

# week\_1\_solution\_17\_1

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, 30,10], cost=network2.CrossEntropyCost, act.
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: 10.0170719798
Accuracy on training data: 12575 / 50000
Cost on evaluation data: 14.4069609609
Accuracy on evaluation data: 2539 / 10000
```

Epoch 1 training complete  
Cost on training data: 3.90493741502  
Accuracy on training data: 5687 / 50000  
Cost on evaluation data: 7.89011330957  
Accuracy on evaluation data: 1137 / 10000

Epoch 2 training complete  
Cost on training data: 5.6233528032  
Accuracy on training data: 14432 / 50000  
Cost on evaluation data: 9.24205338115  
Accuracy on evaluation data: 2914 / 10000

Epoch 3 training complete  
Cost on training data: 7.60004553535  
Accuracy on training data: 13081 / 50000  
Cost on evaluation data: 10.8995464838  
Accuracy on evaluation data: 2566 / 10000

Epoch 4 training complete  
Cost on training data: 4.11953738173  
Accuracy on training data: 26747 / 50000  
Cost on evaluation data: 7.10364006625  
Accuracy on evaluation data: 5322 / 10000

Epoch 5 training complete  
Cost on training data: 4.36769487828  
Accuracy on training data: 22329 / 50000  
Cost on evaluation data: 7.04737632251  
Accuracy on evaluation data: 4487 / 10000

Epoch 6 training complete  
Cost on training data: 5.57478360452  
Accuracy on training data: 26790 / 50000  
Cost on evaluation data: 8.01074161152  
Accuracy on evaluation data: 5428 / 10000

Epoch 7 training complete  
Cost on training data: 2.91034323357  
Accuracy on training data: 30233 / 50000  
Cost on evaluation data: 5.11757564848  
Accuracy on evaluation data: 6065 / 10000

Epoch 8 training complete  
Cost on training data: 4.69602858903  
Accuracy on training data: 30797 / 50000  
Cost on evaluation data: 6.71378487563  
Accuracy on evaluation data: 6184 / 10000

Epoch 9 training complete  
Cost on training data: 3.00358441646  
Accuracy on training data: 36435 / 50000  
Cost on evaluation data: 4.81756182216  
Accuracy on evaluation data: 7349 / 10000

Epoch 10 training complete  
Cost on training data: 3.53159008885  
Accuracy on training data: 38228 / 50000  
Cost on evaluation data: 5.15943449849  
Accuracy on evaluation data: 7670 / 10000

Epoch 11 training complete  
Cost on training data: 3.64304242831  
Accuracy on training data: 42236 / 50000  
Cost on evaluation data: 5.13177088126  
Accuracy on evaluation data: 8466 / 10000

Epoch 12 training complete  
Cost on training data: 1.57578614479  
Accuracy on training data: 44438 / 50000  
Cost on evaluation data: 2.93450264746  
Accuracy on evaluation data: 8848 / 10000

Epoch 13 training complete  
Cost on training data: 1.62634192096  
Accuracy on training data: 44758 / 50000  
Cost on evaluation data: 2.86387532943  
Accuracy on evaluation data: 8942 / 10000

Epoch 14 training complete  
Cost on training data: 1.68385116069  
Accuracy on training data: 45415 / 50000  
Cost on evaluation data: 2.80075053772  
Accuracy on evaluation data: 9064 / 10000

Epoch 15 training complete  
Cost on training data: 1.79982921656  
Accuracy on training data: 45399 / 50000  
Cost on evaluation data: 2.81934643154  
Accuracy on evaluation data: 9052 / 10000

Epoch 16 training complete  
Cost on training data: 1.34058835705  
Accuracy on training data: 45761 / 50000  
Cost on evaluation data: 2.28047278096  
Accuracy on evaluation data: 9095 / 10000

Epoch 17 training complete  
Cost on training data: 1.121212903  
Accuracy on training data: 45720 / 50000  
Cost on evaluation data: 1.97714934083  
Accuracy on evaluation data: 9092 / 10000

Epoch 18 training complete  
Cost on training data: 1.38203462254  
Accuracy on training data: 45909 / 50000  
Cost on evaluation data: 2.16690511227  
Accuracy on evaluation data: 9111 / 10000

Epoch 19 training complete  
Cost on training data: 1.069192526  
Accuracy on training data: 46079 / 50000  
Cost on evaluation data: 1.79611592731  
Accuracy on evaluation data: 9160 / 10000

Epoch 20 training complete  
Cost on training data: 1.26363745153  
Accuracy on training data: 45550 / 50000  
Cost on evaluation data: 1.9281994332  
Accuracy on evaluation data: 9023 / 10000

Epoch 21 training complete  
Cost on training data: 0.938787536285  
Accuracy on training data: 46142 / 50000  
Cost on evaluation data: 1.53672924514  
Accuracy on evaluation data: 9145 / 10000

Epoch 22 training complete  
Cost on training data: 0.825216610145  
Accuracy on training data: 46523 / 50000  
Cost on evaluation data: 1.37731258854  
Accuracy on evaluation data: 9218 / 10000

Epoch 23 training complete  
Cost on training data: 0.731918852108  
Accuracy on training data: 46611 / 50000  
Cost on evaluation data: 1.24317639775  
Accuracy on evaluation data: 9227 / 10000

Epoch 24 training complete  
Cost on training data: 0.777166023449  
Accuracy on training data: 46575 / 50000  
Cost on evaluation data: 1.24423033003  
Accuracy on evaluation data: 9234 / 10000

Epoch 25 training complete  
Cost on training data: 0.705020764999  
Accuracy on training data: 46812 / 50000  
Cost on evaluation data: 1.13167434112  
Accuracy on evaluation data: 9274 / 10000

Epoch 26 training complete  
Cost on training data: 0.655959061001  
Accuracy on training data: 46763 / 50000  
Cost on evaluation data: 1.06220827056  
Accuracy on evaluation data: 9264 / 10000

Epoch 27 training complete  
Cost on training data: 0.611855733371  
Accuracy on training data: 46874 / 50000  
Cost on evaluation data: 0.980910383399  
Accuracy on evaluation data: 9300 / 10000

Epoch 28 training complete  
Cost on training data: 0.655722486566  
Accuracy on training data: 46898 / 50000  
Cost on evaluation data: 1.00223196329  
Accuracy on evaluation data: 9294 / 10000

Epoch 29 training complete  
Cost on training data: 0.681857866569  
Accuracy on training data: 46900 / 50000  
Cost on evaluation data: 1.0040078589  
Accuracy on evaluation data: 9316 / 10000