

week_1_solution_19_2

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 [16]: import network2
```

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

```
evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tr
    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

Cost on training data: 5.7647485068

Accuracy on training data: 7788 / 50000

Cost on evaluation data: 10.4523401748

Accuracy on evaluation data: 1564 / 10000

Epoch 1 training complete

Cost on training data: 4.39117086568

Accuracy on training data: 10427 / 50000

Cost on evaluation data: 8.73843980734
Accuracy on evaluation data: 2095 / 10000

Epoch 2 training complete
Cost on training data: 5.4610704424
Accuracy on training data: 15959 / 50000
Cost on evaluation data: 9.49079169137
Accuracy on evaluation data: 3181 / 10000

Epoch 3 training complete
Cost on training data: 3.42964504338
Accuracy on training data: 13004 / 50000
Cost on evaluation data: 7.12153316431
Accuracy on evaluation data: 2659 / 10000

Epoch 4 training complete
Cost on training data: 4.75477208608
Accuracy on training data: 12716 / 50000
Cost on evaluation data: 8.16310207165
Accuracy on evaluation data: 2527 / 10000

Epoch 5 training complete
Cost on training data: 3.53510629695
Accuracy on training data: 11599 / 50000
Cost on evaluation data: 6.6352588809
Accuracy on evaluation data: 2290 / 10000

Epoch 6 training complete
Cost on training data: 5.30782196857
Accuracy on training data: 12587 / 50000
Cost on evaluation data: 8.23425141364
Accuracy on evaluation data: 2535 / 10000

Epoch 7 training complete
Cost on training data: 5.15604140594
Accuracy on training data: 20126 / 50000
Cost on evaluation data: 7.84042914143
Accuracy on evaluation data: 4104 / 10000

Epoch 8 training complete
Cost on training data: 4.82532348696
Accuracy on training data: 11517 / 50000
Cost on evaluation data: 7.33459363871
Accuracy on evaluation data: 2279 / 10000

Epoch 9 training complete
Cost on training data: 3.40006679763
Accuracy on training data: 26371 / 50000

Cost on evaluation data: 5.6411530981
Accuracy on evaluation data: 5293 / 10000

Epoch 10 training complete
Cost on training data: 2.47496571866
Accuracy on training data: 32609 / 50000
Cost on evaluation data: 4.50245851021
Accuracy on evaluation data: 6488 / 10000

Epoch 11 training complete
Cost on training data: 1.88041418282
Accuracy on training data: 40513 / 50000
Cost on evaluation data: 3.68186469983
Accuracy on evaluation data: 8137 / 10000

Epoch 12 training complete
Cost on training data: 1.77602533725
Accuracy on training data: 41497 / 50000
Cost on evaluation data: 3.42012251385
Accuracy on evaluation data: 8267 / 10000

Epoch 13 training complete
Cost on training data: 1.62071416645
Accuracy on training data: 41879 / 50000
Cost on evaluation data: 3.10629162815
Accuracy on evaluation data: 8346 / 10000

Epoch 14 training complete
Cost on training data: 1.364190229
Accuracy on training data: 43195 / 50000
Cost on evaluation data: 2.69569013665
Accuracy on evaluation data: 8634 / 10000

Epoch 15 training complete
Cost on training data: 1.2218838632
Accuracy on training data: 43460 / 50000
Cost on evaluation data: 2.42815077987
Accuracy on evaluation data: 8676 / 10000

Epoch 16 training complete
Cost on training data: 1.23395510688
Accuracy on training data: 44017 / 50000
Cost on evaluation data: 2.3180350736
Accuracy on evaluation data: 8782 / 10000

Epoch 17 training complete
Cost on training data: 1.34348649224
Accuracy on training data: 40272 / 50000

Cost on evaluation data: 2.31613246687
Accuracy on evaluation data: 8071 / 10000

Epoch 18 training complete
Cost on training data: 0.936797654504
Accuracy on training data: 44912 / 50000
Cost on evaluation data: 1.81657702454
Accuracy on evaluation data: 8982 / 10000

Epoch 19 training complete
Cost on training data: 1.29957535554
Accuracy on training data: 41338 / 50000
Cost on evaluation data: 2.09605129761
Accuracy on evaluation data: 8295 / 10000

Epoch 20 training complete
Cost on training data: 0.900884037961
Accuracy on training data: 45124 / 50000
Cost on evaluation data: 1.60864198572
Accuracy on evaluation data: 9049 / 10000

Epoch 21 training complete
Cost on training data: 0.821434750812
Accuracy on training data: 45624 / 50000
Cost on evaluation data: 1.46476997649
Accuracy on evaluation data: 9106 / 10000

Epoch 22 training complete
Cost on training data: 0.759733332533
Accuracy on training data: 45812 / 50000
Cost on evaluation data: 1.34682530156
Accuracy on evaluation data: 9151 / 10000

Epoch 23 training complete
Cost on training data: 0.751453065151
Accuracy on training data: 45952 / 50000
Cost on evaluation data: 1.27740661888
Accuracy on evaluation data: 9172 / 10000

Epoch 24 training complete
Cost on training data: 0.837044011648
Accuracy on training data: 45802 / 50000
Cost on evaluation data: 1.31651713646
Accuracy on evaluation data: 9157 / 10000

Epoch 25 training complete
Cost on training data: 0.71293833452
Accuracy on training data: 46023 / 50000

Cost on evaluation data: 1.15278268583
Accuracy on evaluation data: 9184 / 10000

Epoch 26 training complete
Cost on training data: 0.70792567961
Accuracy on training data: 46412 / 50000
Cost on evaluation data: 1.10594474871
Accuracy on evaluation data: 9252 / 10000

Epoch 27 training complete
Cost on training data: 0.600480255383
Accuracy on training data: 46495 / 50000
Cost on evaluation data: 0.972359482559
Accuracy on evaluation data: 9250 / 10000

Epoch 28 training complete
Cost on training data: 0.634604887958
Accuracy on training data: 46519 / 50000
Cost on evaluation data: 0.966400446945
Accuracy on evaluation data: 9269 / 10000

Epoch 29 training complete
Cost on training data: 0.722682080008
Accuracy on training data: 46537 / 50000
Cost on evaluation data: 1.02779317731
Accuracy on evaluation data: 9276 / 10000