In [1]:
```
# Configure matplotlib.
%matplotlib inline
```

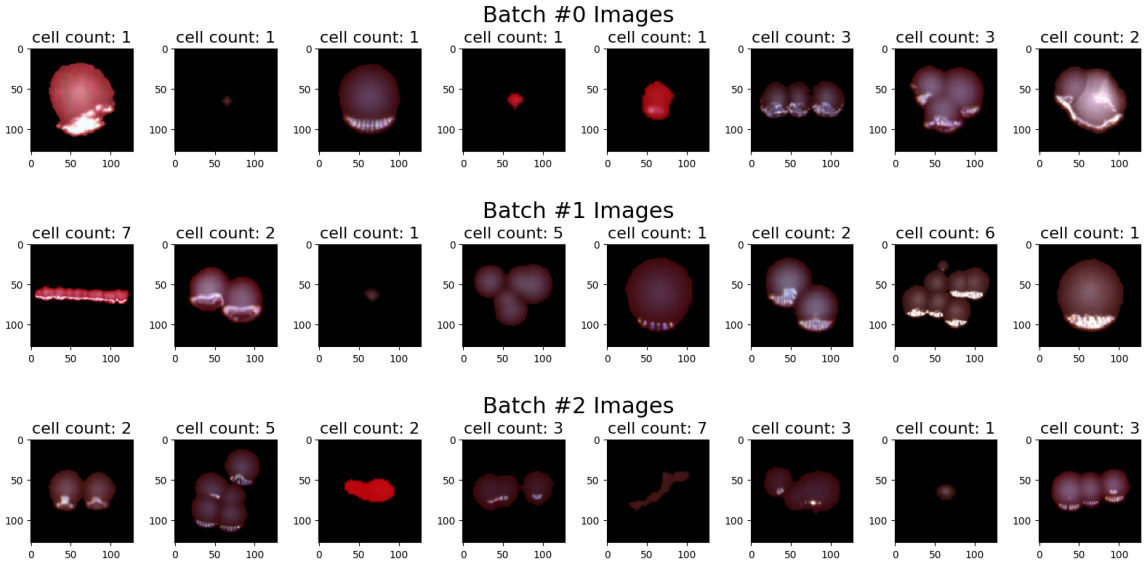
In [2]:
```
# Import our package.
import sys, importlib
sys.path.append("/home/ubuntu/cell_counting")

from src import dataset, visualization, preprocess, metric
from src.model import model
from src.model import neural_net
from src.model.segment_counting.convnet1 import convnet1
```

```
/home/ubuntu/anaconda3/envs/tensorflow_p36/lib/python3.6/importlib/_bootstrap.py
:219: RuntimeWarning: compiletime version 3.5 of module 'tensorflow.python.frame
work.fast_tensor_util' does not match runtime version 3.6
  return f(*args, **kwds)
```

In [ ]:
```
# (if changes are made) Re-import our package.
for module in (dataset, visualization, preprocess, metric, model, neural_net, conv
net1):
    importlib.reload(module)
```

In [3]:
```
# Load the microbia_segments dataset.
def image_path_getter(example_metadata):
    return "/home/ubuntu/cell_counting/data/microbia_segments/raw/" + example_meta
data["Segment Relative Path"]
def mask_path_getter(example_metadata):
    return "/home/ubuntu/cell_counting/data/microbia_segments/raw/" + example_meta
data["Binary Segment Relative Path"]
def label_getter(example_metadata):
    return example_metadata["data"]["segment_type"]["data"]
microbia_segments = dataset.Dataset(1000)
microbia_segments.load_images_masks_labels_from_json(
    "/home/ubuntu/cell_counting/data/microbia_segments/raw/enumeration_segments.js
on", image_path_getter,
    mask_path_getter, label_getter, (128, 128))
```

In [4]:
```
# Plot a few batches.
for batch in range(3):
    inputs, outputs = microbia_segments.get_batch(8)
    visualization.show_image_grid(inputs, 1, 8, 2.5, 16, "Batch #{0} Images".forma
t(batch),
        ["cell count: {0}".format(count + 1 if count != 7 else "<OUTLIER>") for co
unt in outputs])
```



In [5]:
```
# Make the labels one-hot.
def to_one_hot(examples):
    inputs, outputs = examples
    outputs = preprocess.one_hot_encode(outputs, 7)
    return inputs, outputs
microbia_segments.map_batch(to_one_hot)
```

In [6]:
```
# Split the dataset.
train, test = microbia_segments.split(0.1)
```

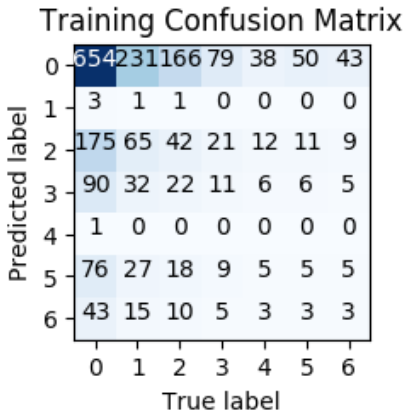
In [7]:
```
# Create the net.
import tensorflow as tf
net = convnet1.ConvNet1("saves/17-12-03-PM-10-35", 120)
```

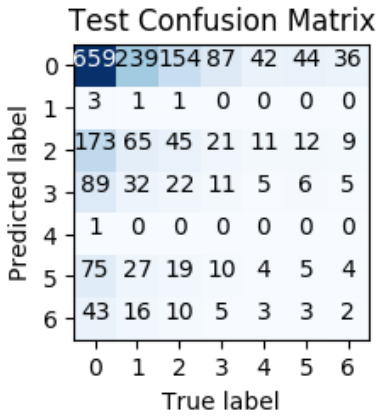
```
INFO:tensorflow:Using config: {'_model_dir': 'saves/17-12-03-PM-10-35', '_tf_ran
dom_seed': None, '_save_summary_steps': 100, '_save_checkpoints_steps': None, '_
save_checkpoints_secs': 120, '_session_config': None, '_keep_checkpoint_max': 2,
'_keep_checkpoint_every_n_hours': 10000, '_log_step_count_steps': 100, '_service
': None, '_cluster_spec': <tensorflow.python.training.server_lib.ClusterSpec obj
ect at 0x7f23c402ddd8>, '_task_type': 'worker', '_task_id': 0, '_master': '', '_
is_chief': True, '_num_ps_replicas': 0, '_num_worker_replicas': 1}
```

In [8]:
```
# Create some metrics.
train_data = train.get_batch(2000)
test_data = test.get_batch(2000)
def loss_fn(labels, predictions):
    with tf.Session() as sess:
        predictions = tf.add(predictions, tf.constant(1e-4))
        loss = tf.losses.softmax_cross_entropy(labels, predictions)
        loss = sess.run(loss)
    return loss
metrics = {
    "train_conf_mtx": metric.NonexclusiveConfusionMatrixMetric(train_data, 7),
    "test_conf_mtx": metric.NonexclusiveConfusionMatrixMetric(test_data, 7),
    "train_loss": metric.LossMetric(train_data, loss_fn),
    "test_loss": metric.LossMetric(test_data, loss_fn),
    "train_off_by_counts": metric.OffByCountMetric(train_data, 7),
    "test_off_by_counts": metric.OffByCountMetric(test_data, 7)
}
```

In [9]:
```
# Make a function for plotting the metrics.
def plot_metrics():
    train_conf_mtx = metrics["train_conf_mtx"].get_results()[1][-1]
    visualization.plot_confusion_matrix(train_conf_mtx, "Training Confusion Matrix
", 2.5, 2.5)

    test_conf_mtx = metrics["test_conf_mtx"].get_results()[1][-1]
    visualization.plot_confusion_matrix(test_conf_mtx, "Test Confusion Matrix", 2.
5, 2.5)

    xs, ys = metrics["train_loss"].get_results()
    visualization.plot_line(xs, ys, "Training Loss", "training iterations", "cross
-entropy loss", 2.5, 12)

    xs, ys = metrics["test_loss"].get_results()
    visualization.plot_line(xs, ys, "Test Loss", "training iterations", "cross-ent
ropy loss", 2.5, 12)

    xs, sets_of_ys = metrics["train_off_by_counts"].get_results()
    visualization.plot_lines(xs, sets_of_ys, "Training Off-By Counts", "training i
terations", "count of examples",
                             ["off by {0}".format(x) for x in range(-7, 7 + 1)], 2.
5, 12)

    xs, sets_of_ys = metrics["test_off_by_counts"].get_results()
    visualization.plot_lines(xs, sets_of_ys, "Test Off-By Counts", "training itera
tions", "count of examples",
                             ["off by {0}".format(x) for x in range(-7, 7 + 1)], 2.
5, 12)
```

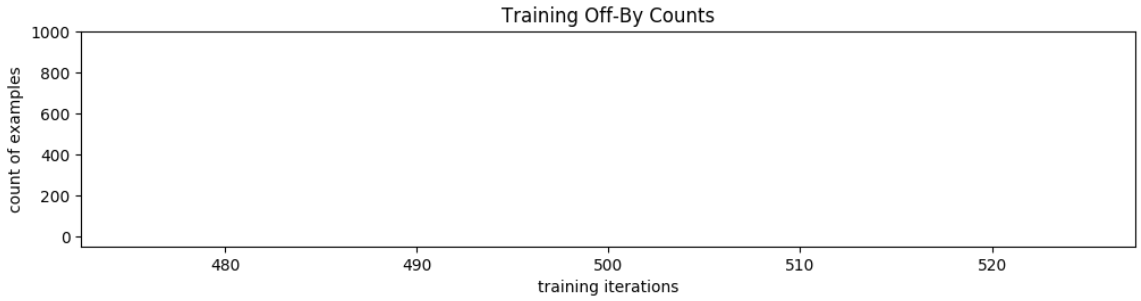
In [10]:
```
# Alternately train and evaluate the net for 30 minutes.
for _ in range(30//3):
    net.train(train, 3*60)
    net.evaluate(metrics)
    plot_metrics()
```

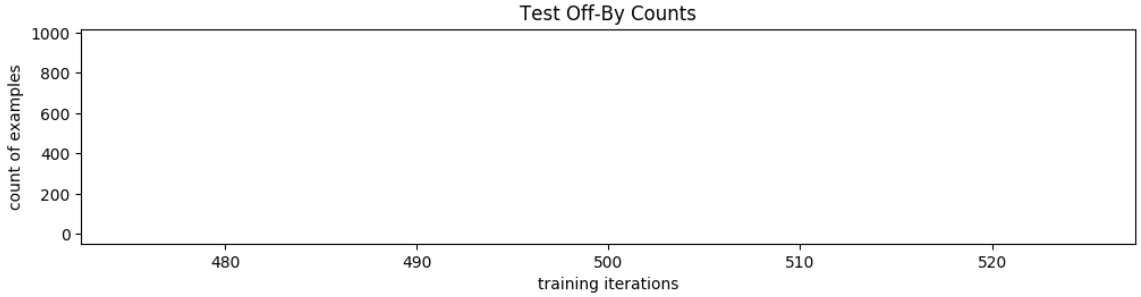

Training Confusion Matrix
Predicted label
True label
0 654 231 166 79 38 50 43
1 3 1 1 0 0 0 0
2 175 65 42 21 12 11 9
3 90 32 22 11 6 6 5
4 1 0 0 0 0 0 0
5 76 27 18 9 5 5 5
6 43 15 10 5 3 3 3
0 1 2 3 4 5 6

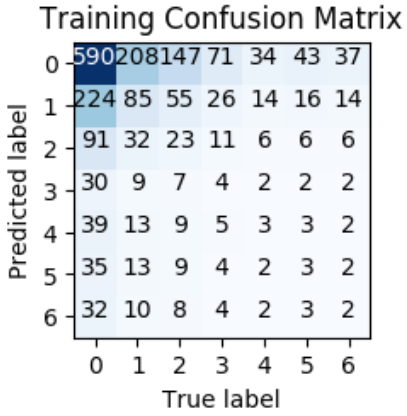

Test Confusion Matrix
Predicted label
True label
0 659 239 154 87 42 44 36
1 3 1 1 0 0 0 0
2 173 65 45 21 11 12 9
3 89 32 22 11 5 6 5
4 1 0 0 0 0 0 0
5 75 27 19 10 4 5 4
6 43 16 10 5 3 3 2
0 1 2 3 4 5 6

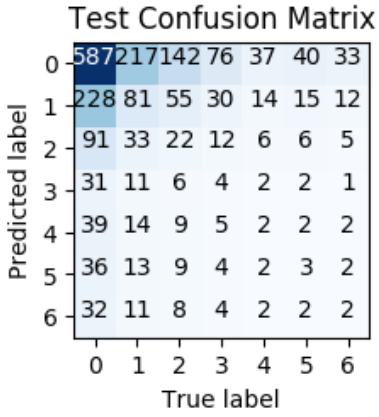

Training Loss
cross-entropy loss
−290
−300
−310
−320
480
490
500
510
520
training iterations

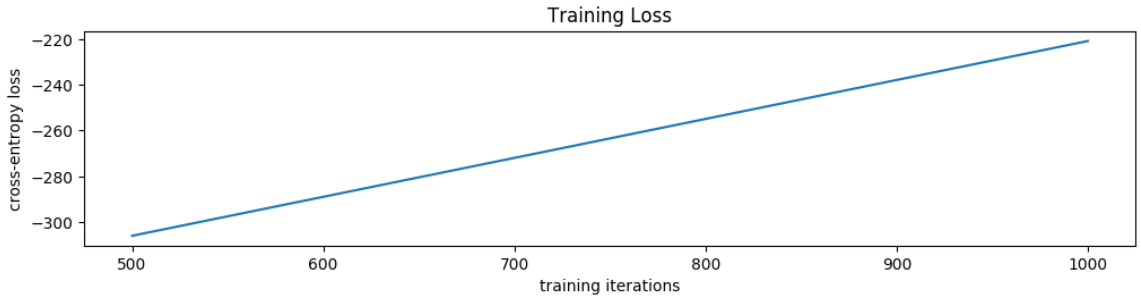

Test Loss
cross-entropy loss
−290
−300
−310
−320
480
490
500
510
520
training iterations

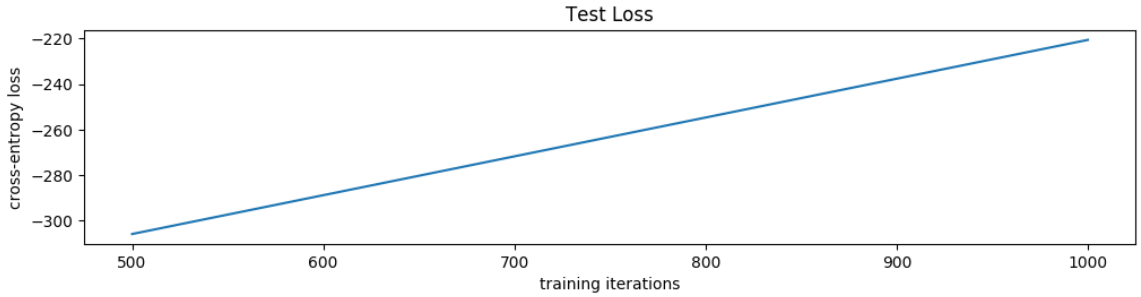

Training Off-By Counts
count of examples
1000
800
600
400
200
0
480
490
500
510
520
training iterations

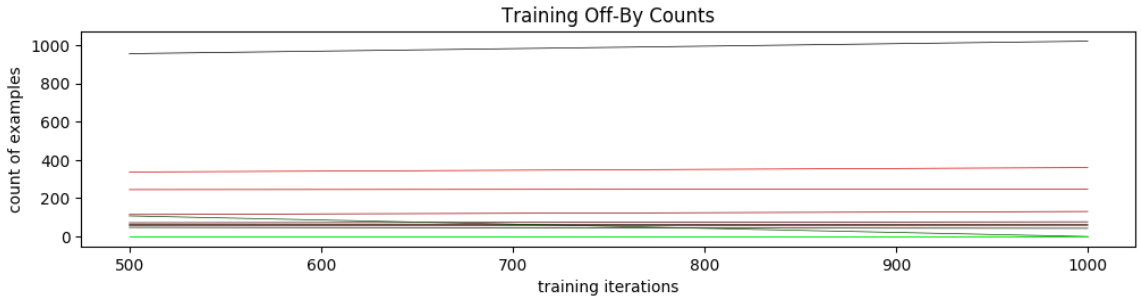

Test Off-By Counts
count of examples
1000
800
600
400
200
0
480
490
500
510
520
training iterations

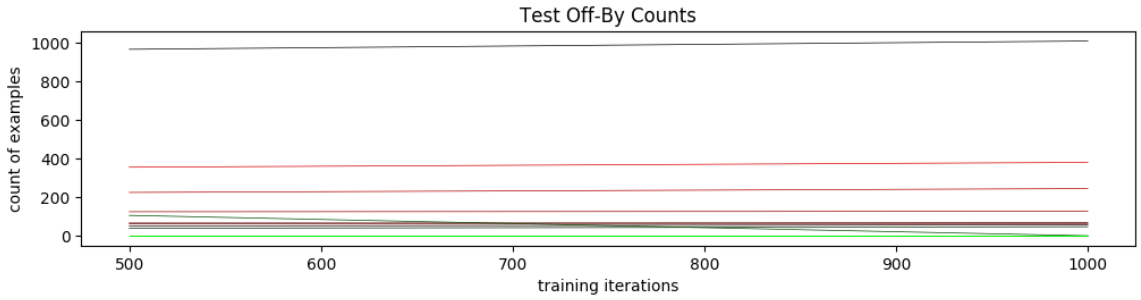

Training Confusion Matrix
Predicted label
True label
590 208 147 71 34 43 37
224 85 55 26 14 16 14
91 32 23 11 6 6 6
30 9 7 4 2 2 2
39 13 9 5 3 3 2
35 13 9 4 2 3 2
32 10 8 4 2 3 2
0 1 2 3 4 5 6

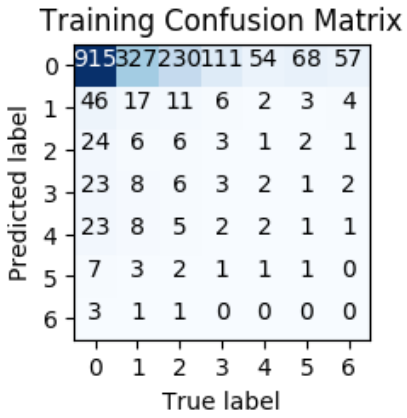

Test Confusion Matrix
Predicted label
True label
587 217 142 76 37 40 33
228 81 55 30 14 15 12
91 33 22 12 6 6 5
31 11 6 4 2 2 1
39 14 9 5 2 2 2
36 13 9 4 2 3 2
32 11 8 4 2 2 2
0 1 2 3 4 5 6

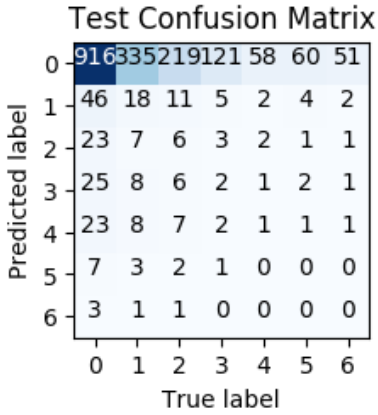

Training Loss
cross-entropy loss
−220
−240
−260
−280
−300
500
600
700
800
900
1000
training iterations


Test Loss
cross-entropy loss
−220
−240
−260
−280
−300
500
600
700
800
900
1000
training iterations

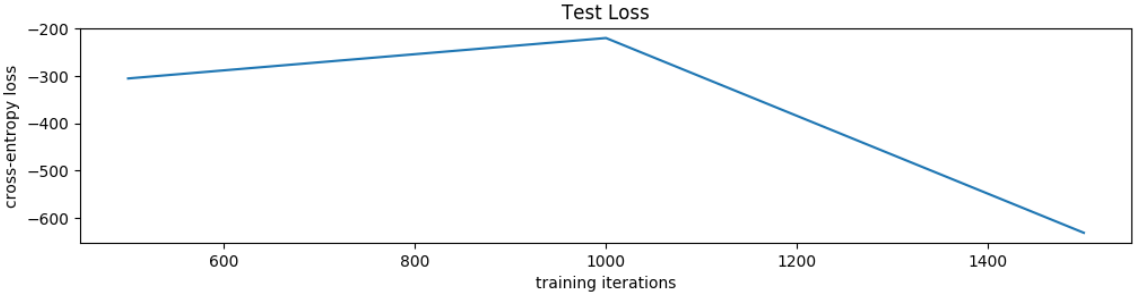

Training Off-By Counts
count of examples
1000
800
600
400
200
0
500
600
700
800
900
1000
training iterations

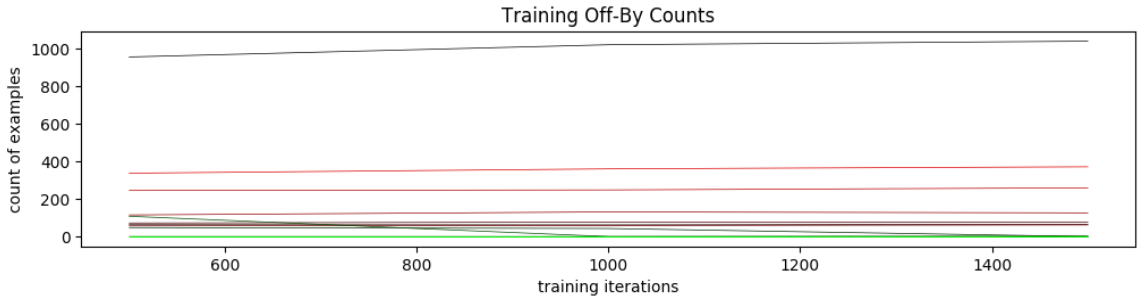

Test Off-By Counts
count of examples
1000
800
600
400
200
0
500
600
700
800
900
1000
training iterations

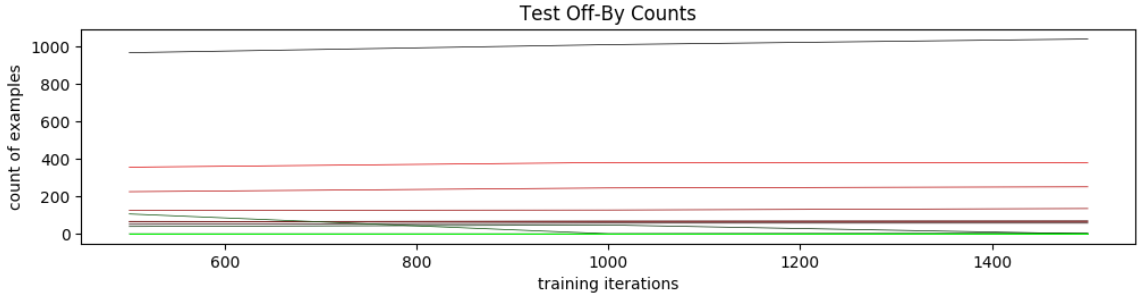

Training Confusion Matrix
Predicted label
True label
0 915 327 230 111 54 68 57
1 46 17 11 6 2 3 4
2 24 6 6 3 1 2 1
3 23 8 6 3 2 1 2
4 23 8 5 2 2 1 1
5 7 3 2 1 1 1 0
6 3 1 1 0 0 0 0
0 1 2 3 4 5 6

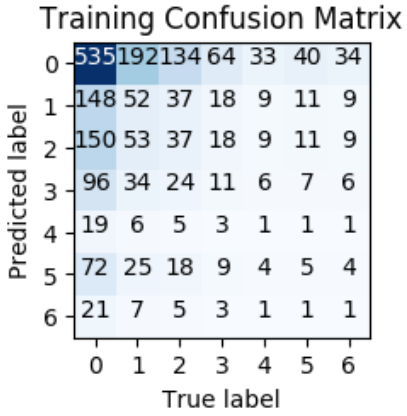

Test Confusion Matrix
Predicted label
True label
0 916 335 219 121 58 60 51
1 46 18 11 5 2 4 2
2 23 7 6 3 2 1 1
3 25 8 6 2 1 2 1
4 23 8 7 2 1 1 1
5 7 3 2 1 0 0 0
6 3 1 1 0 0 0 0
0 1 2 3 4 5 6

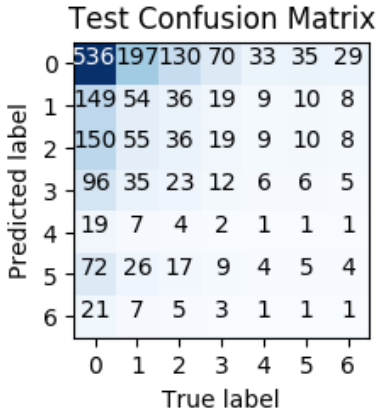

Training Loss
cross-entropy loss
−200
−300
−400
−500
−600
600
800
1000
1200
1400
training iterations


Test Loss
cross-entropy loss
−200
−300
−400
−500
−600
600
800
1000
1200
1400
training iterations


Training Off-By Counts
count of examples
training iterations
0
200
400
600
800
1000
600
800
1000
1200
1400

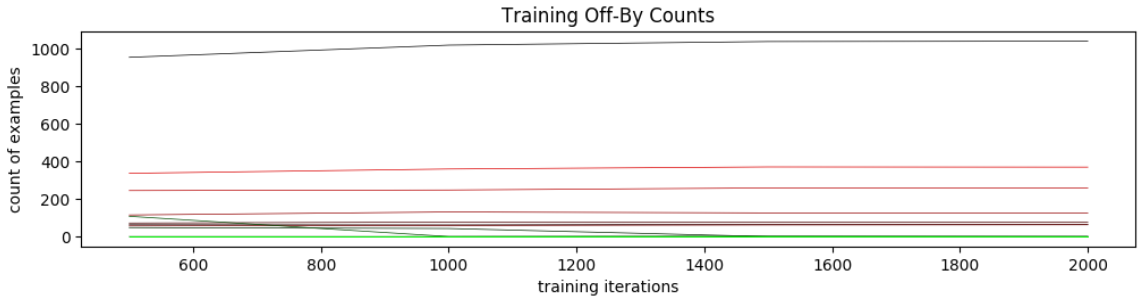

Test Off-By Counts
count of examples
training iterations
0
200
400
600
800
1000
600
800
1000
1200
1400


Training Confusion Matrix
Predicted label
True label
535 192 134 64 33 40 34
148 52 37 18 9 11 9
150 53 37 18 9 11 9
96 34 24 11 6 7 6
19 6 5 3 1 1 1
72 25 18 9 4 5 4
21 7 5 3 1 1 1
0 1 2 3 4 5 6


Test Confusion Matrix
Predicted label
True label
536 197 130 70 33 35 29
149 54 36 19 9 10 8
150 55 36 19 9 10 8
96 35 23 12 6 6 5
19 7 4 2 1 1 1
72 26 17 9 4 5 4
21 7 5 3 1 1 1
0 1 2 3 4 5 6

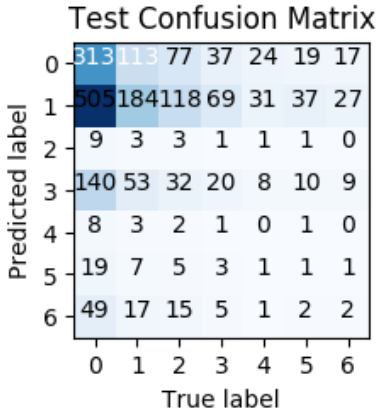

Training Loss
cross-entropy loss
−200
−400
−600
600
800
1000
1200
1400
1600
1800
2000
training iterations

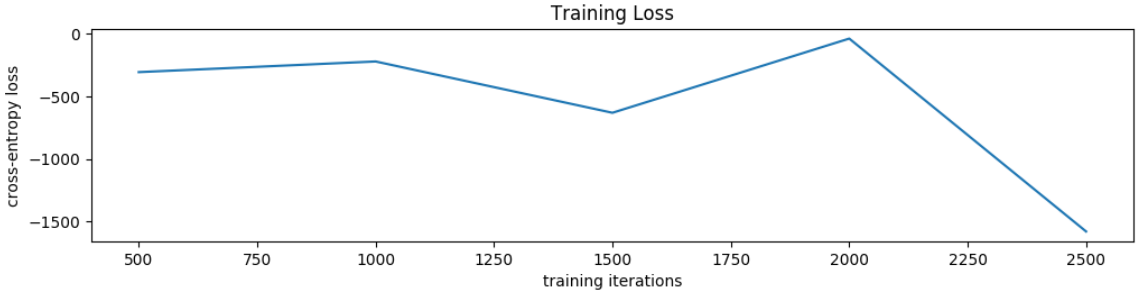

Test Loss
cross-entropy loss
−200
−400
−600
600
800
1000
1200
1400
1600
1800
2000
training iterations


Training Off-By Counts
count of examples
1000
800
600
400
200
0
600
800
1000
1200
1400
1600
1800
2000
training iterations

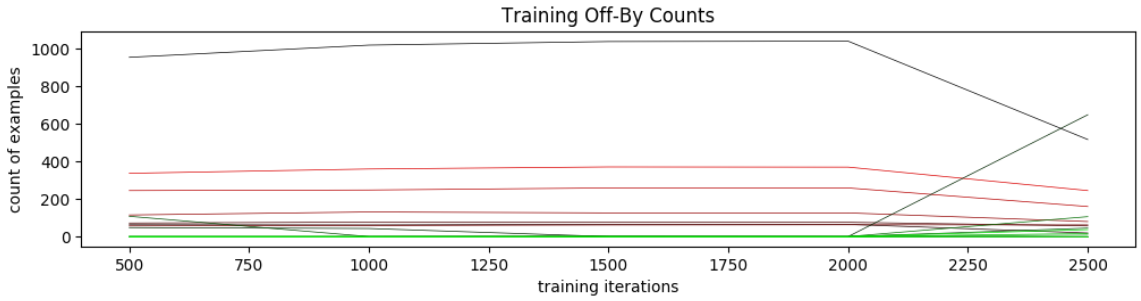

Test Off-By Counts
count of examples
1000
800
600
400
200
0
600
800
1000
1200
1400
1600
1800
2000
training iterations

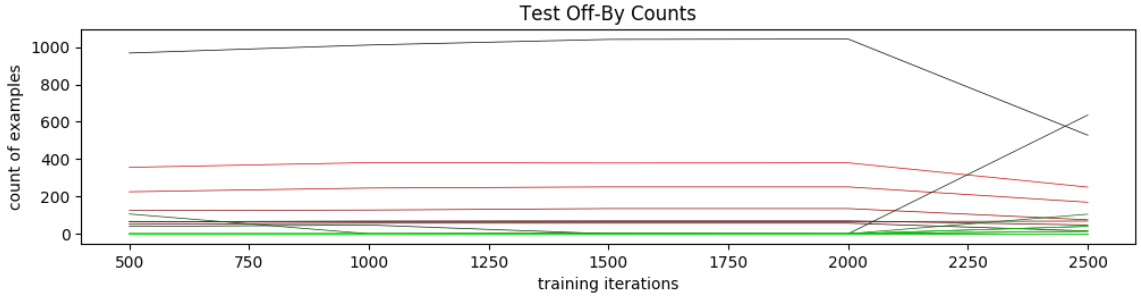

Training Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
311 105 84 37 18 23 20
508 183 123 62 30 35 29
9 3 3 1 1 0 1
141 52 34 17 9 9 9
8 3 2 1 0 1 1
18 7 5 2 1 2 2
46 17 9 5 3 6 3

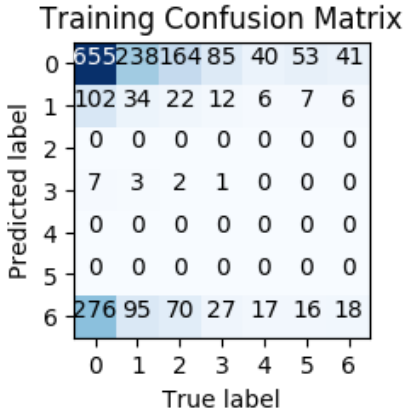

Test Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
313 113 77 37 24 19 17
505 184 118 69 31 37 27
9 3 3 1 1 1 0
140 53 32 20 8 10 9
8 3 2 1 0 1 0
19 7 5 3 1 1 1
49 17 15 5 1 2 2

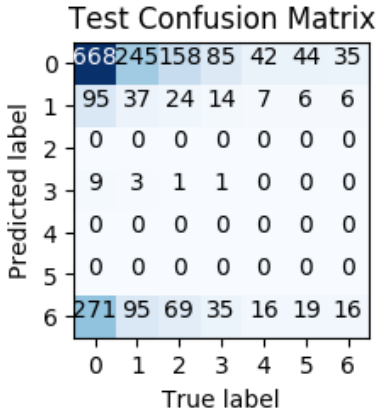

Training Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
500 750 1000 1250 1500 1750 2000 2250 2500


Test Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
500 750 1000 1250 1500 1750 2000 2250 2500


Training Off-By Counts
count of examples
training iterations

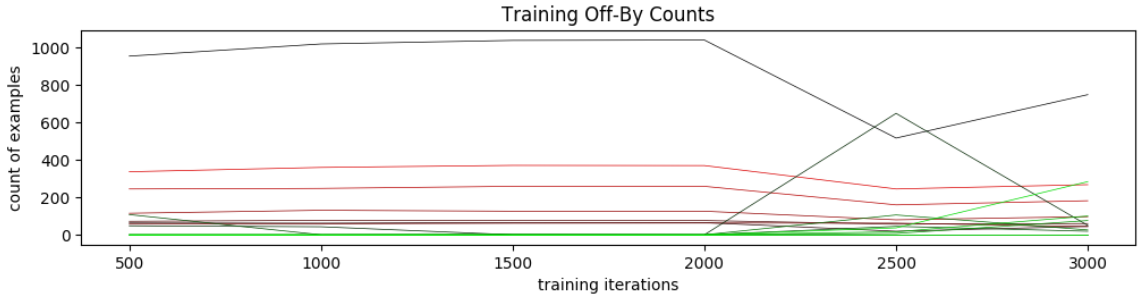

Test Off-By Counts
count of examples
training iterations


Training Confusion Matrix
Predicted label
True label


Test Confusion Matrix
Predicted label
True label

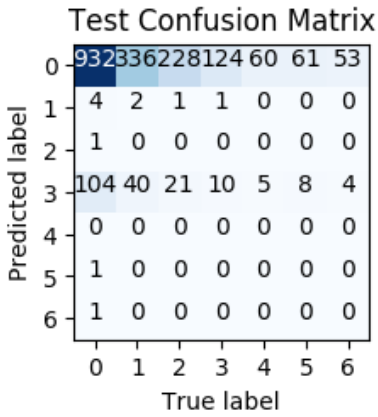

Training Loss
cross-entropy loss
0
−500
−1000
−1500
500
1000
1500
2000
2500
3000
training iterations

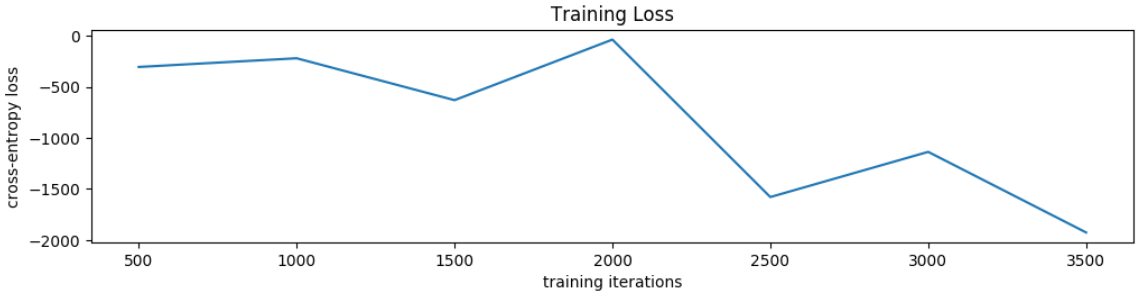

Test Loss
cross-entropy loss
0
−500
−1000
−1500
500
1000
1500
2000
2500
3000
training iterations

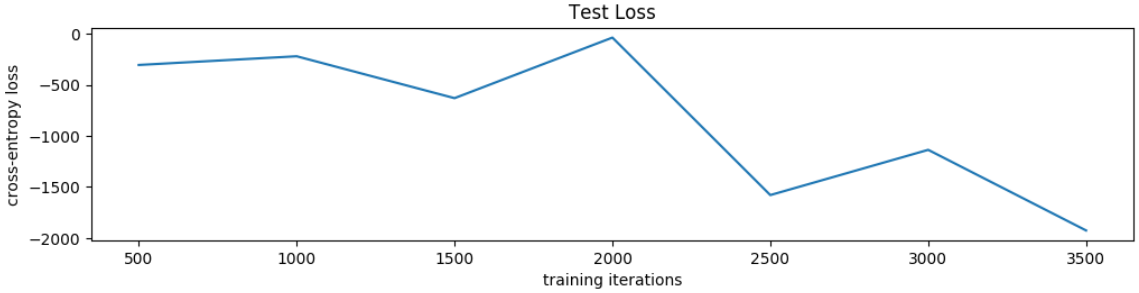

Training Off-By Counts
count of examples
1000
800
600
400
200
0
500
1000
1500
2000
2500
3000
training iterations

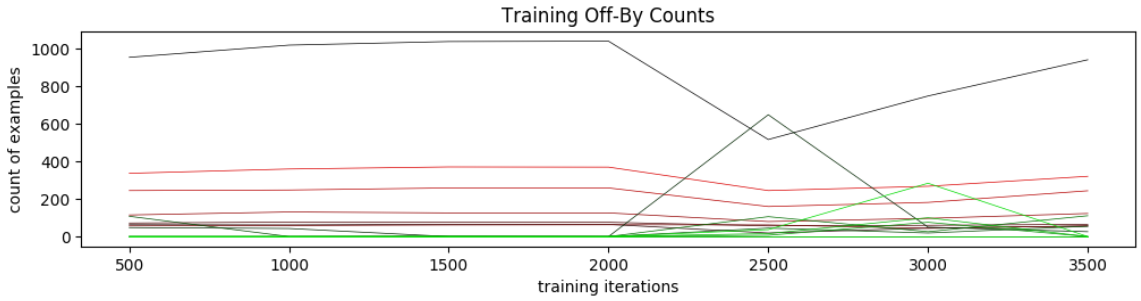

Test Off-By Counts
count of examples
1000
800
600
400
200
0
500
1000
1500
2000
2500
3000
training iterations

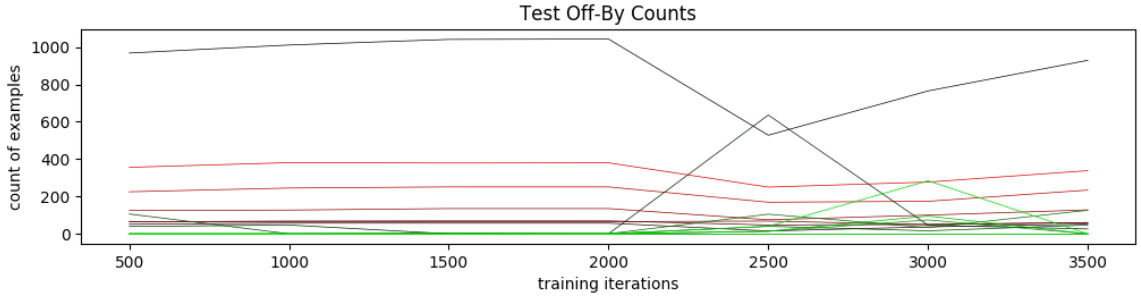

Training Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
938 322 238 116 57 67 57
5 2 1 1 0 0 0
1 0 0 0 0 0 0
95 45 20 9 6 9 7
0 0 0 0 0 0 0
1 0 0 0 0 0 0
1 0 0 0 0 0 0

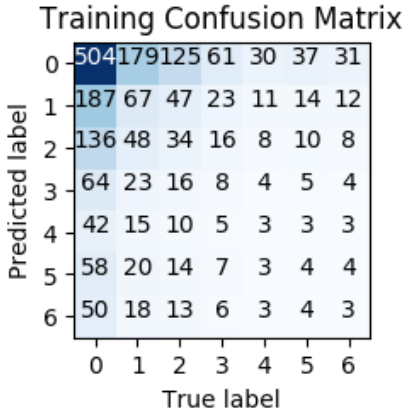

Test Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
932 336 228 124 60 61 53
4 2 1 1 0 0 0
1 0 0 0 0 0 0
104 40 21 10 5 8 4
0 0 0 0 0 0 0
1 0 0 0 0 0 0
1 0 0 0 0 0 0

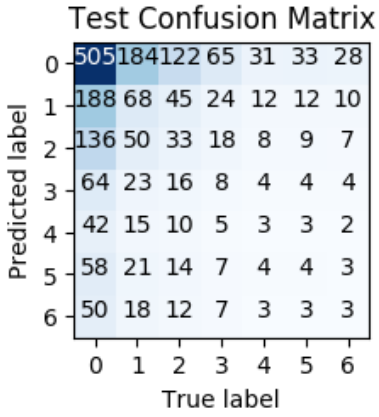

Training Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
500 1000 1500 2000 2500 3000 3500

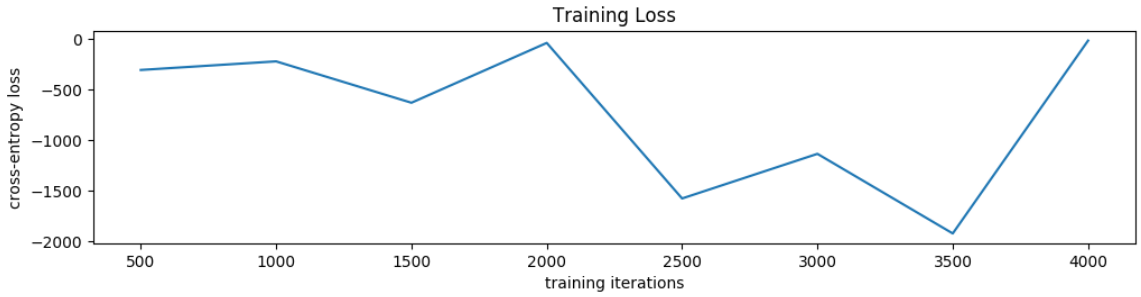

Test Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
500 1000 1500 2000 2500 3000 3500


Training Off-By Counts
count of examples
training iterations
0
200
400
600
800
1000
500
1000
1500
2000
2500
3000
3500

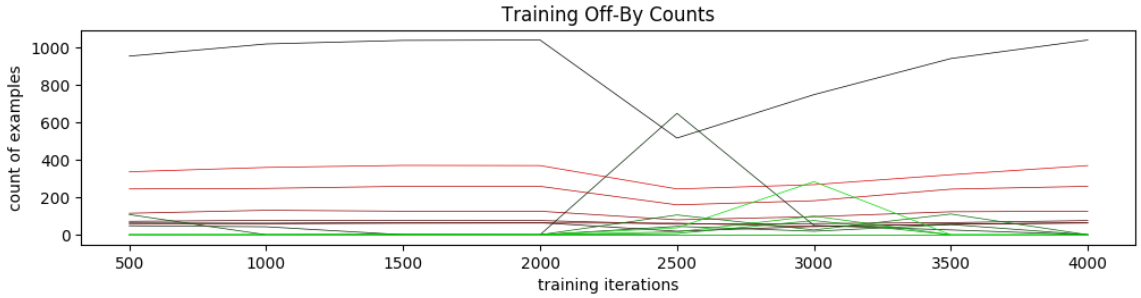

Test Off-By Counts
count of examples
training iterations
0
200
400
600
800
1000
500
1000
1500
2000
2500
3000
3500

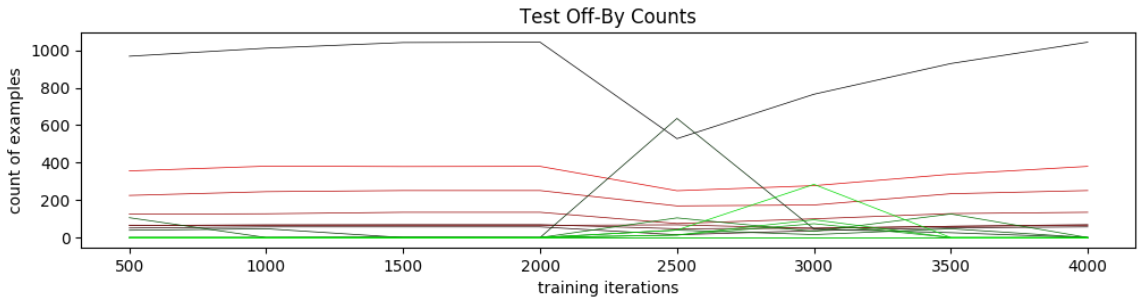

Training Confusion Matrix
Predicted label
True label
504 179 125 61 30 37 31
187 67 47 23 11 14 12
136 48 34 16 8 10 8
64 23 16 8 4 5 4
42 15 10 5 3 3 3
58 20 14 7 3 4 4
50 18 13 6 3 4 3
0 1 2 3 4 5 6

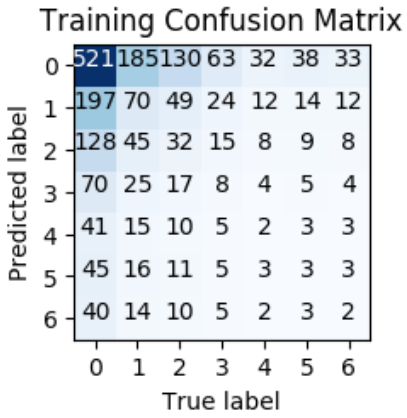

Test Confusion Matrix
Predicted label
True label
505 184 122 65 31 33 28
188 68 45 24 12 12 10
136 50 33 18 8 9 7
64 23 16 8 4 4 4
42 15 10 5 3 3 2
58 21 14 7 4 4 3
50 18 12 7 3 3 3
0 1 2 3 4 5 6

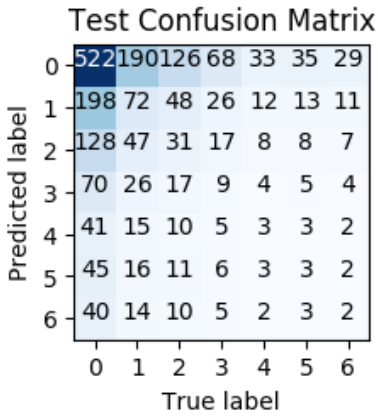

Training Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
500
1000
1500
2000
2500
3000
3500
4000
training iterations

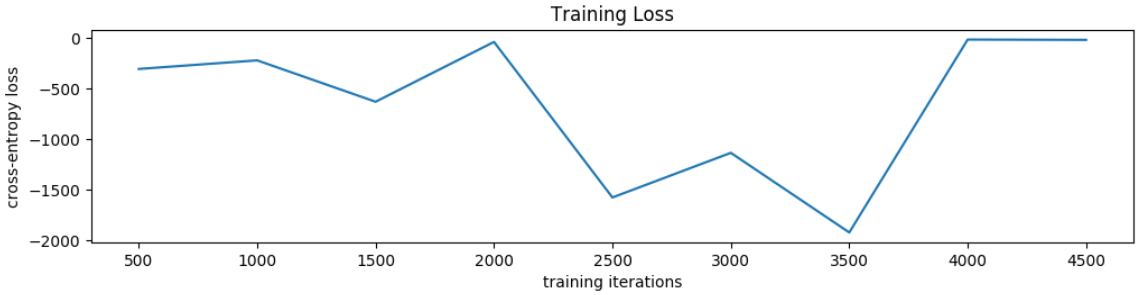

Test Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
500
1000
1500
2000
2500
3000
3500
4000
training iterations

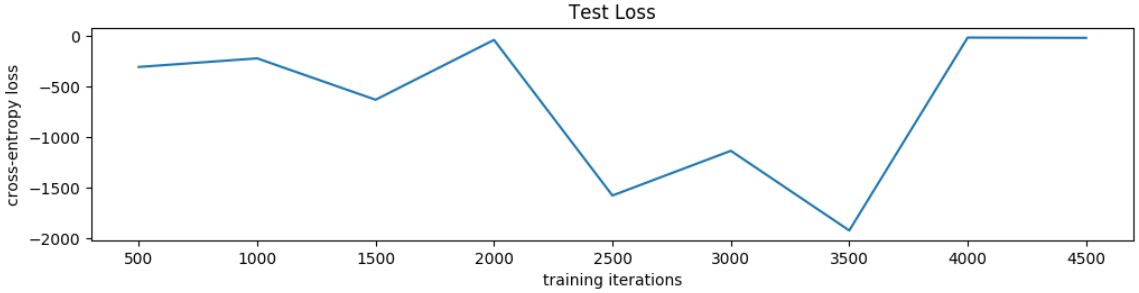

Training Off-By Counts
count of examples
1000
800
600
400
200
0
500
1000
1500
2000
2500
3000
3500
4000
training iterations

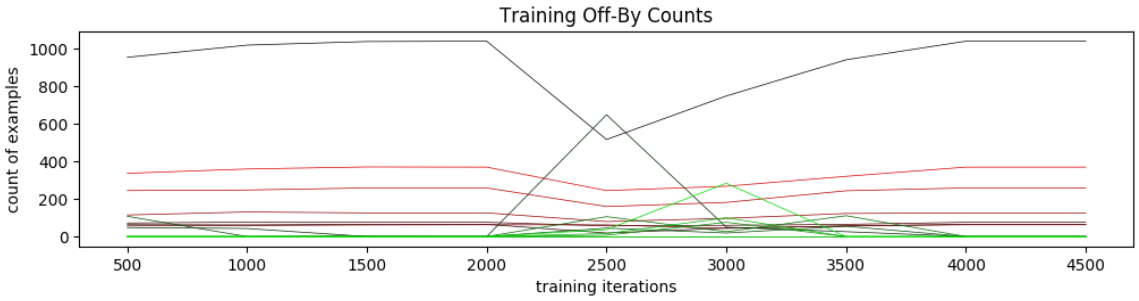

Test Off-By Counts
count of examples
1000
800
600
400
200
0
500
1000
1500
2000
2500
3000
3500
4000
training iterations

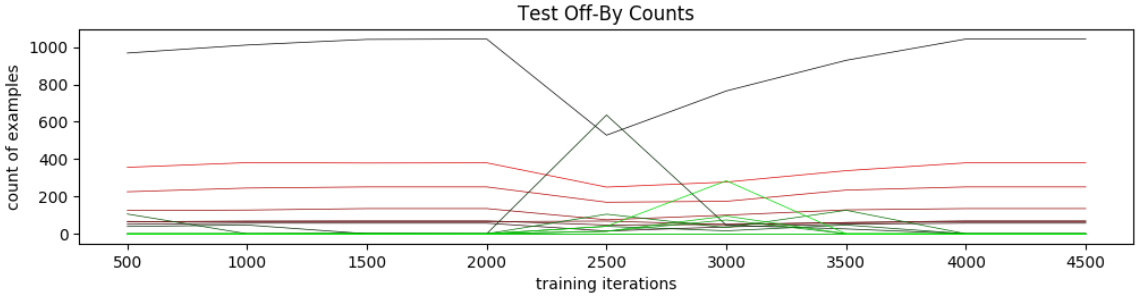

Training Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
521 185 130 63 32 38 33
197 70 49 24 12 14 12
128 45 32 15 8 9 8
70 25 17 8 4 5 4
41 15 10 5 2 3 3
45 16 11 5 3 3 3
40 14 10 5 2 3 2

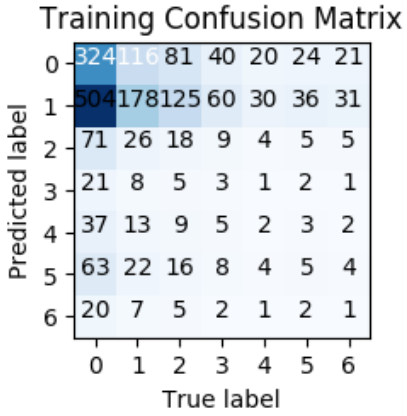

Test Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
522 190 126 68 33 35 29
198 72 48 26 12 13 11
128 47 31 17 8 8 7
70 26 17 9 4 5 4
41 15 10 5 3 3 2
45 16 11 6 3 3 2
40 14 10 5 2 3 2

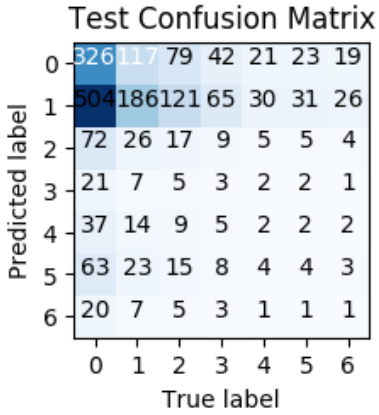

Training Loss
cross-entropy loss
training iterations
0 −500 −1000 −1500 −2000
500 1000 1500 2000 2500 3000 3500 4000 4500

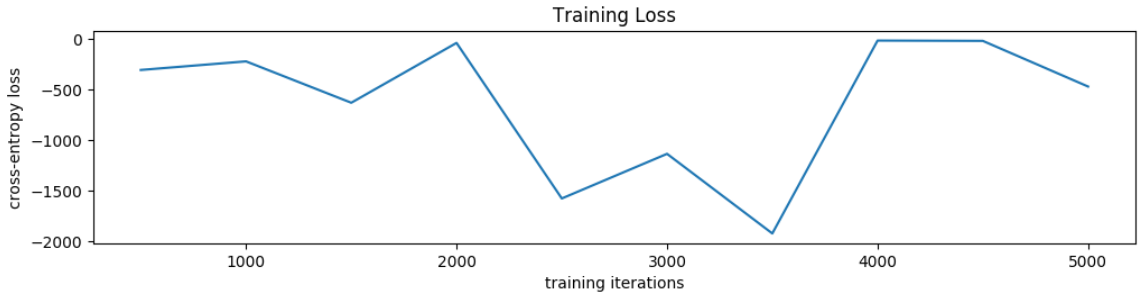

Test Loss
cross-entropy loss
training iterations
0 −500 −1000 −1500 −2000
500 1000 1500 2000 2500 3000 3500 4000 4500

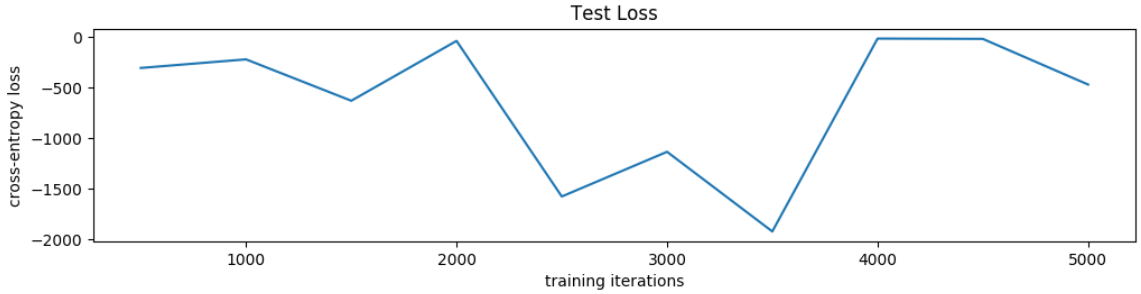

Training Off-By Counts
count of examples
training iterations

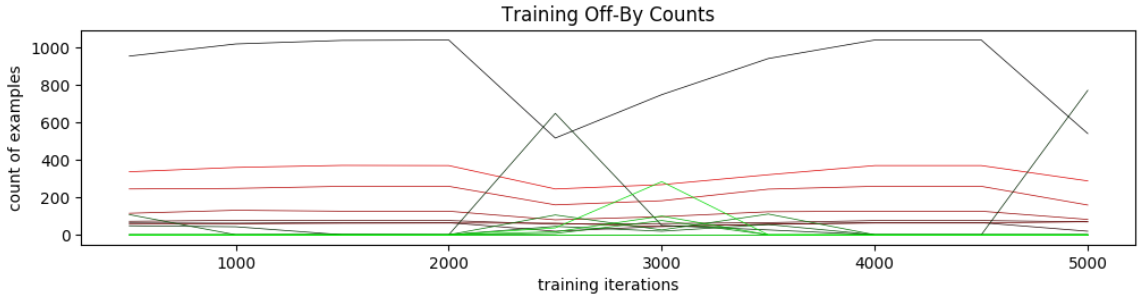

Test Off-By Counts
count of examples
training iterations

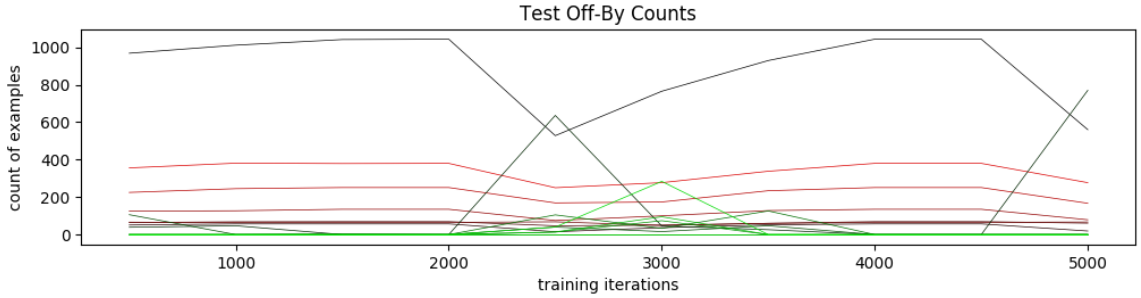

Training Confusion Matrix
Predicted label
True label


Test Confusion Matrix
Predicted label
True label

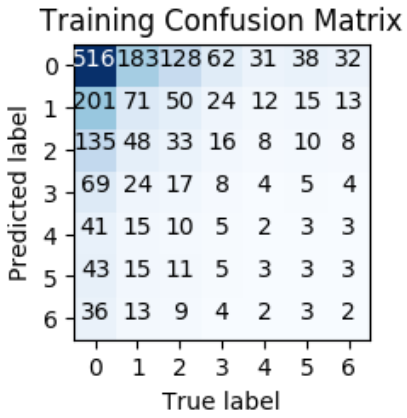

Training Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
training iterations

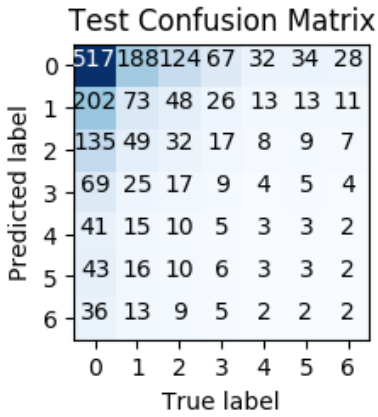

Test Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
training iterations

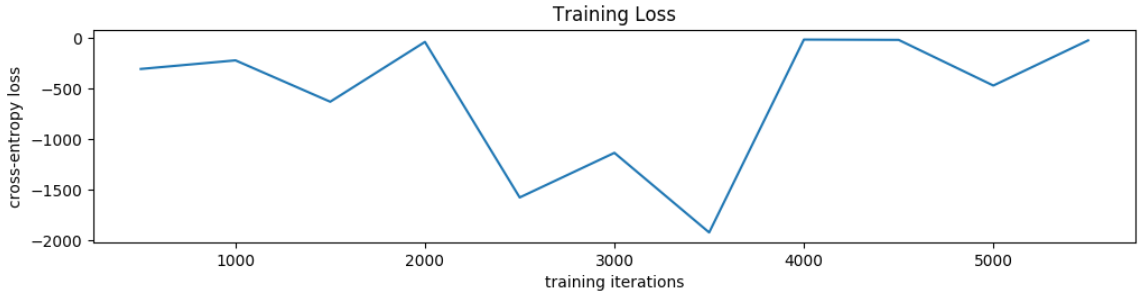

Training Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
training iterations


Test Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
training iterations

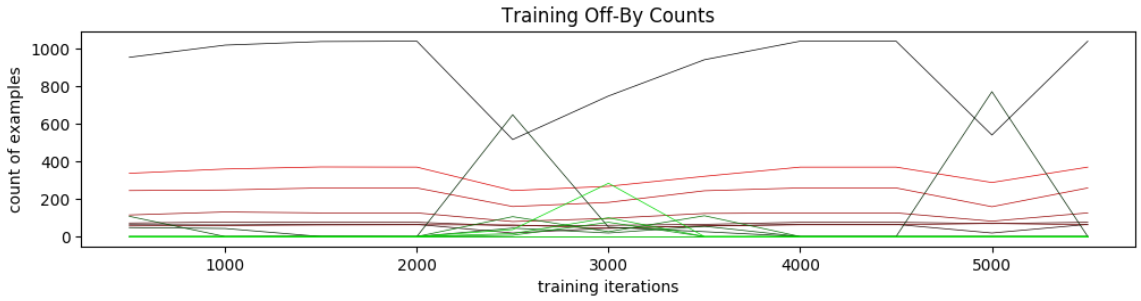
In [11]:
```
# Alternately train and evaluate the net for 30 minutes.
for _ in range(30//3):
    net.train(train, 3*60)
    net.evaluate(metrics)
    plot_metrics()
```

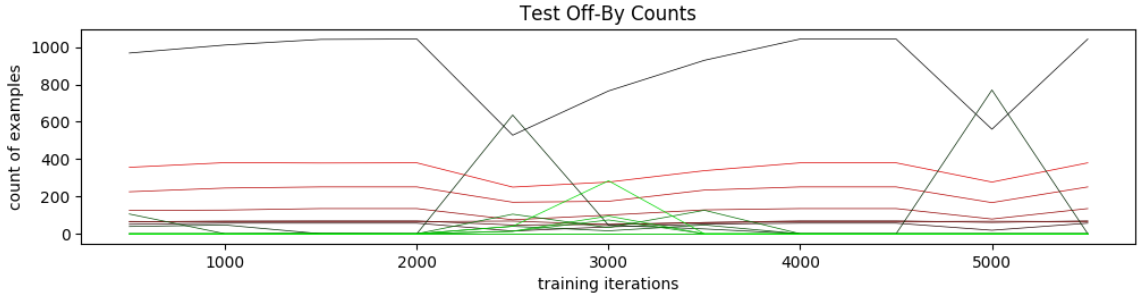

Training Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
516 183 128 62 31 38 32
201 71 50 24 12 15 13
135 48 33 16 8 10 8
69 24 17 8 4 5 4
41 15 10 5 2 3 3
43 15 11 5 3 3 3
36 13 9 4 2 3 2

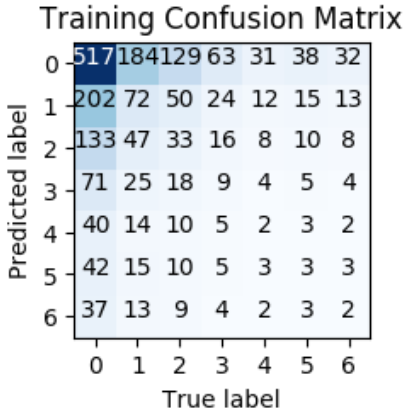

Test Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
517 188 124 67 32 34 28
202 73 48 26 13 13 11
135 49 32 17 8 9 7
69 25 17 9 4 5 4
41 15 10 5 3 3 2
43 16 10 6 3 3 2
36 13 9 5 2 2 2

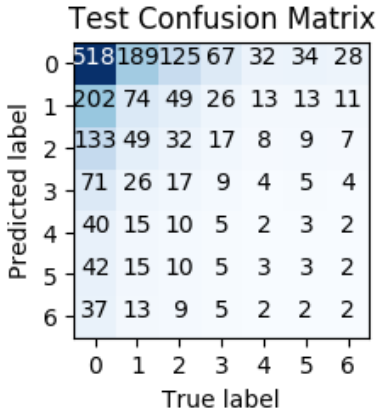

Training Loss
cross-entropy loss
training iterations
0 −500 −1000 −1500 −2000
1000 2000 3000 4000 5000

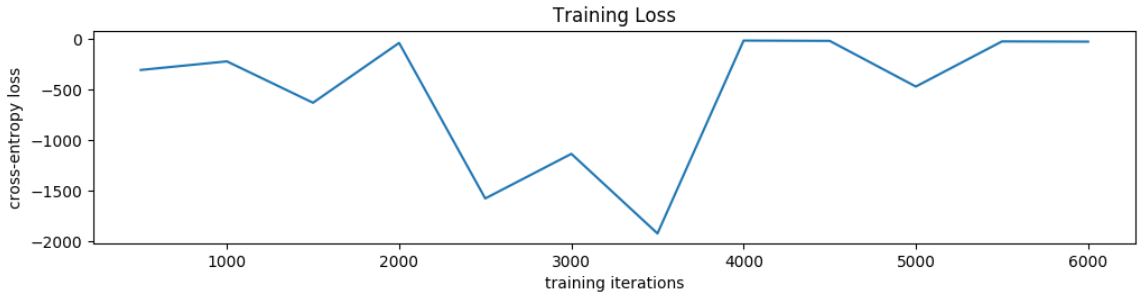

Test Loss
cross-entropy loss
training iterations
0 −500 −1000 −1500 −2000
1000 2000 3000 4000 5000

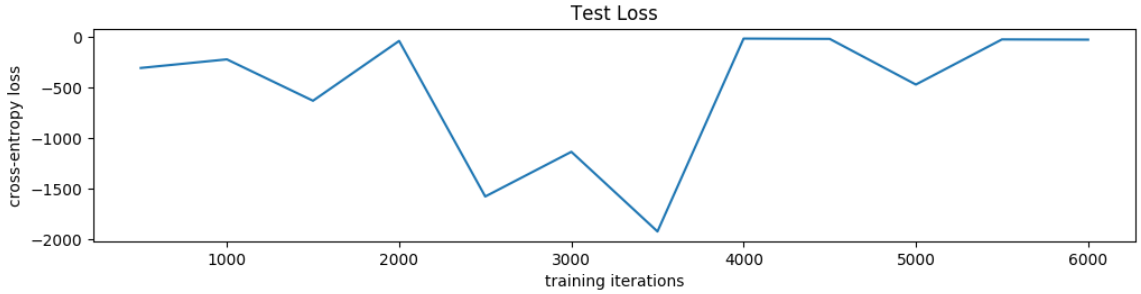

Training Off-By Counts
count of examples
training iterations

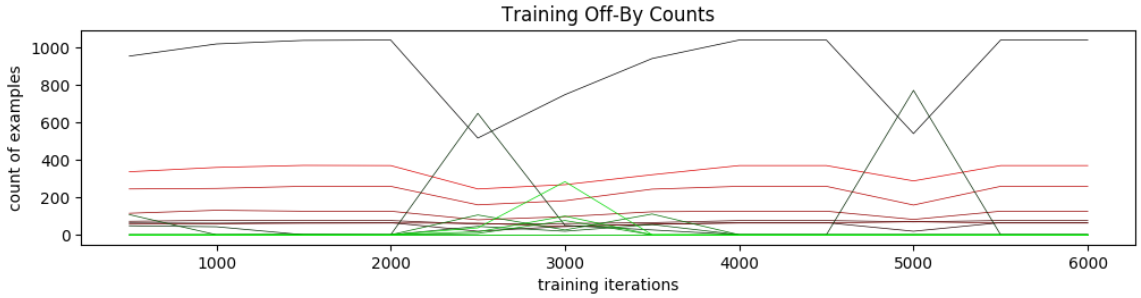

Test Off-By Counts
count of examples
training iterations

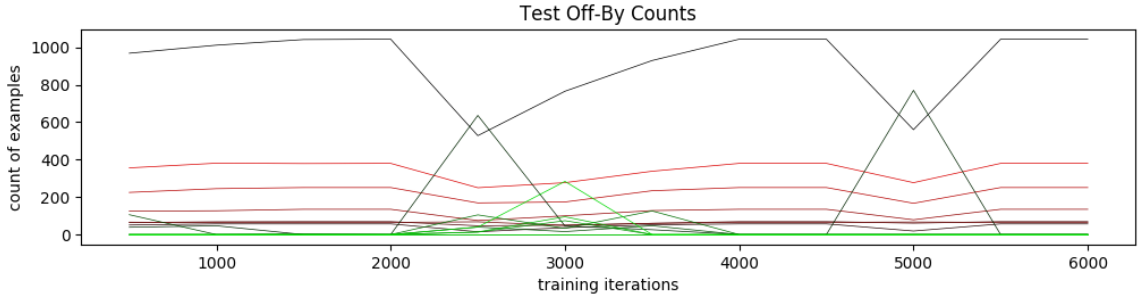

Training Confusion Matrix
Predicted label
True label

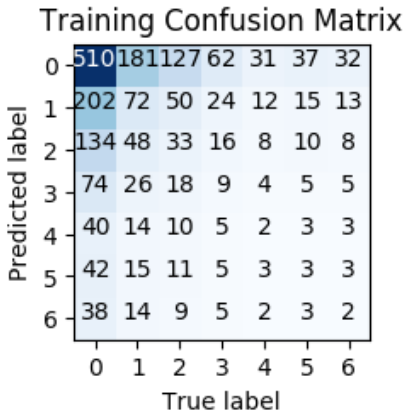

Test Confusion Matrix
Predicted label
True label

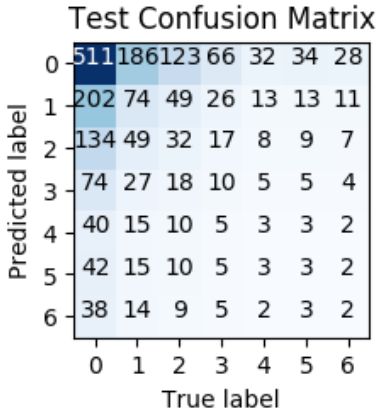

Training Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
training iterations


Test Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
training iterations


Training Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
6000
training iterations

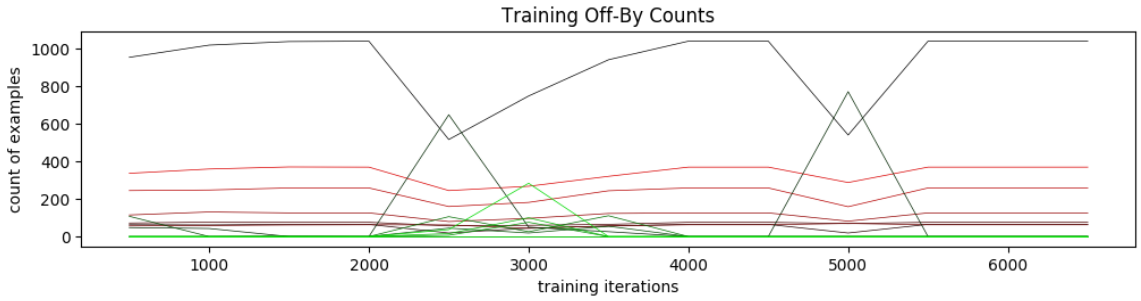

Test Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
6000
training iterations

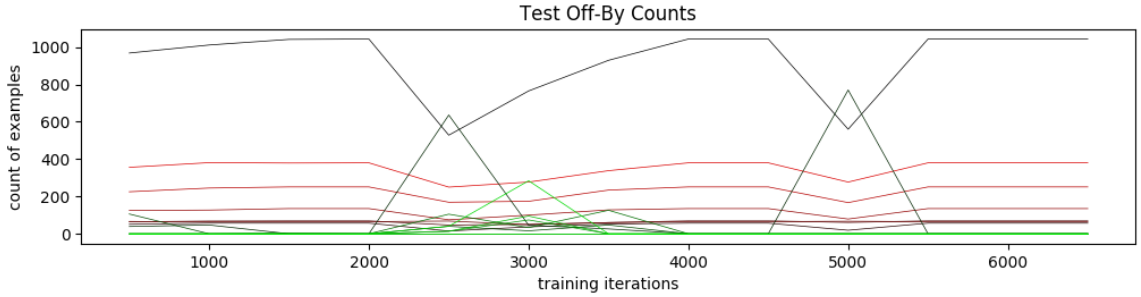

Training Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
510 181 127 62 31 37 32
202 72 50 24 12 15 13
134 48 33 16 8 10 8
74 26 18 9 4 5 5
40 14 10 5 2 3 3
42 15 11 5 3 3 3
38 14 9 5 2 3 2

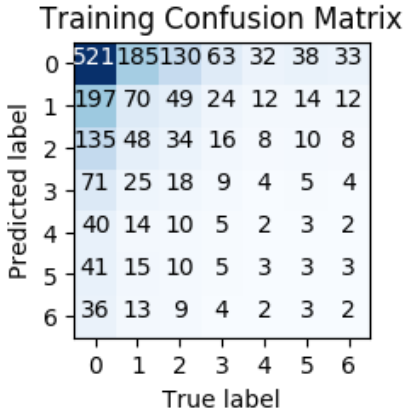

Test Confusion Matrix
Predicted label
True label
0 1 2 3 4 5 6
511 186 123 66 32 34 28
202 74 49 26 13 13 11
134 49 32 17 8 9 7
74 27 18 10 5 5 4
40 15 10 5 3 3 2
42 15 10 5 3 3 2
38 14 9 5 2 3 2

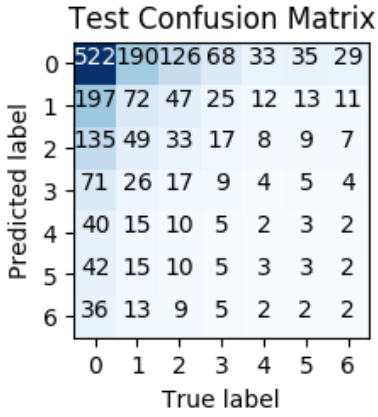

Training Loss
cross-entropy loss
training iterations
0 −500 −1000 −1500 −2000
1000 2000 3000 4000 5000 6000


Test Loss
cross-entropy loss
training iterations
0 −500 −1000 −1500 −2000
1000 2000 3000 4000 5000 6000


Training Off-By Counts
count of examples
training iterations

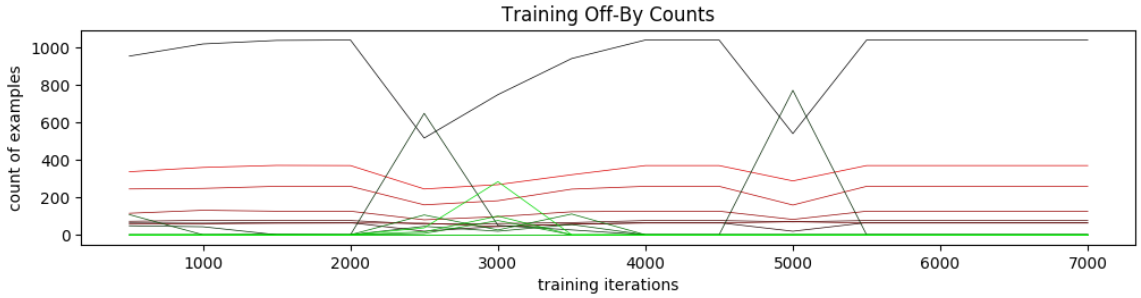

Test Off-By Counts
count of examples
training iterations

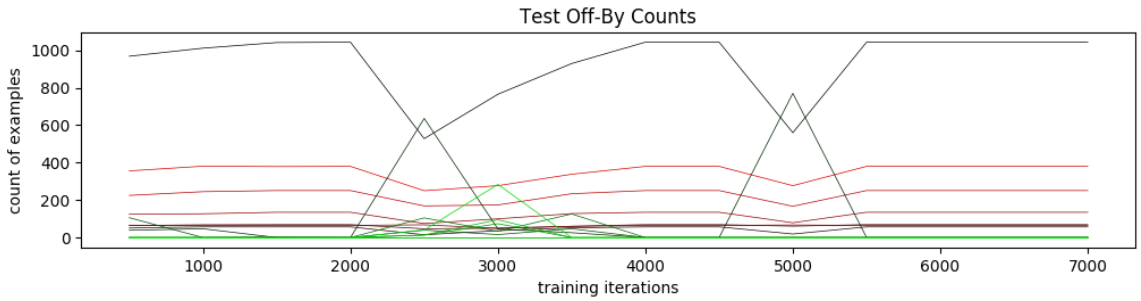

Training Confusion Matrix
Predicted label
True label

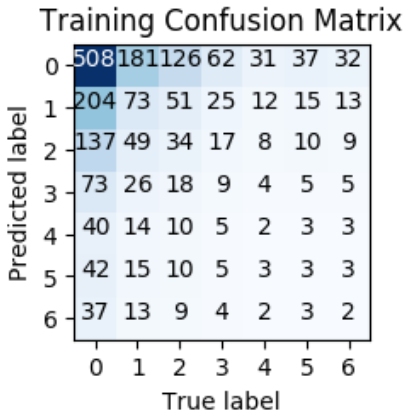

Test Confusion Matrix
Predicted label
True label

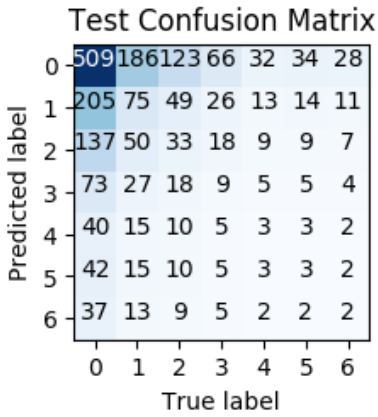

Training Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
7000
training iterations


Test Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
7000
training iterations


Training Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
6000
7000
training iterations

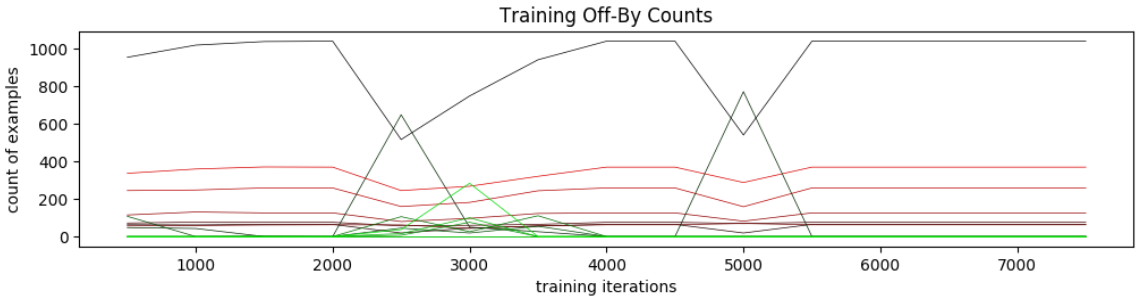

Test Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
6000
7000
training iterations

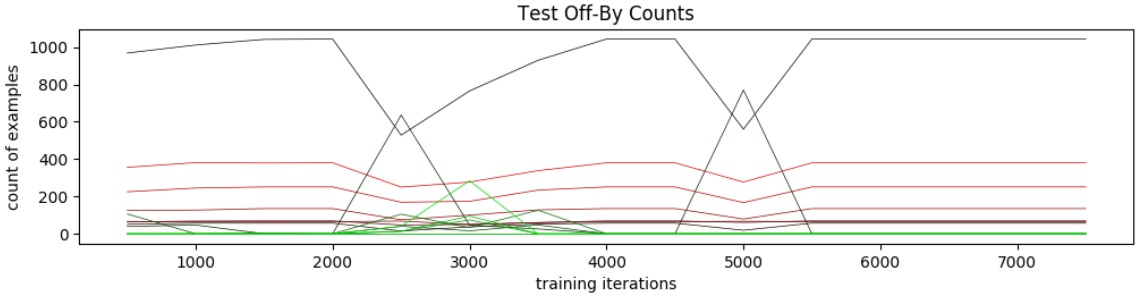

Training Confusion Matrix
Predicted label
True label
0 508 181 126 62 31 37 32
1 204 73 51 25 12 15 13
2 137 49 34 17 8 10 9
3 73 26 18 9 4 5 5
4 40 14 10 5 2 3 3
5 42 15 10 5 3 3 3
6 37 13 9 4 2 3 2
0 1 2 3 4 5 6

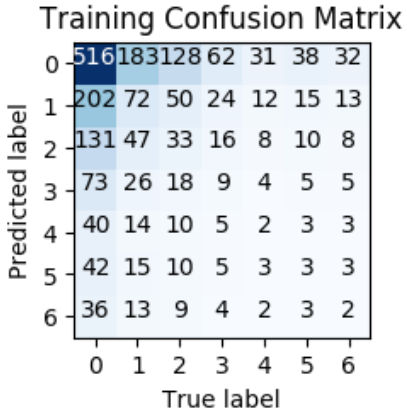

Test Confusion Matrix
Predicted label
True label
0 509 186 123 66 32 34 28
1 205 75 49 26 13 14 11
2 137 50 33 18 9 9 7
3 73 27 18 9 5 5 4
4 40 15 10 5 3 3 2
5 42 15 10 5 3 3 2
6 37 13 9 5 2 2 2
0 1 2 3 4 5 6

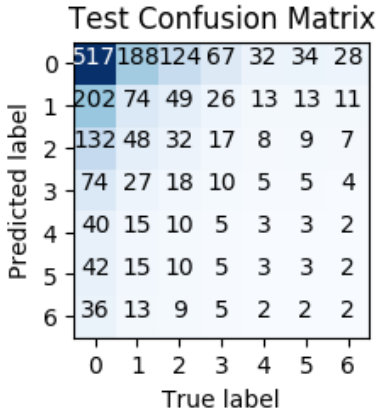

Training Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
7000


Test Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
7000


Training Off-By Counts
count of examples
training iterations
0
200
400
600
800
1000
1000
2000
3000
4000
5000
6000
7000

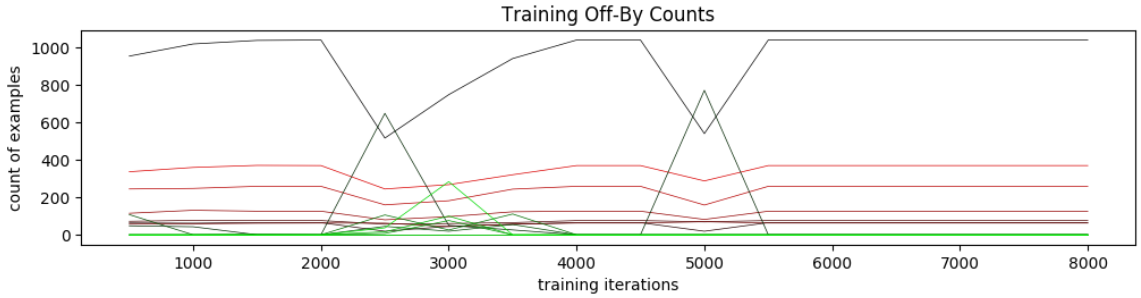

Test Off-By Counts
count of examples
training iterations
0
200
400
600
800
1000
1000
2000
3000
4000
5000
6000
7000

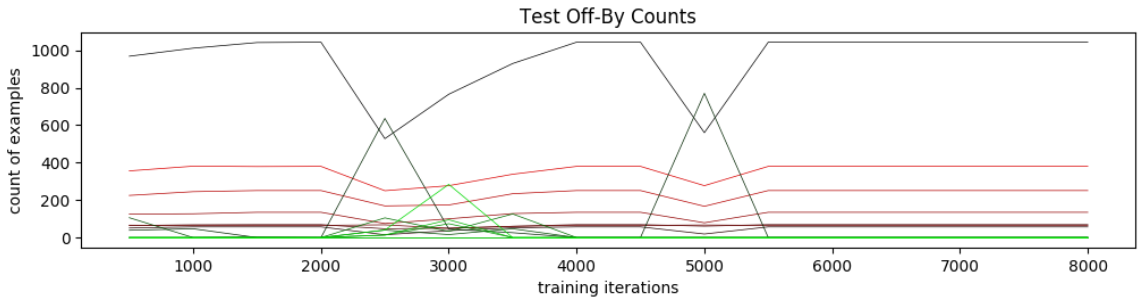

Training Confusion Matrix
Predicted label
True label
516 183 128 62 31 38 32
202 72 50 24 12 15 13
131 47 33 16 8 10 8
73 26 18 9 4 5 5
40 14 10 5 2 3 3
42 15 10 5 3 3 3
36 13 9 4 2 3 2
0 1 2 3 4 5 6

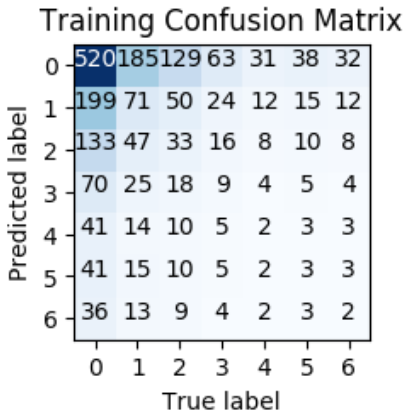

Test Confusion Matrix
Predicted label
True label
517 188 124 67 32 34 28
202 74 49 26 13 13 11
132 48 32 17 8 9 7
74 27 18 10 5 5 4
40 15 10 5 3 3 2
42 15 10 5 3 3 2
36 13 9 5 2 2 2
0 1 2 3 4 5 6

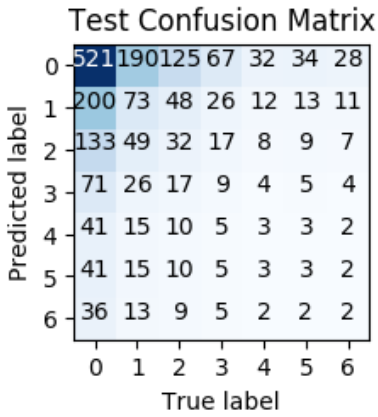

Training Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
7000
8000
training iterations


Test Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
1000
2000
3000
4000
5000
6000
7000
8000
training iterations


Training Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
6000
7000
8000
training iterations

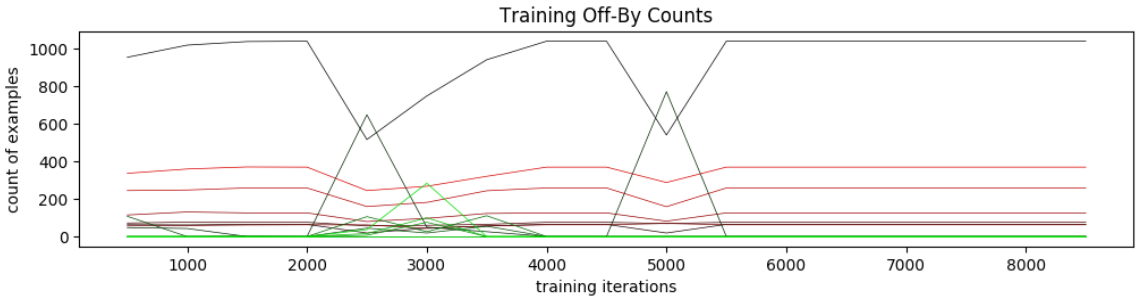

Test Off-By Counts
count of examples
1000
800
600
400
200
0
1000
2000
3000
4000
5000
6000
7000
8000
training iterations

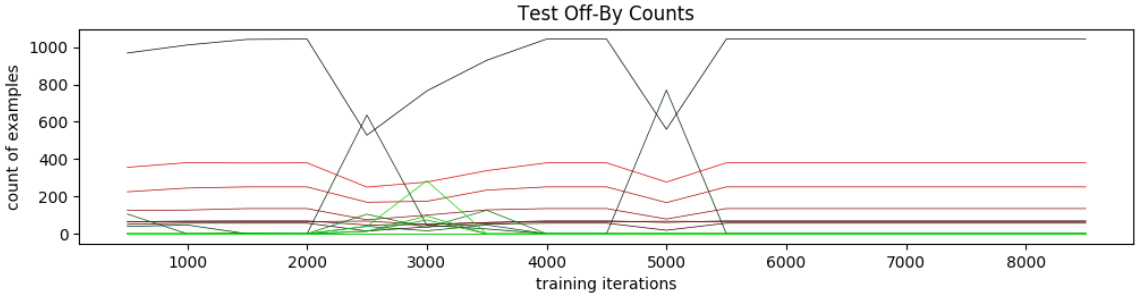

Training Confusion Matrix
Predicted label
True label
0 520 185 129 63 31 38 32
1 199 71 50 24 12 15 12
2 133 47 33 16 8 10 8
3 70 25 18 9 4 5 4
4 41 14 10 5 2 3 3
5 41 15 10 5 2 3 3
6 36 13 9 4 2 3 2
0 1 2 3 4 5 6

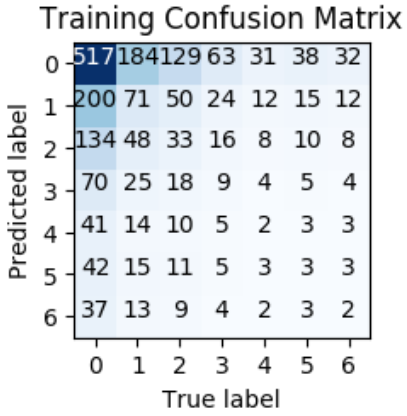

Test Confusion Matrix
Predicted label
True label
0 521 190 125 67 32 34 28
1 200 73 48 26 12 13 11
2 133 49 32 17 8 9 7
3 71 26 17 9 4 5 4
4 41 15 10 5 3 3 2
5 41 15 10 5 3 3 2
6 36 13 9 5 2 2 2
0 1 2 3 4 5 6

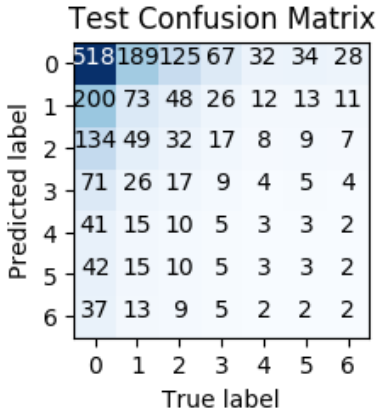

Training Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
1000 2000 3000 4000 5000 6000 7000 8000


Test Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
1000 2000 3000 4000 5000 6000 7000 8000


Training Off-By Counts
count of examples
training iterations

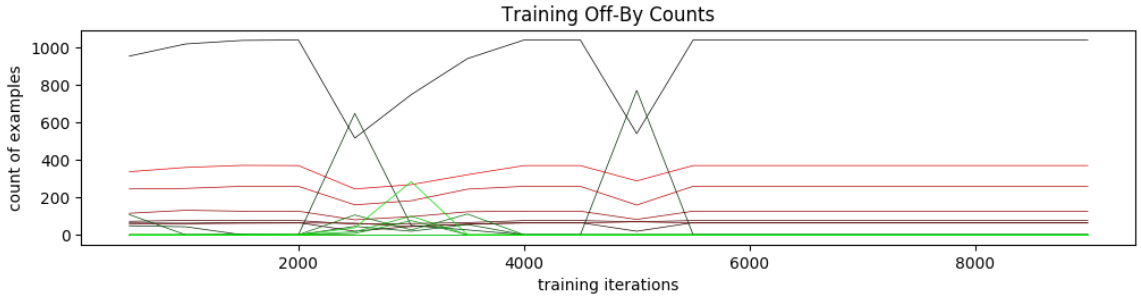

Test Off-By Counts
count of examples
training iterations

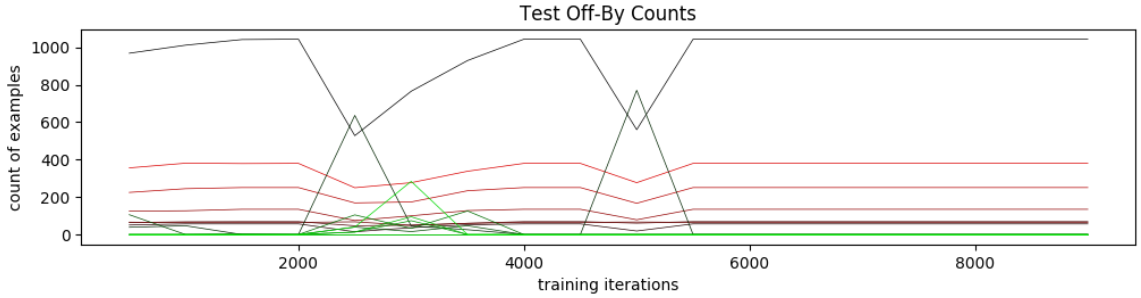

Training Confusion Matrix
Predicted label
True label

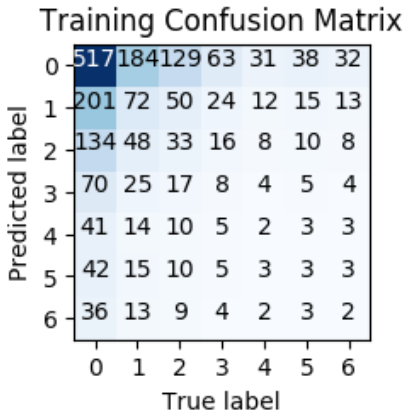

Test Confusion Matrix
Predicted label
True label

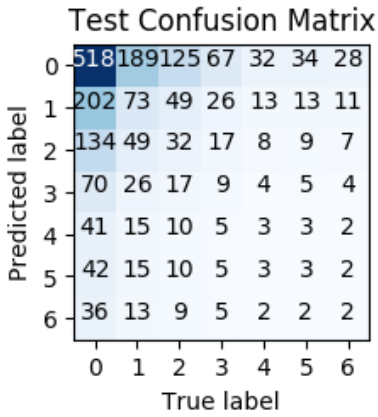

Training Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
2000
4000
6000
8000
training iterations

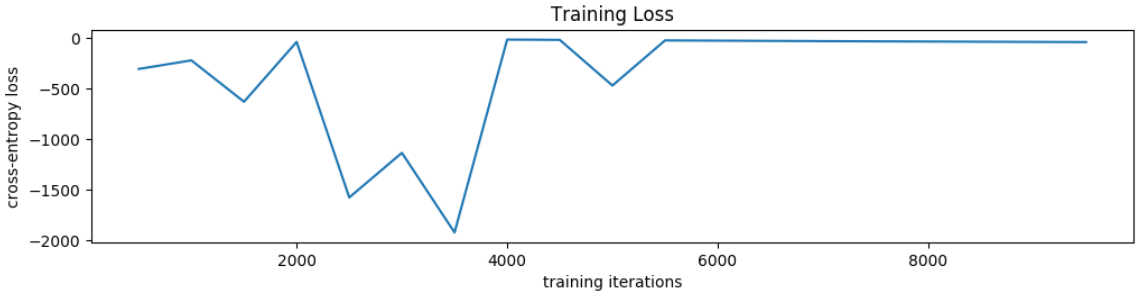

Test Loss
cross-entropy loss
0
−500
−1000
−1500
−2000
2000
4000
6000
8000
training iterations


Training Off-By Counts
count of examples
1000
800
600
400
200
0
2000
4000
6000
8000
training iterations

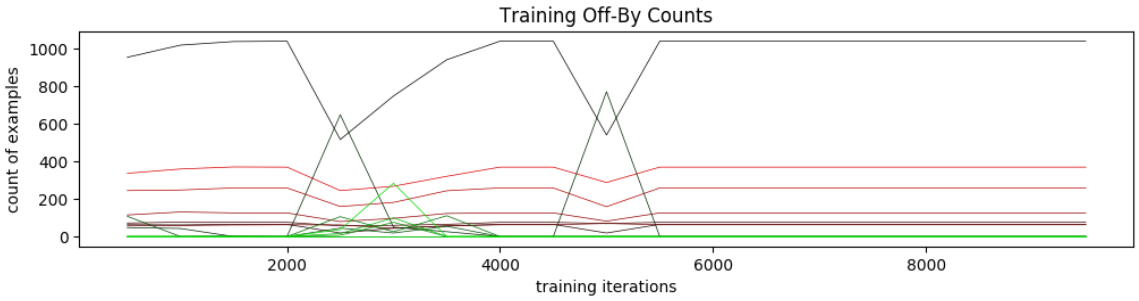

Test Off-By Counts
count of examples
1000
800
600
400
200
0
2000
4000
6000
8000
training iterations

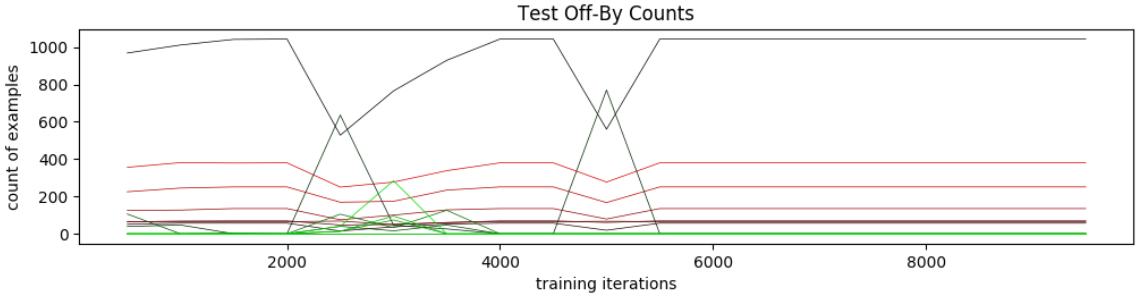

Training Confusion Matrix
Predicted label
True label
0 517 184 129 63 31 38 32
1 201 72 50 24 12 15 13
2 134 48 33 16 8 10 8
3 70 25 17 8 4 5 4
4 41 14 10 5 2 3 3
5 42 15 10 5 3 3 3
6 36 13 9 4 2 3 2
0 1 2 3 4 5 6

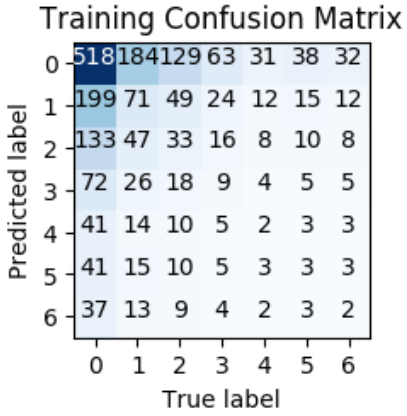

Test Confusion Matrix
Predicted label
True label
0 518 189 125 67 32 34 28
1 202 73 49 26 13 13 11
2 134 49 32 17 8 9 7
3 70 26 17 9 4 5 4
4 41 15 10 5 3 3 2
5 42 15 10 5 3 3 2
6 36 13 9 5 2 2 2
0 1 2 3 4 5 6

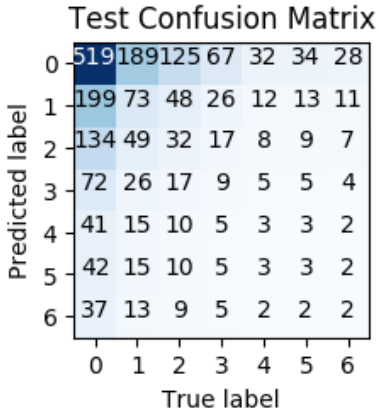

Training Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
2000
4000
6000
8000


Test Loss
cross-entropy loss
training iterations
0
−500
−1000
−1500
−2000
2000
4000
6000
8000


Training Off-By Counts
count of examples
1000
800
600
400
200
0
2000
4000
6000
8000
training iterations


Test Off-By Counts
count of examples
1000
800
600
400
200
0
2000
4000
6000
8000
training iterations


Training Confusion Matrix
Predicted label
True label
518 184 129 63 31 38 32
199 71 49 24 12 15 12
133 47 33 16 8 10 8
72 26 18 9 4 5 5
41 14 10 5 2 3 3
41 15 10 5 3 3 3
37 13 9 4 2 3 2
0 1 2 3 4 5 6


Test Confusion Matrix
Predicted label
True label
519 189 125 67 32 34 28
199 73 48 26 12 13 11
134 49 32 17 8 9 7
72 26 17 9 5 5 4
41 15 10 5 3 3 2
42 15 10 5 3 3 2
37 13 9 5 2 2 2
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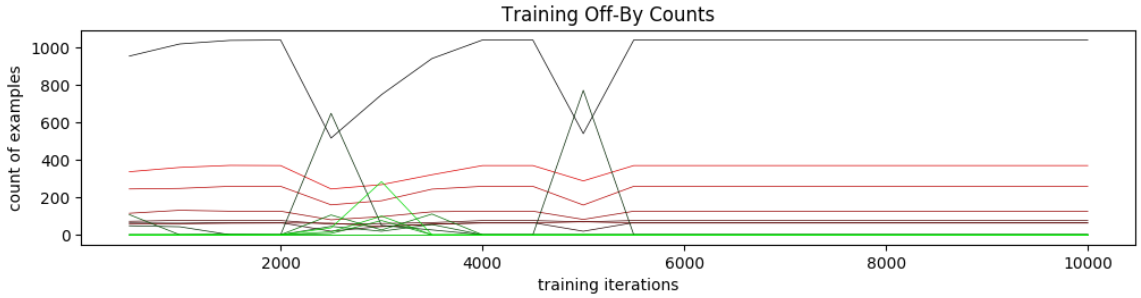

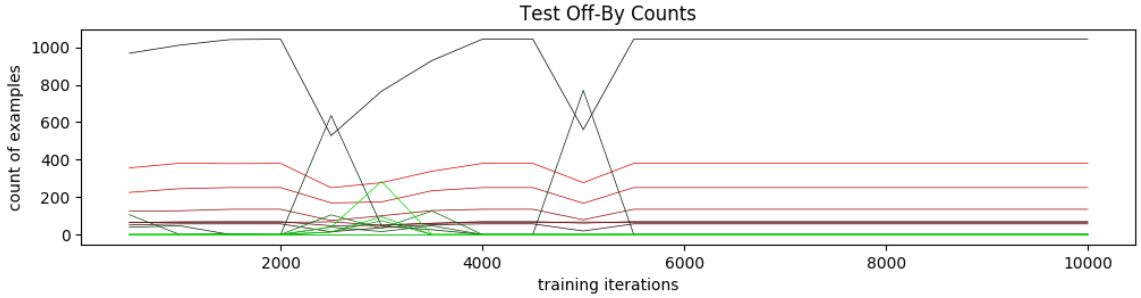

In [ ]:
```
# Close the dataset.
microbia_segments.close()
```