week_1_solution_19_3

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
        network2 = reload(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, trai
            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: 4.09287019391
Accuracy on training data: 13463 / 50000
Cost on evaluation data: 8.63849969298
Accuracy on evaluation data: 2777 / 10000

Epoch 1 training complete
Cost on training data: 3.53030823223
Accuracy on training data: 12651 / 50000
```

1

```
Cost on evaluation data: 7.65371410186
Accuracy on evaluation data: 2590 / 10000

Epoch 2 training complete
Cost on training data: 3.72716475241
Accuracy on training data: 17182 / 50000
Cost on evaluation data: 7.44733267858
Accuracy on evaluation data: 3526 / 10000

Epoch 3 training complete
Cost on training data: 3.17098250567
Accuracy on training data: 23280 / 50000
Cost on evaluation data: 6.53486048461
Accuracy on evaluation data: 4719 / 10000

Epoch 4 training complete
Cost on training data: 2.96924517378
Accuracy on training data: 24551 / 50000
Cost on evaluation data: 5.97898046387
Accuracy on evaluation data: 5044 / 10000

Epoch 5 training complete
Cost on training data: 2.81664757462
Accuracy on training data: 27111 / 50000
Cost on evaluation data: 5.56062232751
Accuracy on evaluation data: 5539 / 10000

Epoch 6 training complete
Cost on training data: 2.50695370208
Accuracy on training data: 28934 / 50000
Cost on evaluation data: 4.9866699409
Accuracy on evaluation data: 5831 / 10000

Epoch 7 training complete
Cost on training data: 2.05830172469
Accuracy on training data: 34574 / 50000
Cost on evaluation data: 4.2984111265
Accuracy on evaluation data: 6972 / 10000

Epoch 8 training complete
Cost on training data: 2.07840687003
Accuracy on training data: 33398 / 50000
Cost on evaluation data: 4.10975258572
Accuracy on evaluation data: 6747 / 10000

Epoch 9 training complete
Cost on training data: 1.84411528622
Accuracy on training data: 35786 / 50000
```

```
Cost on evaluation data: 3.68248962649
Accuracy on evaluation data: 7215 / 10000

Epoch 10 training complete
Cost on training data: 1.73780275335
Accuracy on training data: 36500 / 50000
Cost on evaluation data: 3.39113272762
Accuracy on evaluation data: 7356 / 10000

Epoch 11 training complete
Cost on training data: 1.58514759769
Accuracy on training data: 37530 / 50000
Cost on evaluation data: 3.07532006236
Accuracy on evaluation data: 7562 / 10000

Epoch 12 training complete
Cost on training data: 1.42334601561
Accuracy on training data: 38701 / 50000
Cost on evaluation data: 2.78733043294
Accuracy on evaluation data: 7777 / 10000

Epoch 13 training complete
Cost on training data: 1.32927198738
Accuracy on training data: 40691 / 50000
Cost on evaluation data: 2.55435862155
Accuracy on evaluation data: 8169 / 10000

Epoch 14 training complete
Cost on training data: 1.36031711486
Accuracy on training data: 42103 / 50000
Cost on evaluation data: 2.45786899682
Accuracy on evaluation data: 8494 / 10000

Epoch 15 training complete
Cost on training data: 1.23989722513
Accuracy on training data: 42616 / 50000
Cost on evaluation data: 2.23440369823
Accuracy on evaluation data: 8582 / 10000

Epoch 16 training complete
Cost on training data: 1.12522144254
Accuracy on training data: 43576 / 50000
Cost on evaluation data: 2.03952849294
Accuracy on evaluation data: 8736 / 10000

Epoch 17 training complete
Cost on training data: 1.15312080712
Accuracy on training data: 44063 / 50000
```

```
Cost on evaluation data: 1.98553982384
Accuracy on evaluation data: 8788 / 10000


Epoch 18 training complete
Cost on training data: 0.876813066447
Accuracy on training data: 44617 / 50000
Cost on evaluation data: 1.62202463821
Accuracy on evaluation data: 8907 / 10000


Epoch 19 training complete
Cost on training data: 0.857394076185
Accuracy on training data: 45071 / 50000
Cost on evaluation data: 1.53459555182
Accuracy on evaluation data: 9016 / 10000


Epoch 20 training complete
Cost on training data: 0.811458967301
Accuracy on training data: 45468 / 50000
Cost on evaluation data: 1.43984102367
Accuracy on evaluation data: 9076 / 10000


Epoch 21 training complete
Cost on training data: 0.680548428816
Accuracy on training data: 45666 / 50000
Cost on evaluation data: 1.24359589632
Accuracy on evaluation data: 9102 / 10000


Epoch 22 training complete
Cost on training data: 0.747033327653
Accuracy on training data: 45976 / 50000
Cost on evaluation data: 1.26154946213
Accuracy on evaluation data: 9152 / 10000


Epoch 23 training complete
Cost on training data: 0.742925229765
Accuracy on training data: 46116 / 50000
Cost on evaluation data: 1.21225251472
Accuracy on evaluation data: 9149 / 10000


Epoch 24 training complete
Cost on training data: 0.702159882782
Accuracy on training data: 46324 / 50000
Cost on evaluation data: 1.1331444326
Accuracy on evaluation data: 9193 / 10000


Epoch 25 training complete
Cost on training data: 0.689369346842
Accuracy on training data: 46551 / 50000
```

```
Cost on evaluation data: 1.08821578
Accuracy on evaluation data: 9236 / 10000

Epoch 26 training complete
Cost on training data: 0.563047175884
Accuracy on training data: 46692 / 50000
Cost on evaluation data: 0.921282909148
Accuracy on evaluation data: 9281 / 10000

Epoch 27 training complete
Cost on training data: 0.626763658591
Accuracy on training data: 46651 / 50000
Cost on evaluation data: 0.956741084537
Accuracy on evaluation data: 9268 / 10000

Epoch 28 training complete
Cost on training data: 0.605058249854
Accuracy on training data: 46854 / 50000
Cost on evaluation data: 0.898659820238
Accuracy on evaluation data: 9308 / 10000

Epoch 29 training complete
Cost on training data: 0.582832566579
Accuracy on training data: 47150 / 50000
Cost on evaluation data: 0.863283062334
Accuracy on evaluation data: 9341 / 10000
```