

week_1_solution_17_3

March 15, 2018

```
In [1]: import mnist_loader
import numpy as np
import pandas as pd
```

```
training_data, validation_data, test_data = mnist_loader.load_data_wrapper()
print("Training data, validation data and test data loaded.")
```

Training data, validation data and test data loaded.

```
In [2]: import network2
```

```
net2_all_train = network2.Network([784,30, 30, 30, 30, 10], cost=network2.CrossEntropy)
net2_all_train.large_weight_initializer()
```

```
evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
    training_data=training_data,
    epochs=30,
    mini_batch_size=10,
    eta=0.1,
    evaluation_data=test_data,
    lambda=5.0,
    monitor_evaluation_cost=True,
    monitor_evaluation_accuracy=True,
    monitor_training_cost=True,
    monitor_training_accuracy=True
)
```

Epoch 0 training complete

```
network2.py:54: RuntimeWarning: invalid value encountered in log
    return np.sum(np.nan_to_num(-y*np.log(a)-(1-y)*np.log(1-a)))
```

```
Cost on training data: 6.02309787696
Accuracy on training data: 12095 / 50000
Cost on evaluation data: 10.8759260913
Accuracy on evaluation data: 2450 / 10000
```

Epoch 1 training complete
Cost on training data: 4.21948388712
Accuracy on training data: 10179 / 50000
Cost on evaluation data: 8.6092242796
Accuracy on evaluation data: 2041 / 10000

Epoch 2 training complete
Cost on training data: 3.77018981364
Accuracy on training data: 21438 / 50000
Cost on evaluation data: 7.74776708012
Accuracy on evaluation data: 4324 / 10000

Epoch 3 training complete
Cost on training data: 3.25747867169
Accuracy on training data: 21164 / 50000
Cost on evaluation data: 6.84827410508
Accuracy on evaluation data: 4228 / 10000

Epoch 4 training complete
Cost on training data: 2.72920451265
Accuracy on training data: 31683 / 50000
Cost on evaluation data: 5.99967997739
Accuracy on evaluation data: 6222 / 10000

Epoch 5 training complete
Cost on training data: 2.37274214928
Accuracy on training data: 36780 / 50000
Cost on evaluation data: 5.3459488555
Accuracy on evaluation data: 7351 / 10000

Epoch 6 training complete
Cost on training data: 2.2784198537
Accuracy on training data: 37323 / 50000
Cost on evaluation data: 4.98096238339
Accuracy on evaluation data: 7433 / 10000

Epoch 7 training complete
Cost on training data: 2.17993979677
Accuracy on training data: 36078 / 50000
Cost on evaluation data: 4.62180733593
Accuracy on evaluation data: 7161 / 10000

Epoch 8 training complete
Cost on training data: 1.59548871389
Accuracy on training data: 41057 / 50000
Cost on evaluation data: 3.83261920077
Accuracy on evaluation data: 8197 / 10000

Epoch 9 training complete
Cost on training data: 1.70128854645
Accuracy on training data: 41472 / 50000
Cost on evaluation data: 3.73070578306
Accuracy on evaluation data: 8270 / 10000

Epoch 10 training complete
Cost on training data: 1.40463731589
Accuracy on training data: 43311 / 50000
Cost on evaluation data: 3.24147397423
Accuracy on evaluation data: 8666 / 10000

Epoch 11 training complete
Cost on training data: 1.20039313587
Accuracy on training data: 43658 / 50000
Cost on evaluation data: 2.89492740348
Accuracy on evaluation data: 8677 / 10000

Epoch 12 training complete
Cost on training data: 1.4073851066
Accuracy on training data: 43525 / 50000
Cost on evaluation data: 2.9306808364
Accuracy on evaluation data: 8650 / 10000

Epoch 13 training complete
Cost on training data: 1.20541043315
Accuracy on training data: 44674 / 50000
Cost on evaluation data: 2.58263133999
Accuracy on evaluation data: 8911 / 10000

Epoch 14 training complete
Cost on training data: 1.17412796465
Accuracy on training data: 44931 / 50000
Cost on evaluation data: 2.44869473642
Accuracy on evaluation data: 8945 / 10000

Epoch 15 training complete
Cost on training data: 0.898369913654
Accuracy on training data: 45307 / 50000
Cost on evaluation data: 2.06604845545
Accuracy on evaluation data: 9025 / 10000

Epoch 16 training complete
Cost on training data: 0.969400147238
Accuracy on training data: 45728 / 50000
Cost on evaluation data: 2.02590546826
Accuracy on evaluation data: 9106 / 10000

Epoch 17 training complete
Cost on training data: 0.96428222255
Accuracy on training data: 45391 / 50000
Cost on evaluation data: 1.92172680998
Accuracy on evaluation data: 9007 / 10000

Epoch 18 training complete
Cost on training data: 0.841769967827
Accuracy on training data: 45690 / 50000
Cost on evaluation data: 1.73173008112
Accuracy on evaluation data: 9077 / 10000

Epoch 19 training complete
Cost on training data: 0.884552639162
Accuracy on training data: 45823 / 50000
Cost on evaluation data: 1.71278731318
Accuracy on evaluation data: 9112 / 10000

Epoch 20 training complete
Cost on training data: 0.6637538688
Accuracy on training data: 46226 / 50000
Cost on evaluation data: 1.4085682489
Accuracy on evaluation data: 9184 / 10000

Epoch 21 training complete
Cost on training data: 0.597835805147
Accuracy on training data: 46658 / 50000
Cost on evaluation data: 1.303582312
Accuracy on evaluation data: 9233 / 10000

Epoch 22 training complete
Cost on training data: 0.635375365816
Accuracy on training data: 46706 / 50000
Cost on evaluation data: 1.28018669345
Accuracy on evaluation data: 9276 / 10000

Epoch 23 training complete
Cost on training data: 0.564795757264
Accuracy on training data: 46693 / 50000
Cost on evaluation data: 1.15485030172
Accuracy on evaluation data: 9266 / 10000

Epoch 24 training complete
Cost on training data: 0.710891786415
Accuracy on training data: 46663 / 50000
Cost on evaluation data: 1.25424327464
Accuracy on evaluation data: 9287 / 10000

Epoch 25 training complete
Cost on training data: 0.719402155454
Accuracy on training data: 46670 / 50000
Cost on evaluation data: 1.22576278985
Accuracy on evaluation data: 9249 / 10000

Epoch 26 training complete
Cost on training data: 0.677451185215
Accuracy on training data: 46626 / 50000
Cost on evaluation data: 1.15666502753
Accuracy on evaluation data: 9221 / 10000

Epoch 27 training complete
Cost on training data: 0.606850946676
Accuracy on training data: 47104 / 50000
Cost on evaluation data: 1.04669687733
Accuracy on evaluation data: 9353 / 10000

Epoch 28 training complete
Cost on training data: 0.581026413968
Accuracy on training data: 47277 / 50000
Cost on evaluation data: 0.982280329274
Accuracy on evaluation data: 9367 / 10000

Epoch 29 training complete
Cost on training data: 0.476099205135
Accuracy on training data: 47404 / 50000
Cost on evaluation data: 0.869928056478
Accuracy on evaluation data: 9398 / 10000