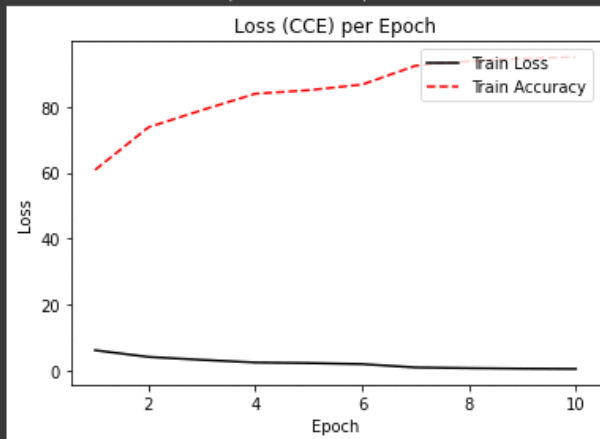L1&L2 regularizaiton (0.01 and 0.01)
LR=3E-3

```
Number of Epoch = 1 - Average CCE Lost:= 6.087306875
Training Accuracy = 60.81200408935547
Number of Epoch = 2 - Average CCE Lost:= 4.069475625
Training Accuracy = 73.76000213623047
Number of Epoch = 3 - Average CCE Lost:= 3.1755653125
Training Accuracy = 78.95800018310547
Number of Epoch = 4 - Average CCE Lost:= 2.3820634375
Training Accuracy = 83.92400360107422
Number of Epoch = 5 - Average CCE Lost:= 2.20265609375
Training Accuracy = 84.99800109863281
Number of Epoch = 6 - Average CCE Lost:= 1.890210625
Training Accuracy = 86.71399688720703
Number of Epoch = 7 - Average CCE Lost:= 0.878397421875
Training Accuracy = 92.41999816894531
Number of Epoch = 8 - Average CCE Lost:= 0.6551895703125
Training Accuracy = 93.81600189208984
Number of Epoch = 9 - Average CCE Lost:= 0.5175462890625
Training Accuracy = 94.59600067138672
Number of Epoch = 10 - Average CCE Lost:= 0.42305234375
Training Accuracy = 95.09000396728516

Total time taken (in seconds): 723.31
```
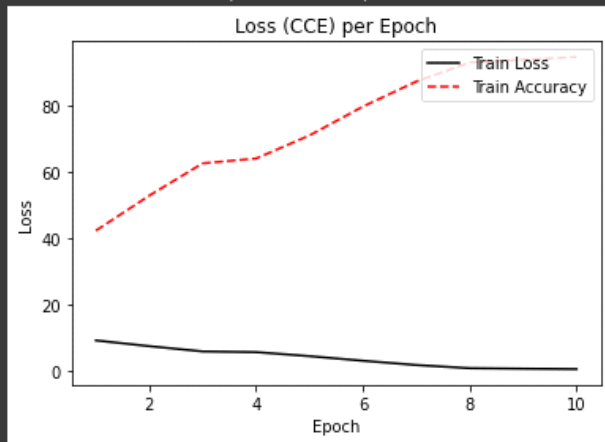

Loss (CCE) per Epoch

```
Test CCE: 0.1006
test accuracy = 93.95999908447266
```

Seed #2 9012

```
Number of Epoch = 1 - Average CCE Lost:= 9.19934875
Training Accuracy = 42.22999954223633
Number of Epoch = 2 - Average CCE Lost:= 7.469855
Training Accuracy = 52.771995544433594
Number of Epoch = 3 - Average CCE Lost:= 5.891315625
Training Accuracy = 62.49799728393555
Number of Epoch = 4 - Average CCE Lost:= 5.675378125
Training Accuracy = 63.94600296020508
Number of Epoch = 5 - Average CCE Lost:= 4.468358125
Training Accuracy = 70.89199829101562
Number of Epoch = 6 - Average CCE Lost:= 3.081160625
Training Accuracy = 79.57599639892578
Number of Epoch = 7 - Average CCE Lost:= 1.79514828125
Training Accuracy = 87.12000274658203
Number of Epoch = 8 - Average CCE Lost:= 0.836524375
Training Accuracy = 92.843994140625
Number of Epoch = 9 - Average CCE Lost:= 0.692005546875
Training Accuracy = 93.69200134277344
Number of Epoch = 10 - Average CCE Lost:= 0.565557734375
Training Accuracy = 94.50399780273438

Total time taken (in seconds): 634.73
```


Loss (CCE) per Epoch

```
Test CCE: 0.1169
test accuracy = 94.20999908447266
```
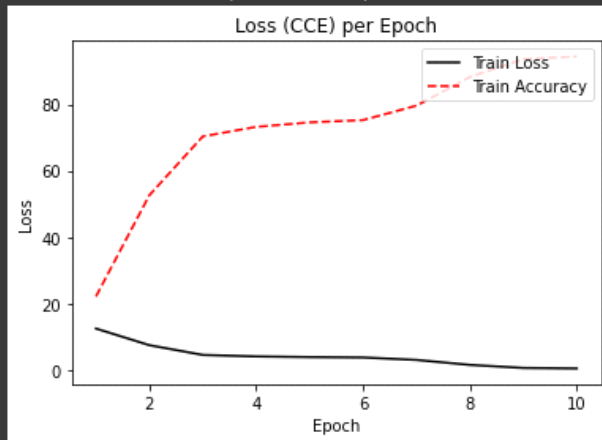
Seed #3 1122

```
Number of Epoch = 1 - Average CCE Lost:= 12.50234875
Training Accuracy = 22.145999908447266
Number of Epoch = 2 - Average CCE Lost:= 7.49766125
Training Accuracy = 52.624000549316406
Number of Epoch = 3 - Average CCE Lost:= 4.5591309375
Training Accuracy = 70.32600402832031
Number of Epoch = 4 - Average CCE Lost:= 4.11470125
Training Accuracy = 73.19800567626953
Number of Epoch = 5 - Average CCE Lost:= 3.917358125
Training Accuracy = 74.54399871826172
Number of Epoch = 6 - Average CCE Lost:= 3.79639125
Training Accuracy = 75.23600006103516
Number of Epoch = 7 - Average CCE Lost:= 3.0615640625
Training Accuracy = 79.59600067138672
Number of Epoch = 8 - Average CCE Lost:= 1.56639359375
Training Accuracy = 88.2040023803711
Number of Epoch = 9 - Average CCE Lost:= 0.648179140625
Training Accuracy = 93.59200286865234
Number of Epoch = 10 - Average CCE Lost:= 0.4990646875
Training Accuracy = 94.3740005493164

Total time taken (in seconds): 688.80
```


Loss (CCE) per Epoch

```
Test CCE: 0.1087
test accuracy = 93.77999877929688
```
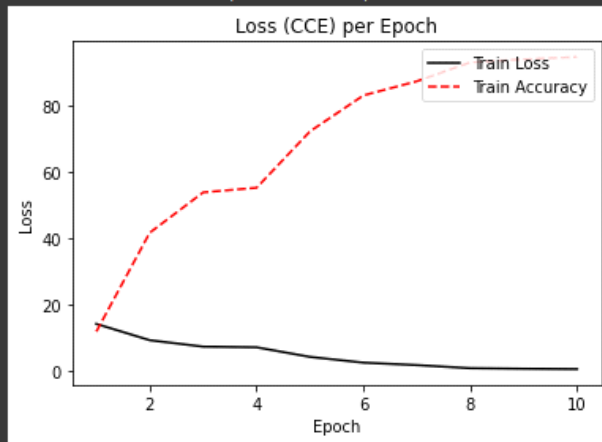
Seed #4 1432

```
Number of Epoch = 1 - Average CCE Lost:= 14.18805375
Training Accuracy = 11.860000610351562
Number of Epoch = 2 - Average CCE Lost:= 9.26682375
Training Accuracy = 41.652000427246094
Number of Epoch = 3 - Average CCE Lost:= 7.33429
Training Accuracy = 53.80399703979492
Number of Epoch = 4 - Average CCE Lost:= 7.132474375
Training Accuracy = 55.198001861572266
Number of Epoch = 5 - Average CCE Lost:= 4.245501875
Training Accuracy = 72.18800354003906
Number of Epoch = 6 - Average CCE Lost:= 2.509595625
Training Accuracy = 83.01599884033203
Number of Epoch = 7 - Average CCE Lost:= 1.77292015625
Training Accuracy = 87.27799987792969
Number of Epoch = 8 - Average CCE Lost:= 0.83359328125
Training Accuracy = 92.96600341796875
Number of Epoch = 9 - Average CCE Lost:= 0.67412140625
Training Accuracy = 93.91999816894531
Number of Epoch = 10 - Average CCE Lost:= 0.5624616015625
Training Accuracy = 94.60199737548828

Total time taken (in seconds): 750.16
```


Loss (CCE) per Epoch

```
Test CCE: 0.1157
test accuracy = 94.38999938964844
```
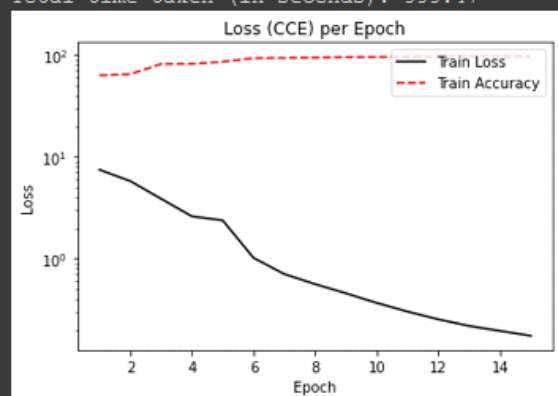
Seed #5 5555

```
Number of Epoch = 1 - Average Training Lost:= 7.454268125
Training Accuracy = 62.99600005149841
Number of Epoch = 2 - Average Training Lost:= 5.76742875
Training Accuracy = 64.63599801063538
Number of Epoch = 3 - Average Training Lost:= 3.867014375
Training Accuracy = 81.47000074386597
Number of Epoch = 4 - Average Training Lost:= 2.60027859375
Training Accuracy = 81.65000081062317
Number of Epoch = 5 - Average Training Lost:= 2.37441375
Training Accuracy = 85.6220006942749
Number of Epoch = 6 - Average Training Lost:= 1.0161909375
Training Accuracy = 92.93000102043152
Number of Epoch = 7 - Average Training Lost:= 0.7040178125
Training Accuracy = 93.39799880981445
Number of Epoch = 8 - Average Training Lost:= 0.561350078125
Training Accuracy = 94.17200088500977
Number of Epoch = 9 - Average Training Lost:= 0.455956796875
Training Accuracy = 95.22799849510193
Number of Epoch = 10 - Average Training Lost:= 0.36663546875
Training Accuracy = 95.4859972000122
Number of Epoch = 11 - Average Training Lost:= 0.3015725
Training Accuracy = 95.94200253486633
Number of Epoch = 12 - Average Training Lost:= 0.2529173828125
Training Accuracy = 96.21800184249878
Number of Epoch = 13 - Average Training Lost:= 0.21808826171875
Training Accuracy = 96.45599722862244
Number of Epoch = 14 - Average Training Lost:= 0.1948542578125
Training Accuracy = 96.7199981212616
Number of Epoch = 15 - Average Training Lost:= 0.17446791015625
Training Accuracy = 96.8999981880188

Total time taken (in seconds): 999.47
```


Loss (CCE) per Epoch

```
Test CCE: 0.0682
test accuracy = 94.41999816894531
```
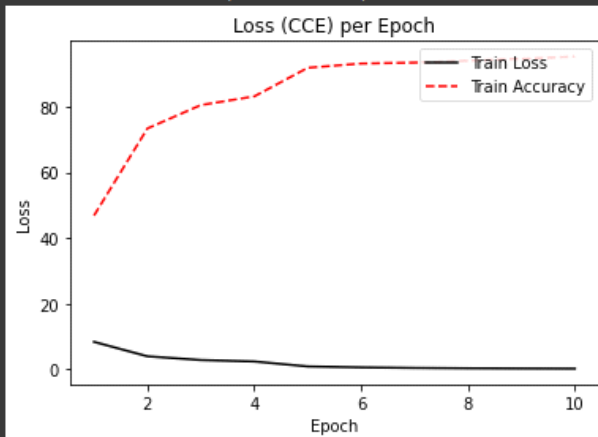
Seed #6 6627

```
Number of Epoch = 1 - Average CCE Lost:= 8.379446875
Training Accuracy = 46.784000396728516
Number of Epoch = 2 - Average CCE Lost:= 3.9767146875
Training Accuracy = 73.31600189208984
Number of Epoch = 3 - Average CCE Lost:= 2.8462746875
Training Accuracy = 80.43800354003906
Number of Epoch = 4 - Average CCE Lost:= 2.40460984375
Training Accuracy = 83.0780029296875
Number of Epoch = 5 - Average CCE Lost:= 0.894736328125
Training Accuracy = 91.77799987792969
Number of Epoch = 6 - Average CCE Lost:= 0.6115683984375
Training Accuracy = 93.0780029296875
Number of Epoch = 7 - Average CCE Lost:= 0.4392470703125
Training Accuracy = 93.35399627685547
Number of Epoch = 8 - Average CCE Lost:= 0.33494515625
Training Accuracy = 93.94000244140625
Number of Epoch = 9 - Average CCE Lost:= 0.27251837890625
Training Accuracy = 94.5260009765625
Number of Epoch = 10 - Average CCE Lost:= 0.231268671875
Training Accuracy = 95.1919937133789


Total time taken (in seconds): 702.99
```


Loss (CCE) per Epoch
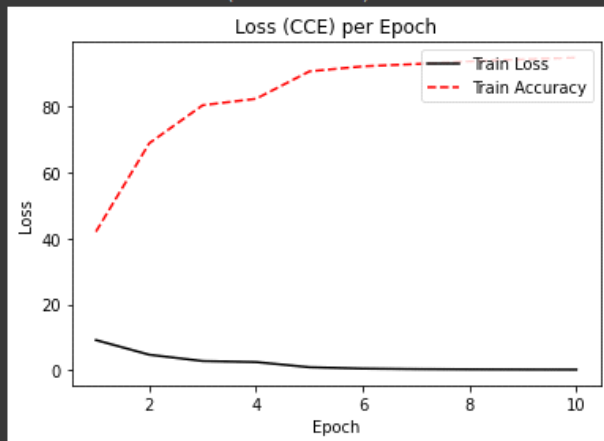
```
Test CCE: 0.0624
test accuracy = 93.4800033569336
```

Seed #7 7723

```
Number of Epoch = 1 - Average CCE Lost:= 9.15921
Training Accuracy = 42.01599884033203
Number of Epoch = 2 - Average CCE Lost:= 4.7158596875
Training Accuracy = 68.83999633789062
Number of Epoch = 3 - Average CCE Lost:= 2.8048403125
Training Accuracy = 80.3479995727539
Number of Epoch = 4 - Average CCE Lost:= 2.490914375
Training Accuracy = 82.30400085449219
Number of Epoch = 5 - Average CCE Lost:= 0.924162421875
Training Accuracy = 90.61400604248047
Number of Epoch = 6 - Average CCE Lost:= 0.519007265625
Training Accuracy = 92.13200378417969
Number of Epoch = 7 - Average CCE Lost:= 0.35881828125
Training Accuracy = 92.83399963378906
Number of Epoch = 8 - Average CCE Lost:= 0.28161283203125
Training Accuracy = 93.62200164794922
Number of Epoch = 9 - Average CCE Lost:= 0.23780716796875
Training Accuracy = 94.25399780273438
Number of Epoch = 10 - Average CCE Lost:= 0.208856171875
Training Accuracy = 94.77400207519531

Total time taken (in seconds): 705.05
```


Loss (CCE) per Epoch

```
Test CCE: 0.0542
test accuracy = 93.37000274658203
```
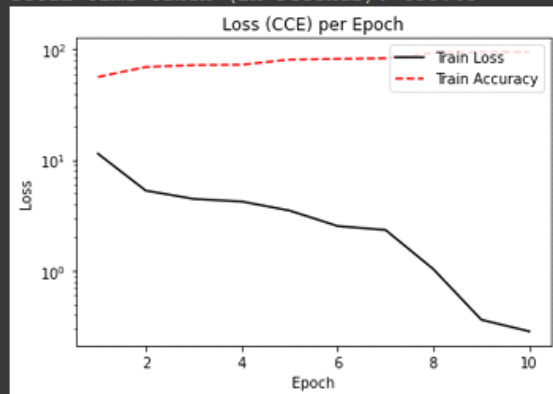
Seed #8 8823

```
Number of Epoch = 1 - Average Training Lost:= 11.43686625
Training Accuracy = 56.383997201919556
Number of Epoch = 2 - Average Training Lost:= 5.29386625
Training Accuracy = 69.43399906158447
Number of Epoch = 3 - Average Training Lost:= 4.4602790625
Training Accuracy = 72.18999862670898
Number of Epoch = 4 - Average Training Lost:= 4.2242
Training Accuracy = 72.86400198936462
Number of Epoch = 5 - Average Training Lost:= 3.495794375
Training Accuracy = 81.03600144386292
Number of Epoch = 6 - Average Training Lost:= 2.53521046875
Training Accuracy = 82.09400177001953
Number of Epoch = 7 - Average Training Lost:= 2.33816984375
Training Accuracy = 83.17199945449829
Number of Epoch = 8 - Average Training Lost:= 1.0326671875
Training Accuracy = 93.14600229263306
Number of Epoch = 9 - Average Training Lost:= 0.3606898046875
Training Accuracy = 94.36399936676025
Number of Epoch = 10 - Average Training Lost:= 0.28310884765625
Training Accuracy = 94.85399723052979

Total time taken (in seconds): 690.48
```


Loss (CCE) per Epoch

```
Test CCE: 0.0758
test accuracy = 93.0199966430664
```
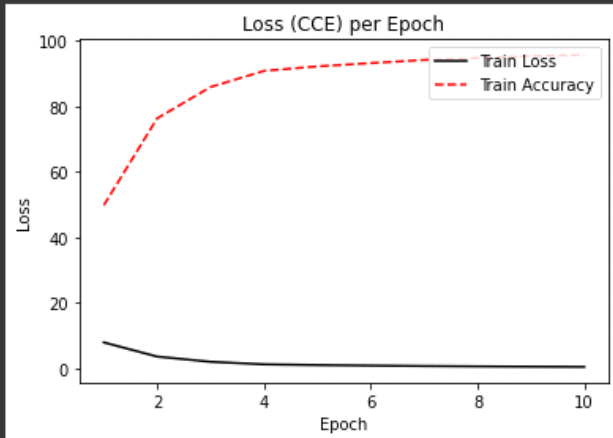
Seed # 9 9923

```
Number of Epoch = 1 - Average CCE Lost:= 7.911675625
Training Accuracy = 49.801998138427734
Number of Epoch = 2 - Average CCE Lost:= 3.5744440625
Training Accuracy = 76.3759994506836
Number of Epoch = 3 - Average CCE Lost:= 1.9794040625
Training Accuracy = 85.95600128173828
Number of Epoch = 4 - Average CCE Lost:= 1.202516015625
Training Accuracy = 90.8759994506836
Number of Epoch = 5 - Average CCE Lost:= 0.9839128125
Training Accuracy = 92.25
Number of Epoch = 6 - Average CCE Lost:= 0.826198203125
Training Accuracy = 93.2560043334961
Number of Epoch = 7 - Average CCE Lost:= 0.684348671875
Training Accuracy = 94.21399688720703
Number of Epoch = 8 - Average CCE Lost:= 0.5819169140625
Training Accuracy = 94.7979965209961
Number of Epoch = 9 - Average CCE Lost:= 0.499183984375
Training Accuracy = 95.4260025024414
Number of Epoch = 10 - Average CCE Lost:= 0.433414921875
Training Accuracy = 95.75799560546875

Total time taken (in seconds): 703.51
```


Loss (CCE) per Epoch

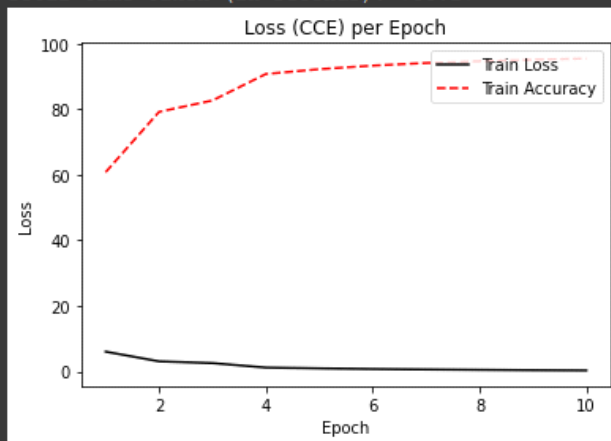```
Test CCE: 0.1118
test accuracy = 94.52999877929688
```

Seed # 10 1023

```
Number of Epoch = 1 - Average CCE Lost:= 6.066676875
Training Accuracy = 60.772003173828125
Number of Epoch = 2 - Average CCE Lost:= 3.1072409375
Training Accuracy = 79.16799926757812
Number of Epoch = 3 - Average CCE Lost:= 2.5723459375
Training Accuracy = 82.63800048828125
Number of Epoch = 4 - Average CCE Lost:= 1.209880234375
Training Accuracy = 90.71599578857422
Number of Epoch = 5 - Average CCE Lost:= 0.9684709375
Training Accuracy = 92.18199920654297
Number of Epoch = 6 - Average CCE Lost:= 0.775217109375
Training Accuracy = 93.26599884033203
Number of Epoch = 7 - Average CCE Lost:= 0.6358496484375
Training Accuracy = 94.0719985961914
Number of Epoch = 8 - Average CCE Lost:= 0.522108203125
Training Accuracy = 94.59600067138672
Number of Epoch = 9 - Average CCE Lost:= 0.4140223828125
Training Accuracy = 95.09000396728516
Number of Epoch = 10 - Average CCE Lost:= 0.3427028515625
Training Accuracy = 95.42400360107422


Total time taken (in seconds): 733.27
```


Loss (CCE) per Epoch

```
Test CCE: 0.0846
test accuracy = 94.25
```
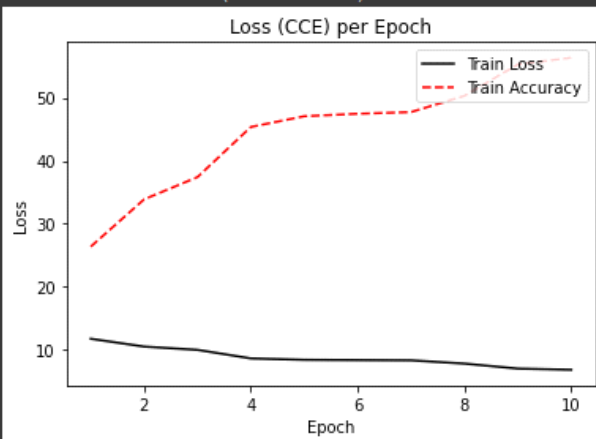
#######No REGULARIZATIOn LR 1E-4
SEED 1 #1567

```
Number of Epoch = 1 - Average CCE Lost:= 11.7652425
Training Accuracy = 26.374000549316406
Number of Epoch = 2 - Average CCE Lost:= 10.522965
Training Accuracy = 33.880001068115234
Number of Epoch = 3 - Average CCE Lost:= 10.003528125
Training Accuracy = 37.4119987487793
Number of Epoch = 4 - Average CCE Lost:= 8.64629125
Training Accuracy = 45.36600112915039
Number of Epoch = 5 - Average CCE Lost:= 8.426091875
Training Accuracy = 47.066001892089844
Number of Epoch = 6 - Average CCE Lost:= 8.3779025
Training Accuracy = 47.45800018310547
Number of Epoch = 7 - Average CCE Lost:= 8.342680625
Training Accuracy = 47.72599792480469
Number of Epoch = 8 - Average CCE Lost:= 7.82483125
Training Accuracy = 50.30400085449219
Number of Epoch = 9 - Average CCE Lost:= 7.033145625
Training Accuracy = 55.29199981689453
Number of Epoch = 10 - Average CCE Lost:= 6.8464
Training Accuracy = 56.349998474121094


Total time taken (in seconds): 644.46
```


Loss (CCE) per Epoch

```
Test CCE: 1.1735
test accuracy = 61.80999755859375
```
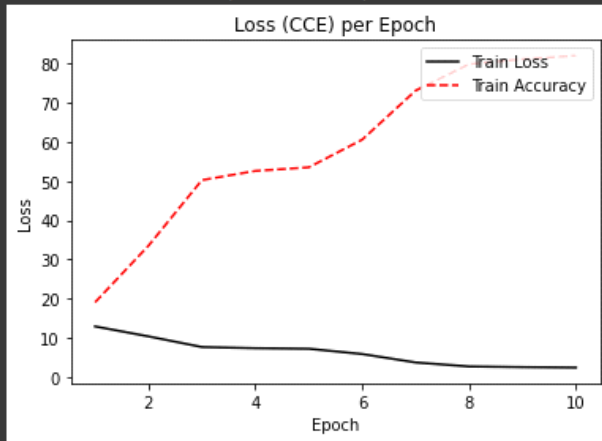
SEED 2 #2245

```
Number of Epoch = 1 - Average CCE Lost:= 12.96222375
Training Accuracy = 19.09600067138672
Number of Epoch = 2 - Average CCE Lost:= 10.41840875
Training Accuracy = 33.529998779296875
Number of Epoch = 3 - Average CCE Lost:= 7.70494875
Training Accuracy = 50.257999420166016
Number of Epoch = 4 - Average CCE Lost:= 7.405769375
Training Accuracy = 52.596004486083984
Number of Epoch = 5 - Average CCE Lost:= 7.266604375
Training Accuracy = 53.50800323486328
Number of Epoch = 6 - Average CCE Lost:= 5.918141875
Training Accuracy = 60.57599639892578
Number of Epoch = 7 - Average CCE Lost:= 3.7697225
Training Accuracy = 73.08200073242188
Number of Epoch = 8 - Average CCE Lost:= 2.751970625
Training Accuracy = 79.82599639892578
Number of Epoch = 9 - Average CCE Lost:= 2.58313671875
Training Accuracy = 81.07600402832031
Number of Epoch = 10 - Average CCE Lost:= 2.47247828125
Training Accuracy = 81.98600006103516

Total time taken (in seconds): 607.95
```


Loss (CCE) per Epoch

```
Test CCE: 0.5039
test accuracy = 81.4000015258789
```
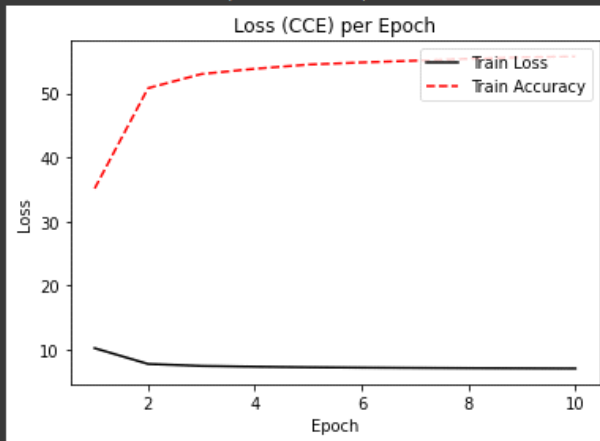
SEED 3 # 3349

```
Number of Epoch = 1 - Average CCE Lost:= 10.19058125
Training Accuracy = 35.12000274658203
Number of Epoch = 2 - Average CCE Lost:= 7.72553875
Training Accuracy = 50.805999755859375
Number of Epoch = 3 - Average CCE Lost:= 7.41450625
Training Accuracy = 53.013999938964844
Number of Epoch = 4 - Average CCE Lost:= 7.297153125
Training Accuracy = 53.8339958190918
Number of Epoch = 5 - Average CCE Lost:= 7.2064825
Training Accuracy = 54.49200439453125
Number of Epoch = 6 - Average CCE Lost:= 7.15163
Training Accuracy = 54.821998596191406
Number of Epoch = 7 - Average CCE Lost:= 7.10737125
Training Accuracy = 55.10600280761719
Number of Epoch = 8 - Average CCE Lost:= 7.0713675
Training Accuracy = 55.38199996948242
Number of Epoch = 9 - Average CCE Lost:= 7.043489375
Training Accuracy = 55.64200210571289
Number of Epoch = 10 - Average CCE Lost:= 7.01905625
Training Accuracy = 55.757999420166016

Total time taken (in seconds): 646.60
```


Loss (CCE) per Epoch

```
Test CCE: 1.4019
test accuracy = 55.779998779296875
```
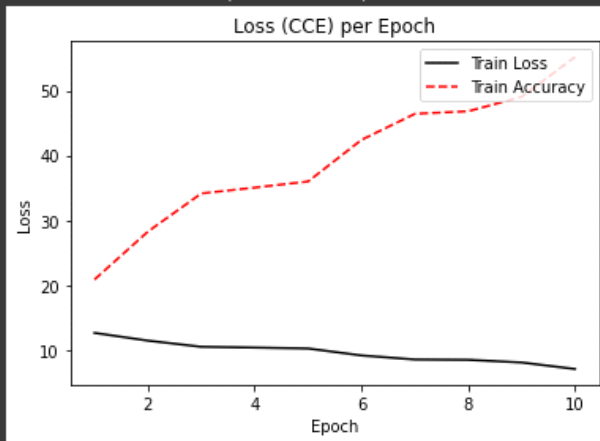
SEED 4 # 4439

```
Number of Epoch = 1 - Average CCE Lost:= 12.6269025
Training Accuracy = 20.857999801635742
Number of Epoch = 2 - Average CCE Lost:= 11.43264125
Training Accuracy = 28.251998901367188
Number of Epoch = 3 - Average CCE Lost:= 10.483699375
Training Accuracy = 34.13399887084961
Number of Epoch = 4 - Average CCE Lost:= 10.36299625
Training Accuracy = 35.0359992980957
Number of Epoch = 5 - Average CCE Lost:= 10.22243875
Training Accuracy = 35.97800064086914
Number of Epoch = 6 - Average CCE Lost:= 9.1494775
Training Accuracy = 42.39999771118164
Number of Epoch = 7 - Average CCE Lost:= 8.525264375
Training Accuracy = 46.41600036621094
Number of Epoch = 8 - Average CCE Lost:= 8.47538625
Training Accuracy = 46.81399917602539
Number of Epoch = 9 - Average CCE Lost:= 8.06461375
Training Accuracy = 49.02400207519531
Number of Epoch = 10 - Average CCE Lost:= 7.05963875
Training Accuracy = 55.18400192260742

Total time taken (in seconds): 671.97
```


Loss (CCE) per Epoch

```
Test CCE: 1.4085
test accuracy = 55.31999969482422
```
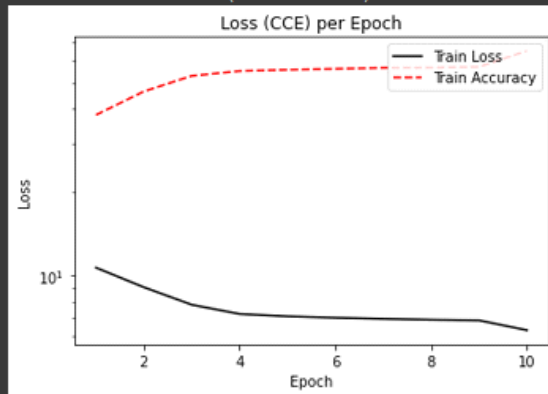
SEED 5 # 5590

```
Number of Epoch = 1 - Average Training Lost:= 10.65185875
Training Accuracy = 38.08799982070923
Number of Epoch = 2 - Average Training Lost:= 9.0446625
Training Accuracy = 46.366000175476074
Number of Epoch = 3 - Average Training Lost:= 7.81741875
Training Accuracy = 52.799999713897705
Number of Epoch = 4 - Average Training Lost:= 7.235443125
Training Accuracy = 54.96399998664856
Number of Epoch = 5 - Average Training Lost:= 7.09471875
Training Accuracy = 55.53600192070007
Number of Epoch = 6 - Average Training Lost:= 7.01357875
Training Accuracy = 55.98199963569641
Number of Epoch = 7 - Average Training Lost:= 6.949273125
Training Accuracy = 56.43399953842163
Number of Epoch = 8 - Average Training Lost:= 6.8960375
Training Accuracy = 56.529998779296875
Number of Epoch = 9 - Average Training Lost:= 6.85946125
Training Accuracy = 56.92399740219116
Number of Epoch = 10 - Average Training Lost:= 6.318363125
Training Accuracy = 65.03999829292297

Total time taken (in seconds): 440.83
```


Loss (CCE) per Epoch

```
Test CCE: 1.0979
test accuracy = 64.67000579833984
```
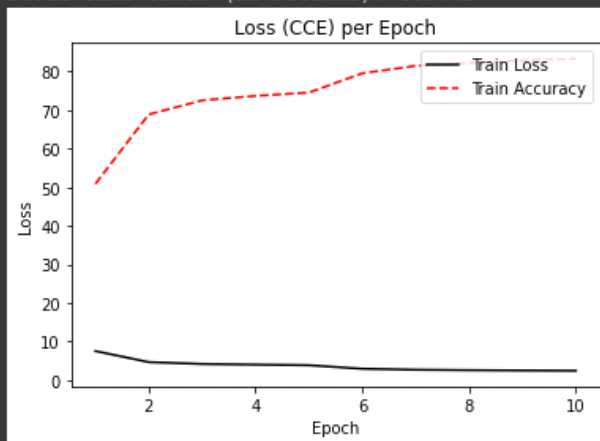
SEED 6 # 6691 LR6E-4

```
Number of Epoch = 1 - Average CCE Lost:= 7.512560625
Training Accuracy = 50.86600112915039
Number of Epoch = 2 - Average CCE Lost:= 4.6434609375
Training Accuracy = 68.9000015258789
Number of Epoch = 3 - Average CCE Lost:= 4.1635903125
Training Accuracy = 72.55400085449219
Number of Epoch = 4 - Average CCE Lost:= 3.997845625
Training Accuracy = 73.70399475097656
Number of Epoch = 5 - Average CCE Lost:= 3.8352275
Training Accuracy = 74.56600189208984
Number of Epoch = 6 - Average CCE Lost:= 2.9225946875
Training Accuracy = 79.57599639892578
Number of Epoch = 7 - Average CCE Lost:= 2.664965625
Training Accuracy = 81.50199890136719
Number of Epoch = 8 - Average CCE Lost:= 2.55816484375
Training Accuracy = 82.26200103759766
Number of Epoch = 9 - Average CCE Lost:= 2.47694703125
Training Accuracy = 82.8800048828125
Number of Epoch = 10 - Average CCE Lost:= 2.41445125
Training Accuracy = 83.3759994506836

Total time taken (in seconds): 691.42
```


Loss (CCE) per Epoch

```
Test CCE: 0.4982
test accuracy = 82.48999786376953
```
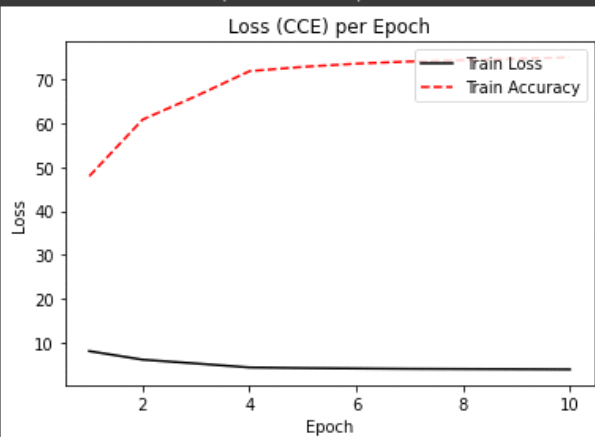
SEED 7 #7711x

```
Number of Epoch = 1 - Average CCE Lost:= 8.03527375
Training Accuracy = 47.93600082397461
Number of Epoch = 2 - Average CCE Lost:= 6.08173375
Training Accuracy = 60.86199951171875
Number of Epoch = 3 - Average CCE Lost:= 5.209325625
Training Accuracy = 66.21199798583984
Number of Epoch = 4 - Average CCE Lost:= 4.3084703125
Training Accuracy = 71.90599822998047
Number of Epoch = 5 - Average CCE Lost:= 4.1675609375
Training Accuracy = 72.88600158691406
Number of Epoch = 6 - Average CCE Lost:= 4.0739325
Training Accuracy = 73.61599731445312
Number of Epoch = 7 - Average CCE Lost:= 3.99267
Training Accuracy = 74.1199951171875
Number of Epoch = 8 - Average CCE Lost:= 3.949973125
Training Accuracy = 74.41799926757812
Number of Epoch = 9 - Average CCE Lost:= 3.90502875
Training Accuracy = 74.74200439453125
Number of Epoch = 10 - Average CCE Lost:= 3.8594784375
Training Accuracy = 75.05599975585938


Total time taken (in seconds): 762.17
```


Loss (CCE) per Epoch

```
Test CCE: 0.7735
test accuracy = 74.8499984741211
```
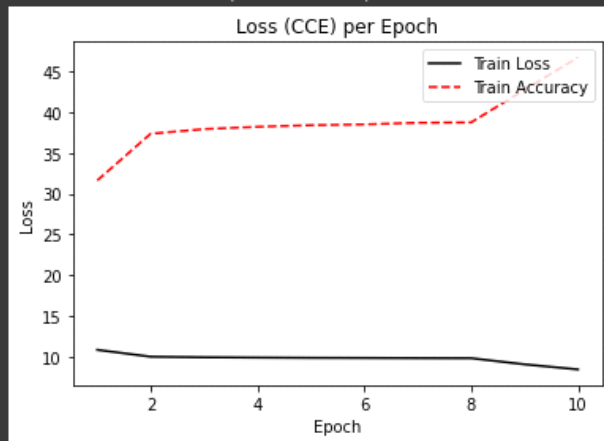
SEED 8 # 8877x

```
Number of Epoch = 1 - Average CCE Lost:= 10.8531725
Training Accuracy = 31.618000030517578
Number of Epoch = 2 - Average CCE Lost:= 10.012534375
Training Accuracy = 37.354000091552734
Number of Epoch = 3 - Average CCE Lost:= 9.94196375
Training Accuracy = 37.92000198364258
Number of Epoch = 4 - Average CCE Lost:= 9.90472875
Training Accuracy = 38.20399856567383
Number of Epoch = 5 - Average CCE Lost:= 9.87340875
Training Accuracy = 38.39799880981445
Number of Epoch = 6 - Average CCE Lost:= 9.858243125
Training Accuracy = 38.49599838256836
Number of Epoch = 7 - Average CCE Lost:= 9.83672
Training Accuracy = 38.697998046875
Number of Epoch = 8 - Average CCE Lost:= 9.826355625
Training Accuracy = 38.742000579833984
Number of Epoch = 9 - Average CCE Lost:= 9.073195
Training Accuracy = 42.73999786376953
Number of Epoch = 10 - Average CCE Lost:= 8.4529575
Training Accuracy = 46.715999603271484

Total time taken (in seconds): 732.99
```


Loss (CCE) per Epoch

```
Test CCE: 1.6794
test accuracy = 46.869998931884766
```
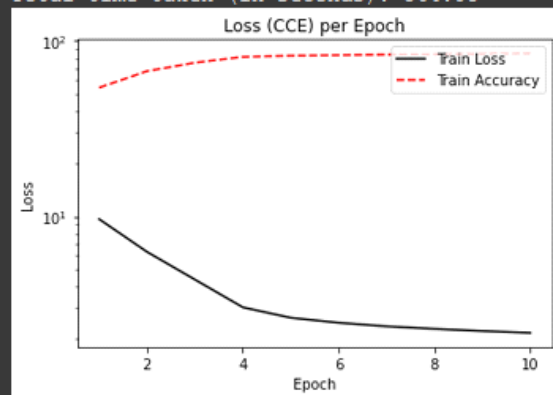
SEED 9 # 1091x

```
Number of Epoch = 1 - Average Training Lost:= 9.656994375
Training Accuracy = 54.221999645233154
Number of Epoch = 2 - Average Training Lost:= 6.280700625
Training Accuracy = 67.3520028591156
Number of Epoch = 3 - Average Training Lost:= 4.3650646875
Training Accuracy = 75.27400255203247
Number of Epoch = 4 - Average Training Lost:= 3.0344796875
Training Accuracy = 81.20800256729126
Number of Epoch = 5 - Average Training Lost:= 2.6441465625
Training Accuracy = 82.51799941062927
Number of Epoch = 6 - Average Training Lost:= 2.47821125
Training Accuracy = 83.0839991569519
Number of Epoch = 7 - Average Training Lost:= 2.3635675
Training Accuracy = 83.70599746704102
Number of Epoch = 8 - Average Training Lost:= 2.2861490625
Training Accuracy = 84.07599925994873
Number of Epoch = 9 - Average Training Lost:= 2.2216834375
Training Accuracy = 84.52200293540955
Number of Epoch = 10 - Average Training Lost:= 2.17052421875
Training Accuracy = 85.00800132751465

Total time taken (in seconds): 364.08
```


Loss (CCE) per Epoch
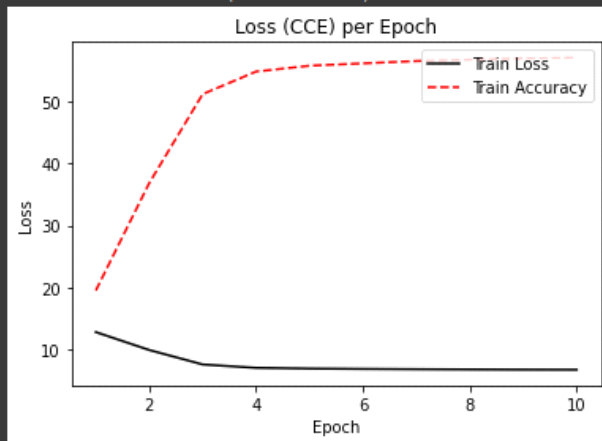
```
Test CCE: 0.4349
test accuracy = 84.5999984741211
```

SEED 10 #1010

```
Number of Epoch = 1 - Average CCE Lost:= 12.87364625
Training Accuracy = 19.553998947143555
Number of Epoch = 2 - Average CCE Lost:= 9.991310625
Training Accuracy = 36.84000015258789
Number of Epoch = 3 - Average CCE Lost:= 7.667231875
Training Accuracy = 51.134002685546875
Number of Epoch = 4 - Average CCE Lost:= 7.12479625
Training Accuracy = 54.76400375366211
Number of Epoch = 5 - Average CCE Lost:= 7.008765
Training Accuracy = 55.698001861572266
Number of Epoch = 6 - Average CCE Lost:= 6.94984
Training Accuracy = 56.08000183105469
Number of Epoch = 7 - Average CCE Lost:= 6.903968125
Training Accuracy = 56.454002380371094
Number of Epoch = 8 - Average CCE Lost:= 6.86743
Training Accuracy = 56.672000885009766
Number of Epoch = 9 - Average CCE Lost:= 6.837999375
Training Accuracy = 56.875999450683594
Number of Epoch = 10 - Average CCE Lost:= 6.825435
Training Accuracy = 57.007999420166016

Total time taken (in seconds): 653.08
```


Loss (CCE) per Epoch

```
Test CCE: 1.3820
test accuracy = 56.400001525878906
```
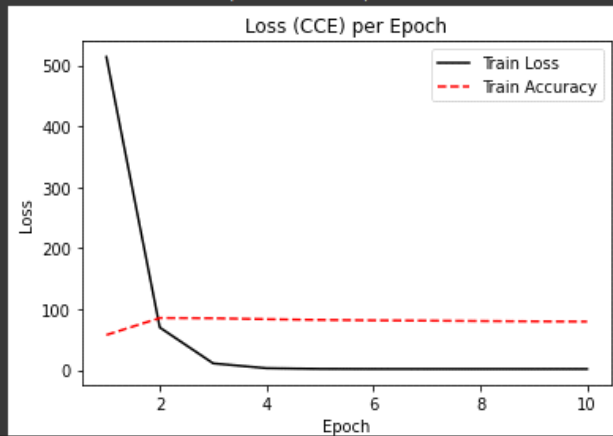
L2 regularizaiton LR 6E-4
SEEd 1 2245

```
Number of Epoch = 1 - Average CCE Lost:= 513.88204
Training Accuracy = 57.503997802734375
Number of Epoch = 2 - Average CCE Lost:= 69.740835
Training Accuracy = 85.35599517822266
Number of Epoch = 3 - Average CCE Lost:= 10.8420775
Training Accuracy = 84.9739990234375
Number of Epoch = 4 - Average CCE Lost:= 2.90066625
Training Accuracy = 83.37000274658203
Number of Epoch = 5 - Average CCE Lost:= 1.80866109375
Training Accuracy = 82.22000122070312
Number of Epoch = 6 - Average CCE Lost:= 1.6500446875
Training Accuracy = 81.43799591064453
Number of Epoch = 7 - Average CCE Lost:= 1.62057515625
Training Accuracy = 80.94999694824219
Number of Epoch = 8 - Average CCE Lost:= 1.6111115625
Training Accuracy = 80.35200500488281
Number of Epoch = 9 - Average CCE Lost:= 1.60615390625
Training Accuracy = 79.83599853515625
Number of Epoch = 10 - Average CCE Lost:= 1.5998728125
Training Accuracy = 79.48999786376953

Total time taken (in seconds): 703.26
```


Loss (CCE) per Epoch

```
Test CCE: 0.5039
test accuracy = 81.4000015258789
```
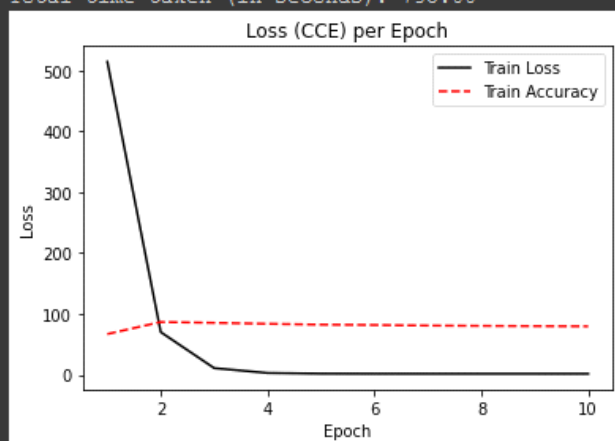
SEED 2 3349

```
Number of Epoch = 1 - Average CCE Lost:= 514.2342
Training Accuracy = 66.8280029296875
Number of Epoch = 2 - Average CCE Lost:= 70.012215
Training Accuracy = 86.65800476074219
Number of Epoch = 3 - Average CCE Lost:= 10.87397
Training Accuracy = 85.26800537109375
Number of Epoch = 4 - Average CCE Lost:= 2.90197625
Training Accuracy = 83.67000579833984
Number of Epoch = 5 - Average CCE Lost:= 1.80607875
Training Accuracy = 82.27799987792969
Number of Epoch = 6 - Average CCE Lost:= 1.64569078125
Training Accuracy = 81.7239990234375
Number of Epoch = 7 - Average CCE Lost:= 1.6169253125
Training Accuracy = 80.78800201416016
Number of Epoch = 8 - Average CCE Lost:= 1.60661890625
Training Accuracy = 80.29399871826172
Number of Epoch = 9 - Average CCE Lost:= 1.60016578125
Training Accuracy = 79.86399841308594
Number of Epoch = 10 - Average CCE Lost:= 1.59441328125
Training Accuracy = 79.52400207519531

Total time taken (in seconds): 795.00
```


Loss (CCE) per Epoch

```
Test CCE: 0.3156
test accuracy = 79.06999969482422
```
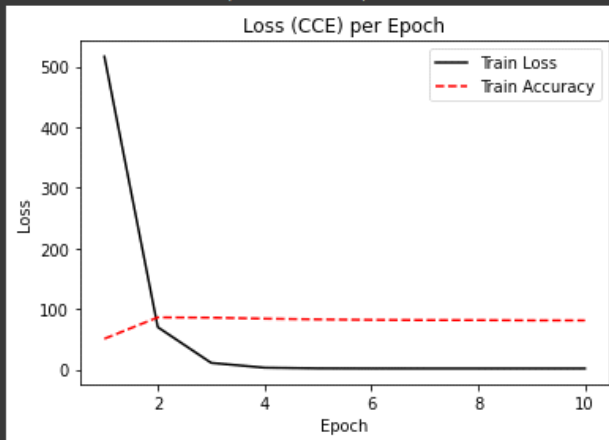
SEED 3 4439

```
47 plt.show()
```

```
Number of Epoch = 1 - Average CCE Lost:= 516.42496
Training Accuracy = 50.63999938964844
Number of Epoch = 2 - Average CCE Lost:= 69.799575
Training Accuracy = 85.94999694824219
Number of Epoch = 3 - Average CCE Lost:= 10.8301525
Training Accuracy = 85.5
Number of Epoch = 4 - Average CCE Lost:= 2.8996396875
Training Accuracy = 83.81199645996094
Number of Epoch = 5 - Average CCE Lost:= 1.80883046875
Training Accuracy = 82.64399719238281
Number of Epoch = 6 - Average CCE Lost:= 1.64911359375
Training Accuracy = 81.88999938964844
Number of Epoch = 7 - Average CCE Lost:= 1.618009375
Training Accuracy = 81.447998046875
Number of Epoch = 8 - Average CCE Lost:= 1.60767828125
Training Accuracy = 81.37799835205078
Number of Epoch = 9 - Average CCE Lost:= 1.603963125
Training Accuracy = 80.95399475097656
Number of Epoch = 10 - Average CCE Lost:= 1.60153234375
Training Accuracy = 80.91600036621094

Total time taken (in seconds): 796.40
```


Loss (CCE) per Epoch

```
Test CCE: 0.3185
test accuracy = 79.93000030517578
```
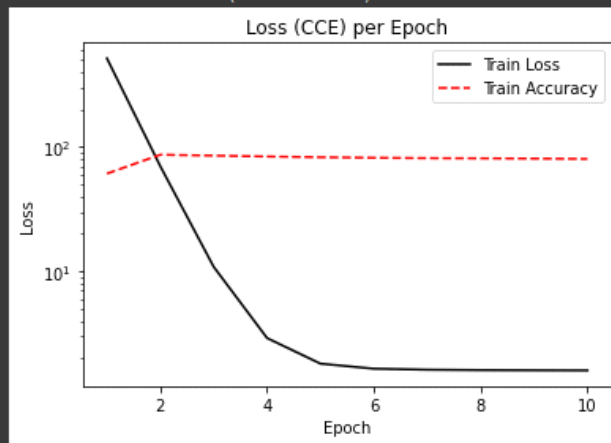
SEED 4 5540

```
Number of Epoch = 1 - Average CCE Lost:= 514.9946
Training Accuracy = 60.9579963684082
Number of Epoch = 2 - Average CCE Lost:= 69.921605
Training Accuracy = 86.48399353027344
Number of Epoch = 3 - Average CCE Lost:= 10.86499125
Training Accuracy = 85.09400177001953
Number of Epoch = 4 - Average CCE Lost:= 2.90698375
Training Accuracy = 83.68000030517578
Number of Epoch = 5 - Average CCE Lost:= 1.8105825
Training Accuracy = 82.53600311279297
Number of Epoch = 6 - Average CCE Lost:= 1.64959484375
Training Accuracy = 81.72000122070312
Number of Epoch = 7 - Average CCE Lost:= 1.618814375
Training Accuracy = 81.14600372314453
Number of Epoch = 8 - Average CCE Lost:= 1.6071734375
Training Accuracy = 80.89399719238281
Number of Epoch = 9 - Average CCE Lost:= 1.60204515625
Training Accuracy = 80.53800201416016
Number of Epoch = 10 - Average CCE Lost:= 1.59836171875
Training Accuracy = 80.04000091552734

Total time taken (in seconds): 733.88
```


Loss (CCE) per Epoch

```
Test CCE: 0.5039
test accuracy = 81.4000015258789
```
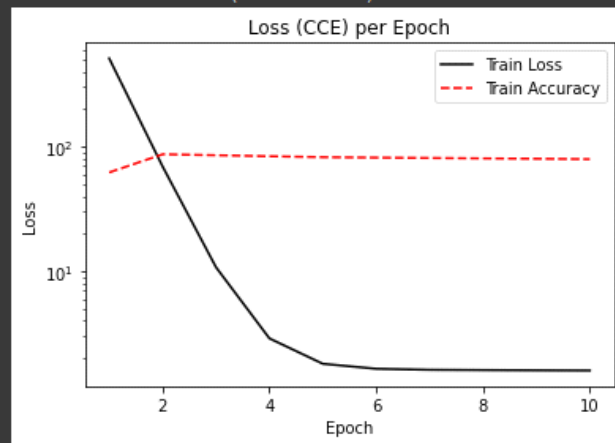
Seed 5 6628

```
Number of Epoch = 1 - Average CCE Lost:= 510.54472
Training Accuracy = 62.077999114990234
Number of Epoch = 2 - Average CCE Lost:= 69.289935
Training Accuracy = 86.802001953125
Number of Epoch = 3 - Average CCE Lost:= 10.7729475
Training Accuracy = 85.30799865722656
Number of Epoch = 4 - Average CCE Lost:= 2.8930228125
Training Accuracy = 83.67599487304688
Number of Epoch = 5 - Average CCE Lost:= 1.80972640625
Training Accuracy = 82.30400085449219
Number of Epoch = 6 - Average CCE Lost:= 1.65082171875
Training Accuracy = 81.64399719238281
Number of Epoch = 7 - Average CCE Lost:= 1.61939015625
Training Accuracy = 81.04399871826172
Number of Epoch = 8 - Average CCE Lost:= 1.611338125
Training Accuracy = 80.43800354003906
Number of Epoch = 9 - Average CCE Lost:= 1.60394078125
Training Accuracy = 79.91400146484375
Number of Epoch = 10 - Average CCE Lost:= 1.5989259375
Training Accuracy = 79.31600189208984

Total time taken (in seconds): 714.24
```


Loss (CCE) per Epoch

```
Test CCE: 0.3173
test accuracy = 79.33999633789062
```
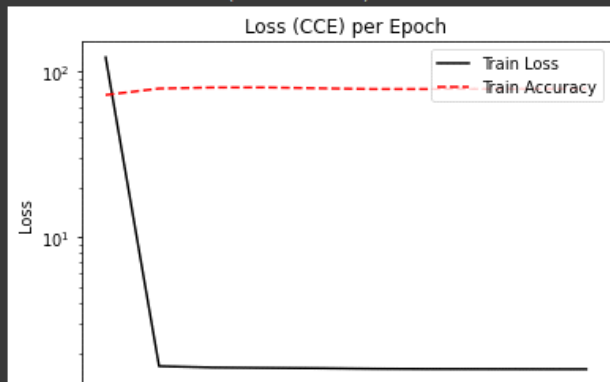
Seed 6 7711

```
Number of Epoch = 1 - Average CCE Lost:= 121.43025
Training Accuracy = 71.99199676513672
Number of Epoch = 2 - Average CCE Lost:= 1.6611946875
Training Accuracy = 78.66799926757812
Number of Epoch = 3 - Average CCE Lost:= 1.63060265625
Training Accuracy = 79.8080062866211
Number of Epoch = 4 - Average CCE Lost:= 1.621990625
Training Accuracy = 79.87200164794922
Number of Epoch = 5 - Average CCE Lost:= 1.61406234375
Training Accuracy = 78.93800354003906
Number of Epoch = 6 - Average CCE Lost:= 1.60204265625
Training Accuracy = 78.08799743652344
Number of Epoch = 7 - Average CCE Lost:= 1.59682265625
Training Accuracy = 78.09400177001953
Number of Epoch = 8 - Average CCE Lost:= 1.5953334375
Training Accuracy = 78.33999633789062
Number of Epoch = 9 - Average CCE Lost:= 1.59366625
Training Accuracy = 78.33000183105469
Number of Epoch = 10 - Average CCE Lost:= 1.592684375
Training Accuracy = 78.61000061035156

Total time taken (in seconds): 799.21
```


Loss (CCE) per Epoch

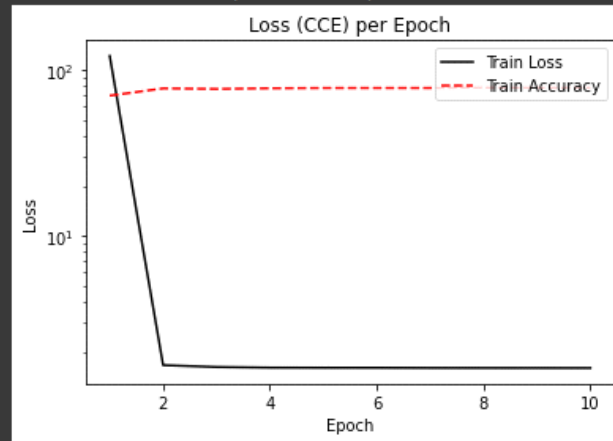```
Test CCE: 0.3183
test accuracy = 78.05999755859375
```

Seed 7 2234

```
Number of Epoch = 1 - Average CCE Lost:= 121.63732
Training Accuracy = 70.09199523925781
Number of Epoch = 2 - Average CCE Lost:= 1.65903421875
Training Accuracy = 77.51200103759766
Number of Epoch = 3 - Average CCE Lost:= 1.6162846875
Training Accuracy = 76.95999908447266
Number of Epoch = 4 - Average CCE Lost:= 1.60278578125
Training Accuracy = 77.61000061035156
Number of Epoch = 5 - Average CCE Lost:= 1.6007896875
Training Accuracy = 77.91799926757812
Number of Epoch = 6 - Average CCE Lost:= 1.59976453125
Training Accuracy = 77.9219970703125
Number of Epoch = 7 - Average CCE Lost:= 1.5962003125
Training Accuracy = 77.94200134277344
Number of Epoch = 8 - Average CCE Lost:= 1.59534109375
Training Accuracy = 78.27400207519531
Number of Epoch = 9 - Average CCE Lost:= 1.59471015625
Training Accuracy = 78.1780014038086
Number of Epoch = 10 - Average CCE Lost:= 1.59382515625
Training Accuracy = 78.18800354003906

Total time taken (in seconds): 747.00
```


Loss (CCE) per Epoch

```
Test CCE: 0.3209
test accuracy = 76.5999984741211
```
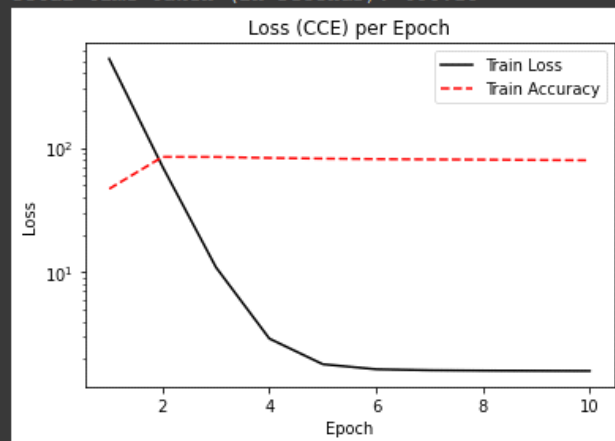
Seed8 1234

```
Number of Epoch = 1 - Average CCE Lost:= 520.93916
Training Accuracy = 46.74800109863281
Number of Epoch = 2 - Average CCE Lost:= 70.39021
Training Accuracy = 84.53599548339844
Number of Epoch = 3 - Average CCE Lost:= 10.91567125
Training Accuracy = 84.42400360107422
Number of Epoch = 4 - Average CCE Lost:= 2.91004125
Training Accuracy = 82.93799591064453
Number of Epoch = 5 - Average CCE Lost:= 1.8101265625
Training Accuracy = 81.9000015258789
Number of Epoch = 6 - Average CCE Lost:= 1.64895453125
Training Accuracy = 81.17799377441406
Number of Epoch = 7 - Average CCE Lost:= 1.6185475
Training Accuracy = 80.68600463867188
Number of Epoch = 8 - Average CCE Lost:= 1.60858953125
Training Accuracy = 80.31200408935547
Number of Epoch = 9 - Average CCE Lost:= 1.6024059375
Training Accuracy = 79.79000091552734
Number of Epoch = 10 - Average CCE Lost:= 1.59766890625
Training Accuracy = 79.41400146484375

Total time taken (in seconds): 650.13
```


Loss (CCE) per Epoch
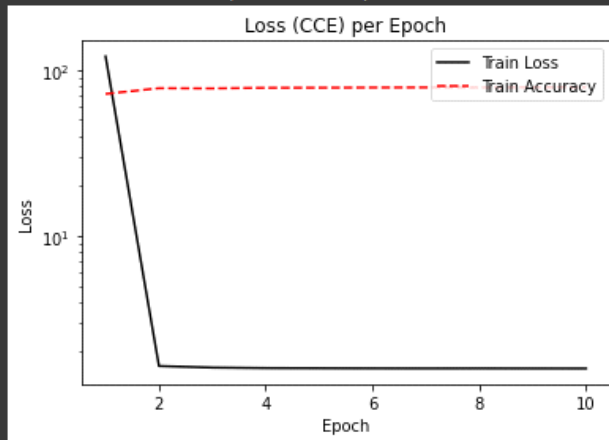
```
Test CCE: 0.3179
test accuracy = 78.38999938964844
```

Seed 9 1023

```
Number of Epoch = 1 - Average CCE Lost:= 120.49771
Training Accuracy = 71.6240005493164
Number of Epoch = 2 - Average CCE Lost:= 1.64614453125
Training Accuracy = 77.49000549316406
Number of Epoch = 3 - Average CCE Lost:= 1.6113871875
Training Accuracy = 77.26399993896484
Number of Epoch = 4 - Average CCE Lost:= 1.6001975
Training Accuracy = 77.9219970703125
Number of Epoch = 5 - Average CCE Lost:= 1.5971978125
Training Accuracy = 78.04199981689453
Number of Epoch = 6 - Average CCE Lost:= 1.5947284375
Training Accuracy = 78.2459945678711
Number of Epoch = 7 - Average CCE Lost:= 1.59328046875
Training Accuracy = 78.36000061035156
Number of Epoch = 8 - Average CCE Lost:= 1.59399546875
Training Accuracy = 78.30599975585938
Number of Epoch = 9 - Average CCE Lost:= 1.59269203125
Training Accuracy = 78.54999542236328
Number of Epoch = 10 - Average CCE Lost:= 1.59188328125
Training Accuracy = 78.49400329589844

Total time taken (in seconds): 794.19
```


Loss (CCE) per Epoch

```
Test CCE: 0.3229
test accuracy = 76.19000244140625
```
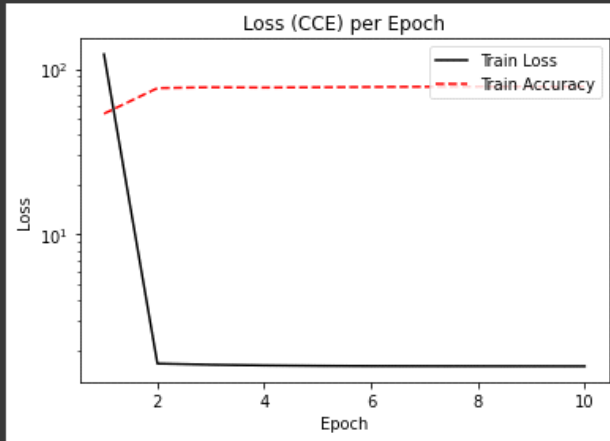
Seed 10 4001

```
Number of Epoch = 1 - Average CCE Lost:= 122.99658
Training Accuracy = 53.72599792480469
Number of Epoch = 2 - Average CCE Lost:= 1.654775
Training Accuracy = 76.70999908447266
Number of Epoch = 3 - Average CCE Lost:= 1.628091875
Training Accuracy = 77.63400268554688
Number of Epoch = 4 - Average CCE Lost:= 1.6123825
Training Accuracy = 77.30400085449219
Number of Epoch = 5 - Average CCE Lost:= 1.60353375
Training Accuracy = 77.63199615478516
Number of Epoch = 6 - Average CCE Lost:= 1.5983321875
Training Accuracy = 77.95600128173828
Number of Epoch = 7 - Average CCE Lost:= 1.59655578125
Training Accuracy = 78.197998046875
Number of Epoch = 8 - Average CCE Lost:= 1.59543828125
Training Accuracy = 78.24800109863281
Number of Epoch = 9 - Average CCE Lost:= 1.5945621875
Training Accuracy = 78.31599426269531
Number of Epoch = 10 - Average CCE Lost:= 1.5936765625
Training Accuracy = 78.4000015258789

Total time taken (in seconds): 765.65
```



```
Test CCE: 0.3198
test accuracy = 76.8499984741211
```