

# week\_1\_solution\_16

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 [7]: import network2
```

```
net2_all_train = network2.Network([784,100,10], cost=network2.CrossEntropyCost, activation='tanh')
net2_all_train.large_weight_initializer()
```

```
evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, training_accuracy_all_train = net2_all_train.evaluate(
    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: 15.3821054439

Accuracy on training data: 19087 / 50000

Cost on evaluation data: 29.6149619313

Accuracy on evaluation data: 3856 / 10000

Epoch 1 training complete

Cost on training data: 12.2378776154

Accuracy on training data: 13279 / 50000

Cost on evaluation data: 25.2541536144

Accuracy on evaluation data: 2721 / 10000

Epoch 2 training complete  
Cost on training data: 8.30867029689  
Accuracy on training data: 19287 / 50000  
Cost on evaluation data: 20.1810968357  
Accuracy on evaluation data: 3782 / 10000

Epoch 3 training complete  
Cost on training data: 9.78417145954  
Accuracy on training data: 19483 / 50000  
Cost on evaluation data: 20.4935637064  
Accuracy on evaluation data: 3914 / 10000

Epoch 4 training complete  
Cost on training data: 10.7320847957  
Accuracy on training data: 23005 / 50000  
Cost on evaluation data: 20.5221250868  
Accuracy on evaluation data: 4588 / 10000

Epoch 5 training complete  
Cost on training data: 9.21475347865  
Accuracy on training data: 24826 / 50000  
Cost on evaluation data: 18.0142213541  
Accuracy on evaluation data: 5152 / 10000

Epoch 6 training complete  
Cost on training data: 5.98316510357  
Accuracy on training data: 27265 / 50000  
Cost on evaluation data: 13.9472547231  
Accuracy on evaluation data: 5434 / 10000

Epoch 7 training complete  
Cost on training data: 7.35662975159  
Accuracy on training data: 25896 / 50000  
Cost on evaluation data: 14.5594459029  
Accuracy on evaluation data: 5308 / 10000

Epoch 8 training complete  
Cost on training data: 7.60569435711  
Accuracy on training data: 28639 / 50000  
Cost on evaluation data: 14.1879408135  
Accuracy on evaluation data: 5766 / 10000

Epoch 9 training complete  
Cost on training data: 5.35144309175  
Accuracy on training data: 24091 / 50000  
Cost on evaluation data: 11.2609894002  
Accuracy on evaluation data: 4895 / 10000

Epoch 10 training complete  
Cost on training data: 6.03725575693  
Accuracy on training data: 20648 / 50000  
Cost on evaluation data: 11.3889539641  
Accuracy on evaluation data: 4165 / 10000

Epoch 11 training complete  
Cost on training data: 7.15599414797  
Accuracy on training data: 24894 / 50000  
Cost on evaluation data: 12.1198842405  
Accuracy on evaluation data: 4865 / 10000

Epoch 12 training complete  
Cost on training data: 5.68865128109  
Accuracy on training data: 26719 / 50000  
Cost on evaluation data: 10.0647072757  
Accuracy on evaluation data: 5419 / 10000

Epoch 13 training complete  
Cost on training data: 7.13469706384  
Accuracy on training data: 29359 / 50000  
Cost on evaluation data: 11.1106287574  
Accuracy on evaluation data: 5792 / 10000

Epoch 14 training complete  
Cost on training data: 4.78641290457  
Accuracy on training data: 31725 / 50000  
Cost on evaluation data: 8.37767309911  
Accuracy on evaluation data: 6332 / 10000

Epoch 15 training complete  
Cost on training data: 4.27825474642  
Accuracy on training data: 31841 / 50000  
Cost on evaluation data: 7.53986585119  
Accuracy on evaluation data: 6389 / 10000

Epoch 16 training complete  
Cost on training data: 3.90236171888  
Accuracy on training data: 36136 / 50000  
Cost on evaluation data: 6.85990567907  
Accuracy on evaluation data: 7240 / 10000

Epoch 17 training complete  
Cost on training data: 4.64451169483  
Accuracy on training data: 36316 / 50000  
Cost on evaluation data: 7.24719872361  
Accuracy on evaluation data: 7312 / 10000

Epoch 18 training complete  
Cost on training data: 3.19018515785  
Accuracy on training data: 40444 / 50000  
Cost on evaluation data: 5.60393826118  
Accuracy on evaluation data: 8059 / 10000

Epoch 19 training complete  
Cost on training data: 2.18769246342  
Accuracy on training data: 42669 / 50000  
Cost on evaluation data: 4.34005851504  
Accuracy on evaluation data: 8617 / 10000

Epoch 20 training complete  
Cost on training data: 2.65758692628  
Accuracy on training data: 40457 / 50000  
Cost on evaluation data: 4.58848830642  
Accuracy on evaluation data: 8070 / 10000

Epoch 21 training complete  
Cost on training data: 2.57872231258  
Accuracy on training data: 43305 / 50000  
Cost on evaluation data: 4.35182973085  
Accuracy on evaluation data: 8612 / 10000

Epoch 22 training complete  
Cost on training data: 2.35452629165  
Accuracy on training data: 41100 / 50000  
Cost on evaluation data: 3.92505877299  
Accuracy on evaluation data: 8248 / 10000

Epoch 23 training complete  
Cost on training data: 2.03244553154  
Accuracy on training data: 41820 / 50000  
Cost on evaluation data: 3.45124506806  
Accuracy on evaluation data: 8394 / 10000

Epoch 24 training complete  
Cost on training data: 1.83488200153  
Accuracy on training data: 44992 / 50000  
Cost on evaluation data: 3.12811541056  
Accuracy on evaluation data: 8979 / 10000

Epoch 25 training complete  
Cost on training data: 1.97540298292  
Accuracy on training data: 43119 / 50000  
Cost on evaluation data: 3.13127497585  
Accuracy on evaluation data: 8624 / 10000

Epoch 26 training complete  
Cost on training data: 2.20383187285  
Accuracy on training data: 40906 / 50000  
Cost on evaluation data: 3.26701878429  
Accuracy on evaluation data: 8143 / 10000

Epoch 27 training complete  
Cost on training data: 1.76278199513  
Accuracy on training data: 43272 / 50000  
Cost on evaluation data: 2.69604911507  
Accuracy on evaluation data: 8646 / 10000

Epoch 28 training complete  
Cost on training data: 1.67025114881  
Accuracy on training data: 46047 / 50000  
Cost on evaluation data: 2.50511679927  
Accuracy on evaluation data: 9192 / 10000

Epoch 29 training complete  
Cost on training data: 1.53041153777  
Accuracy on training data: 45565 / 50000  
Cost on evaluation data: 2.29196090545  
Accuracy on evaluation data: 9059 / 10000