

```
In [1]: # Library imports.
import matplotlib.pyplot as plt
import numpy as np
import torch
from mpl_toolkits.mplot3d import Axes3D

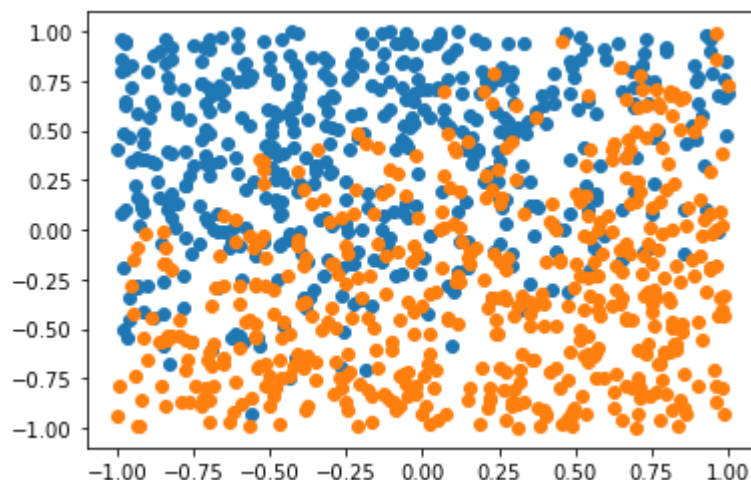
# Repository imports.
import DataGenerator
import LocalNetBase
import network
import train
```

Visualize random halfspace data

Note: For the clearest separation, set dim = 2 (we only plot the first two dimensions here).

```
In [2]: dim = 3
n = 1000
points, labels = DataGenerator.random_halfspace_data(dim, n)
print('points:', points.shape, points.dtype)
print('labels:', labels.shape, labels.dtype)
ones = labels
zeros = np.invert(labels)
plt.scatter(points[:, 0][ones], points[:, 1][ones])
plt.scatter(points[:, 0][zeros], points[:, 1][zeros])
plt.show()
```

```
points: (1000, 3) float64
labels: (1000,) bool
```



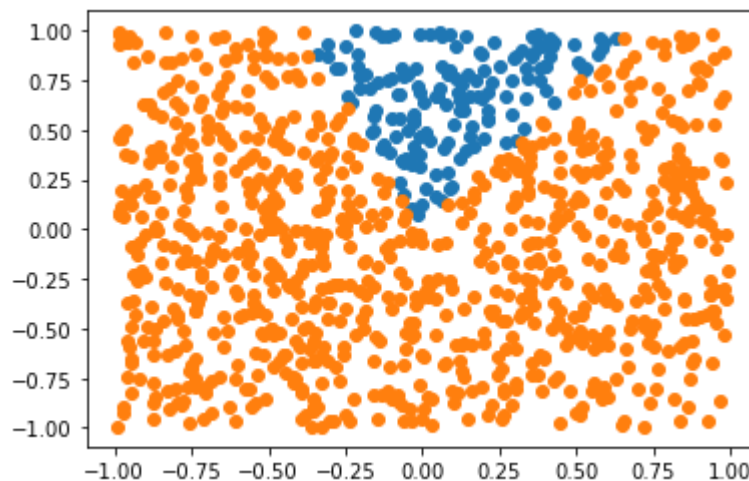
Visualize random ReLU data

Note: Sometimes, all points end up having the same label.

```
In [13]: dim = 2
n = 1000
k = 10
points, labels = DataGenerator.layer_relu_data(dim, n, k)
print('points:', points.shape, points.dtype)
print('labels:', labels.shape, labels.dtype)
ones = labels.astype(np.bool)
zeros = np.invert(ones)
# ax.scatter(points[:, 0][ones], points[:, 1][ones], labels[ones])
# ax.scatter(points[:, 0][zeros], points[:, 1][zeros], labels[zeros])
plt.scatter(points[:, 0][ones], points[:, 1][ones])
plt.scatter(points[:, 0][zeros], points[:, 1][zeros])
plt.show()
```

points: (1000, 2) float32

labels: (1000,) int64



Visualize MNIST

```
In [4]: import torchvision
import torchvision.datasets
mnist_train = torchvision.datasets.MNIST(root='./data', train=True, download=True, transform=None)
mnist_test = torchvision.datasets.MNIST(root='./data', train=False, download=True, transform=None)
print('mnist_train:', len(mnist_train))
print('mnist_test:', len(mnist_test))
```

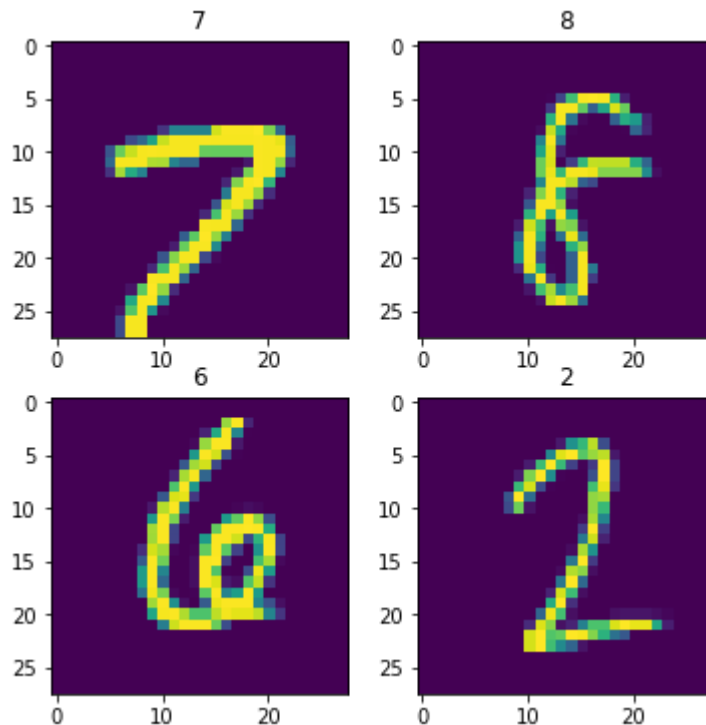
mnist_train: 60000

mnist_test: 10000

```
In [5]: X = np.array([np.array(pair[0]) for pair in mnist_train]) / 255.0
y = np.array([pair[1] for pair in mnist_train])
X_test = np.array([np.array(pair[0]) for pair in mnist_test]) / 255.0
y_test = np.array([pair[1] for pair in mnist_test])
print('X:', X.shape)
print('y:', y.shape)
print('X_test:', X_test.shape)
print('y_test:', y_test.shape)
mnist_X, mnist_y, mnist_X_test, mnist_y_test = X, y, X_test, y_test
```

```
X: (60000, 28, 28)
y: (60000,)
X_test: (10000, 28, 28)
y_test: (10000,)
```

```
In [6]: fig, ax = plt.subplots(2, 2, figsize=(6, 6))
ax[0, 0].imshow(X[123])
ax[0, 0].set_title(y[123])
ax[0, 1].imshow(X[456])
ax[0, 1].set_title(y[456])
ax[1, 0].imshow(X_test[123])
ax[1, 0].set_title(y_test[123])
ax[1, 1].imshow(X_test[456])
ax[1, 1].set_title(y_test[456])
plt.show()
```



Instantiate and inspect RNN

This is based on the README. Notes:

- The "rounds" parameter seems to be defined as $T-1$, so rounds=1 \Leftrightarrow $T=2$!
- The word "graph" in the code refers to the recurrent portion of the RNN, i.e. the randomly, sparsely connected part, excluding input and output neurons.
- I'm not sure as to what the best options are for which scenario, feel free to experiment with this.

```
In [10]: options = LocalNetBase.Options(
    use_input_rule = False,      # Use an input rule to update input layer weights.
    use_output_rule = False,     # Use an output rule to update input layer weights.
    gd_output_rule = False,      # Learn an output rule, or use fixed one. If GD is used, set 'use_output_rule' to True as well.
    use_graph_rule = True,
    gd_graph_rule = True,
    gd_input = False,            # gd directly on input layer weights.
    gd_output = False,           # gd directly on output layer weights.
    additive_rule = True)       # If false, uses multiplicative updates.

scheme = LocalNetBase.UpdateScheme(
    cross_entropy_loss = True,   # By default, uses cross entropy loss.
    mse_loss = False,
    update_misclassified = True,  # By default only update weights when we misclassify.
    update_all_edges = False)    # For output rule, update all edges, or only edge to correct and predicted label.

local_net = network.LocalNet(n = 4, # number of input features (= dimension)
                             m = 2, # number of possible labels
                             num_v = 100, # number of nodes in graph
                             p = .5, # probability that an edge exists in the graph
                             cap = 50, # choose top 'cap' nodes which fire
                             rounds = 1, # number of times the graph 'fires'
                             options = options, update_scheme = scheme)

print('local_net input_rule:')
print(local_net.input_rule) # 2^T, randomly initialized
print('local_net rnn_rule:')
print(local_net.get_rnn_rule()) # 2^T x 2^T, randomly initialized
print('local_net output_rule:')
print(local_net.get_output_rule()) # 2^T x 2, all zero
```

```
local_net input_rule:
tensor([-0.0347,  0.4027, -1.2018, -0.1318])
local_net rnn_rule:
tensor([[ 1.4585,  0.6048,  2.1276, -0.3497],
        [ 0.0055,  2.4536,  0.2799,  0.0368],
        [ 0.0706, -1.4677, -1.3575,  0.3159],
        [-0.8956,  1.1856,  1.0928,  0.7184]])
local_net output_rule:
tensor([[0., 0.],
        [0., 0.],
        [0., 0.],
        [0., 0.]])
```

Meta-learn rules using gradient descent on halfspace

```
In [11]: # Generate data.
dimension = 4
n = 1000
X, y = DataGenerator.random_halfspace_data(dim = dimension, n = 2*n)
X_test = X[:n]
y_test = y[:n]
X = X[n:]
y = y[n:]

# Learn rules.
losses, train_accuracies, test_accuracies = train.train_local_rule(
    X,                                # Training Examples
    y,                                # Training Labels
    local_net,                        # The BrainNet
    X_test = X_test,
    y_test = y_test,
    rule_epochs = 100,                # Number of times to run through the data
    epochs = 1,                       # Number of time to run through a single batch for
a single training pass
    batch = 100,                      # Number of examples in a batch.
    lr = 1e-2,                        # Learning Rate
    verbose = True)                   # If True, evaluates network on test/train data ea
ch epoch, otherwise, only once at the end
```

```
Starting Train
Outer epoch 1
Acc of class 0 :0.5392
Acc of class 1 :0.6899
Train Accuracy: 0.6150
Acc of class 0 :0.4865
Acc of class 1 :0.7148
Test Accuracy: 0.6050
Current loss: 0.596109508526911
Mean loss so far: 0.596109508526911
Outer epoch 2
Acc of class 0 :0.3722
Acc of class 1 :0.8330
Train Accuracy: 0.6040
Acc of class 0 :0.3825
Acc of class 1 :0.8266
Test Accuracy: 0.6130
Current loss: 0.6663743206130077
Mean loss so far: 0.6312419145699594
Outer epoch 3
Acc of class 0 :0.5734
Acc of class 1 :0.9066
Train Accuracy: 0.7410
Acc of class 0 :0.6258
Acc of class 1 :0.8940
Test Accuracy: 0.7650
Current loss: 0.6512995014411166
Mean loss so far: 0.6379277768603452
Outer epoch 4
Acc of class 0 :0.5694
Acc of class 1 :0.9642
Train Accuracy: 0.7680
Acc of class 0 :0.6112
Acc of class 1 :0.9807
Test Accuracy: 0.8030
Current loss: 0.5439445080354621
Mean loss so far: 0.6144319596541243
Outer epoch 5
Acc of class 0 :0.6761
Acc of class 1 :0.9642
Train Accuracy: 0.8210
Acc of class 0 :0.6944
Acc of class 1 :0.9518
Test Accuracy: 0.8280
Current loss: 0.6391638048709526
Mean loss so far: 0.61937832869749
Outer epoch 6
Acc of class 0 :0.4990
Acc of class 1 :0.9503
Train Accuracy: 0.7260
Acc of class 0 :0.5239
Acc of class 1 :0.9653
Test Accuracy: 0.7530
Current loss: 0.5925962263763748
Mean loss so far: 0.6149146449773041
Outer epoch 7
Acc of class 0 :0.6861
```

Acc of class 1 :0.9404
Train Accuracy: 0.8140
Acc of class 0 :0.7006
Acc of class 1 :0.9595
Test Accuracy: 0.8350
Current loss: 0.5880016321994728
Mean loss so far: 0.6110699288661854
Outer epoch 8
Acc of class 0 :0.5694
Acc of class 1 :0.9722
Train Accuracy: 0.7720
Acc of class 0 :0.6175
Acc of class 1 :0.9750
Test Accuracy: 0.8030
Current loss: 0.5405420637928365
Mean loss so far: 0.6022539457320167
Outer epoch 9
Acc of class 0 :0.4769
Acc of class 1 :1.0000
Train Accuracy: 0.7400
Acc of class 0 :0.5031
Acc of class 1 :1.0000
Test Accuracy: 0.7610
Current loss: 0.5120288097304491
Mean loss so far: 0.5922289306207315
Outer epoch 10
Acc of class 0 :0.6439
Acc of class 1 :0.9125
Train Accuracy: 0.7790
Acc of class 0 :0.6819
Acc of class 1 :0.9017
Test Accuracy: 0.7960
Current loss: 0.4922573344398608
Mean loss so far: 0.5822317710026443
Outer epoch 11
Acc of class 0 :0.5332
Acc of class 1 :0.8787
Train Accuracy: 0.7070
Acc of class 0 :0.5759
Acc of class 1 :0.9152
Test Accuracy: 0.7520
Current loss: 0.5368887363012552
Mean loss so far: 0.5781096769388817
Outer epoch 12
Acc of class 0 :0.6700
Acc of class 1 :0.9622
Train Accuracy: 0.8170
Acc of class 0 :0.7006
Acc of class 1 :0.9692
Test Accuracy: 0.8400
Current loss: 0.5069898366851933
Mean loss so far: 0.5721830235844076
Outer epoch 13
Acc of class 0 :0.6197
Acc of class 1 :0.9423
Train Accuracy: 0.7820
Acc of class 0 :0.6549

Acc of class 1 :0.9615
Test Accuracy: 0.8140
Current loss: 0.5092796291014715
Mean loss so far: 0.5673443009318742
Outer epoch 14
Acc of class 0 :0.7505
Acc of class 1 :0.9085
Train Accuracy: 0.8300
Acc of class 0 :0.7963
Acc of class 1 :0.9287
Test Accuracy: 0.8650
Current loss: 0.4716275105486762
Mean loss so far: 0.5605073873330743
Outer epoch 15
Acc of class 0 :0.5614
Acc of class 1 :0.9881
Train Accuracy: 0.7760
Acc of class 0 :0.6195
Acc of class 1 :0.9942
Test Accuracy: 0.8140
Current loss: 0.4710138503492586
Mean loss so far: 0.5545411515341532
Outer epoch 16
Acc of class 0 :0.8169
Acc of class 1 :0.8549
Train Accuracy: 0.8360
Acc of class 0 :0.8545
Acc of class 1 :0.8555
Test Accuracy: 0.8550
Current loss: 0.4758845405435837
Mean loss so far: 0.5496251133472426
Outer epoch 17
Acc of class 0 :0.6700
Acc of class 1 :0.9702
Train Accuracy: 0.8210
Acc of class 0 :0.7235
Acc of class 1 :0.9807
Test Accuracy: 0.8570
Current loss: 0.46415896060883916
Mean loss so far: 0.5445976925979248
Outer epoch 18
Acc of class 0 :0.7002
Acc of class 1 :0.8489
Train Accuracy: 0.7750
Acc of class 0 :0.6902
Acc of class 1 :0.8748
Test Accuracy: 0.7860
Current loss: 0.4722021232371425
Mean loss so far: 0.5405757165223258
Outer epoch 19
Acc of class 0 :0.6922
Acc of class 1 :0.9483
Train Accuracy: 0.8210
Acc of class 0 :0.7505
Acc of class 1 :0.9403
Test Accuracy: 0.8490
Current loss: 0.4577093580002208

Mean loss so far: 0.5362143292316887
Outer epoch 20
Acc of class 0 :0.8390
Acc of class 1 :0.8787
Train Accuracy: 0.8590
Acc of class 0 :0.8857
Acc of class 1 :0.8902
Test Accuracy: 0.8880
Current loss: 0.45034233633747994
Mean loss so far: 0.5319207295869782
Outer epoch 21
Acc of class 0 :0.8149
Acc of class 1 :0.9085
Train Accuracy: 0.8620
Acc of class 0 :0.8836
Acc of class 1 :0.9441
Test Accuracy: 0.9150
Current loss: 0.45723583861790756
Mean loss so far: 0.5283643062074987
Outer epoch 22
Acc of class 0 :0.8028
Acc of class 1 :0.8847
Train Accuracy: 0.8440
Acc of class 0 :0.8628
Acc of class 1 :0.9037
Test Accuracy: 0.8840
Current loss: 0.4521414168084624
Mean loss so far: 0.5248996294166335
Outer epoch 23
Acc of class 0 :0.8008
Acc of class 1 :0.9105
Train Accuracy: 0.8560
Acc of class 0 :0.8524
Acc of class 1 :0.9364
Test Accuracy: 0.8960
Current loss: 0.444857911761814
Mean loss so far: 0.5214195547359891
Outer epoch 24
Acc of class 0 :0.8008
Acc of class 1 :0.8847
Train Accuracy: 0.8430
Acc of class 0 :0.8669
Acc of class 1 :0.8960
Test Accuracy: 0.8820
Current loss: 0.4478932690018885
Mean loss so far: 0.5183559594970683
Outer epoch 25
Acc of class 0 :0.8672
Acc of class 1 :0.8986
Train Accuracy: 0.8830
Acc of class 0 :0.9064
Acc of class 1 :0.9191
Test Accuracy: 0.9130
Current loss: 0.46215890260472714
Mean loss so far: 0.5161080772213746
Outer epoch 26
Acc of class 0 :0.8913

Acc of class 1 :0.9046
Train Accuracy: 0.8980
Acc of class 0 :0.9252
Acc of class 1 :0.9249
Test Accuracy: 0.9250
Current loss: 0.44336352049154104
Mean loss so far: 0.5133102096548426
Outer epoch 27
Acc of class 0 :0.8109
Acc of class 1 :0.9662
Train Accuracy: 0.8890
Acc of class 0 :0.8378
Acc of class 1 :0.9730
Test Accuracy: 0.9080
Current loss: 0.45299815237598623
Mean loss so far: 0.5110764297556257
Outer epoch 28
Acc of class 0 :0.8169
Acc of class 1 :0.9185
Train Accuracy: 0.8680
Acc of class 0 :0.8462
Acc of class 1 :0.9249
Test Accuracy: 0.8870
Current loss: 0.45059688611435994
Mean loss so far: 0.5089164460541519
Outer epoch 29
Acc of class 0 :0.8672
Acc of class 1 :0.8767
Train Accuracy: 0.8720
Acc of class 0 :0.8898
Acc of class 1 :0.8940
Test Accuracy: 0.8920
Current loss: 0.4562283423018353
Mean loss so far: 0.507099614890279
Outer epoch 30
Acc of class 0 :0.8008
Acc of class 1 :0.9185
Train Accuracy: 0.8600
Acc of class 0 :0.8358
Acc of class 1 :0.9306
Test Accuracy: 0.8850
Current loss: 0.45777075550479945
Mean loss so far: 0.5054553195774296
Outer epoch 31
Acc of class 0 :0.7646
Acc of class 1 :0.9543
Train Accuracy: 0.8600
Acc of class 0 :0.8420
Acc of class 1 :0.9672
Test Accuracy: 0.9070
Current loss: 0.43328481740832414
Mean loss so far: 0.5031272388622973
Outer epoch 32
Acc of class 0 :0.8209
Acc of class 1 :0.8191
Train Accuracy: 0.8200
Acc of class 0 :0.8669

Acc of class 1 :0.8459
Test Accuracy: 0.8560
Current loss: 0.45885495124578907
Mean loss so far: 0.5017437298742813
Outer epoch 33
Acc of class 0 :0.9115
Acc of class 1 :0.8827
Train Accuracy: 0.8970
Acc of class 0 :0.9543
Acc of class 1 :0.9037
Test Accuracy: 0.9280
Current loss: 0.4539834325780707
Mean loss so far: 0.5002964481380324
Outer epoch 34
Acc of class 0 :0.7988
Acc of class 1 :0.7972
Train Accuracy: 0.7980
Acc of class 0 :0.8462
Acc of class 1 :0.7900
Test Accuracy: 0.8170
Current loss: 0.45433750559131647
Mean loss so far: 0.49894471453371725
Outer epoch 35
Acc of class 0 :0.7022
Acc of class 1 :0.9503
Train Accuracy: 0.8270
Acc of class 0 :0.7256
Acc of class 1 :0.9557
Test Accuracy: 0.8450
Current loss: 0.4536479759462836
Mean loss so far: 0.4976505220026477
Outer epoch 36
Acc of class 0 :0.7847
Acc of class 1 :0.8588
Train Accuracy: 0.8220
Acc of class 0 :0.8462
Acc of class 1 :0.8497
Test Accuracy: 0.8480
Current loss: 0.4554556479594397
Mean loss so far: 0.4964784421681141
Outer epoch 37
Acc of class 0 :0.8129
Acc of class 1 :0.8966
Train Accuracy: 0.8550
Acc of class 0 :0.8607
Acc of class 1 :0.8979
Test Accuracy: 0.8800
Current loss: 0.4560492598021953
Mean loss so far: 0.49538576156362985
Outer epoch 38
Acc of class 0 :0.7988
Acc of class 1 :0.9006
Train Accuracy: 0.8500
Acc of class 0 :0.8378
Acc of class 1 :0.9171
Test Accuracy: 0.8790
Current loss: 0.47304919723186617

Mean loss so far: 0.49479795723910974
Outer epoch 39
Acc of class 0 :0.8048
Acc of class 1 :0.8748
Train Accuracy: 0.8400
Acc of class 0 :0.8482
Acc of class 1 :0.8844
Test Accuracy: 0.8670
Current loss: 0.4673420533998085
Mean loss so far: 0.49409395970476866
Outer epoch 40
Acc of class 0 :0.7485
Acc of class 1 :0.8529
Train Accuracy: 0.8010
Acc of class 0 :0.7859
Acc of class 1 :0.8709
Test Accuracy: 0.8300
Current loss: 0.47213378996714156
Mean loss so far: 0.4935449554613281
Outer epoch 41
Acc of class 0 :0.8229
Acc of class 1 :0.7555
Train Accuracy: 0.7890
Acc of class 0 :0.8462
Acc of class 1 :0.7457
Test Accuracy: 0.7940
Current loss: 0.4818017053103789
Mean loss so far: 0.49325853472593906
Outer epoch 42
Acc of class 0 :0.7324
Acc of class 1 :0.9304
Train Accuracy: 0.8320
Acc of class 0 :0.7796
Acc of class 1 :0.9576
Test Accuracy: 0.8720
Current loss: 0.4536787048298262
Mean loss so far: 0.4923161578236507
Outer epoch 43
Acc of class 0 :0.5252
Acc of class 1 :0.9622
Train Accuracy: 0.7450
Acc of class 0 :0.5364
Acc of class 1 :0.9846
Test Accuracy: 0.7690
Current loss: 0.46667562810833985
Mean loss so far: 0.49171986643492255
Outer epoch 44
Acc of class 0 :0.7284
Acc of class 1 :0.8887
Train Accuracy: 0.8090
Acc of class 0 :0.7796
Acc of class 1 :0.9114
Test Accuracy: 0.8480
Current loss: 0.48173698322039077
Mean loss so far: 0.49149298272550135
Outer epoch 45
Acc of class 0 :0.7545

Acc of class 1 :0.8847
Train Accuracy: 0.8200
Acc of class 0 :0.8108
Acc of class 1 :0.9114
Test Accuracy: 0.8630
Current loss: 0.46742310564560413
Mean loss so far: 0.4909580965681703
Outer epoch 46
Acc of class 0 :0.7324
Acc of class 1 :0.8429
Train Accuracy: 0.7880
Acc of class 0 :0.7900
Acc of class 1 :0.8671
Test Accuracy: 0.8300
Current loss: 0.4707168866704368
Mean loss so far: 0.49051807026604566
Outer epoch 47
Acc of class 0 :0.6700
Acc of class 1 :0.9602
Train Accuracy: 0.8160
Acc of class 0 :0.7443
Acc of class 1 :0.9827
Test Accuracy: 0.8680
Current loss: 0.45343786648027723
Mean loss so far: 0.4897291297599655
Outer epoch 48
Acc of class 0 :0.8008
Acc of class 1 :0.8211
Train Accuracy: 0.8110
Acc of class 0 :0.8669
Acc of class 1 :0.8189
Test Accuracy: 0.8420
Current loss: 0.4677232140292672
Mean loss so far: 0.48927067318224254
Outer epoch 49
Acc of class 0 :0.7485
Acc of class 1 :0.9901
Train Accuracy: 0.8700
Acc of class 0 :0.7963
Acc of class 1 :1.0000
Test Accuracy: 0.9020
Current loss: 0.4698464959763311
Mean loss so far: 0.4888742614025301
Outer epoch 50
Acc of class 0 :0.8531
Acc of class 1 :0.8151
Train Accuracy: 0.8340
Acc of class 0 :0.8815
Acc of class 1 :0.8131
Test Accuracy: 0.8460
Current loss: 0.4524223229418311
Mean loss so far: 0.4881452226333161
Outer epoch 51
Acc of class 0 :0.7425
Acc of class 1 :0.8489
Train Accuracy: 0.7960
Acc of class 0 :0.7963

Acc of class 1 :0.8632
Test Accuracy: 0.8310
Current loss: 0.46059508284471706
Mean loss so far: 0.4876050238139318
Outer epoch 52
Acc of class 0 :0.9034
Acc of class 1 :0.8986
Train Accuracy: 0.9010
Acc of class 0 :0.9148
Acc of class 1 :0.9306
Test Accuracy: 0.9230
Current loss: 0.45136959328516546
Mean loss so far: 0.4869081886114555
Outer epoch 53
Acc of class 0 :0.6700
Acc of class 1 :0.9026
Train Accuracy: 0.7870
Acc of class 0 :0.6819
Acc of class 1 :0.9422
Test Accuracy: 0.8170
Current loss: 0.45893336038830945
Mean loss so far: 0.486380361663849
Outer epoch 54
Acc of class 0 :0.7767
Acc of class 1 :0.9404
Train Accuracy: 0.8590
Acc of class 0 :0.8046
Acc of class 1 :0.9422
Test Accuracy: 0.8760
Current loss: 0.46078032184262163
Mean loss so far: 0.48590628685234477
Outer epoch 55
Acc of class 0 :0.8048
Acc of class 1 :0.9105
Train Accuracy: 0.8580
Acc of class 0 :0.8565
Acc of class 1 :0.9383
Test Accuracy: 0.8990
Current loss: 0.45186108026611577
Mean loss so far: 0.48528728309623154
Outer epoch 56
Acc of class 0 :0.7907
Acc of class 1 :0.8946
Train Accuracy: 0.8430
Acc of class 0 :0.8503
Acc of class 1 :0.9056
Test Accuracy: 0.8790
Current loss: 0.45748093909361476
Mean loss so far: 0.484790741239042
Outer epoch 57
Acc of class 0 :0.7968
Acc of class 1 :0.8748
Train Accuracy: 0.8360
Acc of class 0 :0.8524
Acc of class 1 :0.9171
Test Accuracy: 0.8860
Current loss: 0.465065300709644

Mean loss so far: 0.4844446808788771
Outer epoch 58
Acc of class 0 :0.8189
Acc of class 1 :0.9205
Train Accuracy: 0.8700
Acc of class 0 :0.8690
Acc of class 1 :0.9326
Test Accuracy: 0.9020
Current loss: 0.4467477571081947
Mean loss so far: 0.4837947339173136
Outer epoch 59
Acc of class 0 :0.8229
Acc of class 1 :0.9006
Train Accuracy: 0.8620
Acc of class 0 :0.8545
Acc of class 1 :0.9480
Test Accuracy: 0.9030
Current loss: 0.4470867633302751
Mean loss so far: 0.483172564924313
Outer epoch 60
Acc of class 0 :0.7465
Acc of class 1 :0.8986
Train Accuracy: 0.8230
Acc of class 0 :0.8150
Acc of class 1 :0.9287
Test Accuracy: 0.8740
Current loss: 0.47483982540716874
Mean loss so far: 0.48303368593236057
Outer epoch 61
Acc of class 0 :0.7948
Acc of class 1 :0.9304
Train Accuracy: 0.8630
Acc of class 0 :0.8545
Acc of class 1 :0.9383
Test Accuracy: 0.8980
Current loss: 0.4613775267799425
Mean loss so far: 0.4826786669298619
Outer epoch 62
Acc of class 0 :0.7847
Acc of class 1 :0.8608
Train Accuracy: 0.8230
Acc of class 0 :0.8212
Acc of class 1 :0.8671
Test Accuracy: 0.8450
Current loss: 0.4669033809955769
Mean loss so far: 0.48242422683414765
Outer epoch 63
Acc of class 0 :0.6922
Acc of class 1 :0.9105
Train Accuracy: 0.8020
Acc of class 0 :0.7277
Acc of class 1 :0.9306
Test Accuracy: 0.8330
Current loss: 0.4767349107883896
Mean loss so far: 0.48233392023024674
Outer epoch 64
Acc of class 0 :0.8672

Acc of class 1 :0.8907
Train Accuracy: 0.8790
Acc of class 0 :0.9044
Acc of class 1 :0.8728
Test Accuracy: 0.8880
Current loss: 0.4695239544889895
Mean loss so far: 0.4821337645155395
Outer epoch 65
Acc of class 0 :0.8229
Acc of class 1 :0.9384
Train Accuracy: 0.8810
Acc of class 0 :0.8815
Acc of class 1 :0.9595
Test Accuracy: 0.9220
Current loss: 0.4690889137675379
Mean loss so far: 0.48193307450403183
Outer epoch 66
Acc of class 0 :0.7606
Acc of class 1 :0.9006
Train Accuracy: 0.8310
Acc of class 0 :0.8004
Acc of class 1 :0.9056
Test Accuracy: 0.8550
Current loss: 0.48173073444724385
Mean loss so far: 0.4819300087455956
Outer epoch 67
Acc of class 0 :0.8390
Acc of class 1 :0.9105
Train Accuracy: 0.8750
Acc of class 0 :0.8794
Acc of class 1 :0.9306
Test Accuracy: 0.9060
Current loss: 0.46951119585939
Mean loss so far: 0.48174465332938365
Outer epoch 68
Acc of class 0 :0.7364
Acc of class 1 :0.8767
Train Accuracy: 0.8070
Acc of class 0 :0.8191
Acc of class 1 :0.8979
Test Accuracy: 0.8600
Current loss: 0.4598479178813101
Mean loss so far: 0.4814226425139708
Outer epoch 69
Acc of class 0 :0.9074
Acc of class 1 :0.9384
Train Accuracy: 0.9230
Acc of class 0 :0.9127
Acc of class 1 :0.9441
Test Accuracy: 0.9290
Current loss: 0.4524302657831744
Mean loss so far: 0.4810024631410607
Outer epoch 70
Acc of class 0 :0.7887
Acc of class 1 :0.9583
Train Accuracy: 0.8740
Acc of class 0 :0.8462

Acc of class 1 :0.9730
Test Accuracy: 0.9120
Current loss: 0.44454599335040246
Mean loss so far: 0.4804816564297656
Outer epoch 71
Acc of class 0 :0.9557
Acc of class 1 :0.8270
Train Accuracy: 0.8910
Acc of class 0 :0.9688
Acc of class 1 :0.8266
Test Accuracy: 0.8950
Current loss: 0.45963532284091724
Mean loss so far: 0.4801880460975283
Outer epoch 72
Acc of class 0 :0.8712
Acc of class 1 :0.8370
Train Accuracy: 0.8540
Acc of class 0 :0.8940
Acc of class 1 :0.8247
Test Accuracy: 0.8580
Current loss: 0.47160528404188085
Mean loss so far: 0.4800688410689775
Outer epoch 73
Acc of class 0 :0.7042
Acc of class 1 :0.9642
Train Accuracy: 0.8350
Acc of class 0 :0.7775
Acc of class 1 :0.9846
Test Accuracy: 0.8850
Current loss: 0.4681047482702345
Mean loss so far: 0.47990494938680295
Outer epoch 74
Acc of class 0 :0.7465
Acc of class 1 :0.8350
Train Accuracy: 0.7910
Acc of class 0 :0.8087
Acc of class 1 :0.8671
Test Accuracy: 0.8390
Current loss: 0.4710422351450628
Mean loss so far: 0.4797851829781308
Outer epoch 75
Acc of class 0 :0.8229
Acc of class 1 :0.9423
Train Accuracy: 0.8830
Acc of class 0 :0.8524
Acc of class 1 :0.9653
Test Accuracy: 0.9110
Current loss: 0.47790371279737737
Mean loss so far: 0.47976009670905406
Outer epoch 76
Acc of class 0 :0.7726
Acc of class 1 :0.9026
Train Accuracy: 0.8380
Acc of class 0 :0.8274
Acc of class 1 :0.9056
Test Accuracy: 0.8680
Current loss: 0.4685338468444785

Mean loss so far: 0.47961238289504654
Outer epoch 77
Acc of class 0 :0.8008
Acc of class 1 :0.8509
Train Accuracy: 0.8260
Acc of class 0 :0.8378
Acc of class 1 :0.8709
Test Accuracy: 0.8550
Current loss: 0.471065126486213
Mean loss so far: 0.4795013795650617
Outer epoch 78
Acc of class 0 :0.8350
Acc of class 1 :0.8370
Train Accuracy: 0.8360
Acc of class 0 :0.8815
Acc of class 1 :0.8054
Test Accuracy: 0.8420
Current loss: 0.46646111853640837
Mean loss so far: 0.479334196731361
Outer epoch 79
Acc of class 0 :0.8068
Acc of class 1 :0.9046
Train Accuracy: 0.8560
Acc of class 0 :0.8607
Acc of class 1 :0.9441
Test Accuracy: 0.9040
Current loss: 0.4780167839408224
Mean loss so far: 0.4793175206200884
Outer epoch 80
Acc of class 0 :0.9296
Acc of class 1 :0.8310
Train Accuracy: 0.8800
Acc of class 0 :0.9543
Acc of class 1 :0.8651
Test Accuracy: 0.9080
Current loss: 0.47283540592370077
Mean loss so far: 0.4792364941863836
Outer epoch 81
Acc of class 0 :0.7706
Acc of class 1 :0.7535
Train Accuracy: 0.7620
Acc of class 0 :0.8087
Acc of class 1 :0.7572
Test Accuracy: 0.7820
Current loss: 0.4634248871910412
Mean loss so far: 0.4790412891617497
Outer epoch 82
Acc of class 0 :0.8129
Acc of class 1 :0.8728
Train Accuracy: 0.8430
Acc of class 0 :0.8545
Acc of class 1 :0.8690
Test Accuracy: 0.8620
Current loss: 0.48941471800030334
Mean loss so far: 0.47916779439148816
Outer epoch 83
Acc of class 0 :0.8189

Acc of class 1 :0.8986
Train Accuracy: 0.8590
Acc of class 0 :0.8669
Acc of class 1 :0.8902
Test Accuracy: 0.8790
Current loss: 0.4639268817931074
Mean loss so far: 0.4789841689384956
Outer epoch 84
Acc of class 0 :0.7887
Acc of class 1 :0.8907
Train Accuracy: 0.8400
Acc of class 0 :0.8628
Acc of class 1 :0.9171
Test Accuracy: 0.8910
Current loss: 0.4649642247843258
Mean loss so far: 0.4788172648414222
Outer epoch 85
Acc of class 0 :0.7143
Acc of class 1 :0.8390
Train Accuracy: 0.7770
Acc of class 0 :0.7755
Acc of class 1 :0.8208
Test Accuracy: 0.7990
Current loss: 0.46903569079713303
Mean loss so far: 0.47870218749972465
Outer epoch 86
Acc of class 0 :0.8753
Acc of class 1 :0.9384
Train Accuracy: 0.9070
Acc of class 0 :0.9189
Acc of class 1 :0.9075
Test Accuracy: 0.9130
Current loss: 0.47521929071956404
Mean loss so far: 0.47866168869995535
Outer epoch 87
Acc of class 0 :0.7445
Acc of class 1 :0.8449
Train Accuracy: 0.7950
Acc of class 0 :0.8150
Acc of class 1 :0.8593
Test Accuracy: 0.8380
Current loss: 0.48528684162871977
Mean loss so far: 0.47873783988304464
Outer epoch 88
Acc of class 0 :0.8551
Acc of class 1 :0.8449
Train Accuracy: 0.8500
Acc of class 0 :0.8960
Acc of class 1 :0.8208
Test Accuracy: 0.8570
Current loss: 0.460223837815271
Mean loss so far: 0.47852745349591075
Outer epoch 89
Acc of class 0 :0.8390
Acc of class 1 :0.8509
Train Accuracy: 0.8450
Acc of class 0 :0.8836

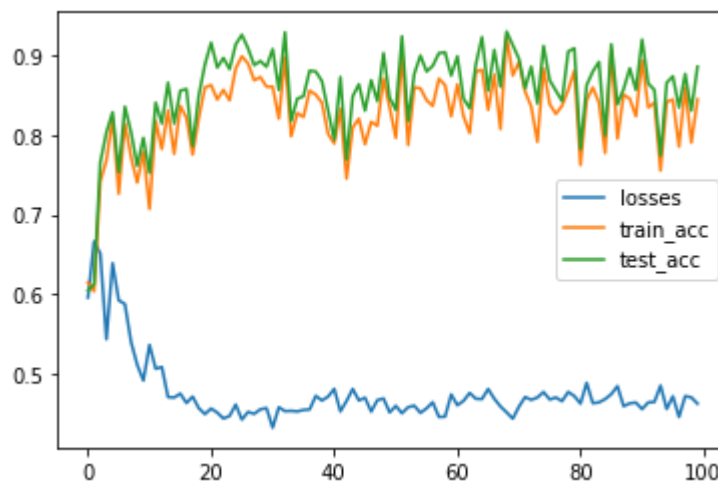
Acc of class 1 :0.8825
Test Accuracy: 0.8830
Current loss: 0.46372903454862574
Mean loss so far: 0.4783611791257166
Outer epoch 90
Acc of class 0 :0.8089
Acc of class 1 :0.8370
Train Accuracy: 0.8230
Acc of class 0 :0.8503
Acc of class 1 :0.8613
Test Accuracy: 0.8560
Current loss: 0.4647389806533905
Mean loss so far: 0.47820982136491297
Outer epoch 91
Acc of class 0 :0.8491
Acc of class 1 :0.9364
Train Accuracy: 0.8930
Acc of class 0 :0.8690
Acc of class 1 :0.9653
Test Accuracy: 0.9190
Current loss: 0.45647342496845084
Mean loss so far: 0.47797095986605076
Outer epoch 92
Acc of class 0 :0.7887
Acc of class 1 :0.8787
Train Accuracy: 0.8340
Acc of class 0 :0.8545
Acc of class 1 :0.8728
Test Accuracy: 0.8640
Current loss: 0.4648892146822763
Mean loss so far: 0.47782876698361837
Outer epoch 93
Acc of class 0 :0.8350
Acc of class 1 :0.8449
Train Accuracy: 0.8400
Acc of class 0 :0.8732
Acc of class 1 :0.8401
Test Accuracy: 0.8560
Current loss: 0.4654724293169682
Mean loss so far: 0.4776959031377404
Outer epoch 94
Acc of class 0 :0.7606
Acc of class 1 :0.7495
Train Accuracy: 0.7550
Acc of class 0 :0.8191
Acc of class 1 :0.7322
Test Accuracy: 0.7740
Current loss: 0.48596111266871633
Mean loss so far: 0.4777838308987083
Outer epoch 95
Acc of class 0 :0.8189
Acc of class 1 :0.8628
Train Accuracy: 0.8410
Acc of class 0 :0.8503
Acc of class 1 :0.8786
Test Accuracy: 0.8650
Current loss: 0.45670061088758374

Mean loss so far: 0.4775619022670122
Outer epoch 96
Acc of class 0 :0.7404
Acc of class 1 :0.9463
Train Accuracy: 0.8440
Acc of class 0 :0.7859
Acc of class 1 :0.9538
Test Accuracy: 0.8730
Current loss: 0.4725946518211397
Mean loss so far: 0.4775101600748677
Outer epoch 97
Acc of class 0 :0.6620
Acc of class 1 :0.9066
Train Accuracy: 0.7850
Acc of class 0 :0.7277
Acc of class 1 :0.9326
Test Accuracy: 0.8340
Current loss: 0.4467186725229679
Mean loss so far: 0.47719272205886876
Outer epoch 98
Acc of class 0 :0.7545
Acc of class 1 :0.9622
Train Accuracy: 0.8590
Acc of class 0 :0.7963
Acc of class 1 :0.9499
Test Accuracy: 0.8760
Current loss: 0.47274224060579667
Mean loss so far: 0.477147308982817
Outer epoch 99
Acc of class 0 :0.7565
Acc of class 1 :0.8231
Train Accuracy: 0.7900
Acc of class 0 :0.8067
Acc of class 1 :0.8516
Test Accuracy: 0.8300
Current loss: 0.47120464772262977
Mean loss so far: 0.47708728210140094
Outer epoch 100
Acc of class 0 :0.8209
Acc of class 1 :0.8668
Train Accuracy: 0.8440
Acc of class 0 :0.8753
Acc of class 1 :0.8940
Test Accuracy: 0.8850
Current loss: 0.4633908818166005
Mean loss so far: 0.47695031809855293

```
In [14]: # Print rules.
print('local_net input_rule:')
print(local_net.input_rule) # Same as before (cannot be learned?).
print('local_net rnn_rule:')
print(local_net.get_rnn_rule()) # Learned.
print('local_net output_rule:')
print(local_net.get_output_rule()) # Same as before (we specified not to learn this).
```

```
local_net input_rule:
tensor([-0.0347,  0.4027, -1.2018, -0.1318])
local_net rnn_rule:
tensor([[ 0.2473,  0.7085,  0.1168,  0.5387],
        [-0.0520,  0.2540,  0.1201,  0.2609],
        [-0.1856, -0.0168,  0.4250,  0.1244],
        [-0.0237, -0.2087,  0.5390,  0.3937]], dtype=torch.float64)
local_net output_rule:
tensor([[0., 0.],
        [0., 0.],
        [0., 0.],
        [0., 0.]])
```

```
In [15]: # Plot training curves.
plt.plot(losses, label='losses')
plt.plot(np.reshape(train_accuracies, -1), label='train_acc')
plt.plot(np.reshape(test_accuracies, -1), label='test_acc')
plt.legend()
plt.show()
print('Last outer epoch loss:', losses[-1])
print('Last outer epoch train_accuracies:', train_accuracies[-1])
print('Last outer epoch test_accuracies:', test_accuracies[-1])
```



```
Last outer epoch loss: 0.4633908818166005
Last outer epoch train_accuracies: [0.844]
Last outer epoch test_accuracies: [0.885]
```

Train with the already learned rules on a different halfspace

```
In [16]: # Generate data.
dimension = 4
n = 5000
X, y = DataGenerator.random_halfspace_data(dim = dimension, n = 3*n)
X_test = X[:n]
y_test = y[:n]
X = X[n:]
y = y[n:]

# NOTE: This method trains only once over all examples, updating the stats every 500 steps.
train_accuracies, test_accuracies = train.train_given_rule(
    X,                                # Training Examples
    y,                                # Training Labels
    local_net,                        # The BrainNet
    X_test = X_test,
    y_test = y_test,
    verbose = True)                  # If True, evaluates network on test/train data each epoch, otherwise, only once at the end
```


Train on 0 examples.
Acc of class 0 :1.0000
Acc of class 1 :0.0000
Train Accuracy: 0.4964
Acc of class 0 :1.0000
Acc of class 1 :0.0000
Test Accuracy: 0.4898
Train on 500 examples.
Acc of class 0 :0.0367
Acc of class 1 :0.6050
Train Accuracy: 0.3229
Acc of class 0 :0.0433
Acc of class 1 :0.5919
Test Accuracy: 0.3232
Train on 1000 examples.
Acc of class 0 :0.0485
Acc of class 1 :0.6207
Train Accuracy: 0.3367
Acc of class 0 :0.0519
Acc of class 1 :0.6170
Test Accuracy: 0.3402
Train on 1500 examples.
Acc of class 0 :0.0397
Acc of class 1 :0.6309
Train Accuracy: 0.3374
Acc of class 0 :0.0445
Acc of class 1 :0.6264
Test Accuracy: 0.3414
Train on 2000 examples.
Acc of class 0 :0.0479
Acc of class 1 :0.6398
Train Accuracy: 0.3460
Acc of class 0 :0.0531
Acc of class 1 :0.6374
Test Accuracy: 0.3512
Train on 2500 examples.
Acc of class 0 :0.0373
Acc of class 1 :0.6436
Train Accuracy: 0.3426
Acc of class 0 :0.0416
Acc of class 1 :0.6413
Test Accuracy: 0.3476
Train on 3000 examples.
Acc of class 0 :0.0260
Acc of class 1 :0.6571
Train Accuracy: 0.3438
Acc of class 0 :0.0298
Acc of class 1 :0.6480
Test Accuracy: 0.3452
Train on 3500 examples.
Acc of class 0 :0.0274
Acc of class 1 :0.6489
Train Accuracy: 0.3404
Acc of class 0 :0.0306
Acc of class 1 :0.6421
Test Accuracy: 0.3426
Train on 4000 examples.

Acc of class 0 :0.0258
Acc of class 1 :0.6583
Train Accuracy: 0.3443
Acc of class 0 :0.0265
Acc of class 1 :0.6527
Test Accuracy: 0.3460
Train on 4500 examples.
Acc of class 0 :0.0230
Acc of class 1 :0.6537
Train Accuracy: 0.3406
Acc of class 0 :0.0237
Acc of class 1 :0.6476
Test Accuracy: 0.3420
Train on 5000 examples.
Acc of class 0 :0.0232
Acc of class 1 :0.6493
Train Accuracy: 0.3385
Acc of class 0 :0.0249
Acc of class 1 :0.6452
Test Accuracy: 0.3414
Train on 5500 examples.
Acc of class 0 :0.0210
Acc of class 1 :0.6513
Train Accuracy: 0.3384
Acc of class 0 :0.0212
Acc of class 1 :0.6425
Test Accuracy: 0.3382
Train on 6000 examples.
Acc of class 0 :0.0193
Acc of class 1 :0.6517
Train Accuracy: 0.3378
Acc of class 0 :0.0188
Acc of class 1 :0.6429
Test Accuracy: 0.3372
Train on 6500 examples.
Acc of class 0 :0.0203
Acc of class 1 :0.6614
Train Accuracy: 0.3432
Acc of class 0 :0.0184
Acc of class 1 :0.6495
Test Accuracy: 0.3404
Train on 7000 examples.
Acc of class 0 :0.0222
Acc of class 1 :0.6587
Train Accuracy: 0.3427
Acc of class 0 :0.0212
Acc of class 1 :0.6464
Test Accuracy: 0.3402
Train on 7500 examples.
Acc of class 0 :0.0224
Acc of class 1 :0.6515
Train Accuracy: 0.3392
Acc of class 0 :0.0233
Acc of class 1 :0.6452
Test Accuracy: 0.3406
Train on 8000 examples.
Acc of class 0 :0.0234

```

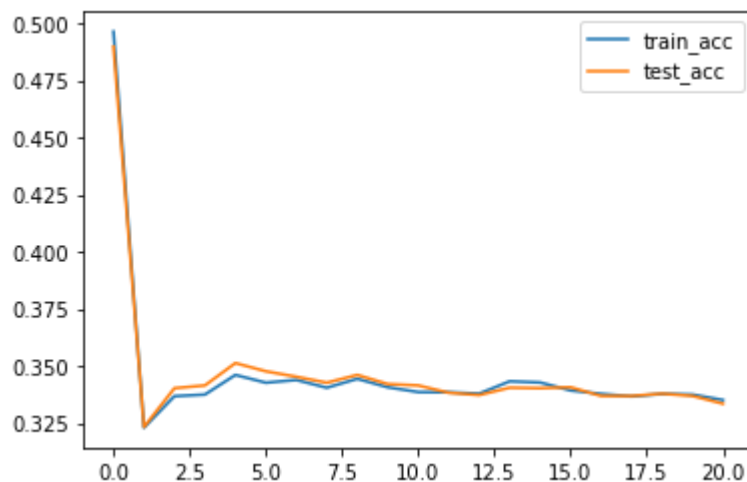
Acc of class 1 :0.6475
Train Accuracy: 0.3377
Acc of class 0 :0.0249
Acc of class 1 :0.6362
Test Accuracy: 0.3368
Train on 8500 examples.
Acc of class 0 :0.0240
Acc of class 1 :0.6448
Train Accuracy: 0.3366
Acc of class 0 :0.0269
Acc of class 1 :0.6343
Test Accuracy: 0.3368
Train on 9000 examples.
Acc of class 0 :0.0232
Acc of class 1 :0.6477
Train Accuracy: 0.3377
Acc of class 0 :0.0257
Acc of class 1 :0.6374
Test Accuracy: 0.3378
Train on 9500 examples.
Acc of class 0 :0.0236
Acc of class 1 :0.6467
Train Accuracy: 0.3374
Acc of class 0 :0.0241
Acc of class 1 :0.6370
Test Accuracy: 0.3368
Train on 9999 examples.
Acc of class 0 :0.0238
Acc of class 1 :0.6418
Train Accuracy: 0.3350
Acc of class 0 :0.0249
Acc of class 1 :0.6296
Test Accuracy: 0.3334

```

```

In [17]: # Plot training curves.
plt.plot(np.reshape(train_accuracies, -1), label='train_acc')
plt.plot(np.reshape(test_accuracies, -1), label='test_acc')
plt.legend()
plt.show()

```



Meta-learn rules on halfspace, train with fixed rules on MNIST

NOTE: the reason this doesn't work too well is because the actual procedures in the paper are a little more complicated, see **Appendix A.2**. I suspect the halfspace dimension is much less than 28×28 (and the number of classes should obviously be 2, not 10), and then the rules are copied across different networks.

Interestingly, even if the upstream accuracy is chance (50%), the downstream training still works...

```

In [18]: options = LocalNetBase.Options(
    use_input_rule = False,      # Use an input rule to update input layer weights.
    use_output_rule = True,      # Use an output rule to update input layer weights.
    gd_output_rule = True,       # Learn an output rule, or use fixed one. If GD is used, set 'use_output_rule' to True as well.
    use_graph_rule = True,
    gd_graph_rule = True,
    gd_input = False,            # gd directly on input layer weights.
    gd_output = False,           # gd directly on output layer weights.
    additive_rule = True)        # If false, uses multiplicative updates.

# ==== TODO: create different upstream (halfspace) vs downstream (MNIST) network! ====

# Initialize new network.
dimension = 28 * 28
local_net = network.LocalNet(n = dimension, # number of input features (= dimension)

                                m = 10, # number of possible labels
                                num_v = 100, # number of nodes in graph
                                p = .5, # probability that an edge exists in the graph

                                cap = 50, # choose top 'cap' nodes which fire
                                rounds = 1, # number of times the graph 'fires'
                                options = options, update_scheme = scheme)

# Generate halfspace data.
n = 5000
X, y = DataGenerator.random_halfspace_data(dim = dimension, n = 3*n)
X_test = X[:n]
y_test = y[:n]
X = X[n:]
y = y[n:]

# Learn rules.
losses, train_accuracies, test_accuracies = train.train_local_rule(
    X, # Training Examples
    y, # Training Labels
    local_net, # The BrainNet
    X_test = X_test,
    y_test = y_test,
    rule_epochs = 100, # Number of times to run through the data
    epochs = 1, # Number of time to run through a single batch for a single training pass
    batch = 100, # Number of examples in a batch.
    lr = 1e-2, # Learning Rate
    verbose = True) # If True, evaluates network on test/train data each epoch, otherwise, only once at the end

```

```
Starting Train
Outer epoch 1
Acc of class 0 :0.7419
Acc of class 1 :0.2682
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5088
Acc of class 0 :0.7386
Acc of class 1 :0.2701
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5020
Current loss: 1.972556997760708
Mean loss so far: 1.972556997760708
Outer epoch 2
Acc of class 0 :0.7033
Acc of class 1 :0.3392
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5241
Acc of class 0 :0.7083
Acc of class 1 :0.3446
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5246
Current loss: 1.867345326480033
Mean loss so far: 1.9199511621203706
Outer epoch 3
Acc of class 0 :0.3601
Acc of class 1 :0.6669
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
```

```
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5111
Acc of class 0 :0.3527
Acc of class 1 :0.6578
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5068
Current loss: 1.8957090615397114
Mean loss so far: 1.9118704619268174
Outer epoch 4
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.1173533979016743
Mean loss so far: 1.9632411959205318
Outer epoch 5
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
```

Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.196702831041534
Mean loss so far: 2.009933522944732
Outer epoch 6
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.456747259084768
Mean loss so far: 2.0844024789680717
Outer epoch 7
Acc of class 0 :0.3302
Acc of class 1 :0.7208
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5224
Acc of class 0 :0.3451
Acc of class 1 :0.7176
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000

Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5332
Current loss: 2.0437996459718986
Mean loss so far: 2.0786020742543325
Outer epoch 8
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.2539345268002773
Mean loss so far: 2.1005186308225756
Outer epoch 9
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.461146667872958
Mean loss so far: 2.140588412717063
Outer epoch 10
Acc of class 0 :0.0000

```
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4611233661232714
Mean loss so far: 2.1726419080576838
Outer epoch 11
Acc of class 0 :0.8854
Acc of class 1 :0.1357
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5165
Acc of class 0 :0.8824
Acc of class 1 :0.1251
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5000
Current loss: 2.0976047550915347
Mean loss so far: 2.1658203486971246
Outer epoch 12
Acc of class 0 :0.1837
Acc of class 1 :0.8382
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
```

```
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5058
Acc of class 0 :0.1798
Acc of class 1 :0.8400
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5132
Current loss: 1.8874693448639324
Mean loss so far: 2.1426244317110252
Outer epoch 13
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.3383975643975
Mean loss so far: 2.1576839034561384
Outer epoch 14
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
```

Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4611467419120037
Mean loss so far: 2.1793598204887004
Outer epoch 15
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.461137229959023
Mean loss so far: 2.198144981120055
Outer epoch 16
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000

Current loss: 2.4611390437085943
Mean loss so far: 2.214582110031839
Outer epoch 17
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4611331779849137
Mean loss so far: 2.2290851140290786
Outer epoch 18
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4611380615084597
Mean loss so far: 2.2419769444445996
Outer epoch 19
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000

Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4611346588283918
Mean loss so far: 2.253511560991115
Outer epoch 20
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4611099814158717
Mean loss so far: 2.263891482012353
Outer epoch 21
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000

Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4611304827905838
Mean loss so far: 2.273283815382745
Outer epoch 22
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.0000
Acc of class 0 :0.0000
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.0000
Current loss: 2.4610592243738414
Mean loss so far: 2.2818190612459763
Outer epoch 23
Acc of class 0 :0.8354
Acc of class 1 :0.0685
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4580
Acc of class 0 :0.8392
Acc of class 1 :0.0622
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000

Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4468
Current loss: 2.366082950100468
Mean loss so far: 2.2854827085874763
Outer epoch 24
Acc of class 0 :0.3954
Acc of class 1 :0.6074
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4997
Acc of class 0 :0.3923
Acc of class 1 :0.6123
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5034
Current loss: 1.9204121520940742
Mean loss so far: 2.2702714354002507
Outer epoch 25
Acc of class 0 :0.3843
Acc of class 1 :0.6243
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5024
Acc of class 0 :0.3681
Acc of class 1 :0.6273
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4990
Current loss: 1.8957531794730105
Mean loss so far: 2.255290705163161
Outer epoch 26

Acc of class 0 :0.5623
Acc of class 1 :0.4804
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5220
Acc of class 0 :0.5511
Acc of class 1 :0.4657
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5080
Current loss: 1.830756600996143
Mean loss so far: 2.2389624703875066
Outer epoch 27
Acc of class 0 :0.6304
Acc of class 1 :0.4093
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5216
Acc of class 0 :0.6521
Acc of class 1 :0.4036
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5266
Current loss: 1.792090266857229
Mean loss so far: 2.2224116480345337
Outer epoch 28
Acc of class 0 :0.5466
Acc of class 1 :0.4448
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000

Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4965
Acc of class 0 :0.5333
Acc of class 1 :0.4539
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4932
Current loss: 1.779332746109385
Mean loss so far: 2.206587401537207
Outer epoch 29
Acc of class 0 :0.4560
Acc of class 1 :0.5818
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5179
Acc of class 0 :0.4618
Acc of class 1 :0.5873
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5252
Current loss: 1.768636175405443
Mean loss so far: 2.19148563511887
Outer epoch 30
Acc of class 0 :0.3613
Acc of class 1 :0.6755
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5159
Acc of class 0 :0.3451
Acc of class 1 :0.6800
Acc of class 2 :0.0000

Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5142
Current loss: 1.7535114539061825
Mean loss so far: 2.176886495745114
Outer epoch 31
Acc of class 0 :0.4326
Acc of class 1 :0.6050
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5174
Acc of class 0 :0.4182
Acc of class 1 :0.6107
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5154
Current loss: 1.7510995315933082
Mean loss so far: 2.163151432385378
Outer epoch 32
Acc of class 0 :0.4034
Acc of class 1 :0.6438
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5217
Acc of class 0 :0.4263
Acc of class 1 :0.6384
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000

Test Accuracy: 0.5334
Current loss: 1.7458486074286899
Mean loss so far: 2.1501107191054816
Outer epoch 33
Acc of class 0 :0.4964
Acc of class 1 :0.5450
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5203
Acc of class 0 :0.5014
Acc of class 1 :0.5311
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5164
Current loss: 1.7492056206032816
Mean loss so far: 2.13796207975693
Outer epoch 34
Acc of class 0 :0.4400
Acc of class 1 :0.5818
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5098
Acc of class 0 :0.4323
Acc of class 1 :0.5850
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5094
Current loss: 1.7567543115248083
Mean loss so far: 2.126750086573632
Outer epoch 35
Acc of class 0 :0.6094
Acc of class 1 :0.4578
Acc of class 2 :0.0000

Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5348
Acc of class 0 :0.5584
Acc of class 1 :0.4594
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5084
Current loss: 1.7495865671318669
Mean loss so far: 2.1159739860181532
Outer epoch 36
Acc of class 0 :0.3550
Acc of class 1 :0.6708
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5104
Acc of class 0 :0.3564
Acc of class 1 :0.6531
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5062
Current loss: 1.7333126943347725
Mean loss so far: 2.1053445056936146
Outer epoch 37
Acc of class 0 :0.3566
Acc of class 1 :0.6590
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000

Train Accuracy: 0.5054
Acc of class 0 :0.3883
Acc of class 1 :0.6499
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5204
Current loss: 1.7493288800983626
Mean loss so far: 2.0957224617586077
Outer epoch 38
Acc of class 0 :0.5180
Acc of class 1 :0.4851
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5018
Acc of class 0 :0.5200
Acc of class 1 :0.4970
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5084
Current loss: 1.7611115305909133
Mean loss so far: 2.086916910938405
Outer epoch 39
Acc of class 0 :0.2347
Acc of class 1 :0.8037
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5147
Acc of class 0 :0.2501
Acc of class 1 :0.7897
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000

Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5226
Current loss: 1.7734668403041765
Mean loss so far: 2.078879729640092
Outer epoch 40
Acc of class 0 :0.6759
Acc of class 1 :0.3172
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4994
Acc of class 0 :0.6788
Acc of class 1 :0.3220
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4986
Current loss: 1.7646396986120392
Mean loss so far: 2.071023728864391
Outer epoch 41
Acc of class 0 :0.3749
Acc of class 1 :0.6350
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5029
Acc of class 0 :0.3463
Acc of class 1 :0.6356
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4924
Current loss: 1.745148645223374
Mean loss so far: 2.063075556092659

```
Outer epoch 42
Acc of class 0 :0.5869
Acc of class 1 :0.4160
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5028
Acc of class 0 :0.5640
Acc of class 1 :0.4143
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4884
Current loss: 1.7464545655562482
Mean loss so far: 2.0555369610798873
Outer epoch 43
Acc of class 0 :0.5572
Acc of class 1 :0.4863
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5223
Acc of class 0 :0.5677
Acc of class 1 :0.4693
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5180
Current loss: 1.7524107324024145
Mean loss so far: 2.048487513901341
Outer epoch 44
Acc of class 0 :0.3477
Acc of class 1 :0.6722
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
```


Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5074
Acc of class 0 :0.3459
Acc of class 1 :0.6804
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5148
Current loss: 1.760079645763209
Mean loss so far: 2.041932789625475
Outer epoch 45
Acc of class 0 :0.4680
Acc of class 1 :0.5312
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4991
Acc of class 0 :0.4743
Acc of class 1 :0.5263
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5006
Current loss: 1.7495997116830673
Mean loss so far: 2.035436499004532
Outer epoch 46
Acc of class 0 :0.6407
Acc of class 1 :0.3621
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5036
Acc of class 0 :0.6335
Acc of class 1 :0.3691

Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5000
Current loss: 1.7491337380256275
Mean loss so far: 2.0292125259397737
Outer epoch 47
Acc of class 0 :0.5007
Acc of class 1 :0.5320
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5161
Acc of class 0 :0.5152
Acc of class 1 :0.5275
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5214
Current loss: 1.7517248688031413
Mean loss so far: 2.0233085332347387
Outer epoch 48
Acc of class 0 :0.3003
Acc of class 1 :0.7407
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5170
Acc of class 0 :0.2796
Acc of class 1 :0.7402
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000

Acc of class 9 :0.0000
Test Accuracy: 0.5122
Current loss: 1.7532392362725795
Mean loss so far: 2.017682089548027
Outer epoch 49
Acc of class 0 :0.5531
Acc of class 1 :0.4914
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5227
Acc of class 0 :0.5677
Acc of class 1 :0.4970
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5320
Current loss: 1.7606408330274248
Mean loss so far: 2.012436349619035
Outer epoch 50
Acc of class 0 :0.3105
Acc of class 1 :0.6964
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5004
Acc of class 0 :0.2974
Acc of class 1 :0.6907
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4960
Current loss: 1.7389746207900407
Mean loss so far: 2.0069671150424555
Outer epoch 51
Acc of class 0 :0.6649
Acc of class 1 :0.3593

```
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5145
Acc of class 0 :0.6485
Acc of class 1 :0.3707
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5082
Current loss: 1.7555201662151534
Mean loss so far: 2.002036782712508
Outer epoch 52
Acc of class 0 :0.4395
Acc of class 1 :0.6149
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5258
Acc of class 0 :0.4255
Acc of class 1 :0.6099
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5186
Current loss: 1.7471262229769728
Mean loss so far: 1.997134656563748
Outer epoch 53
Acc of class 0 :0.5879
Acc of class 1 :0.4481
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
```

Acc of class 9 :0.0000
Train Accuracy: 0.5191
Acc of class 0 :0.5859
Acc of class 1 :0.4539
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5192
Current loss: 1.7563248240856764
Mean loss so far: 1.9925910748188786
Outer epoch 54
Acc of class 0 :0.6988
Acc of class 1 :0.3304
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5175
Acc of class 0 :0.7038
Acc of class 1 :0.3414
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5208
Current loss: 1.7408268206122413
Mean loss so far: 1.9879287738150522
Outer epoch 55
Acc of class 0 :0.7740
Acc of class 1 :0.2713
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5266
Acc of class 0 :0.7677
Acc of class 1 :0.2895
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000

Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5262
Current loss: 1.7601243188438742
Mean loss so far: 1.9837868746337581
Outer epoch 56
Acc of class 0 :0.6027
Acc of class 1 :0.4471
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5261
Acc of class 0 :0.6105
Acc of class 1 :0.4416
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5252
Current loss: 1.7442026157783967
Mean loss so far: 1.9795085842970548
Outer epoch 57
Acc of class 0 :0.5665
Acc of class 1 :0.4924
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5300
Acc of class 0 :0.5337
Acc of class 1 :0.4871
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5102
Current loss: 1.7513938269664684

Mean loss so far: 1.9755065710105533

Outer epoch 58

Acc of class 0 :0.4379

Acc of class 1 :0.5635

Acc of class 2 :0.0000

Acc of class 3 :0.0000

Acc of class 4 :0.0000

Acc of class 5 :0.0000

Acc of class 6 :0.0000

Acc of class 7 :0.0000

Acc of class 8 :0.0000

Acc of class 9 :0.0000

Train Accuracy: 0.4997

Acc of class 0 :0.4339

Acc of class 1 :0.5699

Acc of class 2 :0.0000

Acc of class 3 :0.0000

Acc of class 4 :0.0000

Acc of class 5 :0.0000

Acc of class 6 :0.0000

Acc of class 7 :0.0000

Acc of class 8 :0.0000

Acc of class 9 :0.0000

Test Accuracy: 0.5026

Current loss: 1.7411552033821593

Mean loss so far: 1.971466030189374

Outer epoch 59

Acc of class 0 :0.4202

Acc of class 1 :0.5950

Acc of class 2 :0.0000

Acc of class 3 :0.0000

Acc of class 4 :0.0000

Acc of class 5 :0.0000

Acc of class 6 :0.0000

Acc of class 7 :0.0000

Acc of class 8 :0.0000

Acc of class 9 :0.0000

Train Accuracy: 0.5062

Acc of class 0 :0.4218

Acc of class 1 :0.6004

Acc of class 2 :0.0000

Acc of class 3 :0.0000

Acc of class 4 :0.0000

Acc of class 5 :0.0000

Acc of class 6 :0.0000

Acc of class 7 :0.0000

Acc of class 8 :0.0000

Acc of class 9 :0.0000

Test Accuracy: 0.5120

Current loss: 1.7502859311131465

Mean loss so far: 1.9677172149507938

Outer epoch 60

Acc of class 0 :0.4141

Acc of class 1 :0.6249

Acc of class 2 :0.0000

Acc of class 3 :0.0000

Acc of class 4 :0.0000

Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5178
Acc of class 0 :0.4053
Acc of class 1 :0.6071
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5072
Current loss: 1.760519862142176
Mean loss so far: 1.964263925737317
Outer epoch 61
Acc of class 0 :0.7427
Acc of class 1 :0.2652
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5077
Acc of class 0 :0.7382
Acc of class 1 :0.2582
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4958
Current loss: 1.7558136530094344
Mean loss so far: 1.960846708151614
Outer epoch 62
Acc of class 0 :0.5088
Acc of class 1 :0.5013
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5051
Acc of class 0 :0.5099

Acc of class 1 :0.4974
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5036
Current loss: 1.753340131336901
Mean loss so far: 1.957499827880409
Outer epoch 63
Acc of class 0 :0.4495
Acc of class 1 :0.5787
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5131
Acc of class 0 :0.4691
Acc of class 1 :0.5513
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5106
Current loss: 1.7577649797083088
Mean loss so far: 1.9543294334649788
Outer epoch 64
Acc of class 0 :0.3617
Acc of class 1 :0.6547
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5059
Acc of class 0 :0.3552
Acc of class 1 :0.6444
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000

Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5012
Current loss: 1.7546911938599958
Mean loss so far: 1.9512100859711512
Outer epoch 65
Acc of class 0 :0.4926
Acc of class 1 :0.5393
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5156
Acc of class 0 :0.5022
Acc of class 1 :0.5327
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5176
Current loss: 1.7468609471133558
Mean loss so far: 1.9480662530656467
Outer epoch 66
Acc of class 0 :0.4115
Acc of class 1 :0.6054
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5069
Acc of class 0 :0.4166
Acc of class 1 :0.5945
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5064
Current loss: 1.7381531436190192
Mean loss so far: 1.9448857514073647
Outer epoch 67
Acc of class 0 :0.4446

Acc of class 1 :0.5940
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5181
Acc of class 0 :0.4590
Acc of class 1 :0.5778
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5190
Current loss: 1.7376376060184675
Mean loss so far: 1.941792495506038
Outer epoch 68
Acc of class 0 :0.4550
Acc of class 1 :0.5718
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5125
Acc of class 0 :0.4743
Acc of class 1 :0.5596
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5174
Current loss: 1.758557792779337
Mean loss so far: 1.9390978675247628
Outer epoch 69
Acc of class 0 :0.4932
Acc of class 1 :0.5438
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000

Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5181
Acc of class 0 :0.4784
Acc of class 1 :0.5398
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5094
Current loss: 1.76016453956146
Mean loss so far: 1.9365046308876133
Outer epoch 70
Acc of class 0 :0.8049
Acc of class 1 :0.2087
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5115
Acc of class 0 :0.8024
Acc of class 1 :0.2012
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4988
Current loss: 1.7518550331211733
Mean loss so far: 1.9338667794909497
Outer epoch 71
Acc of class 0 :0.3310
Acc of class 1 :0.7214
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5231
Acc of class 0 :0.3325
Acc of class 1 :0.6994
Acc of class 2 :0.0000
Acc of class 3 :0.0000

Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5178
Current loss: 1.75980186077462
Mean loss so far: 1.9314151609174803
Outer epoch 72
Acc of class 0 :0.5237
Acc of class 1 :0.5452
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5343
Acc of class 0 :0.4848
Acc of class 1 :0.5410
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5132
Current loss: 1.7398847886025197
Mean loss so far: 1.9287550168575502
Outer epoch 73
Acc of class 0 :0.5991
Acc of class 1 :0.3894
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4959
Acc of class 0 :0.6044
Acc of class 1 :0.3972
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4998

Current loss: 1.741414367797515
Mean loss so far: 1.926188706596454
Outer epoch 74
Acc of class 0 :0.4865
Acc of class 1 :0.5523
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5189
Acc of class 0 :0.4816
Acc of class 1 :0.5568
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5196
Current loss: 1.7511726104544303
Mean loss so far: 1.9238236242161564
Outer epoch 75
Acc of class 0 :0.9049
Acc of class 1 :0.1132
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5153
Acc of class 0 :0.8840
Acc of class 1 :0.1141
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4952
Current loss: 1.7572698880228055
Mean loss so far: 1.9216029077335786
Outer epoch 76
Acc of class 0 :0.7094
Acc of class 1 :0.2871
Acc of class 2 :0.0000
Acc of class 3 :0.0000

Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5016
Acc of class 0 :0.7345
Acc of class 1 :0.2915
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5108
Current loss: 1.7621262129453337
Mean loss so far: 1.9195045301705753
Outer epoch 77
Acc of class 0 :0.4930
Acc of class 1 :0.5011
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4970
Acc of class 0 :0.4921
Acc of class 1 :0.5053
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4988
Current loss: 1.7552762773160646
Mean loss so far: 1.9173716957179192
Outer epoch 78
Acc of class 0 :0.4200
Acc of class 1 :0.6385
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5275

Acc of class 0 :0.4048
Acc of class 1 :0.6388
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5230
Current loss: 1.7480397650459583
Mean loss so far: 1.9152007735298169
Outer epoch 79
Acc of class 0 :0.6551
Acc of class 1 :0.3650
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5123
Acc of class 0 :0.6586
Acc of class 1 :0.3743
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5150
Current loss: 1.7473335872004723
Mean loss so far: 1.9130758724370405
Outer epoch 80
Acc of class 0 :0.4958
Acc of class 1 :0.5409
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5180
Acc of class 0 :0.4966
Acc of class 1 :0.5255
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000

Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5112
Current loss: 1.7472420068931067
Mean loss so far: 1.9110029491177414
Outer epoch 81
Acc of class 0 :0.6653
Acc of class 1 :0.3192
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4950
Acc of class 0 :0.6469
Acc of class 1 :0.3172
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4804
Current loss: 1.7537312175132436
Mean loss so far: 1.9090613228016364
Outer epoch 82
Acc of class 0 :0.4296
Acc of class 1 :0.5623
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4949
Acc of class 0 :0.4263
Acc of class 1 :0.5644
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4960
Current loss: 1.7454599403785573
Mean loss so far: 1.907066183991599
Outer epoch 83

Acc of class 0 :0.5879
Acc of class 1 :0.4483
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5192
Acc of class 0 :0.5689
Acc of class 1 :0.4642
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5160
Current loss: 1.7538597438750754
Mean loss so far: 1.9052203232673035
Outer epoch 84
Acc of class 0 :0.4454
Acc of class 1 :0.5792
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5112
Acc of class 0 :0.4335
Acc of class 1 :0.5699
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5024
Current loss: 1.7551366225172602
Mean loss so far: 1.9034336125440885
Outer epoch 85
Acc of class 0 :0.5397
Acc of class 1 :0.4944
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000

Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5174
Acc of class 0 :0.5560
Acc of class 1 :0.5057
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5306
Current loss: 1.7530854948698427
Mean loss so far: 1.9016648111596857
Outer epoch 86
Acc of class 0 :0.6543
Acc of class 1 :0.3961
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5272
Acc of class 0 :0.6396
Acc of class 1 :0.3830
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5100
Current loss: 1.7639771711280252
Mean loss so far: 1.9000637920895502
Outer epoch 87
Acc of class 0 :0.2499
Acc of class 1 :0.7927
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5170
Acc of class 0 :0.2251
Acc of class 1 :0.7885
Acc of class 2 :0.0000

Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5096
Current loss: 1.7520944191353585
Mean loss so far: 1.8983629946992722
Outer epoch 88
Acc of class 0 :0.3251
Acc of class 1 :0.6830
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5012
Acc of class 0 :0.3188
Acc of class 1 :0.6677
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4950
Current loss: 1.7545626398059622
Mean loss so far: 1.8967288997573026
Outer epoch 89
Acc of class 0 :0.4471
Acc of class 1 :0.5810
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5130
Acc of class 0 :0.4178
Acc of class 1 :0.5873
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000

Test Accuracy: 0.5034
Current loss: 1.7444632332100658
Mean loss so far: 1.8950180495713786
Outer epoch 90
Acc of class 0 :0.2690
Acc of class 1 :0.7537
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5075
Acc of class 0 :0.2739
Acc of class 1 :0.7390
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5088
Current loss: 1.753301570983205
Mean loss so far: 1.89344342203151
Outer epoch 91
Acc of class 0 :0.5202
Acc of class 1 :0.4404
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4809
Acc of class 0 :0.5386
Acc of class 1 :0.4519
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4948
Current loss: 1.763028124298722
Mean loss so far: 1.8920102868915893
Outer epoch 92
Acc of class 0 :0.6824
Acc of class 1 :0.3717
Acc of class 2 :0.0000

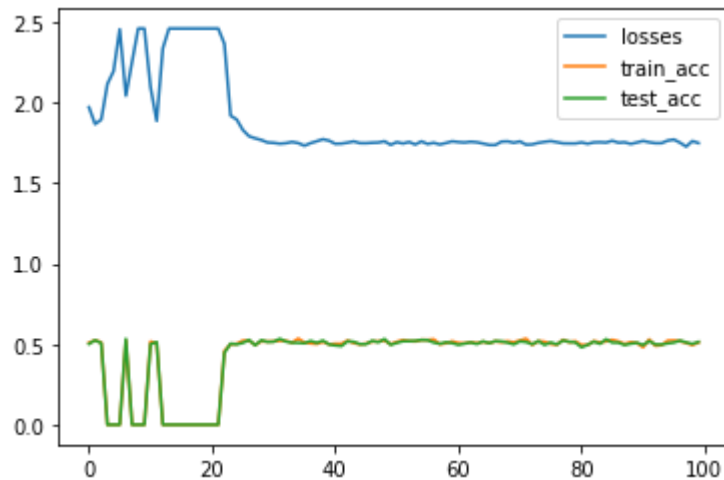
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5295
Acc of class 0 :0.6861
Acc of class 1 :0.3556
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5192
Current loss: 1.7546759479477851
Mean loss so far: 1.8905175223378523
Outer epoch 93
Acc of class 0 :0.2248
Acc of class 1 :0.7641
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4902
Acc of class 0 :0.2352
Acc of class 1 :0.7560
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4982
Current loss: 1.7492783485400387
Mean loss so far: 1.8889988215443274
Outer epoch 94
Acc of class 0 :0.3894
Acc of class 1 :0.6019
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000

Train Accuracy: 0.4940
Acc of class 0 :0.3838
Acc of class 1 :0.6095
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.4978
Current loss: 1.7494078809207076
Mean loss so far: 1.887513811537693
Outer epoch 95
Acc of class 0 :0.8738
Acc of class 1 :0.1587
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5219
Acc of class 0 :0.8638
Acc of class 1 :0.1537
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5052
Current loss: 1.7651260653537224
Mean loss so far: 1.8862255194725985
Outer epoch 96
Acc of class 0 :0.8126
Acc of class 1 :0.2241
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5230
Acc of class 0 :0.8129
Acc of class 1 :0.2135
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000

Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5102
Current loss: 1.771654700446274
Mean loss so far: 1.8850320734410744
Outer epoch 97
Acc of class 0 :0.4093
Acc of class 1 :0.6310
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5184
Acc of class 0 :0.4081
Acc of class 1 :0.6345
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5224
Current loss: 1.7520497861258812
Mean loss so far: 1.883661122025454
Outer epoch 98
Acc of class 0 :0.4552
Acc of class 1 :0.5629
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5082
Acc of class 0 :0.4489
Acc of class 1 :0.5715
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5108
Current loss: 1.7277004927519
Mean loss so far: 1.8820696870328666


```
Outer epoch 99
Acc of class 0 :0.0541
Acc of class 1 :0.9490
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.4945
Acc of class 0 :0.0461
Acc of class 1 :0.9489
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5020
Current loss: 1.7621638242564917
Mean loss so far: 1.8808585167017922
Outer epoch 100
Acc of class 0 :0.2829
Acc of class 1 :0.7460
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Train Accuracy: 0.5108
Acc of class 0 :0.2590
Acc of class 1 :0.7640
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.0000
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.0000
Test Accuracy: 0.5140
Current loss: 1.7497008566585293
Mean loss so far: 1.8795469401013596
```

```
In [19]: # Plot training curves.
plt.plot(losses, label='losses')
plt.plot(np.reshape(train_accuracies, -1), label='train_acc')
plt.plot(np.reshape(test_accuracies, -1), label='test_acc')
plt.legend()
plt.show()
print('Last outer epoch loss:', losses[-1])
print('Last outer epoch train_accuracies:', train_accuracies[-1])
print('Last outer epoch test_accuracies:', test_accuracies[-1])
```



Last outer epoch loss: 1.7497008566585293
Last outer epoch train_accuracies: [0.5108]
Last outer epoch test_accuracies: [0.514]

```
In [20]: # Recall MNIST data.
X, y, X_test, y_test = mnist_X, mnist_y, mnist_X_test, mnist_y_test
X = X.reshape(-1, 28 * 28)
X_test = X_test.reshape(-1, 28 * 28)

# NOTE: This method trains only once over all examples, updating the stats every 500 steps.
train_accuracies, test_accuracies = train.train_given_rule(
    X,                                # Training Examples
    y,                                # Training Labels
    local_net,                        # The BrainNet
    X_test = X_test,
    y_test = y_test,
    verbose = True)                  # If True, evaluates network on test/train data each epoch, otherwise, only once at the end
```

```
Train on 0 examples.
Acc of class 0 :0.1774
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.2241
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.6994
Train Accuracy: 0.1071
Acc of class 0 :0.1827
Acc of class 1 :0.0000
Acc of class 2 :0.0000
Acc of class 3 :0.0000
Acc of class 4 :0.0000
Acc of class 5 :0.2209
Acc of class 6 :0.0000
Acc of class 7 :0.0000
Acc of class 8 :0.0000
Acc of class 9 :0.7215
Test Accuracy: 0.1104
Train on 500 examples.
Acc of class 0 :0.2440
Acc of class 1 :0.9275
Acc of class 2 :0.6108
Acc of class 3 :0.6950
Acc of class 4 :0.3790
Acc of class 5 :0.6873
Acc of class 6 :0.7325
Acc of class 7 :0.8080
Acc of class 8 :0.1025
Acc of class 9 :0.6899
Train Accuracy: 0.5940
Acc of class 0 :0.2408
Acc of class 1 :0.9313
Acc of class 2 :0.5824
Acc of class 3 :0.7030
Acc of class 4 :0.3666
Acc of class 5 :0.6816
Acc of class 6 :0.7599
Acc of class 7 :0.7899
Acc of class 8 :0.0821
Acc of class 9 :0.7403
Test Accuracy: 0.5939
Train on 1000 examples.
Acc of class 0 :0.7810
Acc of class 1 :0.8460
Acc of class 2 :0.3639
Acc of class 3 :0.6722
Acc of class 4 :0.7729
Acc of class 5 :0.4342
Acc of class 6 :0.8621
Acc of class 7 :0.8800
Acc of class 8 :0.6621
Acc of class 9 :0.2851
```

Train Accuracy: 0.6612
Acc of class 0 :0.7908
Acc of class 1 :0.8608
Acc of class 2 :0.3450
Acc of class 3 :0.6851
Acc of class 4 :0.7851
Acc of class 5 :0.4473
Acc of class 6 :0.8570
Acc of class 7 :0.8881
Acc of class 8 :0.6366
Acc of class 9 :0.3300
Test Accuracy: 0.6657
Train on 1500 examples.
Acc of class 0 :0.7501
Acc of class 1 :0.8555
Acc of class 2 :0.5554
Acc of class 3 :0.7898
Acc of class 4 :0.7651
Acc of class 5 :0.7510
Acc of class 6 :0.7751
Acc of class 7 :0.5761
Acc of class 8 :0.2251
Acc of class 9 :0.7502
Train Accuracy: 0.6813
Acc of class 0 :0.7633
Acc of class 1 :0.8722
Acc of class 2 :0.5320
Acc of class 3 :0.7802
Acc of class 4 :0.7637
Acc of class 5 :0.7791
Acc of class 6 :0.7735
Acc of class 7 :0.5710
Acc of class 8 :0.2064
Acc of class 9 :0.7691
Test Accuracy: 0.6825
Train on 2000 examples.
Acc of class 0 :0.8761
Acc of class 1 :0.8622
Acc of class 2 :0.7174
Acc of class 3 :0.5593
Acc of class 4 :0.5149
Acc of class 5 :0.8152
Acc of class 6 :0.6921
Acc of class 7 :0.8217
Acc of class 8 :0.4662
Acc of class 9 :0.7495
Train Accuracy: 0.7094
Acc of class 0 :0.8898
Acc of class 1 :0.8758
Acc of class 2 :0.7045
Acc of class 3 :0.5564
Acc of class 4 :0.5163
Acc of class 5 :0.8206
Acc of class 6 :0.6952
Acc of class 7 :0.8093
Acc of class 8 :0.4784
Acc of class 9 :0.7889

Test Accuracy: 0.7154
Train on 2500 examples.
Acc of class 0 :0.7268
Acc of class 1 :0.8982
Acc of class 2 :0.6032
Acc of class 3 :0.7942
Acc of class 4 :0.8322
Acc of class 5 :0.4804
Acc of class 6 :0.8008
Acc of class 7 :0.8351
Acc of class 8 :0.5652
Acc of class 9 :0.5174
Train Accuracy: 0.7108
Acc of class 0 :0.7439
Acc of class 1 :0.9093
Acc of class 2 :0.5640
Acc of class 3 :0.8000
Acc of class 4 :0.8411
Acc of class 5 :0.4854
Acc of class 6 :0.7954
Acc of class 7 :0.8375
Acc of class 8 :0.5749
Acc of class 9 :0.5699
Test Accuracy: 0.7168
Train on 3000 examples.
Acc of class 0 :0.8099
Acc of class 1 :0.9201
Acc of class 2 :0.6571
Acc of class 3 :0.7416
Acc of class 4 :0.7473
Acc of class 5 :0.6659
Acc of class 6 :0.7879
Acc of class 7 :0.7920
Acc of class 8 :0.5996
Acc of class 9 :0.6620
Train Accuracy: 0.7418
Acc of class 0 :0.8245
Acc of class 1 :0.9286
Acc of class 2 :0.6579
Acc of class 3 :0.7545
Acc of class 4 :0.7546
Acc of class 5 :0.7074
Acc of class 6 :0.7902
Acc of class 7 :0.7763
Acc of class 8 :0.5986
Acc of class 9 :0.6878
Test Accuracy: 0.7507
Train on 3500 examples.
Acc of class 0 :0.8551
Acc of class 1 :0.8671
Acc of class 2 :0.6494
Acc of class 3 :0.7464
Acc of class 4 :0.8230
Acc of class 5 :0.5853
Acc of class 6 :0.6580
Acc of class 7 :0.8032
Acc of class 8 :0.5748

Acc of class 9 :0.7158
Train Accuracy: 0.7314
Acc of class 0 :0.8663
Acc of class 1 :0.8749
Acc of class 2 :0.6463
Acc of class 3 :0.7634
Acc of class 4 :0.8289
Acc of class 5 :0.6143
Acc of class 6 :0.6357
Acc of class 7 :0.8016
Acc of class 8 :0.5873
Acc of class 9 :0.7166
Test Accuracy: 0.7370
Train on 4000 examples.
Acc of class 0 :0.6483
Acc of class 1 :0.8139
Acc of class 2 :0.7536
Acc of class 3 :0.5797
Acc of class 4 :0.8184
Acc of class 5 :0.5733
Acc of class 6 :0.7273
Acc of class 7 :0.7936
Acc of class 8 :0.7626
Acc of class 9 :0.5957
Train Accuracy: 0.7090
Acc of class 0 :0.6755
Acc of class 1 :0.8203
Acc of class 2 :0.7607
Acc of class 3 :0.5911
Acc of class 4 :0.8289
Acc of class 5 :0.5874
Acc of class 6 :0.7286
Acc of class 7 :0.7811
Acc of class 8 :0.7813
Acc of class 9 :0.6274
Test Accuracy: 0.7208
Train on 4500 examples.
Acc of class 0 :0.8513
Acc of class 1 :0.8610
Acc of class 2 :0.7721
Acc of class 3 :0.5869
Acc of class 4 :0.8942
Acc of class 5 :0.6637
Acc of class 6 :0.7781
Acc of class 7 :0.7010
Acc of class 8 :0.6790
Acc of class 9 :0.3975
Train Accuracy: 0.7200
Acc of class 0 :0.8643
Acc of class 1 :0.8564
Acc of class 2 :0.7713
Acc of class 3 :0.6020
Acc of class 4 :0.9145
Acc of class 5 :0.6984
Acc of class 6 :0.7651
Acc of class 7 :0.7014
Acc of class 8 :0.6992

Acc of class 9 :0.4113
Test Accuracy: 0.7294
Train on 5000 examples.
Acc of class 0 :0.8410
Acc of class 1 :0.8554
Acc of class 2 :0.7158
Acc of class 3 :0.5650
Acc of class 4 :0.4926
Acc of class 5 :0.7015
Acc of class 6 :0.6365
Acc of class 7 :0.6733
Acc of class 8 :0.7612
Acc of class 9 :0.8102
Train Accuracy: 0.7069
Acc of class 0 :0.8551
Acc of class 1 :0.8661
Acc of class 2 :0.6948
Acc of class 3 :0.5802
Acc of class 4 :0.4796
Acc of class 5 :0.7074
Acc of class 6 :0.6545
Acc of class 7 :0.6625
Acc of class 8 :0.7680
Acc of class 9 :0.8315
Test Accuracy: 0.7121
Train on 5500 examples.
Acc of class 0 :0.9147
Acc of class 1 :0.9340
Acc of class 2 :0.6532
Acc of class 3 :0.8118
Acc of class 4 :0.6979
Acc of class 5 :0.4757
Acc of class 6 :0.8013
Acc of class 7 :0.8128
Acc of class 8 :0.5640
Acc of class 9 :0.7183
Train Accuracy: 0.7441
Acc of class 0 :0.9235
Acc of class 1 :0.9392
Acc of class 2 :0.6289
Acc of class 3 :0.8158
Acc of class 4 :0.7189
Acc of class 5 :0.5157
Acc of class 6 :0.7954
Acc of class 7 :0.8123
Acc of class 8 :0.5483
Acc of class 9 :0.7225
Test Accuracy: 0.7470
Train on 6000 examples.
Acc of class 0 :0.8894
Acc of class 1 :0.9057
Acc of class 2 :0.7012
Acc of class 3 :0.7902
Acc of class 4 :0.7299
Acc of class 5 :0.6289
Acc of class 6 :0.8047
Acc of class 7 :0.7928

Acc of class 8 :0.5621
Acc of class 9 :0.6937
Train Accuracy: 0.7536
Acc of class 0 :0.9020
Acc of class 1 :0.9128
Acc of class 2 :0.6822
Acc of class 3 :0.7970
Acc of class 4 :0.7515
Acc of class 5 :0.6446
Acc of class 6 :0.7944
Acc of class 7 :0.7977
Acc of class 8 :0.5667
Acc of class 9 :0.7185
Test Accuracy: 0.7600
Train on 6500 examples.
Acc of class 0 :0.7728
Acc of class 1 :0.8673
Acc of class 2 :0.7487
Acc of class 3 :0.8462
Acc of class 4 :0.6808
Acc of class 5 :0.5685
Acc of class 6 :0.7165
Acc of class 7 :0.8547
Acc of class 8 :0.5632
Acc of class 9 :0.6650
Train Accuracy: 0.7330
Acc of class 0 :0.8061
Acc of class 1 :0.8696
Acc of class 2 :0.7238
Acc of class 3 :0.8416
Acc of class 4 :0.6986
Acc of class 5 :0.5886
Acc of class 6 :0.7077
Acc of class 7 :0.8385
Acc of class 8 :0.5914
Acc of class 9 :0.6789
Test Accuracy: 0.7386
Train on 7000 examples.
Acc of class 0 :0.8477
Acc of class 1 :0.8750
Acc of class 2 :0.5980
Acc of class 3 :0.5175
Acc of class 4 :0.8355
Acc of class 5 :0.5698
Acc of class 6 :0.6671
Acc of class 7 :0.8332
Acc of class 8 :0.8464
Acc of class 9 :0.4344
Train Accuracy: 0.7055
Acc of class 0 :0.8735
Acc of class 1 :0.8749
Acc of class 2 :0.5775
Acc of class 3 :0.5208
Acc of class 4 :0.8788
Acc of class 5 :0.5762
Acc of class 6 :0.6336
Acc of class 7 :0.8191

Acc of class 8 :0.8573
Acc of class 9 :0.4638
Test Accuracy: 0.7100
Train on 7500 examples.
Acc of class 0 :0.9060
Acc of class 1 :0.8825
Acc of class 2 :0.7862
Acc of class 3 :0.5358
Acc of class 4 :0.7415
Acc of class 5 :0.6010
Acc of class 6 :0.7486
Acc of class 7 :0.7777
Acc of class 8 :0.7057
Acc of class 9 :0.7685
Train Accuracy: 0.7480
Acc of class 0 :0.9276
Acc of class 1 :0.8899
Acc of class 2 :0.7655
Acc of class 3 :0.5386
Acc of class 4 :0.7790
Acc of class 5 :0.6200
Acc of class 6 :0.7359
Acc of class 7 :0.7695
Acc of class 8 :0.7423
Acc of class 9 :0.7760
Test Accuracy: 0.7573
Train on 8000 examples.
Acc of class 0 :0.8340
Acc of class 1 :0.9215
Acc of class 2 :0.6638
Acc of class 3 :0.7415
Acc of class 4 :0.7436
Acc of class 5 :0.7156
Acc of class 6 :0.7675
Acc of class 7 :0.8444
Acc of class 8 :0.6411
Acc of class 9 :0.6485
Train Accuracy: 0.7553
Acc of class 0 :0.8531
Acc of class 1 :0.9269
Acc of class 2 :0.6599
Acc of class 3 :0.7366
Acc of class 4 :0.7780
Acc of class 5 :0.7253
Acc of class 6 :0.7704
Acc of class 7 :0.8288
Acc of class 8 :0.6345
Acc of class 9 :0.6670
Test Accuracy: 0.7605
Train on 8500 examples.
Acc of class 0 :0.8805
Acc of class 1 :0.9417
Acc of class 2 :0.7296
Acc of class 3 :0.7366
Acc of class 4 :0.7663
Acc of class 5 :0.6307
Acc of class 6 :0.7685

Acc of class 7 :0.8816
Acc of class 8 :0.5261
Acc of class 9 :0.5544
Train Accuracy: 0.7462
Acc of class 0 :0.9000
Acc of class 1 :0.9559
Acc of class 2 :0.7122
Acc of class 3 :0.7356
Acc of class 4 :0.7923
Acc of class 5 :0.6558
Acc of class 6 :0.7599
Acc of class 7 :0.8706
Acc of class 8 :0.5226
Acc of class 9 :0.5837
Test Accuracy: 0.7529
Train on 9000 examples.
Acc of class 0 :0.8621
Acc of class 1 :0.8773
Acc of class 2 :0.7628
Acc of class 3 :0.8059
Acc of class 4 :0.7396
Acc of class 5 :0.3723
Acc of class 6 :0.8743
Acc of class 7 :0.7464
Acc of class 8 :0.6043
Acc of class 9 :0.6937
Train Accuracy: 0.7393
Acc of class 0 :0.8755
Acc of class 1 :0.8855
Acc of class 2 :0.7500
Acc of class 3 :0.8178
Acc of class 4 :0.7607
Acc of class 5 :0.3980
Acc of class 6 :0.8758
Acc of class 7 :0.7364
Acc of class 8 :0.6068
Acc of class 9 :0.6977
Test Accuracy: 0.7456
Train on 9500 examples.
Acc of class 0 :0.8563
Acc of class 1 :0.8908
Acc of class 2 :0.7402
Acc of class 3 :0.6725
Acc of class 4 :0.7687
Acc of class 5 :0.7021
Acc of class 6 :0.8101
Acc of class 7 :0.7800
Acc of class 8 :0.6231
Acc of class 9 :0.7263
Train Accuracy: 0.7593
Acc of class 0 :0.8765
Acc of class 1 :0.8960
Acc of class 2 :0.7141
Acc of class 3 :0.6812
Acc of class 4 :0.7963
Acc of class 5 :0.7175
Acc of class 6 :0.8058

Acc of class 7 :0.7704
Acc of class 8 :0.6283
Acc of class 9 :0.7364
Test Accuracy: 0.7642
Train on 10000 examples.
Acc of class 0 :0.9097
Acc of class 1 :0.7995
Acc of class 2 :0.6749
Acc of class 3 :0.5893
Acc of class 4 :0.7763
Acc of class 5 :0.5759
Acc of class 6 :0.7641
Acc of class 7 :0.8447
Acc of class 8 :0.7894
Acc of class 9 :0.6473
Train Accuracy: 0.7392
Acc of class 0 :0.9316
Acc of class 1 :0.8150
Acc of class 2 :0.6579
Acc of class 3 :0.6089
Acc of class 4 :0.8147
Acc of class 5 :0.5830
Acc of class 6 :0.7505
Acc of class 7 :0.8317
Acc of class 8 :0.7864
Acc of class 9 :0.6779
Test Accuracy: 0.7476
Train on 10500 examples.
Acc of class 0 :0.8094
Acc of class 1 :0.9097
Acc of class 2 :0.6499
Acc of class 3 :0.7702
Acc of class 4 :0.8037
Acc of class 5 :0.6973
Acc of class 6 :0.7979
Acc of class 7 :0.8010
Acc of class 8 :0.6069
Acc of class 9 :0.6465
Train Accuracy: 0.7522
Acc of class 0 :0.8286
Acc of class 1 :0.9110
Acc of class 2 :0.6463
Acc of class 3 :0.7713
Acc of class 4 :0.8350
Acc of class 5 :0.7175
Acc of class 6 :0.7902
Acc of class 7 :0.7899
Acc of class 8 :0.6088
Acc of class 9 :0.6759
Test Accuracy: 0.7596
Train on 11000 examples.
Acc of class 0 :0.8482
Acc of class 1 :0.8917
Acc of class 2 :0.6323
Acc of class 3 :0.7392
Acc of class 4 :0.7968
Acc of class 5 :0.6215

Acc of class 6 :0.8265
Acc of class 7 :0.8469
Acc of class 8 :0.7293
Acc of class 9 :0.6228
Train Accuracy: 0.7588
Acc of class 0 :0.8673
Acc of class 1 :0.8952
Acc of class 2 :0.6221
Acc of class 3 :0.7446
Acc of class 4 :0.8330
Acc of class 5 :0.6177
Acc of class 6 :0.8142
Acc of class 7 :0.8434
Acc of class 8 :0.7331
Acc of class 9 :0.6442
Test Accuracy: 0.7640
Train on 11500 examples.
Acc of class 0 :0.8045
Acc of class 1 :0.8763
Acc of class 2 :0.6304
Acc of class 3 :0.5635
Acc of class 4 :0.7335
Acc of class 5 :0.6801
Acc of class 6 :0.7712
Acc of class 7 :0.8061
Acc of class 8 :0.7930
Acc of class 9 :0.7317
Train Accuracy: 0.7410
Acc of class 0 :0.8276
Acc of class 1 :0.8907
Acc of class 2 :0.6289
Acc of class 3 :0.5782
Acc of class 4 :0.7556
Acc of class 5 :0.6816
Acc of class 6 :0.7620
Acc of class 7 :0.8006
Acc of class 8 :0.8101
Acc of class 9 :0.7671
Test Accuracy: 0.7521
Train on 12000 examples.
Acc of class 0 :0.8837
Acc of class 1 :0.8288
Acc of class 2 :0.6777
Acc of class 3 :0.7429
Acc of class 4 :0.5454
Acc of class 5 :0.7096
Acc of class 6 :0.7323
Acc of class 7 :0.8137
Acc of class 8 :0.6592
Acc of class 9 :0.8043
Train Accuracy: 0.7420
Acc of class 0 :0.8949
Acc of class 1 :0.8317
Acc of class 2 :0.6628
Acc of class 3 :0.7455
Acc of class 4 :0.5428
Acc of class 5 :0.7287

Acc of class 6 :0.7286
Acc of class 7 :0.8084
Acc of class 8 :0.6735
Acc of class 9 :0.8285
Test Accuracy: 0.7462
Train on 12500 examples.
Acc of class 0 :0.8322
Acc of class 1 :0.8698
Acc of class 2 :0.7372
Acc of class 3 :0.6240
Acc of class 4 :0.7761
Acc of class 5 :0.7316
Acc of class 6 :0.8064
Acc of class 7 :0.7713
Acc of class 8 :0.6607
Acc of class 9 :0.7758
Train Accuracy: 0.7599
Acc of class 0 :0.8418
Acc of class 1 :0.8802
Acc of class 2 :0.7209
Acc of class 3 :0.6129
Acc of class 4 :0.7953
Acc of class 5 :0.7590
Acc of class 6 :0.7954
Acc of class 7 :0.7802
Acc of class 8 :0.6982
Acc of class 9 :0.7968
Test Accuracy: 0.7693
Train on 13000 examples.
Acc of class 0 :0.7668
Acc of class 1 :0.8782
Acc of class 2 :0.7467
Acc of class 3 :0.8000
Acc of class 4 :0.7143
Acc of class 5 :0.6573
Acc of class 6 :0.7690
Acc of class 7 :0.6814
Acc of class 8 :0.5343
Acc of class 9 :0.8255
Train Accuracy: 0.7402
Acc of class 0 :0.7969
Acc of class 1 :0.8855
Acc of class 2 :0.7132
Acc of class 3 :0.7960
Acc of class 4 :0.7179
Acc of class 5 :0.6816
Acc of class 6 :0.7630
Acc of class 7 :0.6819
Acc of class 8 :0.5760
Acc of class 9 :0.8414
Test Accuracy: 0.7481
Train on 13500 examples.
Acc of class 0 :0.8496
Acc of class 1 :0.8907
Acc of class 2 :0.7085
Acc of class 3 :0.7146
Acc of class 4 :0.8079

Acc of class 5 :0.6488
Acc of class 6 :0.8092
Acc of class 7 :0.7770
Acc of class 8 :0.7106
Acc of class 9 :0.6885
Train Accuracy: 0.7631
Acc of class 0 :0.8673
Acc of class 1 :0.8899
Acc of class 2 :0.6822
Acc of class 3 :0.7129
Acc of class 4 :0.8187
Acc of class 5 :0.6659
Acc of class 6 :0.8100
Acc of class 7 :0.7821
Acc of class 8 :0.7392
Acc of class 9 :0.6947
Test Accuracy: 0.7683
Train on 14000 examples.
Acc of class 0 :0.7086
Acc of class 1 :0.8520
Acc of class 2 :0.7649
Acc of class 3 :0.7868
Acc of class 4 :0.6024
Acc of class 5 :0.6705
Acc of class 6 :0.7960
Acc of class 7 :0.6993
Acc of class 8 :0.5719
Acc of class 9 :0.8321
Train Accuracy: 0.7311
Acc of class 0 :0.7316
Acc of class 1 :0.8546
Acc of class 2 :0.7403
Acc of class 3 :0.7941
Acc of class 4 :0.6059
Acc of class 5 :0.6962
Acc of class 6 :0.8006
Acc of class 7 :0.6936
Acc of class 8 :0.6027
Acc of class 9 :0.8454
Test Accuracy: 0.7389
Train on 14500 examples.
Acc of class 0 :0.8023
Acc of class 1 :0.7920
Acc of class 2 :0.7825
Acc of class 3 :0.3809
Acc of class 4 :0.7189
Acc of class 5 :0.4289
Acc of class 6 :0.7933
Acc of class 7 :0.8075
Acc of class 8 :0.8554
Acc of class 9 :0.6810
Train Accuracy: 0.7071
Acc of class 0 :0.8153
Acc of class 1 :0.8035
Acc of class 2 :0.7607
Acc of class 3 :0.3594
Acc of class 4 :0.7210

Acc of class 5 :0.4350
Acc of class 6 :0.7912
Acc of class 7 :0.8132
Acc of class 8 :0.8717
Acc of class 9 :0.6888
Test Accuracy: 0.7093
Train on 15000 examples.
Acc of class 0 :0.8166
Acc of class 1 :0.9070
Acc of class 2 :0.7113
Acc of class 3 :0.6713
Acc of class 4 :0.7412
Acc of class 5 :0.5802
Acc of class 6 :0.8212
Acc of class 7 :0.8306
Acc of class 8 :0.7040
Acc of class 9 :0.7487
Train Accuracy: 0.7570
Acc of class 0 :0.8296
Acc of class 1 :0.9233
Acc of class 2 :0.6967
Acc of class 3 :0.6723
Acc of class 4 :0.7678
Acc of class 5 :0.5930
Acc of class 6 :0.8173
Acc of class 7 :0.8414
Acc of class 8 :0.7207
Acc of class 9 :0.7592
Test Accuracy: 0.7658
Train on 15500 examples.
Acc of class 0 :0.8209
Acc of class 1 :0.9000
Acc of class 2 :0.6380
Acc of class 3 :0.6625
Acc of class 4 :0.8293
Acc of class 5 :0.6493
Acc of class 6 :0.8550
Acc of class 7 :0.8054
Acc of class 8 :0.7595
Acc of class 9 :0.6125
Train Accuracy: 0.7559
Acc of class 0 :0.8408
Acc of class 1 :0.9101
Acc of class 2 :0.6153
Acc of class 3 :0.6525
Acc of class 4 :0.8564
Acc of class 5 :0.6614
Acc of class 6 :0.8476
Acc of class 7 :0.8113
Acc of class 8 :0.7618
Acc of class 9 :0.6333
Test Accuracy: 0.7609
Train on 16000 examples.
Acc of class 0 :0.8327
Acc of class 1 :0.8904
Acc of class 2 :0.7231
Acc of class 3 :0.7213

Acc of class 4 :0.6722
Acc of class 5 :0.6820
Acc of class 6 :0.8133
Acc of class 7 :0.7227
Acc of class 8 :0.6382
Acc of class 9 :0.8279
Train Accuracy: 0.7548
Acc of class 0 :0.8480
Acc of class 1 :0.8996
Acc of class 2 :0.7054
Acc of class 3 :0.7218
Acc of class 4 :0.6711
Acc of class 5 :0.7085
Acc of class 6 :0.8069
Acc of class 7 :0.7257
Acc of class 8 :0.6530
Acc of class 9 :0.8474
Test Accuracy: 0.7610
Train on 16500 examples.
Acc of class 0 :0.8317
Acc of class 1 :0.8825
Acc of class 2 :0.7949
Acc of class 3 :0.6885
Acc of class 4 :0.7335
Acc of class 5 :0.7126
Acc of class 6 :0.7839
Acc of class 7 :0.7537
Acc of class 8 :0.6664
Acc of class 9 :0.7468
Train Accuracy: 0.7614
Acc of class 0 :0.8469
Acc of class 1 :0.8925
Acc of class 2 :0.7752
Acc of class 3 :0.6871
Acc of class 4 :0.7546
Acc of class 5 :0.7343
Acc of class 6 :0.7818
Acc of class 7 :0.7549
Acc of class 8 :0.6807
Acc of class 9 :0.7721
Test Accuracy: 0.7700
Train on 17000 examples.
Acc of class 0 :0.8538
Acc of class 1 :0.9066
Acc of class 2 :0.6762
Acc of class 3 :0.6265
Acc of class 4 :0.7328
Acc of class 5 :0.7213
Acc of class 6 :0.8151
Acc of class 7 :0.7883
Acc of class 8 :0.7093
Acc of class 9 :0.7968
Train Accuracy: 0.7647
Acc of class 0 :0.8612
Acc of class 1 :0.9163
Acc of class 2 :0.6599
Acc of class 3 :0.6257

Acc of class 4 :0.7393
Acc of class 5 :0.7466
Acc of class 6 :0.8058
Acc of class 7 :0.7957
Acc of class 8 :0.7156
Acc of class 9 :0.8315
Test Accuracy: 0.7715
Train on 17500 examples.
Acc of class 0 :0.8210
Acc of class 1 :0.9061
Acc of class 2 :0.7714
Acc of class 3 :0.7917
Acc of class 4 :0.8049
Acc of class 5 :0.6753
Acc of class 6 :0.8113
Acc of class 7 :0.7497
Acc of class 8 :0.4999
Acc of class 9 :0.7500
Train Accuracy: 0.7612
Acc of class 0 :0.8337
Acc of class 1 :0.9093
Acc of class 2 :0.7452
Acc of class 3 :0.7832
Acc of class 4 :0.8096
Acc of class 5 :0.7119
Acc of class 6 :0.8058
Acc of class 7 :0.7490
Acc of class 8 :0.5195
Acc of class 9 :0.7602
Test Accuracy: 0.7654
Train on 18000 examples.
Acc of class 0 :0.8379
Acc of class 1 :0.8889
Acc of class 2 :0.7321
Acc of class 3 :0.6767
Acc of class 4 :0.8518
Acc of class 5 :0.6150
Acc of class 6 :0.8089
Acc of class 7 :0.7810
Acc of class 8 :0.7602
Acc of class 9 :0.6312
Train Accuracy: 0.7610
Acc of class 0 :0.8520
Acc of class 1 :0.8969
Acc of class 2 :0.7200
Acc of class 3 :0.6703
Acc of class 4 :0.8727
Acc of class 5 :0.6390
Acc of class 6 :0.8017
Acc of class 7 :0.7870
Acc of class 8 :0.7649
Acc of class 9 :0.6422
Test Accuracy: 0.7670
Train on 18500 examples.
Acc of class 0 :0.8374
Acc of class 1 :0.8566
Acc of class 2 :0.7894

Acc of class 3 :0.6650
Acc of class 4 :0.8899
Acc of class 5 :0.6602
Acc of class 6 :0.8057
Acc of class 7 :0.7652
Acc of class 8 :0.7204
Acc of class 9 :0.5201
Train Accuracy: 0.7527
Acc of class 0 :0.8449
Acc of class 1 :0.8511
Acc of class 2 :0.7665
Acc of class 3 :0.6624
Acc of class 4 :0.8992
Acc of class 5 :0.6805
Acc of class 6 :0.8006
Acc of class 7 :0.7607
Acc of class 8 :0.7474
Acc of class 9 :0.5372
Test Accuracy: 0.7563
Train on 19000 examples.
Acc of class 0 :0.8636
Acc of class 1 :0.8638
Acc of class 2 :0.7622
Acc of class 3 :0.7659
Acc of class 4 :0.7092
Acc of class 5 :0.5802
Acc of class 6 :0.8445
Acc of class 7 :0.7922
Acc of class 8 :0.6507
Acc of class 9 :0.8070
Train Accuracy: 0.7672
Acc of class 0 :0.8673
Acc of class 1 :0.8678
Acc of class 2 :0.7500
Acc of class 3 :0.7713
Acc of class 4 :0.7210
Acc of class 5 :0.5998
Acc of class 6 :0.8434
Acc of class 7 :0.7870
Acc of class 8 :0.6735
Acc of class 9 :0.8325
Test Accuracy: 0.7744
Train on 19500 examples.
Acc of class 0 :0.8036
Acc of class 1 :0.8443
Acc of class 2 :0.7566
Acc of class 3 :0.7705
Acc of class 4 :0.7438
Acc of class 5 :0.6597
Acc of class 6 :0.8118
Acc of class 7 :0.8654
Acc of class 8 :0.6886
Acc of class 9 :0.6825
Train Accuracy: 0.7653
Acc of class 0 :0.8214
Acc of class 1 :0.8493
Acc of class 2 :0.7316

Acc of class 3 :0.7772
Acc of class 4 :0.7668
Acc of class 5 :0.6951
Acc of class 6 :0.8090
Acc of class 7 :0.8589
Acc of class 8 :0.7023
Acc of class 9 :0.7086
Test Accuracy: 0.7739
Train on 20000 examples.
Acc of class 0 :0.8021
Acc of class 1 :0.9097
Acc of class 2 :0.7189
Acc of class 3 :0.6614
Acc of class 4 :0.8576
Acc of class 5 :0.8190
Acc of class 6 :0.7668
Acc of class 7 :0.7812
Acc of class 8 :0.5662
Acc of class 9 :0.5524
Train Accuracy: 0.7450
Acc of class 0 :0.8204
Acc of class 1 :0.9137
Acc of class 2 :0.6880
Acc of class 3 :0.6822
Acc of class 4 :0.8788
Acc of class 5 :0.8374
Acc of class 6 :0.7735
Acc of class 7 :0.7772
Acc of class 8 :0.5924
Acc of class 9 :0.5590
Test Accuracy: 0.7531
Train on 20500 examples.
Acc of class 0 :0.8607
Acc of class 1 :0.9014
Acc of class 2 :0.7711
Acc of class 3 :0.7619
Acc of class 4 :0.7865
Acc of class 5 :0.6425
Acc of class 6 :0.7430
Acc of class 7 :0.7989
Acc of class 8 :0.6004
Acc of class 9 :0.7665
Train Accuracy: 0.7665
Acc of class 0 :0.8724
Acc of class 1 :0.9093
Acc of class 2 :0.7510
Acc of class 3 :0.7644
Acc of class 4 :0.8014
Acc of class 5 :0.6715
Acc of class 6 :0.7432
Acc of class 7 :0.7899
Acc of class 8 :0.6253
Acc of class 9 :0.7820
Test Accuracy: 0.7742
Train on 21000 examples.
Acc of class 0 :0.8102
Acc of class 1 :0.8922

Acc of class 2 :0.6871
Acc of class 3 :0.7593
Acc of class 4 :0.8119
Acc of class 5 :0.4912
Acc of class 6 :0.8163
Acc of class 7 :0.7885
Acc of class 8 :0.7465
Acc of class 9 :0.7277
Train Accuracy: 0.7573
Acc of class 0 :0.8286
Acc of class 1 :0.8969
Acc of class 2 :0.6599
Acc of class 3 :0.7703
Acc of class 4 :0.8330
Acc of class 5 :0.5179
Acc of class 6 :0.8132
Acc of class 7 :0.7899
Acc of class 8 :0.7505
Acc of class 9 :0.7334
Test Accuracy: 0.7631
Train on 21500 examples.
Acc of class 0 :0.8048
Acc of class 1 :0.8582
Acc of class 2 :0.7907
Acc of class 3 :0.7320
Acc of class 4 :0.7241
Acc of class 5 :0.5790
Acc of class 6 :0.8373
Acc of class 7 :0.6599
Acc of class 8 :0.6741
Acc of class 9 :0.8245
Train Accuracy: 0.7510
Acc of class 0 :0.8204
Acc of class 1 :0.8643
Acc of class 2 :0.7771
Acc of class 3 :0.7426
Acc of class 4 :0.7444
Acc of class 5 :0.6177
Acc of class 6 :0.8319
Acc of class 7 :0.6615
Acc of class 8 :0.6971
Acc of class 9 :0.8494
Test Accuracy: 0.7632
Train on 22000 examples.
Acc of class 0 :0.8676
Acc of class 1 :0.8994
Acc of class 2 :0.7257
Acc of class 3 :0.7995
Acc of class 4 :0.8732
Acc of class 5 :0.6329
Acc of class 6 :0.7962
Acc of class 7 :0.7322
Acc of class 8 :0.5688
Acc of class 9 :0.6556
Train Accuracy: 0.7581
Acc of class 0 :0.8755
Acc of class 1 :0.9031

Acc of class 2 :0.7190
Acc of class 3 :0.8139
Acc of class 4 :0.8890
Acc of class 5 :0.6525
Acc of class 6 :0.7850
Acc of class 7 :0.7276
Acc of class 8 :0.5811
Acc of class 9 :0.6611
Test Accuracy: 0.7635
Train on 22500 examples.
Acc of class 0 :0.8560
Acc of class 1 :0.8815
Acc of class 2 :0.7341
Acc of class 3 :0.7232
Acc of class 4 :0.8403
Acc of class 5 :0.6899
Acc of class 6 :0.7837
Acc of class 7 :0.7058
Acc of class 8 :0.6479
Acc of class 9 :0.7331
Train Accuracy: 0.7614
Acc of class 0 :0.8704
Acc of class 1 :0.8916
Acc of class 2 :0.7151
Acc of class 3 :0.7149
Acc of class 4 :0.8615
Acc of class 5 :0.7052
Acc of class 6 :0.7808
Acc of class 7 :0.6936
Acc of class 8 :0.6653
Acc of class 9 :0.7413
Test Accuracy: 0.7657
Train on 23000 examples.
Acc of class 0 :0.8406
Acc of class 1 :0.9117
Acc of class 2 :0.7138
Acc of class 3 :0.8008
Acc of class 4 :0.7877
Acc of class 5 :0.6244
Acc of class 6 :0.8528
Acc of class 7 :0.7863
Acc of class 8 :0.5696
Acc of class 9 :0.7630
Train Accuracy: 0.7687
Acc of class 0 :0.8571
Acc of class 1 :0.9128
Acc of class 2 :0.7045
Acc of class 3 :0.8099
Acc of class 4 :0.8024
Acc of class 5 :0.6435
Acc of class 6 :0.8372
Acc of class 7 :0.7772
Acc of class 8 :0.5945
Acc of class 9 :0.7711
Test Accuracy: 0.7741
Train on 23500 examples.
Acc of class 0 :0.8320

Acc of class 1 :0.8799
Acc of class 2 :0.7222
Acc of class 3 :0.6537
Acc of class 4 :0.7763
Acc of class 5 :0.6381
Acc of class 6 :0.8184
Acc of class 7 :0.7951
Acc of class 8 :0.7826
Acc of class 9 :0.7253
Train Accuracy: 0.7647
Acc of class 0 :0.8490
Acc of class 1 :0.8890
Acc of class 2 :0.7016
Acc of class 3 :0.6535
Acc of class 4 :0.8024
Acc of class 5 :0.6682
Acc of class 6 :0.8132
Acc of class 7 :0.7879
Acc of class 8 :0.7947
Acc of class 9 :0.7542
Test Accuracy: 0.7733
Train on 24000 examples.
Acc of class 0 :0.8256
Acc of class 1 :0.8600
Acc of class 2 :0.7315
Acc of class 3 :0.7695
Acc of class 4 :0.6636
Acc of class 5 :0.6648
Acc of class 6 :0.8287
Acc of class 7 :0.8228
Acc of class 8 :0.6560
Acc of class 9 :0.7869
Train Accuracy: 0.7637
Acc of class 0 :0.8408
Acc of class 1 :0.8634
Acc of class 2 :0.7016
Acc of class 3 :0.7812
Acc of class 4 :0.6660
Acc of class 5 :0.6760
Acc of class 6 :0.8163
Acc of class 7 :0.8230
Acc of class 8 :0.6704
Acc of class 9 :0.8256
Test Accuracy: 0.7688
Train on 24500 examples.
Acc of class 0 :0.8263
Acc of class 1 :0.8616
Acc of class 2 :0.6928
Acc of class 3 :0.7625
Acc of class 4 :0.7371
Acc of class 5 :0.7157
Acc of class 6 :0.7636
Acc of class 7 :0.8177
Acc of class 8 :0.6508
Acc of class 9 :0.7638
Train Accuracy: 0.7614
Acc of class 0 :0.8480

Acc of class 1 :0.8670
Acc of class 2 :0.6531
Acc of class 3 :0.7644
Acc of class 4 :0.7403
Acc of class 5 :0.7365
Acc of class 6 :0.7651
Acc of class 7 :0.8161
Acc of class 8 :0.6632
Acc of class 9 :0.7929
Test Accuracy: 0.7663
Train on 25000 examples.
Acc of class 0 :0.8030
Acc of class 1 :0.8493
Acc of class 2 :0.7828
Acc of class 3 :0.7597
Acc of class 4 :0.6845
Acc of class 5 :0.6881
Acc of class 6 :0.7832
Acc of class 7 :0.7199
Acc of class 8 :0.6324
Acc of class 9 :0.8153
Train Accuracy: 0.7538
Acc of class 0 :0.8224
Acc of class 1 :0.8581
Acc of class 2 :0.7510
Acc of class 3 :0.7644
Acc of class 4 :0.6935
Acc of class 5 :0.7007
Acc of class 6 :0.7777
Acc of class 7 :0.7160
Acc of class 8 :0.6376
Acc of class 9 :0.8454
Test Accuracy: 0.7588
Train on 25500 examples.
Acc of class 0 :0.8043
Acc of class 1 :0.8564
Acc of class 2 :0.6942
Acc of class 3 :0.6718
Acc of class 4 :0.8499
Acc of class 5 :0.6451
Acc of class 6 :0.7653
Acc of class 7 :0.7486
Acc of class 8 :0.8130
Acc of class 9 :0.6228
Train Accuracy: 0.7489
Acc of class 0 :0.8163
Acc of class 1 :0.8678
Acc of class 2 :0.6667
Acc of class 3 :0.6851
Acc of class 4 :0.8635
Acc of class 5 :0.6637
Acc of class 6 :0.7526
Acc of class 7 :0.7481
Acc of class 8 :0.8183
Acc of class 9 :0.6422
Test Accuracy: 0.7540
Train on 26000 examples.

Acc of class 0 :0.8583
Acc of class 1 :0.8781
Acc of class 2 :0.6789
Acc of class 3 :0.7193
Acc of class 4 :0.8646
Acc of class 5 :0.7008
Acc of class 6 :0.8030
Acc of class 7 :0.7840
Acc of class 8 :0.7277
Acc of class 9 :0.5730
Train Accuracy: 0.7607
Acc of class 0 :0.8694
Acc of class 1 :0.8916
Acc of class 2 :0.6647
Acc of class 3 :0.7287
Acc of class 4 :0.8758
Acc of class 5 :0.7164
Acc of class 6 :0.7902
Acc of class 7 :0.7860
Acc of class 8 :0.7464
Acc of class 9 :0.6026
Test Accuracy: 0.7685
Train on 26500 examples.
Acc of class 0 :0.8926
Acc of class 1 :0.8638
Acc of class 2 :0.7083
Acc of class 3 :0.7415
Acc of class 4 :0.7752
Acc of class 5 :0.5552
Acc of class 6 :0.8721
Acc of class 7 :0.8022
Acc of class 8 :0.7365
Acc of class 9 :0.7210
Train Accuracy: 0.7700
Acc of class 0 :0.9020
Acc of class 1 :0.8802
Acc of class 2 :0.6967
Acc of class 3 :0.7505
Acc of class 4 :0.7902
Acc of class 5 :0.5852
Acc of class 6 :0.8622
Acc of class 7 :0.7957
Acc of class 8 :0.7669
Acc of class 9 :0.7502
Test Accuracy: 0.7806
Train on 27000 examples.
Acc of class 0 :0.8285
Acc of class 1 :0.8714
Acc of class 2 :0.6737
Acc of class 3 :0.7511
Acc of class 4 :0.7586
Acc of class 5 :0.5802
Acc of class 6 :0.8696
Acc of class 7 :0.8348
Acc of class 8 :0.7618
Acc of class 9 :0.7115
Train Accuracy: 0.7674

Acc of class 0 :0.8418
Acc of class 1 :0.8775
Acc of class 2 :0.6570
Acc of class 3 :0.7683
Acc of class 4 :0.7821
Acc of class 5 :0.6020
Acc of class 6 :0.8570
Acc of class 7 :0.8307
Acc of class 8 :0.7587
Acc of class 9 :0.7502
Test Accuracy: 0.7751
Train on 27500 examples.
Acc of class 0 :0.8572
Acc of class 1 :0.8629
Acc of class 2 :0.7254
Acc of class 3 :0.6276
Acc of class 4 :0.7333
Acc of class 5 :0.6600
Acc of class 6 :0.8540
Acc of class 7 :0.8449
Acc of class 8 :0.7853
Acc of class 9 :0.6924
Train Accuracy: 0.7665
Acc of class 0 :0.8704
Acc of class 1 :0.8784
Acc of class 2 :0.7151
Acc of class 3 :0.6347
Acc of class 4 :0.7597
Acc of class 5 :0.6839
Acc of class 6 :0.8392
Acc of class 7 :0.8414
Acc of class 8 :0.7864
Acc of class 9 :0.7225
Test Accuracy: 0.7749
Train on 28000 examples.
Acc of class 0 :0.8583
Acc of class 1 :0.8842
Acc of class 2 :0.7798
Acc of class 3 :0.6834
Acc of class 4 :0.7718
Acc of class 5 :0.6947
Acc of class 6 :0.8241
Acc of class 7 :0.8267
Acc of class 8 :0.6310
Acc of class 9 :0.7033
Train Accuracy: 0.7681
Acc of class 0 :0.8765
Acc of class 1 :0.9004
Acc of class 2 :0.7529
Acc of class 3 :0.6931
Acc of class 4 :0.7902
Acc of class 5 :0.7130
Acc of class 6 :0.8163
Acc of class 7 :0.8249
Acc of class 8 :0.6427
Acc of class 9 :0.7235
Test Accuracy: 0.7756

Train on 28500 examples.

Acc of class 0 :0.8475

Acc of class 1 :0.8457

Acc of class 2 :0.7979

Acc of class 3 :0.6315

Acc of class 4 :0.6686

Acc of class 5 :0.7246

Acc of class 6 :0.8111

Acc of class 7 :0.7706

Acc of class 8 :0.6095

Acc of class 9 :0.8136

Train Accuracy: 0.7536

Acc of class 0 :0.8694

Acc of class 1 :0.8652

Acc of class 2 :0.7762

Acc of class 3 :0.6238

Acc of class 4 :0.6660

Acc of class 5 :0.7500

Acc of class 6 :0.8069

Acc of class 7 :0.7685

Acc of class 8 :0.6129

Acc of class 9 :0.8355

Test Accuracy: 0.7591

Train on 29000 examples.

Acc of class 0 :0.8089

Acc of class 1 :0.8361

Acc of class 2 :0.7790

Acc of class 3 :0.7664

Acc of class 4 :0.8192

Acc of class 5 :0.7045

Acc of class 6 :0.8057

Acc of class 7 :0.7941

Acc of class 8 :0.4931

Acc of class 9 :0.7031

Train Accuracy: 0.7531

Acc of class 0 :0.8235

Acc of class 1 :0.8537

Acc of class 2 :0.7616

Acc of class 3 :0.7703

Acc of class 4 :0.8381

Acc of class 5 :0.7209

Acc of class 6 :0.7965

Acc of class 7 :0.7947

Acc of class 8 :0.4908

Acc of class 9 :0.7304

Test Accuracy: 0.7601

Train on 29500 examples.

Acc of class 0 :0.7886

Acc of class 1 :0.8566

Acc of class 2 :0.6692

Acc of class 3 :0.7379

Acc of class 4 :0.7706

Acc of class 5 :0.7840

Acc of class 6 :0.8168

Acc of class 7 :0.8179

Acc of class 8 :0.5941

Acc of class 9 :0.7020

```
Train Accuracy: 0.7553
Acc of class 0 :0.7990
Acc of class 1 :0.8617
Acc of class 2 :0.6502
Acc of class 3 :0.7327
Acc of class 4 :0.7984
Acc of class 5 :0.8105
Acc of class 6 :0.8017
Acc of class 7 :0.8074
Acc of class 8 :0.5801
Acc of class 9 :0.7384
Test Accuracy: 0.7587
Train on 30000 examples.
Acc of class 0 :0.8418
Acc of class 1 :0.8216
Acc of class 2 :0.6823
Acc of class 3 :0.7473
Acc of class 4 :0.7775
Acc of class 5 :0.6373
Acc of class 6 :0.8423
Acc of class 7 :0.7799
Acc of class 8 :0.6992
Acc of class 9 :0.7800
Train Accuracy: 0.7629
Acc of class 0 :0.8592
Acc of class 1 :0.8300
Acc of class 2 :0.6783
Acc of class 3 :0.7554
Acc of class 4 :0.7912
Acc of class 5 :0.6648
Acc of class 6 :0.8299
Acc of class 7 :0.7782
Acc of class 8 :0.6920
Acc of class 9 :0.8097
Test Accuracy: 0.7703
Train on 30500 examples.
Acc of class 0 :0.8690
Acc of class 1 :0.8904
Acc of class 2 :0.7001
Acc of class 3 :0.7208
Acc of class 4 :0.6989
Acc of class 5 :0.6716
Acc of class 6 :0.8603
Acc of class 7 :0.7654
Acc of class 8 :0.5965
Acc of class 9 :0.8314
Train Accuracy: 0.7631
Acc of class 0 :0.8837
Acc of class 1 :0.8960
Acc of class 2 :0.6899
Acc of class 3 :0.7228
Acc of class 4 :0.6976
Acc of class 5 :0.6984
Acc of class 6 :0.8403
Acc of class 7 :0.7617
Acc of class 8 :0.6016
Acc of class 9 :0.8484
```

Test Accuracy: 0.7663
Train on 31000 examples.
Acc of class 0 :0.8460
Acc of class 1 :0.8462
Acc of class 2 :0.7160
Acc of class 3 :0.7700
Acc of class 4 :0.8338
Acc of class 5 :0.5401
Acc of class 6 :0.8741
Acc of class 7 :0.8139
Acc of class 8 :0.7313
Acc of class 9 :0.6361
Train Accuracy: 0.7640
Acc of class 0 :0.8643
Acc of class 1 :0.8617
Acc of class 2 :0.7064
Acc of class 3 :0.7871
Acc of class 4 :0.8462
Acc of class 5 :0.5504
Acc of class 6 :0.8643
Acc of class 7 :0.8103
Acc of class 8 :0.7238
Acc of class 9 :0.6492
Test Accuracy: 0.7692
Train on 31500 examples.
Acc of class 0 :0.8842
Acc of class 1 :0.8468
Acc of class 2 :0.6432
Acc of class 3 :0.7831
Acc of class 4 :0.7768
Acc of class 5 :0.6228
Acc of class 6 :0.8202
Acc of class 7 :0.7976
Acc of class 8 :0.7353
Acc of class 9 :0.7188
Train Accuracy: 0.7654
Acc of class 0 :0.8980
Acc of class 1 :0.8581
Acc of class 2 :0.6260
Acc of class 3 :0.7911
Acc of class 4 :0.7841
Acc of class 5 :0.6300
Acc of class 6 :0.7996
Acc of class 7 :0.7967
Acc of class 8 :0.7310
Acc of class 9 :0.7265
Test Accuracy: 0.7661
Train on 32000 examples.
Acc of class 0 :0.8374
Acc of class 1 :0.8545
Acc of class 2 :0.6814
Acc of class 3 :0.7813
Acc of class 4 :0.7956
Acc of class 5 :0.6879
Acc of class 6 :0.8305
Acc of class 7 :0.8222
Acc of class 8 :0.6597

Acc of class 9 :0.6899
Train Accuracy: 0.7663
Acc of class 0 :0.8561
Acc of class 1 :0.8652
Acc of class 2 :0.6812
Acc of class 3 :0.7901
Acc of class 4 :0.8198
Acc of class 5 :0.6928
Acc of class 6 :0.8100
Acc of class 7 :0.8200
Acc of class 8 :0.6417
Acc of class 9 :0.7126
Test Accuracy: 0.7708
Train on 32500 examples.
Acc of class 0 :0.8052
Acc of class 1 :0.9018
Acc of class 2 :0.7414
Acc of class 3 :0.6878
Acc of class 4 :0.8324
Acc of class 5 :0.6390
Acc of class 6 :0.6744
Acc of class 7 :0.7555
Acc of class 8 :0.7438
Acc of class 9 :0.7203
Train Accuracy: 0.7529
Acc of class 0 :0.8296
Acc of class 1 :0.9093
Acc of class 2 :0.7277
Acc of class 3 :0.6792
Acc of class 4 :0.8554
Acc of class 5 :0.6648
Acc of class 6 :0.6566
Acc of class 7 :0.7607
Acc of class 8 :0.7515
Acc of class 9 :0.7423
Test Accuracy: 0.7607
Train on 33000 examples.
Acc of class 0 :0.8231
Acc of class 1 :0.8888
Acc of class 2 :0.7289
Acc of class 3 :0.7172
Acc of class 4 :0.7527
Acc of class 5 :0.6604
Acc of class 6 :0.7977
Acc of class 7 :0.7524
Acc of class 8 :0.7095
Acc of class 9 :0.7864
Train Accuracy: 0.7641
Acc of class 0 :0.8459
Acc of class 1 :0.8943
Acc of class 2 :0.7161
Acc of class 3 :0.7158
Acc of class 4 :0.7678
Acc of class 5 :0.6861
Acc of class 6 :0.7829
Acc of class 7 :0.7549
Acc of class 8 :0.7125

Acc of class 9 :0.7929
Test Accuracy: 0.7692
Train on 33500 examples.
Acc of class 0 :0.8394
Acc of class 1 :0.8846
Acc of class 2 :0.7004
Acc of class 3 :0.7111
Acc of class 4 :0.6938
Acc of class 5 :0.6159
Acc of class 6 :0.8310
Acc of class 7 :0.7802
Acc of class 8 :0.7395
Acc of class 9 :0.8074
Train Accuracy: 0.7633
Acc of class 0 :0.8561
Acc of class 1 :0.8916
Acc of class 2 :0.6928
Acc of class 3 :0.7119
Acc of class 4 :0.6894
Acc of class 5 :0.6177
Acc of class 6 :0.8142
Acc of class 7 :0.7850
Acc of class 8 :0.7444
Acc of class 9 :0.8137
Test Accuracy: 0.7646
Train on 34000 examples.
Acc of class 0 :0.8215
Acc of class 1 :0.8957
Acc of class 2 :0.7580
Acc of class 3 :0.7046
Acc of class 4 :0.8013
Acc of class 5 :0.7340
Acc of class 6 :0.8129
Acc of class 7 :0.8184
Acc of class 8 :0.5826
Acc of class 9 :0.7169
Train Accuracy: 0.7669
Acc of class 0 :0.8418
Acc of class 1 :0.9040
Acc of class 2 :0.7578
Acc of class 3 :0.7010
Acc of class 4 :0.8167
Acc of class 5 :0.7444
Acc of class 6 :0.7996
Acc of class 7 :0.8220
Acc of class 8 :0.6047
Acc of class 9 :0.7265
Test Accuracy: 0.7740
Train on 34500 examples.
Acc of class 0 :0.8568
Acc of class 1 :0.8643
Acc of class 2 :0.7318
Acc of class 3 :0.7599
Acc of class 4 :0.7838
Acc of class 5 :0.6395
Acc of class 6 :0.8243
Acc of class 7 :0.7947

Acc of class 8 :0.6512
Acc of class 9 :0.7494
Train Accuracy: 0.7682
Acc of class 0 :0.8755
Acc of class 1 :0.8731
Acc of class 2 :0.7326
Acc of class 3 :0.7634
Acc of class 4 :0.7974
Acc of class 5 :0.6357
Acc of class 6 :0.8069
Acc of class 7 :0.7938
Acc of class 8 :0.6663
Acc of class 9 :0.7562
Test Accuracy: 0.7727
Train on 35000 examples.
Acc of class 0 :0.8052
Acc of class 1 :0.8186
Acc of class 2 :0.6959
Acc of class 3 :0.6849
Acc of class 4 :0.7663
Acc of class 5 :0.7043
Acc of class 6 :0.8008
Acc of class 7 :0.8032
Acc of class 8 :0.7659
Acc of class 9 :0.7344
Train Accuracy: 0.7591
Acc of class 0 :0.8306
Acc of class 1 :0.8256
Acc of class 2 :0.6812
Acc of class 3 :0.6812
Acc of class 4 :0.7760
Acc of class 5 :0.7085
Acc of class 6 :0.7829
Acc of class 7 :0.8025
Acc of class 8 :0.7536
Acc of class 9 :0.7443
Test Accuracy: 0.7596
Train on 35500 examples.
Acc of class 0 :0.7881
Acc of class 1 :0.8189
Acc of class 2 :0.7214
Acc of class 3 :0.8322
Acc of class 4 :0.7847
Acc of class 5 :0.5320
Acc of class 6 :0.8069
Acc of class 7 :0.8045
Acc of class 8 :0.6558
Acc of class 9 :0.7292
Train Accuracy: 0.7508
Acc of class 0 :0.8061
Acc of class 1 :0.8317
Acc of class 2 :0.7045
Acc of class 3 :0.8495
Acc of class 4 :0.7872
Acc of class 5 :0.5437
Acc of class 6 :0.7933
Acc of class 7 :0.8054

Acc of class 8 :0.6643
Acc of class 9 :0.7324
Test Accuracy: 0.7551
Train on 36000 examples.
Acc of class 0 :0.8290
Acc of class 1 :0.8171
Acc of class 2 :0.7422
Acc of class 3 :0.5914
Acc of class 4 :0.8374
Acc of class 5 :0.6041
Acc of class 6 :0.8158
Acc of class 7 :0.8211
Acc of class 8 :0.8050
Acc of class 9 :0.6586
Train Accuracy: 0.7539
Acc of class 0 :0.8551
Acc of class 1 :0.8273
Acc of class 2 :0.7287
Acc of class 3 :0.5822
Acc of class 4 :0.8473
Acc of class 5 :0.6020
Acc of class 6 :0.8069
Acc of class 7 :0.8239
Acc of class 8 :0.8080
Acc of class 9 :0.6749
Test Accuracy: 0.7574
Train on 36500 examples.
Acc of class 0 :0.8177
Acc of class 1 :0.8738
Acc of class 2 :0.7096
Acc of class 3 :0.7410
Acc of class 4 :0.7872
Acc of class 5 :0.6419
Acc of class 6 :0.8907
Acc of class 7 :0.7939
Acc of class 8 :0.6491
Acc of class 9 :0.7793
Train Accuracy: 0.7711
Acc of class 0 :0.8337
Acc of class 1 :0.8837
Acc of class 2 :0.7093
Acc of class 3 :0.7475
Acc of class 4 :0.8045
Acc of class 5 :0.6401
Acc of class 6 :0.8800
Acc of class 7 :0.7986
Acc of class 8 :0.6725
Acc of class 9 :0.7879
Test Accuracy: 0.7782
Train on 37000 examples.
Acc of class 0 :0.8226
Acc of class 1 :0.9156
Acc of class 2 :0.7464
Acc of class 3 :0.6965
Acc of class 4 :0.8208
Acc of class 5 :0.5868
Acc of class 6 :0.8915

Acc of class 7 :0.8252
Acc of class 8 :0.7182
Acc of class 9 :0.6771
Train Accuracy: 0.7736
Acc of class 0 :0.8490
Acc of class 1 :0.9339
Acc of class 2 :0.7490
Acc of class 3 :0.7139
Acc of class 4 :0.8381
Acc of class 5 :0.6087
Acc of class 6 :0.8831
Acc of class 7 :0.8288
Acc of class 8 :0.7485
Acc of class 9 :0.6908
Test Accuracy: 0.7876
Train on 37500 examples.
Acc of class 0 :0.7452
Acc of class 1 :0.8894
Acc of class 2 :0.7971
Acc of class 3 :0.8004
Acc of class 4 :0.7554
Acc of class 5 :0.5901
Acc of class 6 :0.8474
Acc of class 7 :0.7976
Acc of class 8 :0.6395
Acc of class 9 :0.7373
Train Accuracy: 0.7636
Acc of class 0 :0.7724
Acc of class 1 :0.8969
Acc of class 2 :0.7665
Acc of class 3 :0.8010
Acc of class 4 :0.7780
Acc of class 5 :0.5942
Acc of class 6 :0.8486
Acc of class 7 :0.7938
Acc of class 8 :0.6704
Acc of class 9 :0.7522
Test Accuracy: 0.7710
Train on 38000 examples.
Acc of class 0 :0.8168
Acc of class 1 :0.9008
Acc of class 2 :0.7576
Acc of class 3 :0.7813
Acc of class 4 :0.8295
Acc of class 5 :0.4992
Acc of class 6 :0.7927
Acc of class 7 :0.8109
Acc of class 8 :0.7165
Acc of class 9 :0.6831
Train Accuracy: 0.7632
Acc of class 0 :0.8357
Acc of class 1 :0.9084
Acc of class 2 :0.7180
Acc of class 3 :0.7901
Acc of class 4 :0.8401
Acc of class 5 :0.5067
Acc of class 6 :0.7891

Acc of class 7 :0.8161
Acc of class 8 :0.7474
Acc of class 9 :0.6918
Test Accuracy: 0.7687
Train on 38500 examples.
Acc of class 0 :0.8094
Acc of class 1 :0.8754
Acc of class 2 :0.8202
Acc of class 3 :0.6544
Acc of class 4 :0.8033
Acc of class 5 :0.6372
Acc of class 6 :0.8395
Acc of class 7 :0.8559
Acc of class 8 :0.6715
Acc of class 9 :0.6845
Train Accuracy: 0.7679
Acc of class 0 :0.8265
Acc of class 1 :0.8863
Acc of class 2 :0.7946
Acc of class 3 :0.6564
Acc of class 4 :0.8310
Acc of class 5 :0.6457
Acc of class 6 :0.8372
Acc of class 7 :0.8512
Acc of class 8 :0.6982
Acc of class 9 :0.7066
Test Accuracy: 0.7761
Train on 39000 examples.
Acc of class 0 :0.8121
Acc of class 1 :0.8670
Acc of class 2 :0.7239
Acc of class 3 :0.7023
Acc of class 4 :0.8535
Acc of class 5 :0.7072
Acc of class 6 :0.7942
Acc of class 7 :0.8524
Acc of class 8 :0.7028
Acc of class 9 :0.6290
Train Accuracy: 0.7665
Acc of class 0 :0.8316
Acc of class 1 :0.8749
Acc of class 2 :0.6996
Acc of class 3 :0.7000
Acc of class 4 :0.8697
Acc of class 5 :0.7164
Acc of class 6 :0.7808
Acc of class 7 :0.8492
Acc of class 8 :0.7125
Acc of class 9 :0.6492
Test Accuracy: 0.7700
Train on 39500 examples.
Acc of class 0 :0.8158
Acc of class 1 :0.8883
Acc of class 2 :0.7509
Acc of class 3 :0.8054
Acc of class 4 :0.7628
Acc of class 5 :0.6689

Acc of class 6 :0.7844
Acc of class 7 :0.8267
Acc of class 8 :0.5749
Acc of class 9 :0.7539
Train Accuracy: 0.7664
Acc of class 0 :0.8378
Acc of class 1 :0.8907
Acc of class 2 :0.7209
Acc of class 3 :0.8168
Acc of class 4 :0.7821
Acc of class 5 :0.6693
Acc of class 6 :0.7797
Acc of class 7 :0.8249
Acc of class 8 :0.5698
Acc of class 9 :0.7740
Test Accuracy: 0.7697
Train on 40000 examples.
Acc of class 0 :0.8455
Acc of class 1 :0.8843
Acc of class 2 :0.7111
Acc of class 3 :0.7376
Acc of class 4 :0.8381
Acc of class 5 :0.6586
Acc of class 6 :0.7753
Acc of class 7 :0.8370
Acc of class 8 :0.7250
Acc of class 9 :0.6529
Train Accuracy: 0.7692
Acc of class 0 :0.8643
Acc of class 1 :0.8890
Acc of class 2 :0.6754
Acc of class 3 :0.7396
Acc of class 4 :0.8544
Acc of class 5 :0.6726
Acc of class 6 :0.7704
Acc of class 7 :0.8346
Acc of class 8 :0.7372
Acc of class 9 :0.6660
Test Accuracy: 0.7725
Train on 40500 examples.
Acc of class 0 :0.8624
Acc of class 1 :0.8671
Acc of class 2 :0.6786
Acc of class 3 :0.7051
Acc of class 4 :0.7460
Acc of class 5 :0.7187
Acc of class 6 :0.8425
Acc of class 7 :0.8109
Acc of class 8 :0.6838
Acc of class 9 :0.7756
Train Accuracy: 0.7709
Acc of class 0 :0.8796
Acc of class 1 :0.8722
Acc of class 2 :0.6550
Acc of class 3 :0.6970
Acc of class 4 :0.7688
Acc of class 5 :0.7231

Acc of class 6 :0.8278
Acc of class 7 :0.8142
Acc of class 8 :0.6971
Acc of class 9 :0.7909
Test Accuracy: 0.7739
Train on 41000 examples.
Acc of class 0 :0.8378
Acc of class 1 :0.8603
Acc of class 2 :0.7299
Acc of class 3 :0.7741
Acc of class 4 :0.7941
Acc of class 5 :0.6431
Acc of class 6 :0.7967
Acc of class 7 :0.8145
Acc of class 8 :0.6946
Acc of class 9 :0.7105
Train Accuracy: 0.7682
Acc of class 0 :0.8602
Acc of class 1 :0.8705
Acc of class 2 :0.6967
Acc of class 3 :0.7713
Acc of class 4 :0.8126
Acc of class 5 :0.6480
Acc of class 6 :0.7923
Acc of class 7 :0.8123
Acc of class 8 :0.6899
Acc of class 9 :0.7156
Test Accuracy: 0.7693
Train on 41500 examples.
Acc of class 0 :0.8435
Acc of class 1 :0.8601
Acc of class 2 :0.7014
Acc of class 3 :0.7002
Acc of class 4 :0.7645
Acc of class 5 :0.5877
Acc of class 6 :0.8099
Acc of class 7 :0.8208
Acc of class 8 :0.7819
Acc of class 9 :0.7396
Train Accuracy: 0.7638
Acc of class 0 :0.8633
Acc of class 1 :0.8652
Acc of class 2 :0.6686
Acc of class 3 :0.7000
Acc of class 4 :0.7770
Acc of class 5 :0.5953
Acc of class 6 :0.8038
Acc of class 7 :0.8220
Acc of class 8 :0.7731
Acc of class 9 :0.7532
Test Accuracy: 0.7647
Train on 42000 examples.
Acc of class 0 :0.8583
Acc of class 1 :0.9003
Acc of class 2 :0.7467
Acc of class 3 :0.8022
Acc of class 4 :0.7451

Acc of class 5 :0.5274
Acc of class 6 :0.8383
Acc of class 7 :0.7713
Acc of class 8 :0.6657
Acc of class 9 :0.7900
Train Accuracy: 0.7687
Acc of class 0 :0.8755
Acc of class 1 :0.9022
Acc of class 2 :0.7141
Acc of class 3 :0.8069
Acc of class 4 :0.7658
Acc of class 5 :0.5493
Acc of class 6 :0.8319
Acc of class 7 :0.7636
Acc of class 8 :0.6550
Acc of class 9 :0.8018
Test Accuracy: 0.7705
Train on 42500 examples.
Acc of class 0 :0.8695
Acc of class 1 :0.8885
Acc of class 2 :0.7254
Acc of class 3 :0.7322
Acc of class 4 :0.7662
Acc of class 5 :0.6641
Acc of class 6 :0.8097
Acc of class 7 :0.7641
Acc of class 8 :0.6551
Acc of class 9 :0.7991
Train Accuracy: 0.7699
Acc of class 0 :0.8837
Acc of class 1 :0.8943
Acc of class 2 :0.6996
Acc of class 3 :0.7317
Acc of class 4 :0.7780
Acc of class 5 :0.6783
Acc of class 6 :0.7933
Acc of class 7 :0.7578
Acc of class 8 :0.6550
Acc of class 9 :0.8127
Test Accuracy: 0.7708
Train on 43000 examples.
Acc of class 0 :0.8627
Acc of class 1 :0.8971
Acc of class 2 :0.7560
Acc of class 3 :0.7190
Acc of class 4 :0.8345
Acc of class 5 :0.6082
Acc of class 6 :0.8018
Acc of class 7 :0.8215
Acc of class 8 :0.6980
Acc of class 9 :0.7100
Train Accuracy: 0.7740
Acc of class 0 :0.8827
Acc of class 1 :0.9004
Acc of class 2 :0.7248
Acc of class 3 :0.7069
Acc of class 4 :0.8534

Acc of class 5 :0.6222
Acc of class 6 :0.7902
Acc of class 7 :0.8239
Acc of class 8 :0.7002
Acc of class 9 :0.7156
Test Accuracy: 0.7750
Train on 43500 examples.
Acc of class 0 :0.8217
Acc of class 1 :0.8454
Acc of class 2 :0.6687
Acc of class 3 :0.7622
Acc of class 4 :0.7677
Acc of class 5 :0.7607
Acc of class 6 :0.8344
Acc of class 7 :0.8228
Acc of class 8 :0.5975
Acc of class 9 :0.7742
Train Accuracy: 0.7671
Acc of class 0 :0.8429
Acc of class 1 :0.8546
Acc of class 2 :0.6434
Acc of class 3 :0.7564
Acc of class 4 :0.7821
Acc of class 5 :0.7747
Acc of class 6 :0.8205
Acc of class 7 :0.8181
Acc of class 8 :0.5811
Acc of class 9 :0.7839
Test Accuracy: 0.7667
Train on 44000 examples.
Acc of class 0 :0.8470
Acc of class 1 :0.8149
Acc of class 2 :0.7355
Acc of class 3 :0.7829
Acc of class 4 :0.8037
Acc of class 5 :0.6558
Acc of class 6 :0.8520
Acc of class 7 :0.8110
Acc of class 8 :0.6807
Acc of class 9 :0.7110
Train Accuracy: 0.7713
Acc of class 0 :0.8531
Acc of class 1 :0.8247
Acc of class 2 :0.7103
Acc of class 3 :0.7851
Acc of class 4 :0.8269
Acc of class 5 :0.6614
Acc of class 6 :0.8424
Acc of class 7 :0.8035
Acc of class 8 :0.6468
Acc of class 9 :0.7265
Test Accuracy: 0.7696
Train on 44500 examples.
Acc of class 0 :0.8253
Acc of class 1 :0.8437
Acc of class 2 :0.6851
Acc of class 3 :0.8225

Acc of class 4 :0.8408
Acc of class 5 :0.6158
Acc of class 6 :0.7984
Acc of class 7 :0.7421
Acc of class 8 :0.6953
Acc of class 9 :0.7095
Train Accuracy: 0.7602
Acc of class 0 :0.8439
Acc of class 1 :0.8476
Acc of class 2 :0.6570
Acc of class 3 :0.8208
Acc of class 4 :0.8483
Acc of class 5 :0.6166
Acc of class 6 :0.8006
Acc of class 7 :0.7315
Acc of class 8 :0.6622
Acc of class 9 :0.7136
Test Accuracy: 0.7563
Train on 45000 examples.
Acc of class 0 :0.7962
Acc of class 1 :0.8423
Acc of class 2 :0.6650
Acc of class 3 :0.6603
Acc of class 4 :0.7703
Acc of class 5 :0.7665
Acc of class 6 :0.8163
Acc of class 7 :0.8306
Acc of class 8 :0.7669
Acc of class 9 :0.7403
Train Accuracy: 0.7664
Acc of class 0 :0.8184
Acc of class 1 :0.8485
Acc of class 2 :0.6366
Acc of class 3 :0.6475
Acc of class 4 :0.7882
Acc of class 5 :0.7881
Acc of class 6 :0.8132
Acc of class 7 :0.8268
Acc of class 8 :0.7639
Acc of class 9 :0.7463
Test Accuracy: 0.7679
Train on 45500 examples.
Acc of class 0 :0.8166
Acc of class 1 :0.8449
Acc of class 2 :0.7831
Acc of class 3 :0.6304
Acc of class 4 :0.7136
Acc of class 5 :0.7738
Acc of class 6 :0.7813
Acc of class 7 :0.8062
Acc of class 8 :0.7043
Acc of class 9 :0.7806
Train Accuracy: 0.7645
Acc of class 0 :0.8408
Acc of class 1 :0.8467
Acc of class 2 :0.7490
Acc of class 3 :0.6129

Acc of class 4 :0.7159
Acc of class 5 :0.7904
Acc of class 6 :0.7735
Acc of class 7 :0.7938
Acc of class 8 :0.7064
Acc of class 9 :0.7988
Test Accuracy: 0.7636
Train on 46000 examples.
Acc of class 0 :0.8177
Acc of class 1 :0.8322
Acc of class 2 :0.7477
Acc of class 3 :0.6854
Acc of class 4 :0.8441
Acc of class 5 :0.6122
Acc of class 6 :0.8109
Acc of class 7 :0.8198
Acc of class 8 :0.8123
Acc of class 9 :0.6194
Train Accuracy: 0.7622
Acc of class 0 :0.8367
Acc of class 1 :0.8370
Acc of class 2 :0.7103
Acc of class 3 :0.6772
Acc of class 4 :0.8595
Acc of class 5 :0.6222
Acc of class 6 :0.8184
Acc of class 7 :0.8084
Acc of class 8 :0.8183
Acc of class 9 :0.6244
Test Accuracy: 0.7628
Train on 46500 examples.
Acc of class 0 :0.7871
Acc of class 1 :0.8489
Acc of class 2 :0.7946
Acc of class 3 :0.8108
Acc of class 4 :0.8097
Acc of class 5 :0.6058
Acc of class 6 :0.7660
Acc of class 7 :0.8463
Acc of class 8 :0.6392
Acc of class 9 :0.6899
Train Accuracy: 0.7631
Acc of class 0 :0.8061
Acc of class 1 :0.8573
Acc of class 2 :0.7626
Acc of class 3 :0.8149
Acc of class 4 :0.8147
Acc of class 5 :0.6099
Acc of class 6 :0.7641
Acc of class 7 :0.8278
Acc of class 8 :0.6366
Acc of class 9 :0.6967
Test Accuracy: 0.7623
Train on 47000 examples.
Acc of class 0 :0.8352
Acc of class 1 :0.8345
Acc of class 2 :0.7226

Acc of class 3 :0.6355
Acc of class 4 :0.8271
Acc of class 5 :0.7421
Acc of class 6 :0.8025
Acc of class 7 :0.8613
Acc of class 8 :0.7676
Acc of class 9 :0.5893
Train Accuracy: 0.7629
Acc of class 0 :0.8582
Acc of class 1 :0.8370
Acc of class 2 :0.6928
Acc of class 3 :0.6267
Acc of class 4 :0.8422
Acc of class 5 :0.7578
Acc of class 6 :0.7965
Acc of class 7 :0.8424
Acc of class 8 :0.7690
Acc of class 9 :0.6046
Test Accuracy: 0.7630
Train on 47500 examples.
Acc of class 0 :0.8774
Acc of class 1 :0.8586
Acc of class 2 :0.7150
Acc of class 3 :0.7413
Acc of class 4 :0.7792
Acc of class 5 :0.6307
Acc of class 6 :0.8288
Acc of class 7 :0.7974
Acc of class 8 :0.7587
Acc of class 9 :0.7287
Train Accuracy: 0.7740
Acc of class 0 :0.8939
Acc of class 1 :0.8670
Acc of class 2 :0.6802
Acc of class 3 :0.7436
Acc of class 4 :0.7882
Acc of class 5 :0.6312
Acc of class 6 :0.8225
Acc of class 7 :0.7967
Acc of class 8 :0.7649
Acc of class 9 :0.7284
Test Accuracy: 0.7737
Train on 48000 examples.
Acc of class 0 :0.7876
Acc of class 1 :0.8588
Acc of class 2 :0.7360
Acc of class 3 :0.7845
Acc of class 4 :0.7395
Acc of class 5 :0.7104
Acc of class 6 :0.8141
Acc of class 7 :0.8091
Acc of class 8 :0.6814
Acc of class 9 :0.7092
Train Accuracy: 0.7652
Acc of class 0 :0.8163
Acc of class 1 :0.8652
Acc of class 2 :0.6996

Acc of class 3 :0.7960
Acc of class 4 :0.7495
Acc of class 5 :0.7388
Acc of class 6 :0.8142
Acc of class 7 :0.7986
Acc of class 8 :0.6612
Acc of class 9 :0.7146
Test Accuracy: 0.7669
Train on 48500 examples.
Acc of class 0 :0.8042
Acc of class 1 :0.8678
Acc of class 2 :0.7546
Acc of class 3 :0.7855
Acc of class 4 :0.7836
Acc of class 5 :0.6567
Acc of class 6 :0.8244
Acc of class 7 :0.7998
Acc of class 8 :0.7024
Acc of class 9 :0.6926
Train Accuracy: 0.7697
Acc of class 0 :0.8286
Acc of class 1 :0.8740
Acc of class 2 :0.7161
Acc of class 3 :0.7990
Acc of class 4 :0.8035
Acc of class 5 :0.6682
Acc of class 6 :0.8236
Acc of class 7 :0.7870
Acc of class 8 :0.6992
Acc of class 9 :0.6947
Test Accuracy: 0.7715
Train on 49000 examples.
Acc of class 0 :0.8378
Acc of class 1 :0.8686
Acc of class 2 :0.7751
Acc of class 3 :0.7535
Acc of class 4 :0.8155
Acc of class 5 :0.6954
Acc of class 6 :0.8227
Acc of class 7 :0.8022
Acc of class 8 :0.6402
Acc of class 9 :0.6944
Train Accuracy: 0.7727
Acc of class 0 :0.8673
Acc of class 1 :0.8722
Acc of class 2 :0.7452
Acc of class 3 :0.7594
Acc of class 4 :0.8238
Acc of class 5 :0.7197
Acc of class 6 :0.8173
Acc of class 7 :0.7947
Acc of class 8 :0.6550
Acc of class 9 :0.7056
Test Accuracy: 0.7777
Train on 49500 examples.
Acc of class 0 :0.8366
Acc of class 1 :0.8612

Acc of class 2 :0.7503
Acc of class 3 :0.7531
Acc of class 4 :0.7277
Acc of class 5 :0.6477
Acc of class 6 :0.8251
Acc of class 7 :0.7777
Acc of class 8 :0.7260
Acc of class 9 :0.7818
Train Accuracy: 0.7711
Acc of class 0 :0.8633
Acc of class 1 :0.8670
Acc of class 2 :0.7122
Acc of class 3 :0.7653
Acc of class 4 :0.7301
Acc of class 5 :0.6614
Acc of class 6 :0.8132
Acc of class 7 :0.7646
Acc of class 8 :0.7310
Acc of class 9 :0.7978
Test Accuracy: 0.7727
Train on 50000 examples.
Acc of class 0 :0.8229
Acc of class 1 :0.8462
Acc of class 2 :0.7338
Acc of class 3 :0.6865
Acc of class 4 :0.7402
Acc of class 5 :0.6694
Acc of class 6 :0.8643
Acc of class 7 :0.8394
Acc of class 8 :0.7636
Acc of class 9 :0.7257
Train Accuracy: 0.7712
Acc of class 0 :0.8459
Acc of class 1 :0.8502
Acc of class 2 :0.7045
Acc of class 3 :0.6941
Acc of class 4 :0.7587
Acc of class 5 :0.6962
Acc of class 6 :0.8486
Acc of class 7 :0.8268
Acc of class 8 :0.7721
Acc of class 9 :0.7542
Test Accuracy: 0.7764
Train on 50500 examples.
Acc of class 0 :0.8361
Acc of class 1 :0.8621
Acc of class 2 :0.6851
Acc of class 3 :0.8062
Acc of class 4 :0.7446
Acc of class 5 :0.6281
Acc of class 6 :0.8604
Acc of class 7 :0.8575
Acc of class 8 :0.6806
Acc of class 9 :0.7352
Train Accuracy: 0.7727
Acc of class 0 :0.8582
Acc of class 1 :0.8652

Acc of class 2 :0.6424
Acc of class 3 :0.8198
Acc of class 4 :0.7617
Acc of class 5 :0.6413
Acc of class 6 :0.8413
Acc of class 7 :0.8424
Acc of class 8 :0.6756
Acc of class 9 :0.7661
Test Accuracy: 0.7737
Train on 51000 examples.
Acc of class 0 :0.8028
Acc of class 1 :0.8845
Acc of class 2 :0.7550
Acc of class 3 :0.6514
Acc of class 4 :0.7761
Acc of class 5 :0.7827
Acc of class 6 :0.8358
Acc of class 7 :0.8298
Acc of class 8 :0.6507
Acc of class 9 :0.7265
Train Accuracy: 0.7710
Acc of class 0 :0.8235
Acc of class 1 :0.9013
Acc of class 2 :0.7287
Acc of class 3 :0.6485
Acc of class 4 :0.7902
Acc of class 5 :0.8016
Acc of class 6 :0.8267
Acc of class 7 :0.8191
Acc of class 8 :0.6786
Acc of class 9 :0.7473
Test Accuracy: 0.7777
Train on 51500 examples.
Acc of class 0 :0.8413
Acc of class 1 :0.8713
Acc of class 2 :0.6673
Acc of class 3 :0.6638
Acc of class 4 :0.7961
Acc of class 5 :0.7652
Acc of class 6 :0.8238
Acc of class 7 :0.8571
Acc of class 8 :0.7310
Acc of class 9 :0.6620
Train Accuracy: 0.7694
Acc of class 0 :0.8633
Acc of class 1 :0.8819
Acc of class 2 :0.6512
Acc of class 3 :0.6723
Acc of class 4 :0.8096
Acc of class 5 :0.7892
Acc of class 6 :0.8058
Acc of class 7 :0.8434
Acc of class 8 :0.7433
Acc of class 9 :0.6749
Test Accuracy: 0.7741
Train on 52000 examples.
Acc of class 0 :0.8275

Acc of class 1 :0.8493
Acc of class 2 :0.6687
Acc of class 3 :0.7854
Acc of class 4 :0.7672
Acc of class 5 :0.7047
Acc of class 6 :0.8135
Acc of class 7 :0.8358
Acc of class 8 :0.7083
Acc of class 9 :0.7062
Train Accuracy: 0.7687
Acc of class 0 :0.8541
Acc of class 1 :0.8555
Acc of class 2 :0.6386
Acc of class 3 :0.8020
Acc of class 4 :0.7841
Acc of class 5 :0.7175
Acc of class 6 :0.7996
Acc of class 7 :0.8268
Acc of class 8 :0.7156
Acc of class 9 :0.7284
Test Accuracy: 0.7735
Train on 52500 examples.
Acc of class 0 :0.8190
Acc of class 1 :0.8649
Acc of class 2 :0.7221
Acc of class 3 :0.7105
Acc of class 4 :0.7544
Acc of class 5 :0.7143
Acc of class 6 :0.8180
Acc of class 7 :0.8042
Acc of class 8 :0.7371
Acc of class 9 :0.7470
Train Accuracy: 0.7709
Acc of class 0 :0.8439
Acc of class 1 :0.8749
Acc of class 2 :0.6928
Acc of class 3 :0.7257
Acc of class 4 :0.7668
Acc of class 5 :0.7365
Acc of class 6 :0.8090
Acc of class 7 :0.7977
Acc of class 8 :0.7433
Acc of class 9 :0.7602
Test Accuracy: 0.7764
Train on 53000 examples.
Acc of class 0 :0.8541
Acc of class 1 :0.8538
Acc of class 2 :0.7842
Acc of class 3 :0.8139
Acc of class 4 :0.7790
Acc of class 5 :0.5350
Acc of class 6 :0.7827
Acc of class 7 :0.8369
Acc of class 8 :0.6418
Acc of class 9 :0.7065
Train Accuracy: 0.7627
Acc of class 0 :0.8806

Acc of class 1 :0.8670
Acc of class 2 :0.7587
Acc of class 3 :0.8208
Acc of class 4 :0.7882
Acc of class 5 :0.5628
Acc of class 6 :0.7745
Acc of class 7 :0.8298
Acc of class 8 :0.6602
Acc of class 9 :0.7225
Test Accuracy: 0.7702
Train on 53500 examples.
Acc of class 0 :0.8496
Acc of class 1 :0.8601
Acc of class 2 :0.7152
Acc of class 3 :0.7871
Acc of class 4 :0.7715
Acc of class 5 :0.7209
Acc of class 6 :0.7550
Acc of class 7 :0.7488
Acc of class 8 :0.6542
Acc of class 9 :0.7563
Train Accuracy: 0.7637
Acc of class 0 :0.8735
Acc of class 1 :0.8696
Acc of class 2 :0.6822
Acc of class 3 :0.8030
Acc of class 4 :0.7902
Acc of class 5 :0.7478
Acc of class 6 :0.7443
Acc of class 7 :0.7461
Acc of class 8 :0.6766
Acc of class 9 :0.7701
Test Accuracy: 0.7717
Train on 54000 examples.
Acc of class 0 :0.8264
Acc of class 1 :0.8420
Acc of class 2 :0.7377
Acc of class 3 :0.7584
Acc of class 4 :0.8304
Acc of class 5 :0.7133
Acc of class 6 :0.7241
Acc of class 7 :0.7049
Acc of class 8 :0.7175
Acc of class 9 :0.6875
Train Accuracy: 0.7554
Acc of class 0 :0.8551
Acc of class 1 :0.8485
Acc of class 2 :0.7103
Acc of class 3 :0.7743
Acc of class 4 :0.8462
Acc of class 5 :0.7276
Acc of class 6 :0.7098
Acc of class 7 :0.6955
Acc of class 8 :0.7259
Acc of class 9 :0.6858
Test Accuracy: 0.7590
Train on 54500 examples.

Acc of class 0 :0.8325
Acc of class 1 :0.8149
Acc of class 2 :0.7509
Acc of class 3 :0.6674
Acc of class 4 :0.7924
Acc of class 5 :0.7757
Acc of class 6 :0.7310
Acc of class 7 :0.8115
Acc of class 8 :0.7209
Acc of class 9 :0.6884
Train Accuracy: 0.7591
Acc of class 0 :0.8602
Acc of class 1 :0.8229
Acc of class 2 :0.7190
Acc of class 3 :0.6762
Acc of class 4 :0.8167
Acc of class 5 :0.8004
Acc of class 6 :0.7255
Acc of class 7 :0.8045
Acc of class 8 :0.7248
Acc of class 9 :0.7116
Test Accuracy: 0.7664
Train on 55000 examples.
Acc of class 0 :0.8457
Acc of class 1 :0.8177
Acc of class 2 :0.7370
Acc of class 3 :0.7920
Acc of class 4 :0.7900
Acc of class 5 :0.7270
Acc of class 6 :0.7484
Acc of class 7 :0.8233
Acc of class 8 :0.6421
Acc of class 9 :0.6732
Train Accuracy: 0.7612
Acc of class 0 :0.8714
Acc of class 1 :0.8247
Acc of class 2 :0.7083
Acc of class 3 :0.8010
Acc of class 4 :0.8096
Acc of class 5 :0.7478
Acc of class 6 :0.7422
Acc of class 7 :0.8084
Acc of class 8 :0.6520
Acc of class 9 :0.6957
Test Accuracy: 0.7671
Train on 55500 examples.
Acc of class 0 :0.8477
Acc of class 1 :0.8085
Acc of class 2 :0.6746
Acc of class 3 :0.7213
Acc of class 4 :0.7715
Acc of class 5 :0.7559
Acc of class 6 :0.7942
Acc of class 7 :0.8324
Acc of class 8 :0.7445
Acc of class 9 :0.6872
Train Accuracy: 0.7646

Acc of class 0 :0.8714
Acc of class 1 :0.8115
Acc of class 2 :0.6434
Acc of class 3 :0.7198
Acc of class 4 :0.7923
Acc of class 5 :0.7691
Acc of class 6 :0.7912
Acc of class 7 :0.8230
Acc of class 8 :0.7402
Acc of class 9 :0.7126
Test Accuracy: 0.7674
Train on 56000 examples.
Acc of class 0 :0.8335
Acc of class 1 :0.8346
Acc of class 2 :0.6868
Acc of class 3 :0.8017
Acc of class 4 :0.7028
Acc of class 5 :0.6174
Acc of class 6 :0.8050
Acc of class 7 :0.8136
Acc of class 8 :0.7590
Acc of class 9 :0.7600
Train Accuracy: 0.7641
Acc of class 0 :0.8551
Acc of class 1 :0.8432
Acc of class 2 :0.6531
Acc of class 3 :0.8089
Acc of class 4 :0.7291
Acc of class 5 :0.6435
Acc of class 6 :0.7933
Acc of class 7 :0.8016
Acc of class 8 :0.7485
Acc of class 9 :0.7929
Test Accuracy: 0.7689
Train on 56500 examples.
Acc of class 0 :0.8752
Acc of class 1 :0.8616
Acc of class 2 :0.7210
Acc of class 3 :0.7475
Acc of class 4 :0.7665
Acc of class 5 :0.7582
Acc of class 6 :0.7922
Acc of class 7 :0.7580
Acc of class 8 :0.5802
Acc of class 9 :0.7739
Train Accuracy: 0.7649
Acc of class 0 :0.8898
Acc of class 1 :0.8705
Acc of class 2 :0.6909
Acc of class 3 :0.7485
Acc of class 4 :0.7841
Acc of class 5 :0.7724
Acc of class 6 :0.7808
Acc of class 7 :0.7549
Acc of class 8 :0.5883
Acc of class 9 :0.7849
Test Accuracy: 0.7677

Train on 57000 examples.

Acc of class 0 :0.8678

Acc of class 1 :0.8601

Acc of class 2 :0.7298

Acc of class 3 :0.6521

Acc of class 4 :0.8379

Acc of class 5 :0.7580

Acc of class 6 :0.8001

Acc of class 7 :0.7724

Acc of class 8 :0.6879

Acc of class 9 :0.6873

Train Accuracy: 0.7663

Acc of class 0 :0.8827

Acc of class 1 :0.8749

Acc of class 2 :0.7035

Acc of class 3 :0.6653

Acc of class 4 :0.8432

Acc of class 5 :0.7724

Acc of class 6 :0.7850

Acc of class 7 :0.7646

Acc of class 8 :0.7156

Acc of class 9 :0.6957

Test Accuracy: 0.7710

Train on 57500 examples.

Acc of class 0 :0.8480

Acc of class 1 :0.8503

Acc of class 2 :0.7764

Acc of class 3 :0.7340

Acc of class 4 :0.6963

Acc of class 5 :0.6538

Acc of class 6 :0.7935

Acc of class 7 :0.8397

Acc of class 8 :0.7322

Acc of class 9 :0.7504

Train Accuracy: 0.7700

Acc of class 0 :0.8704

Acc of class 1 :0.8617

Acc of class 2 :0.7403

Acc of class 3 :0.7545

Acc of class 4 :0.7098

Acc of class 5 :0.6682

Acc of class 6 :0.7881

Acc of class 7 :0.8210

Acc of class 8 :0.7505

Acc of class 9 :0.7770

Test Accuracy: 0.7764

Train on 58000 examples.

Acc of class 0 :0.8697

Acc of class 1 :0.8520

Acc of class 2 :0.7952

Acc of class 3 :0.7659

Acc of class 4 :0.8155

Acc of class 5 :0.5661

Acc of class 6 :0.7950

Acc of class 7 :0.8514

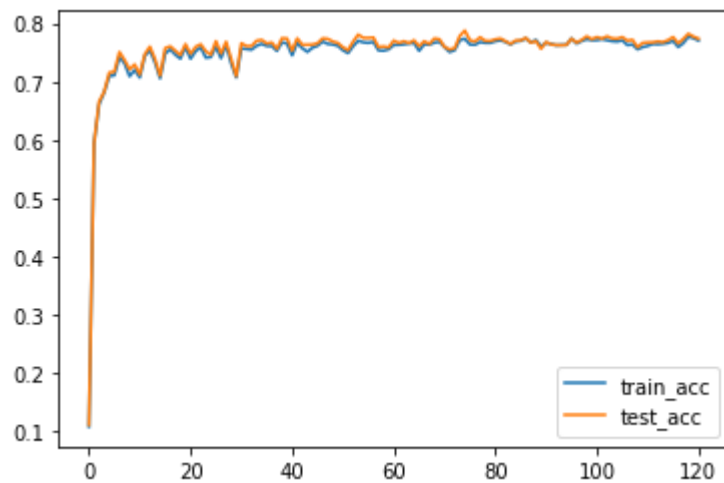
Acc of class 8 :0.7115

Acc of class 9 :0.5374

Train Accuracy: 0.7593
Acc of class 0 :0.8918
Acc of class 1 :0.8652
Acc of class 2 :0.7655
Acc of class 3 :0.7871
Acc of class 4 :0.8320
Acc of class 5 :0.5762
Acc of class 6 :0.7912
Acc of class 7 :0.8307
Acc of class 8 :0.7279
Acc of class 9 :0.5570
Test Accuracy: 0.7655
Train on 58500 examples.
Acc of class 0 :0.8616
Acc of class 1 :0.8784
Acc of class 2 :0.7983
Acc of class 3 :0.7211
Acc of class 4 :0.6008
Acc of class 5 :0.6506
Acc of class 6 :0.8511
Acc of class 7 :0.7970
Acc of class 8 :0.6539
Acc of class 9 :0.8159
Train Accuracy: 0.7658
Acc of class 0 :0.8765
Acc of class 1 :0.8899
Acc of class 2 :0.7800
Acc of class 3 :0.7366
Acc of class 4 :0.6039
Acc of class 5 :0.6603
Acc of class 6 :0.8392
Acc of class 7 :0.7918
Acc of class 8 :0.6889
Acc of class 9 :0.8345
Test Accuracy: 0.7731
Train on 59000 examples.
Acc of class 0 :0.8690
Acc of class 1 :0.8759
Acc of class 2 :0.7801
Acc of class 3 :0.7359
Acc of class 4 :0.7782
Acc of class 5 :0.6680
Acc of class 6 :0.8320
Acc of class 7 :0.8249
Acc of class 8 :0.6982
Acc of class 9 :0.6836
Train Accuracy: 0.7771
Acc of class 0 :0.8827
Acc of class 1 :0.8881
Acc of class 2 :0.7481
Acc of class 3 :0.7505
Acc of class 4 :0.7923
Acc of class 5 :0.6827
Acc of class 6 :0.8194
Acc of class 7 :0.8113
Acc of class 8 :0.7218
Acc of class 9 :0.7027

Test Accuracy: 0.7821
Train on 59500 examples.
Acc of class 0 :0.8501
Acc of class 1 :0.8959
Acc of class 2 :0.7294
Acc of class 3 :0.7054
Acc of class 4 :0.7711
Acc of class 5 :0.7855
Acc of class 6 :0.8256
Acc of class 7 :0.8346
Acc of class 8 :0.6348
Acc of class 9 :0.6947
Train Accuracy: 0.7745
Acc of class 0 :0.8673
Acc of class 1 :0.9093
Acc of class 2 :0.6977
Acc of class 3 :0.7059
Acc of class 4 :0.7933
Acc of class 5 :0.8016
Acc of class 6 :0.8090
Acc of class 7 :0.8142
Acc of class 8 :0.6489
Acc of class 9 :0.7126
Test Accuracy: 0.7772
Train on 59999 examples.
Acc of class 0 :0.8535
Acc of class 1 :0.8907
Acc of class 2 :0.6739
Acc of class 3 :0.7984
Acc of class 4 :0.6984
Acc of class 5 :0.7032
Acc of class 6 :0.8450
Acc of class 7 :0.7992
Acc of class 8 :0.6079
Acc of class 9 :0.8077
Train Accuracy: 0.7705
Acc of class 0 :0.8694
Acc of class 1 :0.8969
Acc of class 2 :0.6541
Acc of class 3 :0.8099
Acc of class 4 :0.7098
Acc of class 5 :0.7074
Acc of class 6 :0.8257
Acc of class 7 :0.8016
Acc of class 8 :0.6119
Acc of class 9 :0.8276
Test Accuracy: 0.7737

```
In [21]: # Plot training curves.  
plt.plot(np.reshape(train_accuracies, -1), label='train_acc')  
plt.plot(np.reshape(test_accuracies, -1), label='test_acc')  
plt.legend()  
plt.show()
```



```
In [ ]:
```