week_1_solution_17_2

March 15, 2018

```
In [3]: 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 [4]: import network2
        net2_all_train = network2.Network([784,30, 30, 30, 10], cost=network2.CrossEntropyCost
        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,
            lmbda=5.0,
            monitor_evaluation_cost=True,
            monitor_evaluation_accuracy=True,
            monitor_training_cost=True,
            monitor_training_accuracy=True
        )

Epoch 0 training complete
Cost on training data: 6.66034809235
Accuracy on training data: 12696 / 50000
Cost on evaluation data: 11.3960220245
Accuracy on evaluation data: 2548 / 10000

Epoch 1 training complete
Cost on training data: 2.47106290974
Accuracy on training data: 17113 / 50000
Cost on evaluation data: 6.74507000529
Accuracy on evaluation data: 3465 / 10000
```

```
Epoch 2 training complete
Cost on training data: 5.35724184727
Accuracy on training data: 14678 / 50000
Cost on evaluation data: 9.24206821924
Accuracy on evaluation data: 2911 / 10000

Epoch 3 training complete
Cost on training data: 2.99881676585
Accuracy on training data: 26448 / 50000
Cost on evaluation data: 6.51932917225
Accuracy on evaluation data: 5289 / 10000

Epoch 4 training complete
Cost on training data: 3.20588508022
Accuracy on training data: 33651 / 50000
Cost on evaluation data: 6.37546840015
Accuracy on evaluation data: 6800 / 10000

Epoch 5 training complete
Cost on training data: 3.87386815979
Accuracy on training data: 29255 / 50000
Cost on evaluation data: 6.75170941428
Accuracy on evaluation data: 5882 / 10000

Epoch 6 training complete
Cost on training data: 3.00116971842
Accuracy on training data: 34683 / 50000
Cost on evaluation data: 5.61786961004
Accuracy on evaluation data: 6947 / 10000

Epoch 7 training complete
Cost on training data: 2.40628344968
Accuracy on training data: 32241 / 50000
Cost on evaluation data: 4.77324370887
Accuracy on evaluation data: 6464 / 10000

Epoch 8 training complete
Cost on training data: 1.95449660927
Accuracy on training data: 39584 / 50000
Cost on evaluation data: 4.10181252229
Accuracy on evaluation data: 7939 / 10000

Epoch 9 training complete
Cost on training data: 2.24322517233
Accuracy on training data: 40053 / 50000
Cost on evaluation data: 4.186631986
Accuracy on evaluation data: 8045 / 10000
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Epoch 10 training complete
Cost on training data: 1.61766548642
Accuracy on training data: 40312 / 50000
Cost on evaluation data: 3.37742034035
Accuracy on evaluation data: 8083 / 10000

Epoch 11 training complete
Cost on training data: 1.43020523372
Accuracy on training data: 42797 / 50000
Cost on evaluation data: 3.04048475421
Accuracy on evaluation data: 8554 / 10000

Epoch 12 training complete
Cost on training data: 1.3469050439
Accuracy on training data: 44897 / 50000
Cost on evaluation data: 2.80553441562
Accuracy on evaluation data: 8957 / 10000

Epoch 13 training complete
Cost on training data: 1.19285538535
Accuracy on training data: 45873 / 50000
Cost on evaluation data: 2.53037152152
Accuracy on evaluation data: 9120 / 10000

Epoch 14 training complete
Cost on training data: 1.5129748589
Accuracy on training data: 45349 / 50000
Cost on evaluation data: 2.72775273533
Accuracy on evaluation data: 9047 / 10000

Epoch 15 training complete
Cost on training data: 1.19678832182
Accuracy on training data: 45882 / 50000
Cost on evaluation data: 2.30867869492
Accuracy on evaluation data: 9144 / 10000

Epoch 16 training complete
Cost on training data: 1.12094690443
Accuracy on training data: 46182 / 50000
Cost on evaluation data: 2.13578887468
Accuracy on evaluation data: 9191 / 10000

Epoch 17 training complete
Cost on training data: 1.22609532634
Accuracy on training data: 45705 / 50000
Cost on evaluation data: 2.14031150796
Accuracy on evaluation data: 9101 / 10000
```

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Epoch 18 training complete
Cost on training data: 0.870233154743
Accuracy on training data: 46648 / 50000
Cost on evaluation data: 1.74118323243
Accuracy on evaluation data: 9235 / 10000

Epoch 19 training complete
Cost on training data: 0.975430683388
Accuracy on training data: 46420 / 50000
Cost on evaluation data: 1.75027696873
Accuracy on evaluation data: 9228 / 10000

Epoch 20 training complete
Cost on training data: 0.709388575115
Accuracy on training data: 46865 / 50000
Cost on evaluation data: 1.43537919495
Accuracy on evaluation data: 9268 / 10000

Epoch 21 training complete
Cost on training data: 0.95771319577
Accuracy on training data: 46543 / 50000
Cost on evaluation data: 1.61297384416
Accuracy on evaluation data: 9242 / 10000

Epoch 22 training complete
Cost on training data: 0.553480287322
Accuracy on training data: 47128 / 50000
Cost on evaluation data: 1.17420841085
Accuracy on evaluation data: 9327 / 10000

Epoch 23 training complete
Cost on training data: 0.605641290155
Accuracy on training data: 47062 / 50000
Cost on evaluation data: 1.17770782867
Accuracy on evaluation data: 9319 / 10000

Epoch 24 training complete
Cost on training data: 0.581447353487
Accuracy on training data: 47147 / 50000
Cost on evaluation data: 1.11193157501
Accuracy on evaluation data: 9340 / 10000

Epoch 25 training complete
Cost on training data: 0.673165527393
Accuracy on training data: 47255 / 50000
Cost on evaluation data: 1.16584752401
Accuracy on evaluation data: 9344 / 10000
```

```
Epoch 26 training complete
Cost on training data: 0.612757435683
Accuracy on training data: 46989 / 50000
Cost on evaluation data: 1.06654211777
Accuracy on evaluation data: 9295 / 10000

Epoch 27 training complete
Cost on training data: 0.51732489639
Accuracy on training data: 47296 / 50000
Cost on evaluation data: 0.944075859641
Accuracy on evaluation data: 9370 / 10000

Epoch 28 training complete
Cost on training data: 0.438282855133
Accuracy on training data: 47674 / 50000
Cost on evaluation data: 0.843683949077
Accuracy on evaluation data: 9434 / 10000

Epoch 29 training complete
Cost on training data: 0.616747680686
Accuracy on training data: 47288 / 50000
Cost on evaluation data: 0.980833932146
Accuracy on evaluation data: 9358 / 10000
```