

week_1_solution_1_9

March 15, 2018

```
In [1]: import os
import urllib2
# import urllib
import io
import gzip

def download_file(remote, local):
    url = remote

    u = urllib2.urlopen(url)
    f = open(local, 'wb')
    meta = u.info()

    file_size = int(meta.getheaders("Content-Length")[0])
    print "Downloading: %s Bytes: %s" % (local, file_size)

    file_size_dl = 0
    block_sz = 8192
    while True:
        buffer = u.read(block_sz)
        if not buffer:
            break

        file_size_dl += len(buffer)
        f.write(buffer)
        status = r"%10d  [%3.2f%%]" % (file_size_dl, file_size_dl * 100. / file_size)
        status = status + chr(8)*(len(status)+1)
        #     print status,

    f.close()

data_dir = "../data"
data_file_url = "https://github.com/mnielsen/neural-networks-and-deep-learning/raw/master"
if os.path.exists(data_dir) == False:
    os.makedirs(data_dir)
    print("Directory created: " + data_dir)
```

```
data_filename = "mnist.pkl.gz"
data_filepath = data_dir + "/" + data_filename

download_file(remote = data_file_url, local = data_filepath)
```

```
# with urllib2.urlopen(data_file_url) as d:
#     data = d.read()
#     d.close()
```

```
# with open(data_filepath, 'wb') as f:
#     f.write(data)
```

```
print("# Completed downloading file: " + data_filename)
```

```
Downloading: ../data/mnist.pkl.gz Bytes: 17051982
# Completed downloading file: mnist.pkl.gz
```

```
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 [31]: print("3. ")
```

```
image_train_list = []
class_train_list = []
```

```
for i in training_data:
    image_train_list.append(i[0])
    class_train_list.append(i[1])
```

```
no_of_image_train, image_size_train, m = np.array(image_train_list).shape
```

```
print("# Size of each image: " + str(image_size_train))
```

```
max_image_data = np.max(image_train_list)
min_image_data = np.min(image_train_list)
```

```
print("# Range of data: max = " + str(max_image_data) + ", min: " + str(min_image_data))
```

```

no_of_image_class, no_of_classes, class_dimension = np.array(class_train_list).shape

print("# Number of classes: " + str(no_of_classes))

3.
# Size of each image: 784
# Range of data: max = 0.99609375, min: 0.0
# Number of classes: 10

In [32]: image_test_list = []
        class_test_list = []

        image_validation_list = []
        class_validation_list = []

        for i in test_data:
            image_test_list.append(i[0])
            class_test_list.append(i[1])

        for i in validation_data:
            image_validation_list.append(i[0])
            class_validation_list.append(i[1])

no_of_image_test, image_size_test, m_test = np.array(image_test_list).shape
no_of_image_validation, image_size_validation, m_validation = np.array(image_validation_list).shape

print("# No of images in train: " + str(no_of_image_train))
print("# No of images in test: " + str(no_of_image_test))
print("# No of images in validation: " + str(no_of_image_validation))

# No of images in train: 50000
# No of images in test: 10000
# No of images in validation: 10000

In [34]: import network

        net = network.Network([784, 30, 10])

Out[34]: <network.Network at 0x659ef98>

In [37]: net.SGD(epochs=30, mini_batch_size=10, training_data=training_data, test_data=test_data)

Epoch 0: 9121 / 10000
Epoch 1: 9225 / 10000
Epoch 2: 9312 / 10000
Epoch 3: 9369 / 10000

```

```
Epoch 4: 9351 / 10000
Epoch 5: 9380 / 10000
Epoch 6: 9420 / 10000
Epoch 7: 9425 / 10000
Epoch 8: 9423 / 10000
Epoch 9: 9471 / 10000
Epoch 10: 9445 / 10000
Epoch 11: 9446 / 10000
Epoch 12: 9454 / 10000
Epoch 13: 9492 / 10000
Epoch 14: 9472 / 10000
Epoch 15: 9484 / 10000
Epoch 16: 9472 / 10000
Epoch 17: 9444 / 10000
Epoch 18: 9474 / 10000
Epoch 19: 9482 / 10000
Epoch 20: 9475 / 10000
Epoch 21: 9477 / 10000
Epoch 22: 9457 / 10000
Epoch 23: 9473 / 10000
Epoch 24: 9488 / 10000
Epoch 25: 9482 / 10000
Epoch 26: 9490 / 10000
Epoch 27: 9472 / 10000
Epoch 28: 9476 / 10000
Epoch 29: 9478 / 10000
```

```
In [39]: print("6. Repeat training step 4,5 but for 100 hidden neurons")
        no_hidden_neuron = 100
        net_100 = network.Network([784, no_hidden_neuron, 10])
        net_100.SGD(epochs=30, mini_batch_size=10, training_data=training_data, test_data=test_data)
```

6. Repeat training step 4,5 but for 100 hidden neurons

```
Epoch 0: 5490 / 10000
Epoch 1: 5638 / 10000
Epoch 2: 5712 / 10000
Epoch 3: 5658 / 10000
Epoch 4: 5687 / 10000
Epoch 5: 5731 / 10000
Epoch 6: 5760 / 10000
Epoch 7: 5731 / 10000
Epoch 8: 5825 / 10000
Epoch 9: 5893 / 10000
Epoch 10: 6028 / 10000
Epoch 11: 7498 / 10000
Epoch 12: 7507 / 10000
Epoch 13: 7503 / 10000
```

```
Epoch 14: 7560 / 10000
Epoch 15: 7534 / 10000
Epoch 16: 7554 / 10000
Epoch 17: 7580 / 10000
Epoch 18: 7594 / 10000
Epoch 19: 7590 / 10000
Epoch 20: 7583 / 10000
Epoch 21: 7572 / 10000
Epoch 22: 7593 / 10000
Epoch 23: 7601 / 10000
Epoch 24: 7606 / 10000
Epoch 25: 7601 / 10000
Epoch 26: 7585 / 10000
Epoch 27: 7588 / 10000
Epoch 28: 7608 / 10000
Epoch 29: 7599 / 10000
```

```
In [41]: print("7. Repeat training step 4,5 but for a learning rate of 0.001 and another time :")
        no_hidden_neuron = 30
        net_eta_001 = network.Network([784, no_hidden_neuron, 10])
        net_eta_001.SGD(epochs=30, mini_batch_size=10, training_data=training_data, test_data=test_data)
```

7. Repeat training step 4,5 but for a learning rate of 0.001 and another time for 100.0

```
Epoch 0: 962 / 10000
Epoch 1: 1012 / 10000
Epoch 2: 984 / 10000
Epoch 3: 982 / 10000
Epoch 4: 982 / 10000
Epoch 5: 982 / 10000
Epoch 6: 982 / 10000
Epoch 7: 983 / 10000
Epoch 8: 994 / 10000
Epoch 9: 1120 / 10000
Epoch 10: 1263 / 10000
Epoch 11: 1322 / 10000
Epoch 12: 1344 / 10000
Epoch 13: 1357 / 10000
Epoch 14: 1396 / 10000
Epoch 15: 1434 / 10000
Epoch 16: 1481 / 10000
Epoch 17: 1546 / 10000
Epoch 18: 1605 / 10000
Epoch 19: 1653 / 10000
Epoch 20: 1698 / 10000
Epoch 21: 1752 / 10000
Epoch 22: 1813 / 10000
Epoch 23: 1887 / 10000
```

```
Epoch 24: 1925 / 10000
Epoch 25: 1967 / 10000
Epoch 26: 2011 / 10000
Epoch 27: 2073 / 10000
Epoch 28: 2109 / 10000
Epoch 29: 2137 / 10000
```

```
In [43]: no_hidden_neuron = 30
        net_eta_100 = network.Network([784, no_hidden_neuron, 10])
        net_eta_100.SGD(epochs=30, mini_batch_size=10, training_data=training_data, test_data=test_data)
```

```
Epoch 0: 977 / 10000
Epoch 1: 1004 / 10000
Epoch 2: 1001 / 10000
Epoch 3: 998 / 10000
Epoch 4: 994 / 10000
Epoch 5: 989 / 10000
Epoch 6: 980 / 10000
Epoch 7: 1217 / 10000
Epoch 8: 1200 / 10000
Epoch 9: 1144 / 10000
Epoch 10: 1425 / 10000
Epoch 11: 1426 / 10000
Epoch 12: 1432 / 10000
Epoch 13: 1426 / 10000
Epoch 14: 1431 / 10000
Epoch 15: 1436 / 10000
Epoch 16: 1438 / 10000
Epoch 17: 1444 / 10000
Epoch 18: 1453 / 10000
Epoch 19: 1457 / 10000
Epoch 20: 1455 / 10000
Epoch 21: 1462 / 10000
Epoch 22: 1465 / 10000
Epoch 23: 1471 / 10000
Epoch 24: 1472 / 10000
Epoch 25: 1478 / 10000
Epoch 26: 1484 / 10000
Epoch 27: 1490 / 10000
Epoch 28: 1500 / 10000
Epoch 29: 1506 / 10000
```

```
In [24]: message = ""
        8. Use the network2.py and repeat 4,5 using cross-entropy cost function,
        learning rate of 0.5, using 10000 training data samples:
        net = network2.Network([784, 30, 10], cost=network2.CrossEntropyCost)
```

```

net.large_weight_initializer()
net.SGD(training_data[:1000], 400, 10, 0.5, evaluation_data=test_data,
... monitor_evaluation_accuracy=True, monitor_training_cost=True
"""
print(message)

import network2

net2 = network2.Network([784, 30, 10], cost=network2.CrossEntropyCost)
net2.large_weight_initializer()

epochs = 400
evaluation_cost, evaluation_accuracy, training_cost, training_accuracy = net2.SGD(
    training_data[:10000],
    epochs,
    10,
    0.5,
    evaluation_data=test_data,
    monitor_evaluation_cost=True,
    monitor_evaluation_accuracy=True,
    monitor_training_cost=True,
    monitor_training_accuracy=True
)

```

8. Use the network2.py and repeat 4,5 using cross-entropy cost function, learning rate of 0.5, using 10000 training data samples:

```

net = network2.Network([784, 30, 10], cost=network2.CrossEntropyCost)
net.large_weight_initializer()
net.SGD(training_data[:1000], 400, 10, 0.5, evaluation_data=test_data,
... monitor_evaluation_accuracy=True, monitor_training_cost=True

```

```

Epoch 0 training complete
Cost on training data: 0.844191821887
Accuracy on training data: 8697 / 10000
Cost on evaluation data: 0.950547988163
Accuracy on evaluation data: 8476 / 10000

```

```

Epoch 1 training complete
Cost on training data: 0.624359301467
Accuracy on training data: 9056 / 10000
Cost on evaluation data: 0.751689316204
Accuracy on evaluation data: 8795 / 10000

```

```

Epoch 2 training complete
Cost on training data: 0.521011780705
Accuracy on training data: 9259 / 10000
Cost on evaluation data: 0.689445793691

```

Accuracy on evaluation data: 8952 / 10000

Epoch 3 training complete

Cost on training data: 0.447727983907

Accuracy on training data: 9366 / 10000

Cost on evaluation data: 0.629181591087

Accuracy on evaluation data: 9064 / 10000

Epoch 4 training complete

Cost on training data: 0.396761678095

Accuracy on training data: 9439 / 10000

Cost on evaluation data: 0.604907362507

Accuracy on evaluation data: 9086 / 10000

Epoch 5 training complete

Cost on training data: 0.356241063934

Accuracy on training data: 9500 / 10000

Cost on evaluation data: 0.592809989241

Accuracy on evaluation data: 9118 / 10000

Epoch 6 training complete

Cost on training data: 0.358962796

Accuracy on training data: 9505 / 10000

Cost on evaluation data: 0.603162304581

Accuracy on evaluation data: 9103 / 10000

Epoch 7 training complete

Cost on training data: 0.339486223667

Accuracy on training data: 9517 / 10000

Cost on evaluation data: 0.60850396271

Accuracy on evaluation data: 9103 / 10000

Epoch 8 training complete

Cost on training data: 0.285860360373

Accuracy on training data: 9613 / 10000

Cost on evaluation data: 0.576646816484

Accuracy on evaluation data: 9169 / 10000

Epoch 9 training complete

Cost on training data: 0.272217656227

Accuracy on training data: 9638 / 10000

Cost on evaluation data: 0.571473720854

Accuracy on evaluation data: 9181 / 10000

Epoch 10 training complete

Cost on training data: 0.259208062952

Accuracy on training data: 9657 / 10000

Cost on evaluation data: 0.576816740297

Accuracy on evaluation data: 9168 / 10000

Epoch 11 training complete

Cost on training data: 0.239963036038

Accuracy on training data: 9689 / 10000

Cost on evaluation data: 0.570968886449

Accuracy on evaluation data: 9176 / 10000

Epoch 12 training complete

Cost on training data: 0.23889980342

Accuracy on training data: 9697 / 10000

Cost on evaluation data: 0.58143036904

Accuracy on evaluation data: 9161 / 10000

Epoch 13 training complete

Cost on training data: 0.209506072597

Accuracy on training data: 9752 / 10000

Cost on evaluation data: 0.574058011921

Accuracy on evaluation data: 9192 / 10000

Epoch 14 training complete

Cost on training data: 0.211233598

Accuracy on training data: 9751 / 10000

Cost on evaluation data: 0.594322307566

Accuracy on evaluation data: 9178 / 10000

Epoch 15 training complete

Cost on training data: 0.194570033817

Accuracy on training data: 9766 / 10000

Cost on evaluation data: 0.58674110229

Accuracy on evaluation data: 9206 / 10000

Epoch 16 training complete

Cost on training data: 0.185202283425

Accuracy on training data: 9779 / 10000

Cost on evaluation data: 0.585566044302

Accuracy on evaluation data: 9215 / 10000

Epoch 17 training complete

Cost on training data: 0.175175650317

Accuracy on training data: 9798 / 10000

Cost on evaluation data: 0.585715828758

Accuracy on evaluation data: 9205 / 10000

Epoch 18 training complete

Cost on training data: 0.172606846171

Accuracy on training data: 9801 / 10000

Cost on evaluation data: 0.603820204376

Accuracy on evaluation data: 9198 / 10000

Epoch 19 training complete

Cost on training data: 0.173402541659

Accuracy on training data: 9799 / 10000

Cost on evaluation data: 0.598955533679

Accuracy on evaluation data: 9174 / 10000

Epoch 20 training complete

Cost on training data: 0.154435006077

Accuracy on training data: 9830 / 10000

Cost on evaluation data: 0.601445410888

Accuracy on evaluation data: 9214 / 10000

Epoch 21 training complete

Cost on training data: 0.159912608052

Accuracy on training data: 9820 / 10000

Cost on evaluation data: 0.607559268023

Accuracy on evaluation data: 9195 / 10000

Epoch 22 training complete

Cost on training data: 0.14536232606

Accuracy on training data: 9823 / 10000

Cost on evaluation data: 0.603255755241

Accuracy on evaluation data: 9220 / 10000

Epoch 23 training complete

Cost on training data: 0.135960410076

Accuracy on training data: 9847 / 10000

Cost on evaluation data: 0.607616600438

Accuracy on evaluation data: 9219 / 10000

Epoch 24 training complete

Cost on training data: 0.137671172277

Accuracy on training data: 9859 / 10000

Cost on evaluation data: 0.630132321677

Accuracy on evaluation data: 9208 / 10000

Epoch 25 training complete

Cost on training data: 0.123891001162

Accuracy on training data: 9865 / 10000

Cost on evaluation data: 0.615772307776

Accuracy on evaluation data: 9217 / 10000

Epoch 26 training complete

Cost on training data: 0.126080389232

Accuracy on training data: 9863 / 10000

Cost on evaluation data: 0.626201557181

Accuracy on evaluation data: 9191 / 10000

Epoch 27 training complete

Cost on training data: 0.118177439126

Accuracy on training data: 9878 / 10000

Cost on evaluation data: 0.622774876214

Accuracy on evaluation data: 9216 / 10000

Epoch 28 training complete

Cost on training data: 0.121010866745

Accuracy on training data: 9876 / 10000

Cost on evaluation data: 0.631114027542

Accuracy on evaluation data: 9203 / 10000

Epoch 29 training complete

Cost on training data: 0.115319901278

Accuracy on training data: 9880 / 10000

Cost on evaluation data: 0.637464151551

Accuracy on evaluation data: 9202 / 10000

Epoch 30 training complete

Cost on training data: 0.108289328151

Accuracy on training data: 9884 / 10000

Cost on evaluation data: 0.637273073066

Accuracy on evaluation data: 9201 / 10000

Epoch 31 training complete

Cost on training data: 0.103264993696

Accuracy on training data: 9888 / 10000

Cost on evaluation data: 0.629101139246

Accuracy on evaluation data: 9225 / 10000

Epoch 32 training complete

Cost on training data: 0.10102542723

Accuracy on training data: 9892 / 10000

Cost on evaluation data: 0.637100861272

Accuracy on evaluation data: 9224 / 10000

Epoch 33 training complete

Cost on training data: 0.100782971259

Accuracy on training data: 9884 / 10000

Cost on evaluation data: 0.651794556456

Accuracy on evaluation data: 9208 / 10000

Epoch 34 training complete

Cost on training data: 0.1030261118

Accuracy on training data: 9893 / 10000

Cost on evaluation data: 0.654701136881

Accuracy on evaluation data: 9215 / 10000

Epoch 35 training complete

Cost on training data: 0.0961988721599

Accuracy on training data: 9900 / 10000

Cost on evaluation data: 0.66042835802

Accuracy on evaluation data: 9212 / 10000

Epoch 36 training complete

Cost on training data: 0.0899961796476

Accuracy on training data: 9903 / 10000

Cost on evaluation data: 0.658125728371

Accuracy on evaluation data: 9216 / 10000

Epoch 37 training complete

Cost on training data: 0.0929722763086

Accuracy on training data: 9901 / 10000

Cost on evaluation data: 0.670190576244

Accuracy on evaluation data: 9227 / 10000

Epoch 38 training complete

Cost on training data: 0.0883294209311

Accuracy on training data: 9906 / 10000

Cost on evaluation data: 0.670251707754

Accuracy on evaluation data: 9214 / 10000

Epoch 39 training complete

Cost on training data: 0.0877400679377

Accuracy on training data: 9905 / 10000

Cost on evaluation data: 0.671898444509

Accuracy on evaluation data: 9200 / 10000

Epoch 40 training complete

Cost on training data: 0.0844602078738

Accuracy on training data: 9917 / 10000

Cost on evaluation data: 0.670173279738

Accuracy on evaluation data: 9220 / 10000

Epoch 41 training complete

Cost on training data: 0.0800120886147

Accuracy on training data: 9912 / 10000

Cost on evaluation data: 0.683410002236

Accuracy on evaluation data: 9221 / 10000

Epoch 42 training complete

Cost on training data: 0.0798667297742

Accuracy on training data: 9916 / 10000

Cost on evaluation data: 0.686733312218

Accuracy on evaluation data: 9215 / 10000

Epoch 43 training complete

Cost on training data: 0.0752045439535

Accuracy on training data: 9922 / 10000

Cost on evaluation data: 0.678717693054

Accuracy on evaluation data: 9221 / 10000

Epoch 44 training complete

Cost on training data: 0.0820601574075

Accuracy on training data: 9910 / 10000

Cost on evaluation data: 0.679504166889

Accuracy on evaluation data: 9223 / 10000

Epoch 45 training complete

Cost on training data: 0.0724729920623

Accuracy on training data: 9927 / 10000

Cost on evaluation data: 0.687236710232

Accuracy on evaluation data: 9220 / 10000

Epoch 46 training complete

Cost on training data: 0.0739379432806

Accuracy on training data: 9924 / 10000

Cost on evaluation data: 0.693760475216

Accuracy on evaluation data: 9226 / 10000

Epoch 47 training complete

Cost on training data: 0.069371794003

Accuracy on training data: 9933 / 10000

Cost on evaluation data: 0.699177140667

Accuracy on evaluation data: 9208 / 10000

Epoch 48 training complete

Cost on training data: 0.0682355949293

Accuracy on training data: 9933 / 10000

Cost on evaluation data: 0.694851644949

Accuracy on evaluation data: 9224 / 10000

Epoch 49 training complete

Cost on training data: 0.067142173303

Accuracy on training data: 9936 / 10000

Cost on evaluation data: 0.709605949544

Accuracy on evaluation data: 9210 / 10000

Epoch 50 training complete

Cost on training data: 0.0629261989453

Accuracy on training data: 9939 / 10000

Cost on evaluation data: 0.705334768165

Accuracy on evaluation data: 9226 / 10000

Epoch 51 training complete

Cost on training data: 0.0705893867354

Accuracy on training data: 9931 / 10000

Cost on evaluation data: 0.71590241962

Accuracy on evaluation data: 9205 / 10000

Epoch 52 training complete

Cost on training data: 0.0617827772251

Accuracy on training data: 9934 / 10000

Cost on evaluation data: 0.71628822428

Accuracy on evaluation data: 9218 / 10000

Epoch 53 training complete

Cost on training data: 0.0618966523128

Accuracy on training data: 9935 / 10000

Cost on evaluation data: 0.717570457745

Accuracy on evaluation data: 9210 / 10000

Epoch 54 training complete

Cost on training data: 0.0589439379849

Accuracy on training data: 9939 / 10000

Cost on evaluation data: 0.720593595856

Accuracy on evaluation data: 9218 / 10000

Epoch 55 training complete

Cost on training data: 0.0598039097136

Accuracy on training data: 9938 / 10000

Cost on evaluation data: 0.719670555319

Accuracy on evaluation data: 9227 / 10000

Epoch 56 training complete

Cost on training data: 0.0564957022452

Accuracy on training data: 9947 / 10000

Cost on evaluation data: 0.719879357527

Accuracy on evaluation data: 9234 / 10000

Epoch 57 training complete

Cost on training data: 0.0550868819881

Accuracy on training data: 9947 / 10000

Cost on evaluation data: 0.726325539536

Accuracy on evaluation data: 9215 / 10000

Epoch 58 training complete

Cost on training data: 0.0551069437481

Accuracy on training data: 9946 / 10000

Cost on evaluation data: 0.7323236825

Accuracy on evaluation data: 9218 / 10000

Epoch 59 training complete

Cost on training data: 0.0535795604239

Accuracy on training data: 9950 / 10000

Cost on evaluation data: 0.738280068495

Accuracy on evaluation data: 9207 / 10000

Epoch 60 training complete

Cost on training data: 0.0522625025627

Accuracy on training data: 9946 / 10000

Cost on evaluation data: 0.731135567418

Accuracy on evaluation data: 9225 / 10000

Epoch 61 training complete

Cost on training data: 0.0508329338718

Accuracy on training data: 9951 / 10000

Cost on evaluation data: 0.735992317005

Accuracy on evaluation data: 9222 / 10000

Epoch 62 training complete

Cost on training data: 0.0494307719278

Accuracy on training data: 9948 / 10000

Cost on evaluation data: 0.741823931899

Accuracy on evaluation data: 9214 / 10000

Epoch 63 training complete

Cost on training data: 0.0500190348356

Accuracy on training data: 9949 / 10000

Cost on evaluation data: 0.747144701449

Accuracy on evaluation data: 9227 / 10000

Epoch 64 training complete

Cost on training data: 0.0512773936024

Accuracy on training data: 9953 / 10000

Cost on evaluation data: 0.758375455519

Accuracy on evaluation data: 9203 / 10000

Epoch 65 training complete

Cost on training data: 0.0478481812449

Accuracy on training data: 9955 / 10000

Cost on evaluation data: 0.750431568204

Accuracy on evaluation data: 9215 / 10000

Epoch 66 training complete

Cost on training data: 0.0472351425897

Accuracy on training data: 9954 / 10000

Cost on evaluation data: 0.756472596803

Accuracy on evaluation data: 9222 / 10000

Epoch 67 training complete

Cost on training data: 0.0458150426858

Accuracy on training data: 9954 / 10000

Cost on evaluation data: 0.759076777627

Accuracy on evaluation data: 9229 / 10000

Epoch 68 training complete

Cost on training data: 0.0465945324133

Accuracy on training data: 9962 / 10000

Cost on evaluation data: 0.761569551807

Accuracy on evaluation data: 9214 / 10000

Epoch 69 training complete

Cost on training data: 0.0452786139707

Accuracy on training data: 9962 / 10000

Cost on evaluation data: 0.763118146501

Accuracy on evaluation data: 9229 / 10000

Epoch 70 training complete

Cost on training data: 0.0453565153354

Accuracy on training data: 9956 / 10000

Cost on evaluation data: 0.76455341196

Accuracy on evaluation data: 9222 / 10000

Epoch 71 training complete

Cost on training data: 0.0440940471383

Accuracy on training data: 9960 / 10000

Cost on evaluation data: 0.768032283291

Accuracy on evaluation data: 9223 / 10000

Epoch 72 training complete

Cost on training data: 0.0424675502399

Accuracy on training data: 9961 / 10000

Cost on evaluation data: 0.771091822279

Accuracy on evaluation data: 9218 / 10000

Epoch 73 training complete

Cost on training data: 0.0432263267849

Accuracy on training data: 9963 / 10000

Cost on evaluation data: 0.776997372638

Accuracy on evaluation data: 9216 / 10000

Epoch 74 training complete

Cost on training data: 0.0421495749586

Accuracy on training data: 9963 / 10000

Cost on evaluation data: 0.785709136479

Accuracy on evaluation data: 9214 / 10000

Epoch 75 training complete

Cost on training data: 0.0424961572265

Accuracy on training data: 9966 / 10000

Cost on evaluation data: 0.779651912762

Accuracy on evaluation data: 9225 / 10000

Epoch 76 training complete

Cost on training data: 0.0415578310773

Accuracy on training data: 9964 / 10000

Cost on evaluation data: 0.788678444405

Accuracy on evaluation data: 9216 / 10000

Epoch 77 training complete

Cost on training data: 0.0401915117259

Accuracy on training data: 9965 / 10000

Cost on evaluation data: 0.789199503711

Accuracy on evaluation data: 9212 / 10000

Epoch 78 training complete

Cost on training data: 0.0398159364864

Accuracy on training data: 9969 / 10000

Cost on evaluation data: 0.785721528715

Accuracy on evaluation data: 9220 / 10000

Epoch 79 training complete

Cost on training data: 0.0390977286877

Accuracy on training data: 9967 / 10000

Cost on evaluation data: 0.798728037688

Accuracy on evaluation data: 9219 / 10000

Epoch 80 training complete

Cost on training data: 0.0381776513607

Accuracy on training data: 9970 / 10000

Cost on evaluation data: 0.794909821049

Accuracy on evaluation data: 9215 / 10000

Epoch 81 training complete

Cost on training data: 0.0381239141145

Accuracy on training data: 9968 / 10000

Cost on evaluation data: 0.791086003577

Accuracy on evaluation data: 9228 / 10000

Epoch 82 training complete

Cost on training data: 0.0380364869116

Accuracy on training data: 9970 / 10000

Cost on evaluation data: 0.801322934014

Accuracy on evaluation data: 9211 / 10000

Epoch 83 training complete

Cost on training data: 0.0377648328592

Accuracy on training data: 9971 / 10000

Cost on evaluation data: 0.805100009625

Accuracy on evaluation data: 9208 / 10000

Epoch 84 training complete

Cost on training data: 0.0362817626302

Accuracy on training data: 9970 / 10000

Cost on evaluation data: 0.80125678258

Accuracy on evaluation data: 9229 / 10000

Epoch 85 training complete

Cost on training data: 0.0371063250593

Accuracy on training data: 9967 / 10000

Cost on evaluation data: 0.81299944027

Accuracy on evaluation data: 9218 / 10000

Epoch 86 training complete

Cost on training data: 0.0367245610337

Accuracy on training data: 9969 / 10000

Cost on evaluation data: 0.806565680532

Accuracy on evaluation data: 9229 / 10000

Epoch 87 training complete

Cost on training data: 0.0364030020996

Accuracy on training data: 9971 / 10000

Cost on evaluation data: 0.811208129296

Accuracy on evaluation data: 9215 / 10000

Epoch 88 training complete

Cost on training data: 0.0350531136311

Accuracy on training data: 9971 / 10000

Cost on evaluation data: 0.817108494823

Accuracy on evaluation data: 9210 / 10000

Epoch 89 training complete

Cost on training data: 0.0349581466247

Accuracy on training data: 9972 / 10000

Cost on evaluation data: 0.818709704365

Accuracy on evaluation data: 9219 / 10000

Epoch 90 training complete

Cost on training data: 0.0350406603007

Accuracy on training data: 9975 / 10000

Cost on evaluation data: 0.829276567747

Accuracy on evaluation data: 9193 / 10000

Epoch 91 training complete

Cost on training data: 0.0333867954393

Accuracy on training data: 9973 / 10000

Cost on evaluation data: 0.824268462497

Accuracy on evaluation data: 9202 / 10000

Epoch 92 training complete

Cost on training data: 0.033135004466

Accuracy on training data: 9973 / 10000

Cost on evaluation data: 0.823740266887

Accuracy on evaluation data: 9209 / 10000

Epoch 93 training complete

Cost on training data: 0.0324232624279

Accuracy on training data: 9974 / 10000

Cost on evaluation data: 0.830128098453

Accuracy on evaluation data: 9210 / 10000

Epoch 94 training complete

Cost on training data: 0.0319661007346

Accuracy on training data: 9978 / 10000

Cost on evaluation data: 0.82888193501

Accuracy on evaluation data: 9210 / 10000

Epoch 95 training complete

Cost on training data: 0.0322813234134

Accuracy on training data: 9974 / 10000

Cost on evaluation data: 0.834771384601

Accuracy on evaluation data: 9205 / 10000

Epoch 96 training complete

Cost on training data: 0.0316140014586

Accuracy on training data: 9975 / 10000

Cost on evaluation data: 0.83419918211

Accuracy on evaluation data: 9212 / 10000

Epoch 97 training complete

Cost on training data: 0.0320255531909

Accuracy on training data: 9978 / 10000

Cost on evaluation data: 0.845850294968

Accuracy on evaluation data: 9206 / 10000

Epoch 98 training complete

Cost on training data: 0.0313710593554

Accuracy on training data: 9977 / 10000

Cost on evaluation data: 0.842512410362

Accuracy on evaluation data: 9200 / 10000

Epoch 99 training complete

Cost on training data: 0.0307296347838

Accuracy on training data: 9979 / 10000

Cost on evaluation data: 0.850544169164

Accuracy on evaluation data: 9201 / 10000

Epoch 100 training complete

Cost on training data: 0.0300213588033

Accuracy on training data: 9977 / 10000

Cost on evaluation data: 0.844566899719

Accuracy on evaluation data: 9206 / 10000

Epoch 101 training complete

Cost on training data: 0.0294891893282

Accuracy on training data: 9979 / 10000

Cost on evaluation data: 0.855557464035

Accuracy on evaluation data: 9195 / 10000

Epoch 102 training complete

Cost on training data: 0.0298215729426

Accuracy on training data: 9978 / 10000

Cost on evaluation data: 0.846420836782

Accuracy on evaluation data: 9203 / 10000

Epoch 103 training complete

Cost on training data: 0.028987710848

Accuracy on training data: 9981 / 10000

Cost on evaluation data: 0.850625247274

Accuracy on evaluation data: 9213 / 10000

Epoch 104 training complete

Cost on training data: 0.028810308359

Accuracy on training data: 9981 / 10000

Cost on evaluation data: 0.850631029419

Accuracy on evaluation data: 9199 / 10000

Epoch 105 training complete

Cost on training data: 0.0287547136238

Accuracy on training data: 9980 / 10000

Cost on evaluation data: 0.859509457452

Accuracy on evaluation data: 9199 / 10000

Epoch 106 training complete

Cost on training data: 0.0282063967202

Accuracy on training data: 9980 / 10000

Cost on evaluation data: 0.856714421086

Accuracy on evaluation data: 9202 / 10000

Epoch 107 training complete

Cost on training data: 0.0278047738511

Accuracy on training data: 9980 / 10000

Cost on evaluation data: 0.861633432968

Accuracy on evaluation data: 9201 / 10000

Epoch 108 training complete

Cost on training data: 0.0275895665411

Accuracy on training data: 9982 / 10000

Cost on evaluation data: 0.861005319221

Accuracy on evaluation data: 9204 / 10000

Epoch 109 training complete

Cost on training data: 0.0278110616505

Accuracy on training data: 9982 / 10000

Cost on evaluation data: 0.860680071668

Accuracy on evaluation data: 9215 / 10000

Epoch 110 training complete

Cost on training data: 0.0272229531342

Accuracy on training data: 9982 / 10000

Cost on evaluation data: 0.868495675875

Accuracy on evaluation data: 9195 / 10000

Epoch 111 training complete

Cost on training data: 0.0265306427906

Accuracy on training data: 9982 / 10000

Cost on evaluation data: 0.868057124344

Accuracy on evaluation data: 9203 / 10000

Epoch 112 training complete

Cost on training data: 0.0271731143477

Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.86413030061

Accuracy on evaluation data: 9207 / 10000

Epoch 113 training complete

Cost on training data: 0.0267057792013

Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.875396279655

Accuracy on evaluation data: 9196 / 10000

Epoch 114 training complete

Cost on training data: 0.0258102429159

Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.877082557858

Accuracy on evaluation data: 9204 / 10000

Epoch 115 training complete

Cost on training data: 0.0257282239443

Accuracy on training data: 9981 / 10000

Cost on evaluation data: 0.870728459158

Accuracy on evaluation data: 9203 / 10000

Epoch 116 training complete

Cost on training data: 0.0262162729495

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.879541342508

Accuracy on evaluation data: 9204 / 10000

Epoch 117 training complete

Cost on training data: 0.026416287837

Accuracy on training data: 9981 / 10000

Cost on evaluation data: 0.870357391611

Accuracy on evaluation data: 9207 / 10000

Epoch 118 training complete

Cost on training data: 0.025059260628

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.878541686819

Accuracy on evaluation data: 9209 / 10000

Epoch 119 training complete

Cost on training data: 0.0247581306878

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.882578439492

Accuracy on evaluation data: 9201 / 10000

Epoch 120 training complete

Cost on training data: 0.0246202775022

Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.887619208069

Accuracy on evaluation data: 9204 / 10000

Epoch 121 training complete

Cost on training data: 0.0244209966857

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.886878930915

Accuracy on evaluation data: 9206 / 10000

Epoch 122 training complete

Cost on training data: 0.0244573368334

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.88698755182

Accuracy on evaluation data: 9212 / 10000

Epoch 123 training complete

Cost on training data: 0.0243157317388

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.887627774807

Accuracy on evaluation data: 9205 / 10000

Epoch 124 training complete

Cost on training data: 0.0240911780951

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.893466123061

Accuracy on evaluation data: 9196 / 10000

Epoch 125 training complete

Cost on training data: 0.0242735576604

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.898320654688

Accuracy on evaluation data: 9190 / 10000

Epoch 126 training complete

Cost on training data: 0.0230517390069

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.894404379391

Accuracy on evaluation data: 9204 / 10000

Epoch 127 training complete

Cost on training data: 0.0239460750991

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.898825407437

Accuracy on evaluation data: 9212 / 10000

Epoch 128 training complete

Cost on training data: 0.0231843944566

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.895035903458

Accuracy on evaluation data: 9210 / 10000

Epoch 129 training complete

Cost on training data: 0.0229826249803

Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.898974390812

Accuracy on evaluation data: 9209 / 10000

Epoch 130 training complete

Cost on training data: 0.022546745256

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.902932502197

Accuracy on evaluation data: 9212 / 10000

Epoch 131 training complete

Cost on training data: 0.0227460087956

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.899187992857

Accuracy on evaluation data: 9212 / 10000

Epoch 132 training complete

Cost on training data: 0.0224056998591

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.90599799206

Accuracy on evaluation data: 9212 / 10000

Epoch 133 training complete

Cost on training data: 0.0222769981919

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.902205304401

Accuracy on evaluation data: 9212 / 10000

Epoch 134 training complete

Cost on training data: 0.0219584980714

Accuracy on training data: 9986 / 10000

Cost on evaluation data: 0.904575038954

Accuracy on evaluation data: 9211 / 10000

Epoch 135 training complete

Cost on training data: 0.0220374499851

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.906759251746

Accuracy on evaluation data: 9215 / 10000

Epoch 136 training complete

Cost on training data: 0.0219292575207

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.911852859146

Accuracy on evaluation data: 9212 / 10000

Epoch 137 training complete

Cost on training data: 0.0220419834058

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.912666690924

Accuracy on evaluation data: 9210 / 10000

Epoch 138 training complete

Cost on training data: 0.0213382900038

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.909397577254

Accuracy on evaluation data: 9216 / 10000

Epoch 139 training complete

Cost on training data: 0.0220058629191

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.918421578938

Accuracy on evaluation data: 9209 / 10000

Epoch 140 training complete

Cost on training data: 0.0211823607998

Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.913205669848

Accuracy on evaluation data: 9216 / 10000

Epoch 141 training complete

Cost on training data: 0.0210342069175

Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.913789357904

Accuracy on evaluation data: 9210 / 10000

Epoch 142 training complete

Cost on training data: 0.020882727867

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.916945287468

Accuracy on evaluation data: 9226 / 10000

Epoch 143 training complete

Cost on training data: 0.0213331019401

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.922612654457

Accuracy on evaluation data: 9208 / 10000

Epoch 144 training complete

Cost on training data: 0.0204883669831

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.919799093182

Accuracy on evaluation data: 9214 / 10000

Epoch 145 training complete

Cost on training data: 0.0203048404013

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.920861307497

Accuracy on evaluation data: 9222 / 10000

Epoch 146 training complete

Cost on training data: 0.0203175059171

Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.920983505105

Accuracy on evaluation data: 9211 / 10000

Epoch 147 training complete

Cost on training data: 0.0203477664773

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.926968294442

Accuracy on evaluation data: 9211 / 10000

Epoch 148 training complete

Cost on training data: 0.0206214591824

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.921005991433

Accuracy on evaluation data: 9220 / 10000

Epoch 149 training complete

Cost on training data: 0.0198472036676

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.92708910322

Accuracy on evaluation data: 9212 / 10000

Epoch 150 training complete

Cost on training data: 0.0198745031653

Accuracy on training data: 9985 / 10000

Cost on evaluation data: 0.92364728654

Accuracy on evaluation data: 9216 / 10000

Epoch 151 training complete

Cost on training data: 0.0204751749361

Accuracy on training data: 9986 / 10000

Cost on evaluation data: 0.933471007147

Accuracy on evaluation data: 9215 / 10000

Epoch 152 training complete

Cost on training data: 0.0193847821856

Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.92914453681

Accuracy on evaluation data: 9218 / 10000

Epoch 153 training complete

Cost on training data: 0.0192524160011

Accuracy on training data: 9988 / 10000

Cost on evaluation data: 0.933037407199

Accuracy on evaluation data: 9213 / 10000

Epoch 154 training complete

Cost on training data: 0.0192066295983

Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.930086794214

Accuracy on evaluation data: 9214 / 10000

Epoch 155 training complete

Cost on training data: 0.0191430230913

Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.933753810336

Accuracy on evaluation data: 9218 / 10000

Epoch 156 training complete

Cost on training data: 0.0188247223292

Accuracy on training data: 9986 / 10000

Cost on evaluation data: 0.933565759364

Accuracy on evaluation data: 9211 / 10000

Epoch 157 training complete

Cost on training data: 0.0187963001535

Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.93594236599

Accuracy on evaluation data: 9217 / 10000

Epoch 158 training complete

Cost on training data: 0.0187073199313

Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.936182949798

Accuracy on evaluation data: 9215 / 10000

Epoch 159 training complete

Cost on training data: 0.0185493878147

Accuracy on training data: 9988 / 10000

Cost on evaluation data: 0.942755630178

Accuracy on evaluation data: 9206 / 10000

Epoch 160 training complete

Cost on training data: 0.0187498633084

Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.938568967904

Accuracy on evaluation data: 9212 / 10000

Epoch 161 training complete

Cost on training data: 0.0187348545883

Accuracy on training data: 9986 / 10000

network2.py:54: RuntimeWarning: divide by zero encountered in log

return np.sum(np.nan_to_num(-y*np.log(a)-(1-y)*np.log(1-a)))

network2.py:54: RuntimeWarning: invalid value encountered in multiply

return np.sum(np.nan_to_num(-y*np.log(a)-(1-y)*np.log(1-a)))

Cost on evaluation data: 0.944693927311
Accuracy on evaluation data: 9225 / 10000

Epoch 162 training complete
Cost on training data: 0.0182534525961
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.942168660857
Accuracy on evaluation data: 9210 / 10000

Epoch 163 training complete
Cost on training data: 0.0181933175353
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.940060432767
Accuracy on evaluation data: 9205 / 10000

Epoch 164 training complete
Cost on training data: 0.0178871336571
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.948063707707
Accuracy on evaluation data: 9211 / 10000

Epoch 165 training complete
Cost on training data: 0.018034866842
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.950971874073
Accuracy on evaluation data: 9210 / 10000

Epoch 166 training complete
Cost on training data: 0.0174949802018
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.947178472766
Accuracy on evaluation data: 9213 / 10000

Epoch 167 training complete
Cost on training data: 0.0175280570698
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.945038248078
Accuracy on evaluation data: 9202 / 10000

Epoch 168 training complete
Cost on training data: 0.017367982305
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.950512616234
Accuracy on evaluation data: 9214 / 10000

Epoch 169 training complete
Cost on training data: 0.017371131102
Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.94991506412
Accuracy on evaluation data: 9208 / 10000

Epoch 170 training complete
Cost on training data: 0.0173513016462
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.952959790374
Accuracy on evaluation data: 9208 / 10000

Epoch 171 training complete
Cost on training data: 0.017203127617
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.959032255237
Accuracy on evaluation data: 9211 / 10000

Epoch 172 training complete
Cost on training data: 0.0168589356353
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.954493809482
Accuracy on evaluation data: 9215 / 10000

Epoch 173 training complete
Cost on training data: 0.0168992794268
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.953384134447
Accuracy on evaluation data: 9210 / 10000

Epoch 174 training complete
Cost on training data: 0.016734297081
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.959550216931
Accuracy on evaluation data: 9215 / 10000

Epoch 175 training complete
Cost on training data: 0.0168030859252
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.955880512653
Accuracy on evaluation data: 9209 / 10000

Epoch 176 training complete
Cost on training data: 0.0166411775398
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.959259525258
Accuracy on evaluation data: 9218 / 10000

Epoch 177 training complete
Cost on training data: 0.0164866488541
Accuracy on training data: 9988 / 10000

Cost on evaluation data: 0.960520589347
Accuracy on evaluation data: 9210 / 10000

Epoch 178 training complete
Cost on training data: 0.0163277595494
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.960604132142
Accuracy on evaluation data: 9215 / 10000

Epoch 179 training complete
Cost on training data: 0.0163266674675
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.96011843255
Accuracy on evaluation data: 9210 / 10000

Epoch 180 training complete
Cost on training data: 0.0161073258655
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.962585891139
Accuracy on evaluation data: 9208 / 10000

Epoch 181 training complete
Cost on training data: 0.0160191523685
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.961747139303
Accuracy on evaluation data: 9210 / 10000

Epoch 182 training complete
Cost on training data: 0.0159390604282
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.964420632506
Accuracy on evaluation data: 9214 / 10000

Epoch 183 training complete
Cost on training data: 0.0160551389122
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.967787246088
Accuracy on evaluation data: 9217 / 10000

Epoch 184 training complete
Cost on training data: 0.0158649846474
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.967327127284
Accuracy on evaluation data: 9208 / 10000

Epoch 185 training complete
Cost on training data: 0.0158419086014
Accuracy on training data: 9988 / 10000

Cost on evaluation data: 0.972435728371
Accuracy on evaluation data: 9204 / 10000

Epoch 186 training complete
Cost on training data: 0.0157341457213
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.972571552146
Accuracy on evaluation data: 9217 / 10000

Epoch 187 training complete
Cost on training data: 0.0157130517912
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.97616595108
Accuracy on evaluation data: 9220 / 10000

Epoch 188 training complete
Cost on training data: 0.0154929427579
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.976830494215
Accuracy on evaluation data: 9223 / 10000

Epoch 189 training complete
Cost on training data: 0.0153454331813
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.974517450801
Accuracy on evaluation data: 9217 / 10000

Epoch 190 training complete
Cost on training data: 0.0780347858698
Accuracy on training data: 9938 / 10000
Cost on evaluation data: 1.06845361224
Accuracy on evaluation data: 9157 / 10000

Epoch 191 training complete
Cost on training data: 0.0549398185207
Accuracy on training data: 9958 / 10000
Cost on evaluation data: 1.04335388794
Accuracy on evaluation data: 9140 / 10000

Epoch 192 training complete
Cost on training data: 0.0509774888683
Accuracy on training data: 9960 / 10000
Cost on evaluation data: 1.01575948048
Accuracy on evaluation data: 9153 / 10000

Epoch 193 training complete
Cost on training data: 0.0170547076303
Accuracy on training data: 9989 / 10000

Cost on evaluation data: 0.9748280385
Accuracy on evaluation data: 9202 / 10000

Epoch 194 training complete
Cost on training data: 0.0161114139201
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.971845184714
Accuracy on evaluation data: 9215 / 10000

Epoch 195 training complete
Cost on training data: 0.0157486855767
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.975816320127
Accuracy on evaluation data: 9200 / 10000

Epoch 196 training complete
Cost on training data: 0.0159535155787
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.976055767664
Accuracy on evaluation data: 9207 / 10000

Epoch 197 training complete
Cost on training data: 0.0155520456721
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.977768874667
Accuracy on evaluation data: 9204 / 10000

Epoch 198 training complete
Cost on training data: 0.0151738534078
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.97688267416
Accuracy on evaluation data: 9201 / 10000

Epoch 199 training complete
Cost on training data: 0.0149942255923
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.982232795606
Accuracy on evaluation data: 9209 / 10000

Epoch 200 training complete
Cost on training data: 0.0148145571019
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.977902332951
Accuracy on evaluation data: 9208 / 10000

Epoch 201 training complete
Cost on training data: 0.0147049107998
Accuracy on training data: 9990 / 10000

Cost on evaluation data: 0.980155198616
Accuracy on evaluation data: 9205 / 10000

Epoch 202 training complete
Cost on training data: 0.0145874083695
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.979883496124
Accuracy on evaluation data: 9205 / 10000

Epoch 203 training complete
Cost on training data: 0.0146640831557
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.988065467915
Accuracy on evaluation data: 9206 / 10000

Epoch 204 training complete
Cost on training data: 0.0144243531496
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.986998804689
Accuracy on evaluation data: 9207 / 10000

Epoch 205 training complete
Cost on training data: 0.0146783432012
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.982956376221
Accuracy on evaluation data: 9207 / 10000

Epoch 206 training complete
Cost on training data: 0.0143938552515
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.98093718487
Accuracy on evaluation data: 9210 / 10000

Epoch 207 training complete
Cost on training data: 0.0144323804511
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.992827287808
Accuracy on evaluation data: 9214 / 10000

Epoch 208 training complete
Cost on training data: 0.0140503893538
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.986790586514
Accuracy on evaluation data: 9215 / 10000

Epoch 209 training complete
Cost on training data: 0.0138991028148
Accuracy on training data: 9991 / 10000

Cost on evaluation data: 0.990999971885
Accuracy on evaluation data: 9207 / 10000

Epoch 210 training complete
Cost on training data: 0.0140372075396
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.991087235487
Accuracy on evaluation data: 9201 / 10000

Epoch 211 training complete
Cost on training data: 0.0139186753128
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.994909552588
Accuracy on evaluation data: 9208 / 10000

Epoch 212 training complete
Cost on training data: 0.0138054583103
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 0.989995374395
Accuracy on evaluation data: 9201 / 10000

Epoch 213 training complete
Cost on training data: 0.0136261679532
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 0.9966314721
Accuracy on evaluation data: 9208 / 10000

Epoch 214 training complete
Cost on training data: 0.0135126416738
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.995480527898
Accuracy on evaluation data: 9209 / 10000

Epoch 215 training complete
Cost on training data: 0.0136267793216
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.996496307322
Accuracy on evaluation data: 9211 / 10000

Epoch 216 training complete
Cost on training data: 0.0135594307524
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.993295501294
Accuracy on evaluation data: 9212 / 10000

Epoch 217 training complete
Cost on training data: 0.0134665620623
Accuracy on training data: 9990 / 10000

Cost on evaluation data: 0.998428149203
Accuracy on evaluation data: 9211 / 10000

Epoch 218 training complete
Cost on training data: 0.0134832712637
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 1.00112840224
Accuracy on evaluation data: 9205 / 10000

Epoch 219 training complete
Cost on training data: 0.0134495729786
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 1.00013213703
Accuracy on evaluation data: 9209 / 10000

Epoch 220 training complete
Cost on training data: 0.0141105424518
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 1.00792357864
Accuracy on evaluation data: 9193 / 10000

Epoch 221 training complete
Cost on training data: 0.013159947885
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.998304252875
Accuracy on evaluation data: 9206 / 10000

Epoch 222 training complete
Cost on training data: 0.0130439791078
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.00566910874
Accuracy on evaluation data: 9211 / 10000

Epoch 223 training complete
Cost on training data: 0.0130475296334
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 1.0037356352
Accuracy on evaluation data: 9203 / 10000

Epoch 224 training complete
Cost on training data: 0.013317980371
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 1.00392944147
Accuracy on evaluation data: 9215 / 10000

Epoch 225 training complete
Cost on training data: 0.0130462824593
Accuracy on training data: 9991 / 10000

Cost on evaluation data: 1.00592089809
Accuracy on evaluation data: 9204 / 10000

Epoch 226 training complete
Cost on training data: 0.0128023902191
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 1.00700323998
Accuracy on evaluation data: 9203 / 10000

Epoch 227 training complete
Cost on training data: 0.0128498506486
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 1.00847448979
Accuracy on evaluation data: 9208 / 10000

Epoch 228 training complete
Cost on training data: 0.0130611384218
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.00932387872
Accuracy on evaluation data: 9206 / 10000

Epoch 229 training complete
Cost on training data: 0.0131241381322
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 1.00822924649
Accuracy on evaluation data: 9210 / 10000

Epoch 230 training complete
Cost on training data: 0.0130070074801
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 1.01241121303
Accuracy on evaluation data: 9202 / 10000

Epoch 231 training complete
Cost on training data: 0.0127621725689
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.01141031378
Accuracy on evaluation data: 9209 / 10000

Epoch 232 training complete
Cost on training data: 0.0130840470534
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.01938250262
Accuracy on evaluation data: 9204 / 10000

Epoch 233 training complete
Cost on training data: 0.0125336213993
Accuracy on training data: 9992 / 10000

Cost on evaluation data: 1.0119041829
Accuracy on evaluation data: 9202 / 10000

Epoch 234 training complete
Cost on training data: 0.0124874808725
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 1.01637024214
Accuracy on evaluation data: 9201 / 10000

Epoch 235 training complete
Cost on training data: 0.0126297365285
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 1.02021966105
Accuracy on evaluation data: 9200 / 10000

Epoch 236 training complete
Cost on training data: 0.0123981538213
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 1.017393978
Accuracy on evaluation data: 9200 / 10000

Epoch 237 training complete
Cost on training data: 0.0125107232137
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.02040444562
Accuracy on evaluation data: 9204 / 10000

Epoch 238 training complete
Cost on training data: 0.0123419023352
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.01992335857
Accuracy on evaluation data: 9204 / 10000

Epoch 239 training complete
Cost on training data: 0.012162673107
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.02003966597
Accuracy on evaluation data: 9198 / 10000

Epoch 240 training complete
Cost on training data: 0.0120707732884
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 1.02388267078
Accuracy on evaluation data: 9199 / 10000

Epoch 241 training complete
Cost on training data: 0.0124021121348
Accuracy on training data: 9993 / 10000

Cost on evaluation data: 1.02218144947
Accuracy on evaluation data: 9190 / 10000

Epoch 242 training complete
Cost on training data: 0.0131312769037
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 1.03105907317
Accuracy on evaluation data: 9187 / 10000

Epoch 243 training complete
Cost on training data: 0.0121634662424
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 1.02587555559
Accuracy on evaluation data: 9199 / 10000

Epoch 244 training complete
Cost on training data: 0.0118854741826
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.02373115287
Accuracy on evaluation data: 9196 / 10000

Epoch 245 training complete
Cost on training data: 0.0116780362259
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 1.03039863196
Accuracy on evaluation data: 9196 / 10000

Epoch 246 training complete
Cost on training data: 0.0116421306245
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.02644300283
Accuracy on evaluation data: 9194 / 10000

Epoch 247 training complete
Cost on training data: 0.0115327977677
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 1.03000126212
Accuracy on evaluation data: 9196 / 10000

Epoch 248 training complete
Cost on training data: 0.0116444804773
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 1.02844688565
Accuracy on evaluation data: 9196 / 10000

Epoch 249 training complete
Cost on training data: 0.0114170600266
Accuracy on training data: 9991 / 10000

Cost on evaluation data: 1.0280386844
Accuracy on evaluation data: 9194 / 10000

Epoch 250 training complete
Cost on training data: 0.0111736797274
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.03010058541
Accuracy on evaluation data: 9189 / 10000

Epoch 251 training complete
Cost on training data: 0.0109857990008
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.0332407613
Accuracy on evaluation data: 9189 / 10000

Epoch 252 training complete
Cost on training data: 0.0112919235428
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.04476721841
Accuracy on evaluation data: 9193 / 10000

Epoch 253 training complete
Cost on training data: 0.0107638679344
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.03785869916
Accuracy on evaluation data: 9184 / 10000

Epoch 254 training complete
Cost on training data: 0.010613016416
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.03552872556
Accuracy on evaluation data: 9183 / 10000

Epoch 255 training complete
Cost on training data: 0.010462110529
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.03979895249
Accuracy on evaluation data: 9182 / 10000

Epoch 256 training complete
Cost on training data: 0.0104354651088
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.03905369845
Accuracy on evaluation data: 9193 / 10000

Epoch 257 training complete
Cost on training data: 0.0104268919118
Accuracy on training data: 9996 / 10000

Cost on evaluation data: 1.04290533997
Accuracy on evaluation data: 9188 / 10000

Epoch 258 training complete
Cost on training data: 0.0105161820324
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.03977630505
Accuracy on evaluation data: 9187 / 10000

Epoch 259 training complete
Cost on training data: 0.0103092025876
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.0417877186
Accuracy on evaluation data: 9185 / 10000

Epoch 260 training complete
Cost on training data: 0.010136506615
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.04614268251
Accuracy on evaluation data: 9177 / 10000

Epoch 261 training complete
Cost on training data: 0.0100776634025
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.04771688745
Accuracy on evaluation data: 9184 / 10000

Epoch 262 training complete
Cost on training data: 0.0102424662886
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.04999717636
Accuracy on evaluation data: 9180 / 10000

Epoch 263 training complete
Cost on training data: 0.0100356155294
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.04782414553
Accuracy on evaluation data: 9187 / 10000

Epoch 264 training complete
Cost on training data: 0.00996008969079
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.04622438908
Accuracy on evaluation data: 9189 / 10000

Epoch 265 training complete
Cost on training data: 0.0100323561392
Accuracy on training data: 9996 / 10000

Cost on evaluation data: 1.05633208143
Accuracy on evaluation data: 9179 / 10000

Epoch 266 training complete
Cost on training data: 0.00983123809272
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.05334332352
Accuracy on evaluation data: 9183 / 10000

Epoch 267 training complete
Cost on training data: 0.00973877307779
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.04937853433
Accuracy on evaluation data: 9184 / 10000

Epoch 268 training complete
Cost on training data: 0.00965960164709
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.05153687527
Accuracy on evaluation data: 9179 / 10000

Epoch 269 training complete
Cost on training data: 0.00974107114271
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.05493264313
Accuracy on evaluation data: 9179 / 10000

Epoch 270 training complete
Cost on training data: 0.00966333322455
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.05445192454
Accuracy on evaluation data: 9185 / 10000

Epoch 271 training complete
Cost on training data: 0.00952353781551
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.05666436499
Accuracy on evaluation data: 9177 / 10000

Epoch 272 training complete
Cost on training data: 0.00975608393133
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.06066743839
Accuracy on evaluation data: 9176 / 10000

Epoch 273 training complete
Cost on training data: 0.00975932991426
Accuracy on training data: 9996 / 10000

Cost on evaluation data: 1.0644078394
Accuracy on evaluation data: 9184 / 10000

Epoch 274 training complete
Cost on training data: 0.00954463054916
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 1.0616294759
Accuracy on evaluation data: 9177 / 10000

Epoch 275 training complete
Cost on training data: 0.00949477062087
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.05771116739
Accuracy on evaluation data: 9183 / 10000

Epoch 276 training complete
Cost on training data: 0.00936787007525
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.06142487257
Accuracy on evaluation data: 9175 / 10000

Epoch 277 training complete
Cost on training data: 0.0093309731193
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.06225617354
Accuracy on evaluation data: 9180 / 10000

Epoch 278 training complete
Cost on training data: 0.00958486773053
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.06280008384
Accuracy on evaluation data: 9171 / 10000

Epoch 279 training complete
Cost on training data: 0.00926887558198
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.06587782841
Accuracy on evaluation data: 9180 / 10000

Epoch 280 training complete
Cost on training data: 0.00922957077443
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.06467793581
Accuracy on evaluation data: 9175 / 10000

Epoch 281 training complete
Cost on training data: 0.00918833704749
Accuracy on training data: 9996 / 10000

Cost on evaluation data: 1.06780225854
Accuracy on evaluation data: 9179 / 10000

Epoch 282 training complete
Cost on training data: 0.00925056681787
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.06529884617
Accuracy on evaluation data: 9176 / 10000

Epoch 283 training complete
Cost on training data: 0.00921852950571
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.06792972712
Accuracy on evaluation data: 9183 / 10000

Epoch 284 training complete
Cost on training data: 0.00913553520738
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.06844242448
Accuracy on evaluation data: 9183 / 10000

Epoch 285 training complete
Cost on training data: 0.00898336077119
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.06909117959
Accuracy on evaluation data: 9179 / 10000

Epoch 286 training complete
Cost on training data: 0.00899479012713
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.07096743138
Accuracy on evaluation data: 9176 / 10000

Epoch 287 training complete
Cost on training data: 0.00898721032491
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.07024135181
Accuracy on evaluation data: 9177 / 10000

Epoch 288 training complete
Cost on training data: 0.00915227544629
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.07273471865
Accuracy on evaluation data: 9177 / 10000

Epoch 289 training complete
Cost on training data: 0.00886303126984
Accuracy on training data: 9996 / 10000

Cost on evaluation data: 1.07063890776
Accuracy on evaluation data: 9181 / 10000

Epoch 290 training complete
Cost on training data: 0.00877527557263
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.07470209753
Accuracy on evaluation data: 9175 / 10000

Epoch 291 training complete
Cost on training data: 0.00884373530636
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.07663479034
Accuracy on evaluation data: 9171 / 10000

Epoch 292 training complete
Cost on training data: 0.00880463850212
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.076971949
Accuracy on evaluation data: 9177 / 10000

Epoch 293 training complete
Cost on training data: 0.00908968312809
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.0757001828
Accuracy on evaluation data: 9179 / 10000

Epoch 294 training complete
Cost on training data: 0.00875647180551
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.07716053341
Accuracy on evaluation data: 9185 / 10000

Epoch 295 training complete
Cost on training data: 0.00869728586352
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.07908744998
Accuracy on evaluation data: 9173 / 10000

Epoch 296 training complete
Cost on training data: 0.00853859645558
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.07885208038
Accuracy on evaluation data: 9183 / 10000

Epoch 297 training complete
Cost on training data: 0.00869591943913
Accuracy on training data: 9995 / 10000

Cost on evaluation data: 1.08173097841
Accuracy on evaluation data: 9183 / 10000

Epoch 298 training complete
Cost on training data: 0.00885069489307
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.08089715522
Accuracy on evaluation data: 9173 / 10000

Epoch 299 training complete
Cost on training data: 0.00874996311675
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.08364877821
Accuracy on evaluation data: 9179 / 10000

Epoch 300 training complete
Cost on training data: 0.00867521506776
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.08540767021
Accuracy on evaluation data: 9181 / 10000

Epoch 301 training complete
Cost on training data: 0.00859361597226
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.08316770578
Accuracy on evaluation data: 9175 / 10000

Epoch 302 training complete
Cost on training data: 0.00856386234362
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.08407899073
Accuracy on evaluation data: 9180 / 10000

Epoch 303 training complete
Cost on training data: 0.00839364440749
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.0851707754
Accuracy on evaluation data: 9179 / 10000

Epoch 304 training complete
Cost on training data: 0.00843742608443
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.08598358444
Accuracy on evaluation data: 9174 / 10000

Epoch 305 training complete
Cost on training data: 0.00839266736138
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.089336366
Accuracy on evaluation data: 9177 / 10000

Epoch 306 training complete
Cost on training data: 0.00829212266527
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.08785104408
Accuracy on evaluation data: 9175 / 10000

Epoch 307 training complete
Cost on training data: 0.00830708766179
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.08965316071
Accuracy on evaluation data: 9172 / 10000

Epoch 308 training complete
Cost on training data: 0.00848903347461
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09261391425
Accuracy on evaluation data: 9174 / 10000

Epoch 309 training complete
Cost on training data: 0.00827894023081
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.08714435166
Accuracy on evaluation data: 9178 / 10000

Epoch 310 training complete
Cost on training data: 0.00836126231935
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.08870877453
Accuracy on evaluation data: 9180 / 10000

Epoch 311 training complete
Cost on training data: 0.00822791722347
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09567183034
Accuracy on evaluation data: 9179 / 10000

Epoch 312 training complete
Cost on training data: 0.00809897563909
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09343291854
Accuracy on evaluation data: 9175 / 10000

Epoch 313 training complete
Cost on training data: 0.00806356878232
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.089158385
Accuracy on evaluation data: 9177 / 10000

Epoch 314 training complete
Cost on training data: 0.00802863227618
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09366491476
Accuracy on evaluation data: 9171 / 10000

Epoch 315 training complete
Cost on training data: 0.00800415660683
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09657440531
Accuracy on evaluation data: 9176 / 10000

Epoch 316 training complete
Cost on training data: 0.00798713662595
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09552058523
Accuracy on evaluation data: 9178 / 10000

Epoch 317 training complete
Cost on training data: 0.00795650053002
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09792265671
Accuracy on evaluation data: 9170 / 10000

Epoch 318 training complete
Cost on training data: 0.00795417371359
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.10185316922
Accuracy on evaluation data: 9177 / 10000

Epoch 319 training complete
Cost on training data: 0.00791946774114
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09520749613
Accuracy on evaluation data: 9175 / 10000

Epoch 320 training complete
Cost on training data: 0.00795323324726
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09984935725
Accuracy on evaluation data: 9183 / 10000

Epoch 321 training complete
Cost on training data: 0.0078251255011
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.09915776317
Accuracy on evaluation data: 9180 / 10000

Epoch 322 training complete
Cost on training data: 0.00779155092916
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.09979035373
Accuracy on evaluation data: 9182 / 10000

Epoch 323 training complete
Cost on training data: 0.00777410582736
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.1025844314
Accuracy on evaluation data: 9173 / 10000

Epoch 324 training complete
Cost on training data: 0.00781872456101
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.10131741234
Accuracy on evaluation data: 9181 / 10000

Epoch 325 training complete
Cost on training data: 0.00797855689845
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.10415458751
Accuracy on evaluation data: 9178 / 10000

Epoch 326 training complete
Cost on training data: 0.00788080799589
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.10434345456
Accuracy on evaluation data: 9175 / 10000

Epoch 327 training complete
Cost on training data: 0.00770729251782
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.10703180433
Accuracy on evaluation data: 9171 / 10000

Epoch 328 training complete
Cost on training data: 0.00764236602433
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.10581600098
Accuracy on evaluation data: 9171 / 10000

Epoch 329 training complete
Cost on training data: 0.00770736728707
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.10502733348
Accuracy on evaluation data: 9176 / 10000

Epoch 330 training complete
Cost on training data: 0.00762317329695
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.10842221145
Accuracy on evaluation data: 9174 / 10000

Epoch 331 training complete
Cost on training data: 0.00758296946215
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11257988507
Accuracy on evaluation data: 9170 / 10000

Epoch 332 training complete
Cost on training data: 0.00761043807907
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.11099520939
Accuracy on evaluation data: 9179 / 10000

Epoch 333 training complete
Cost on training data: 0.00752364651199
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11313072773
Accuracy on evaluation data: 9174 / 10000

Epoch 334 training complete
Cost on training data: 0.00750640862425
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11303618746
Accuracy on evaluation data: 9177 / 10000

Epoch 335 training complete
Cost on training data: 0.00745263336981
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11036039364
Accuracy on evaluation data: 9174 / 10000

Epoch 336 training complete
Cost on training data: 0.00823609488501
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 1.11378972282
Accuracy on evaluation data: 9171 / 10000

Epoch 337 training complete
Cost on training data: 0.00764344506634
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.11385664239
Accuracy on evaluation data: 9175 / 10000

Epoch 338 training complete
Cost on training data: 0.0074821456588
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11775262284
Accuracy on evaluation data: 9170 / 10000

Epoch 339 training complete
Cost on training data: 0.00734035226131
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11731660068
Accuracy on evaluation data: 9172 / 10000

Epoch 340 training complete
Cost on training data: 0.00737996688349
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11365834452
Accuracy on evaluation data: 9178 / 10000

Epoch 341 training complete
Cost on training data: 0.00725258613755
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11685060147
Accuracy on evaluation data: 9175 / 10000

Epoch 342 training complete
Cost on training data: 0.00723587865347
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.11838755576
Accuracy on evaluation data: 9173 / 10000

Epoch 343 training complete
Cost on training data: 0.00773924313842
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.11938582116
Accuracy on evaluation data: 9163 / 10000

Epoch 344 training complete
Cost on training data: 0.00734571867508
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.1200016843
Accuracy on evaluation data: 9172 / 10000

Epoch 345 training complete
Cost on training data: 0.00726564632746
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.11962975041
Accuracy on evaluation data: 9168 / 10000

Epoch 346 training complete
Cost on training data: 0.00713678695943
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12183020541
Accuracy on evaluation data: 9178 / 10000

Epoch 347 training complete
Cost on training data: 0.00719705829279
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 1.1241260075
Accuracy on evaluation data: 9176 / 10000

Epoch 348 training complete
Cost on training data: 0.00696963994433
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12160416924
Accuracy on evaluation data: 9176 / 10000

Epoch 349 training complete
Cost on training data: 0.00702845245887
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12277326608
Accuracy on evaluation data: 9178 / 10000

Epoch 350 training complete
Cost on training data: 0.00694035082604
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12685358559
Accuracy on evaluation data: 9173 / 10000

Epoch 351 training complete
Cost on training data: 0.00678953072099
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12407658363
Accuracy on evaluation data: 9175 / 10000

Epoch 352 training complete
Cost on training data: 0.00675484226026
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.1244551219
Accuracy on evaluation data: 9177 / 10000

Epoch 353 training complete
Cost on training data: 0.00679158105479
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.12699595551
Accuracy on evaluation data: 9176 / 10000

Epoch 354 training complete
Cost on training data: 0.00698573269787
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13060057748
Accuracy on evaluation data: 9172 / 10000

Epoch 355 training complete
Cost on training data: 0.00671559734224
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12851078565
Accuracy on evaluation data: 9174 / 10000

Epoch 356 training complete
Cost on training data: 0.00665556908807
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12805230903
Accuracy on evaluation data: 9173 / 10000

Epoch 357 training complete
Cost on training data: 0.00677367219445
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12518735576
Accuracy on evaluation data: 9173 / 10000

Epoch 358 training complete
Cost on training data: 0.00669678577547
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12404507042
Accuracy on evaluation data: 9173 / 10000

Epoch 359 training complete
Cost on training data: 0.0067418860769
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.12630594088
Accuracy on evaluation data: 9171 / 10000

Epoch 360 training complete
Cost on training data: 0.00692792670072
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13369567727
Accuracy on evaluation data: 9167 / 10000

Epoch 361 training complete
Cost on training data: 0.00674954128371
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.13193748725
Accuracy on evaluation data: 9177 / 10000

Epoch 362 training complete
Cost on training data: 0.00652054821787
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13300799291
Accuracy on evaluation data: 9170 / 10000

Epoch 363 training complete
Cost on training data: 0.00665602539049
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13440948163
Accuracy on evaluation data: 9177 / 10000

Epoch 364 training complete
Cost on training data: 0.00653397306475
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13549114272
Accuracy on evaluation data: 9170 / 10000

Epoch 365 training complete
Cost on training data: 0.00651980387297
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13393926032
Accuracy on evaluation data: 9171 / 10000

Epoch 366 training complete
Cost on training data: 0.00641112626994
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13425551642
Accuracy on evaluation data: 9173 / 10000

Epoch 367 training complete
Cost on training data: 0.00639530002089
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13398740149
Accuracy on evaluation data: 9170 / 10000

Epoch 368 training complete
Cost on training data: 0.00657829747882
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13440204747
Accuracy on evaluation data: 9171 / 10000

Epoch 369 training complete
Cost on training data: 0.00644444619221
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.13224300717
Accuracy on evaluation data: 9174 / 10000

Epoch 370 training complete
Cost on training data: 0.00633404118718
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13358040168
Accuracy on evaluation data: 9173 / 10000

Epoch 371 training complete
Cost on training data: 0.00635276387595
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13477298606
Accuracy on evaluation data: 9176 / 10000

Epoch 372 training complete
Cost on training data: 0.00635207484972
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.13694948223
Accuracy on evaluation data: 9170 / 10000

Epoch 373 training complete
Cost on training data: 0.00634689868077
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.13823911471
Accuracy on evaluation data: 9175 / 10000

Epoch 374 training complete
Cost on training data: 0.00623051503615
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.13886573432
Accuracy on evaluation data: 9175 / 10000

Epoch 375 training complete
Cost on training data: 0.0062368726803
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.14086424702
Accuracy on evaluation data: 9175 / 10000

Epoch 376 training complete
Cost on training data: 0.00632173549356
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.14247898107
Accuracy on evaluation data: 9175 / 10000

Epoch 377 training complete
Cost on training data: 0.00616678036842
Accuracy on training data: 9998 / 10000

Cost on evaluation data: 1.14506231833
Accuracy on evaluation data: 9174 / 10000

Epoch 378 training complete
Cost on training data: 0.00635988612807
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.14544557535
Accuracy on evaluation data: 9172 / 10000

Epoch 379 training complete
Cost on training data: 0.00653734205558
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.14432904556
Accuracy on evaluation data: 9173 / 10000

Epoch 380 training complete
Cost on training data: 0.00633371049105
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.14648210222
Accuracy on evaluation data: 9180 / 10000

Epoch 381 training complete
Cost on training data: 0.00619072924093
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.14590993305
Accuracy on evaluation data: 9176 / 10000

Epoch 382 training complete
Cost on training data: 0.00602023402858
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.14657350429
Accuracy on evaluation data: 9175 / 10000

Epoch 383 training complete
Cost on training data: 0.00632251849396
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15097764337
Accuracy on evaluation data: 9171 / 10000

Epoch 384 training complete
Cost on training data: 0.00593973232947
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.14765441903
Accuracy on evaluation data: 9174 / 10000

Epoch 385 training complete
Cost on training data: 0.00591815674476
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 1.14807665641
Accuracy on evaluation data: 9176 / 10000

Epoch 386 training complete
Cost on training data: 0.00583504600182
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 1.14769409807
Accuracy on evaluation data: 9174 / 10000

Epoch 387 training complete
Cost on training data: 0.00597212043643
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.14947271183
Accuracy on evaluation data: 9177 / 10000

Epoch 388 training complete
Cost on training data: 0.0058825675126
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15381315412
Accuracy on evaluation data: 9171 / 10000

Epoch 389 training complete
Cost on training data: 0.00582751347431
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15378273052
Accuracy on evaluation data: 9176 / 10000

Epoch 390 training complete
Cost on training data: 0.00578185611463
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15286660818
Accuracy on evaluation data: 9174 / 10000

Epoch 391 training complete
Cost on training data: 0.00577965201358
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15028595826
Accuracy on evaluation data: 9181 / 10000

Epoch 392 training complete
Cost on training data: 0.00568699610503
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15434470549
Accuracy on evaluation data: 9180 / 10000

Epoch 393 training complete
Cost on training data: 0.00573123115896
Accuracy on training data: 9998 / 10000

Cost on evaluation data: 1.15830909461
Accuracy on evaluation data: 9170 / 10000

Epoch 394 training complete
Cost on training data: 0.00573629303429
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15482025057
Accuracy on evaluation data: 9178 / 10000

Epoch 395 training complete
Cost on training data: 0.00603901956273
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15327888063
Accuracy on evaluation data: 9179 / 10000

Epoch 396 training complete
Cost on training data: 0.0057092164893
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15713081816
Accuracy on evaluation data: 9180 / 10000

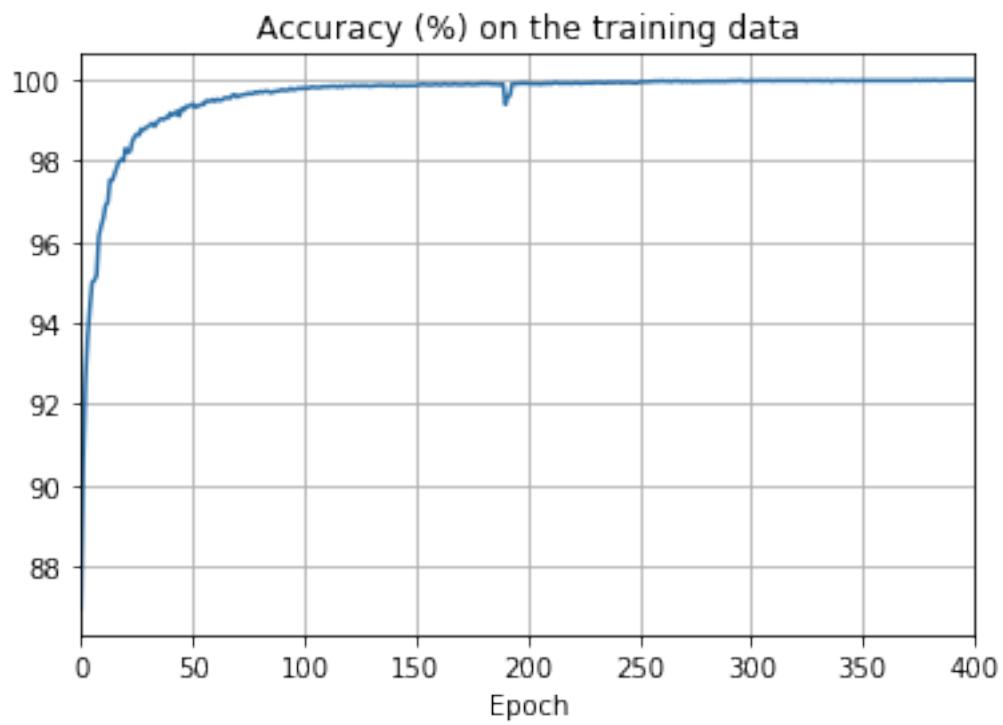
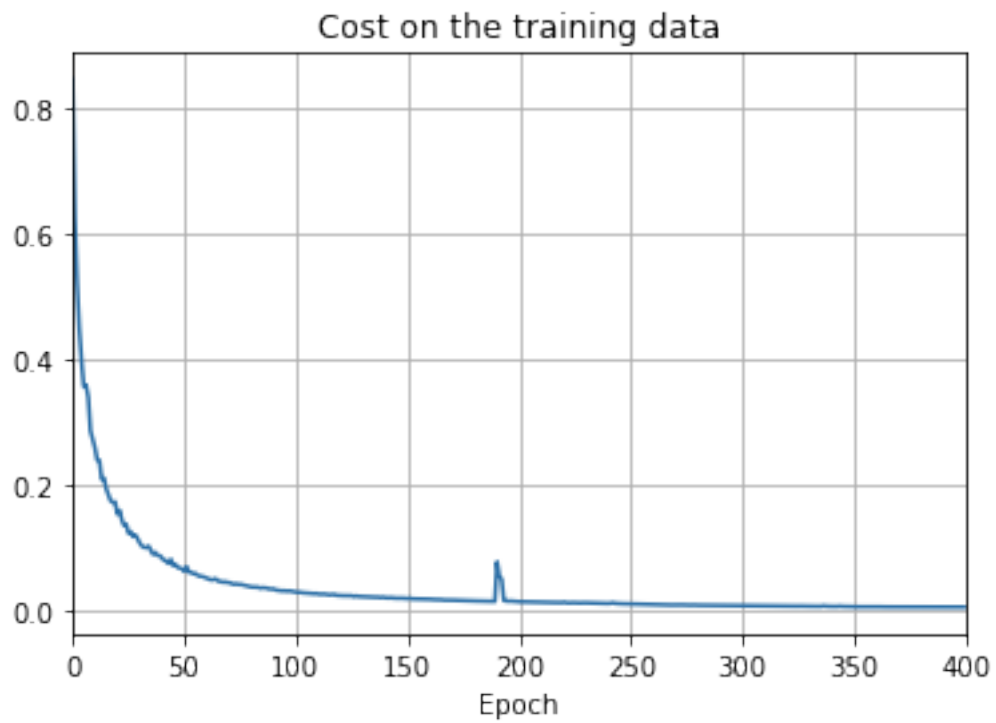
Epoch 397 training complete
Cost on training data: 0.00568197289267
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.15546131499
Accuracy on evaluation data: 9178 / 10000

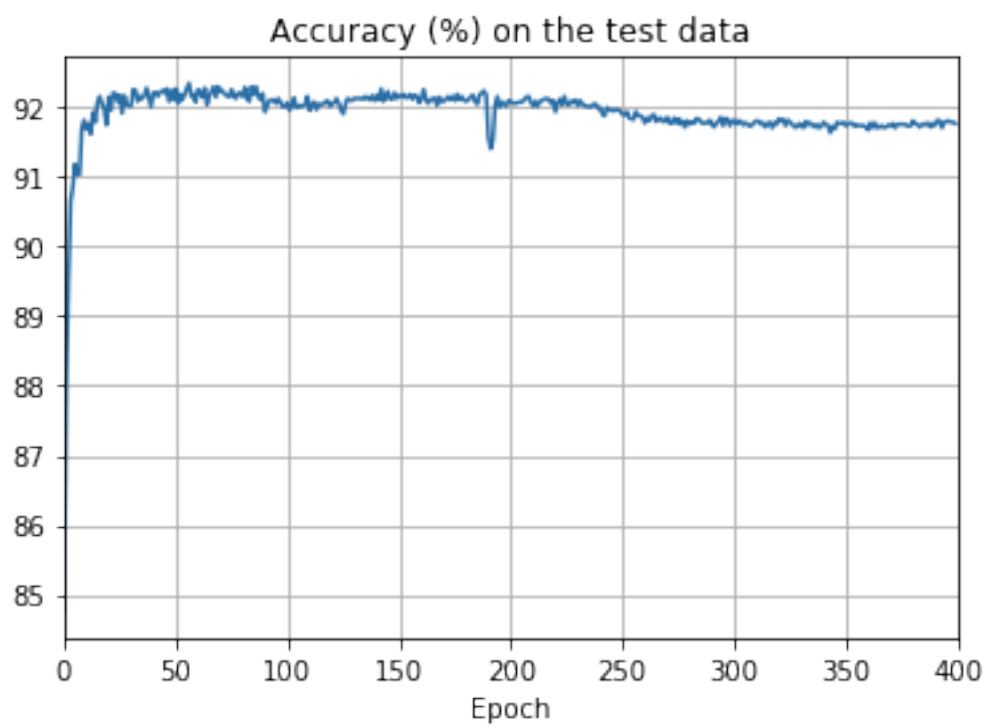
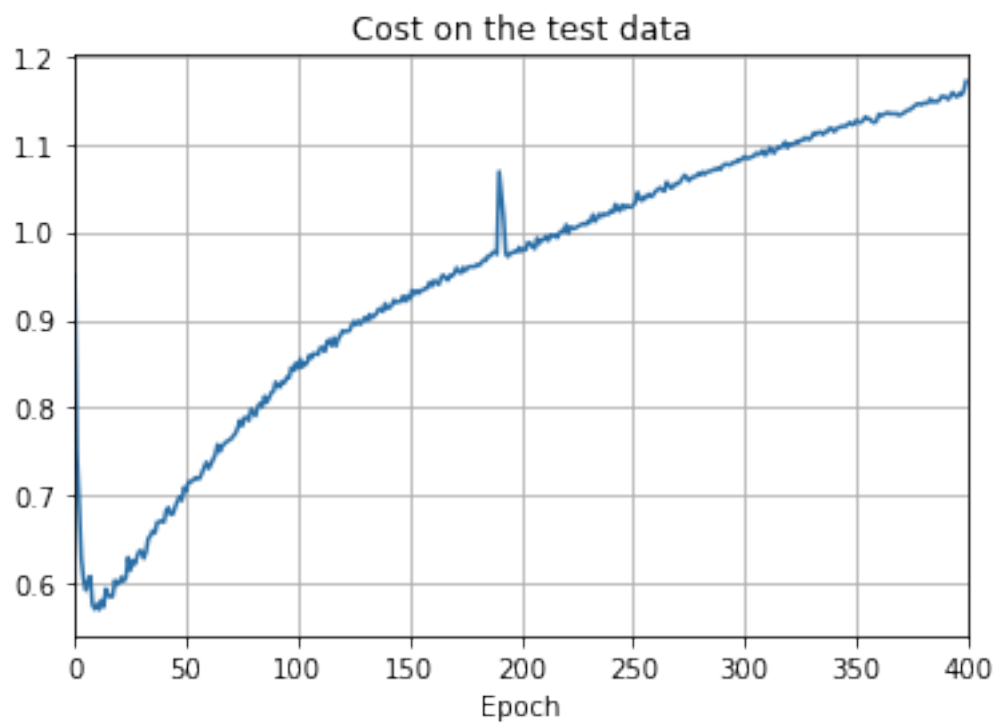
Epoch 398 training complete
Cost on training data: 0.00569588532724
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.16060686202
Accuracy on evaluation data: 9178 / 10000

Epoch 399 training complete
Cost on training data: 0.00627017289375
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 1.17114101475
Accuracy on evaluation data: 9176 / 10000

```
In [25]: import plot_helper
```

```
In [26]: plot_helper.plot_training_cost(num_epochs=epochs, training_cost=training_cost, training_accuracy=training_accuracy, test_cost=evaluation_cost, test_accuracy=evaluation_accuracy, plot_training_cost=True, plot_training_accuracy=True, plot_test_cost=True, plot_test_accuracy=True)
```





week_1_solution_10

March 15, 2018

```
In [1]: import os
import urllib2
# import urllib
import io
import gzip

def download_file(remote, local):
    url = remote

    u = urllib2.urlopen(url)
    f = open(local, 'wb')
    meta = u.info()

    file_size = int(meta.getheaders("Content-Length")[0])
    print "Downloading: %s Bytes: %s" % (local, file_size)

    file_size_dl = 0
    block_sz = 8192
    while True:
        buffer = u.read(block_sz)
        if not buffer:
            break

        file_size_dl += len(buffer)
        f.write(buffer)
        status = r"%10d  [%3.2f%%]" % (file_size_dl, file_size_dl * 100. / file_size)
        status = status + chr(8)*(len(status)+1)
        #     print status,

    f.close()

data_dir = "../data"
data_file_url = "https://github.com/mnielsen/neural-networks-and-deep-learning/raw/master"
if os.path.exists(data_dir) == False:
    os.makedirs(data_dir)
    print("Directory created: " + data_dir)
```

```

data_filename = "mnist.pkl.gz"
data_filepath = data_dir + "/" + data_filename

download_file(remote = data_file_url, local = data_filepath)

# with urllib2.urlopen(data_file_url) as d:
#     data = d.read()
#     d.close()

# with open(data_filepath, 'wb') as f:
#     f.write(data)

print("# Completed downloading file: " + data_filename)

```

Downloading: ../data/mnist.pkl.gz Bytes: 17051982
Completed downloading file: mnist.pkl.gz

```

In [2]: 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 [10]: message = """
Repeat 8,9 using a regularization parameter lambda=0.1 (note python has a reserved word lambda)
net.SGD(training_data[:1000], 400, 10, 0.5,
... evaluation_data=test_data, lmbda = 0.1,
... monitor_evaluation_cost=True, monitor_evaluation_accuracy=True,
... monitor_training_cost=True, monitor_training_accuracy=True)
"""

import network2

net2 = network2.Network([784, 30, 10], cost=network2.CrossEntropyCost)
net2.large_weight_initializer()

epochs = 400

evaluation_cost, evaluation_accuracy, training_cost, training_accuracy = net2.SGD(
    training_data[:10000],
    epochs,
    10,

```

```
    0.5,  
    evaluation_data=test_data,  
    lambda=0.1,  
    monitor_evaluation_cost=True,  
    monitor_evaluation_accuracy=True,  
    monitor_training_cost=True,  
    monitor_training_accuracy=True  
)
```

Epoch 0 training complete

Cost on training data: 0.948709795623

Accuracy on training data: 8753 / 10000

Cost on evaluation data: 1.034100472

Accuracy on evaluation data: 8557 / 10000

Epoch 1 training complete

Cost on training data: 0.73015594784

Accuracy on training data: 9063 / 10000

Cost on evaluation data: 0.851004715191

Accuracy on evaluation data: 8824 / 10000

Epoch 2 training complete

Cost on training data: 0.610741223297

Accuracy on training data: 9288 / 10000

Cost on evaluation data: 0.761230727829

Accuracy on evaluation data: 9017 / 10000

Epoch 3 training complete

Cost on training data: 0.554676834922

Accuracy on training data: 9369 / 10000

Cost on evaluation data: 0.737468388182

Accuracy on evaluation data: 9079 / 10000

Epoch 4 training complete

Cost on training data: 0.521335070386

Accuracy on training data: 9430 / 10000

Cost on evaluation data: 0.704321042228

Accuracy on evaluation data: 9109 / 10000

Epoch 5 training complete

Cost on training data: 0.475575120133

Accuracy on training data: 9502 / 10000

Cost on evaluation data: 0.696112471111

Accuracy on evaluation data: 9137 / 10000

Epoch 6 training complete

Cost on training data: 0.424719454306

Accuracy on training data: 9586 / 10000

Cost on evaluation data: 0.655336927235
Accuracy on evaluation data: 9180 / 10000

Epoch 7 training complete
Cost on training data: 0.401727100578
Accuracy on training data: 9627 / 10000
Cost on evaluation data: 0.64663071817
Accuracy on evaluation data: 9196 / 10000

Epoch 8 training complete
Cost on training data: 0.38950940889
Accuracy on training data: 9640 / 10000
Cost on evaluation data: 0.650313317043
Accuracy on evaluation data: 9216 / 10000

Epoch 9 training complete
Cost on training data: 0.376586017706
Accuracy on training data: 9662 / 10000
Cost on evaluation data: 0.646723930698
Accuracy on evaluation data: 9212 / 10000

Epoch 10 training complete
Cost on training data: 0.3517742728
Accuracy on training data: 9694 / 10000
Cost on evaluation data: 0.639704702511
Accuracy on evaluation data: 9225 / 10000

Epoch 11 training complete
Cost on training data: 0.351300124157
Accuracy on training data: 9686 / 10000
Cost on evaluation data: 0.643479316679
Accuracy on evaluation data: 9233 / 10000

Epoch 12 training complete
Cost on training data: 0.33658430429
Accuracy on training data: 9728 / 10000
Cost on evaluation data: 0.639264349414
Accuracy on evaluation data: 9235 / 10000

Epoch 13 training complete
Cost on training data: 0.324774506765
Accuracy on training data: 9741 / 10000
Cost on evaluation data: 0.635849343996
Accuracy on evaluation data: 9241 / 10000

Epoch 14 training complete
Cost on training data: 0.315956746808
Accuracy on training data: 9759 / 10000

Cost on evaluation data: 0.637886994599
Accuracy on evaluation data: 9217 / 10000

Epoch 15 training complete
Cost on training data: 0.308643725448
Accuracy on training data: 9779 / 10000
Cost on evaluation data: 0.643363438589
Accuracy on evaluation data: 9225 / 10000

Epoch 16 training complete
Cost on training data: 0.29548134089
Accuracy on training data: 9793 / 10000
Cost on evaluation data: 0.634848300573
Accuracy on evaluation data: 9232 / 10000

Epoch 17 training complete
Cost on training data: 0.284495977859
Accuracy on training data: 9801 / 10000
Cost on evaluation data: 0.653442242369
Accuracy on evaluation data: 9223 / 10000

Epoch 18 training complete
Cost on training data: 0.279706038578
Accuracy on training data: 9795 / 10000
Cost on evaluation data: 0.639108075202
Accuracy on evaluation data: 9249 / 10000

Epoch 19 training complete
Cost on training data: 0.29592450871
Accuracy on training data: 9774 / 10000
Cost on evaluation data: 0.675809577575
Accuracy on evaluation data: 9203 / 10000

Epoch 20 training complete
Cost on training data: 0.267824011523
Accuracy on training data: 9814 / 10000
Cost on evaluation data: 0.662706400769
Accuracy on evaluation data: 9250 / 10000

Epoch 21 training complete
Cost on training data: 0.264186277986
Accuracy on training data: 9824 / 10000
Cost on evaluation data: 0.663676794116
Accuracy on evaluation data: 9233 / 10000

Epoch 22 training complete
Cost on training data: 0.263824974764
Accuracy on training data: 9815 / 10000

Cost on evaluation data: 0.674702291333
Accuracy on evaluation data: 9237 / 10000

Epoch 23 training complete
Cost on training data: 0.245129718695
Accuracy on training data: 9854 / 10000
Cost on evaluation data: 0.649403261587
Accuracy on evaluation data: 9251 / 10000

Epoch 24 training complete
Cost on training data: 0.238471519971
Accuracy on training data: 9863 / 10000
Cost on evaluation data: 0.647176399379
Accuracy on evaluation data: 9264 / 10000

Epoch 25 training complete
Cost on training data: 0.237581054125
Accuracy on training data: 9858 / 10000
Cost on evaluation data: 0.660050926491
Accuracy on evaluation data: 9269 / 10000

Epoch 26 training complete
Cost on training data: 0.2307235062
Accuracy on training data: 9872 / 10000
Cost on evaluation data: 0.664080059692
Accuracy on evaluation data: 9243 / 10000

Epoch 27 training complete
Cost on training data: 0.222983931931
Accuracy on training data: 9875 / 10000
Cost on evaluation data: 0.659621825406
Accuracy on evaluation data: 9251 / 10000

Epoch 28 training complete
Cost on training data: 0.223456769959
Accuracy on training data: 9881 / 10000
Cost on evaluation data: 0.666095809311
Accuracy on evaluation data: 9237 / 10000

Epoch 29 training complete
Cost on training data: 0.231634966414
Accuracy on training data: 9868 / 10000
Cost on evaluation data: 0.669979185789
Accuracy on evaluation data: 9245 / 10000

Epoch 30 training complete
Cost on training data: 0.211957287396
Accuracy on training data: 9889 / 10000

Cost on evaluation data: 0.655303143821
Accuracy on evaluation data: 9274 / 10000

Epoch 31 training complete
Cost on training data: 0.208677978354
Accuracy on training data: 9893 / 10000
Cost on evaluation data: 0.661381648788
Accuracy on evaluation data: 9282 / 10000

Epoch 32 training complete
Cost on training data: 0.215318221882
Accuracy on training data: 9879 / 10000
Cost on evaluation data: 0.680329094788
Accuracy on evaluation data: 9272 / 10000

Epoch 33 training complete
Cost on training data: 0.205226655359
Accuracy on training data: 9902 / 10000
Cost on evaluation data: 0.667492679015
Accuracy on evaluation data: 9259 / 10000

Epoch 34 training complete
Cost on training data: 0.206361598826
Accuracy on training data: 9898 / 10000
Cost on evaluation data: 0.672587944598
Accuracy on evaluation data: 9255 / 10000

Epoch 35 training complete
Cost on training data: 0.206041124549
Accuracy on training data: 9904 / 10000
Cost on evaluation data: 0.684756290021
Accuracy on evaluation data: 9260 / 10000

Epoch 36 training complete
Cost on training data: 0.196482104922
Accuracy on training data: 9903 / 10000
Cost on evaluation data: 0.670160390071
Accuracy on evaluation data: 9275 / 10000

Epoch 37 training complete
Cost on training data: 0.189955384375
Accuracy on training data: 9917 / 10000
Cost on evaluation data: 0.674301624158
Accuracy on evaluation data: 9278 / 10000

Epoch 38 training complete
Cost on training data: 0.186878719528
Accuracy on training data: 9914 / 10000

Cost on evaluation data: 0.670084344138
Accuracy on evaluation data: 9267 / 10000

Epoch 39 training complete
Cost on training data: 0.186993011721
Accuracy on training data: 9917 / 10000
Cost on evaluation data: 0.680090713196
Accuracy on evaluation data: 9264 / 10000

Epoch 40 training complete
Cost on training data: 0.181422913399
Accuracy on training data: 9926 / 10000
Cost on evaluation data: 0.670495544539
Accuracy on evaluation data: 9294 / 10000

Epoch 41 training complete
Cost on training data: 0.182853859768
Accuracy on training data: 9922 / 10000
Cost on evaluation data: 0.678942060991
Accuracy on evaluation data: 9274 / 10000

Epoch 42 training complete
Cost on training data: 0.174739792802
Accuracy on training data: 9927 / 10000
Cost on evaluation data: 0.669726512123
Accuracy on evaluation data: 9291 / 10000

Epoch 43 training complete
Cost on training data: 0.176415215079
Accuracy on training data: 9927 / 10000
Cost on evaluation data: 0.678215494812
Accuracy on evaluation data: 9284 / 10000

Epoch 44 training complete
Cost on training data: 0.173888293385
Accuracy on training data: 9929 / 10000
Cost on evaluation data: 0.672966003731
Accuracy on evaluation data: 9291 / 10000

Epoch 45 training complete
Cost on training data: 0.170104333817
Accuracy on training data: 9934 / 10000
Cost on evaluation data: 0.680808445752
Accuracy on evaluation data: 9271 / 10000

Epoch 46 training complete
Cost on training data: 0.168834821507
Accuracy on training data: 9929 / 10000

Cost on evaluation data: 0.674444485343
Accuracy on evaluation data: 9286 / 10000

Epoch 47 training complete
Cost on training data: 0.17278694774
Accuracy on training data: 9931 / 10000
Cost on evaluation data: 0.682278653721
Accuracy on evaluation data: 9265 / 10000

Epoch 48 training complete
Cost on training data: 0.165965719774
Accuracy on training data: 9933 / 10000
Cost on evaluation data: 0.674619265599
Accuracy on evaluation data: 9274 / 10000

Epoch 49 training complete
Cost on training data: 0.162063661452
Accuracy on training data: 9933 / 10000
Cost on evaluation data: 0.679467401277
Accuracy on evaluation data: 9287 / 10000

Epoch 50 training complete
Cost on training data: 0.159779983682
Accuracy on training data: 9942 / 10000
Cost on evaluation data: 0.681281954066
Accuracy on evaluation data: 9273 / 10000

Epoch 51 training complete
Cost on training data: 0.159919260044
Accuracy on training data: 9939 / 10000
Cost on evaluation data: 0.694239257561
Accuracy on evaluation data: 9271 / 10000

Epoch 52 training complete
Cost on training data: 0.157990393365
Accuracy on training data: 9945 / 10000
Cost on evaluation data: 0.688127778661
Accuracy on evaluation data: 9269 / 10000

Epoch 53 training complete
Cost on training data: 0.155222008852
Accuracy on training data: 9946 / 10000
Cost on evaluation data: 0.676978186111
Accuracy on evaluation data: 9295 / 10000

Epoch 54 training complete
Cost on training data: 0.156689730926
Accuracy on training data: 9943 / 10000

Cost on evaluation data: 0.689055428778
Accuracy on evaluation data: 9287 / 10000

Epoch 55 training complete
Cost on training data: 0.153147446649
Accuracy on training data: 9943 / 10000
Cost on evaluation data: 0.696867165349
Accuracy on evaluation data: 9266 / 10000

Epoch 56 training complete
Cost on training data: 0.150051235067
Accuracy on training data: 9950 / 10000
Cost on evaluation data: 0.696506272421
Accuracy on evaluation data: 9277 / 10000

Epoch 57 training complete
Cost on training data: 0.148657183054
Accuracy on training data: 9954 / 10000
Cost on evaluation data: 0.681149008559
Accuracy on evaluation data: 9292 / 10000

Epoch 58 training complete
Cost on training data: 0.149527871323
Accuracy on training data: 9949 / 10000
Cost on evaluation data: 0.684194549854
Accuracy on evaluation data: 9280 / 10000

Epoch 59 training complete
Cost on training data: 0.146166832692
Accuracy on training data: 9955 / 10000
Cost on evaluation data: 0.685794712593
Accuracy on evaluation data: 9270 / 10000

Epoch 60 training complete
Cost on training data: 0.144279633282
Accuracy on training data: 9955 / 10000
Cost on evaluation data: 0.68552083775
Accuracy on evaluation data: 9290 / 10000

Epoch 61 training complete
Cost on training data: 0.14467066031
Accuracy on training data: 9955 / 10000
Cost on evaluation data: 0.686616977973
Accuracy on evaluation data: 9279 / 10000

Epoch 62 training complete
Cost on training data: 0.143419747759
Accuracy on training data: 9957 / 10000

Cost on evaluation data: 0.687552082165
Accuracy on evaluation data: 9285 / 10000

Epoch 63 training complete
Cost on training data: 0.142473449927
Accuracy on training data: 9954 / 10000
Cost on evaluation data: 0.69723095407
Accuracy on evaluation data: 9290 / 10000

Epoch 64 training complete
Cost on training data: 0.140370061558
Accuracy on training data: 9957 / 10000
Cost on evaluation data: 0.690952974989
Accuracy on evaluation data: 9281 / 10000

Epoch 65 training complete
Cost on training data: 0.138503229923
Accuracy on training data: 9958 / 10000
Cost on evaluation data: 0.688736762351
Accuracy on evaluation data: 9279 / 10000

Epoch 66 training complete
Cost on training data: 0.140043783491
Accuracy on training data: 9957 / 10000
Cost on evaluation data: 0.692415574602
Accuracy on evaluation data: 9282 / 10000

Epoch 67 training complete
Cost on training data: 0.136993387232
Accuracy on training data: 9958 / 10000
Cost on evaluation data: 0.690343261579
Accuracy on evaluation data: 9273 / 10000

Epoch 68 training complete
Cost on training data: 0.135760163934
Accuracy on training data: 9960 / 10000
Cost on evaluation data: 0.687201905931
Accuracy on evaluation data: 9275 / 10000

Epoch 69 training complete
Cost on training data: 0.136339221631
Accuracy on training data: 9958 / 10000
Cost on evaluation data: 0.688556882094
Accuracy on evaluation data: 9283 / 10000

Epoch 70 training complete
Cost on training data: 0.133968501961
Accuracy on training data: 9960 / 10000

Cost on evaluation data: 0.69293031236
Accuracy on evaluation data: 9294 / 10000

Epoch 71 training complete
Cost on training data: 0.132906980756
Accuracy on training data: 9964 / 10000
Cost on evaluation data: 0.693616423555
Accuracy on evaluation data: 9286 / 10000

Epoch 72 training complete
Cost on training data: 0.131876616619
Accuracy on training data: 9964 / 10000
Cost on evaluation data: 0.69030686266
Accuracy on evaluation data: 9284 / 10000

Epoch 73 training complete
Cost on training data: 0.130440484615
Accuracy on training data: 9962 / 10000
Cost on evaluation data: 0.691947226337
Accuracy on evaluation data: 9288 / 10000

Epoch 74 training complete
Cost on training data: 0.129616999339
Accuracy on training data: 9962 / 10000
Cost on evaluation data: 0.694151938071
Accuracy on evaluation data: 9276 / 10000

Epoch 75 training complete
Cost on training data: 0.128509879717
Accuracy on training data: 9967 / 10000
Cost on evaluation data: 0.693414921807
Accuracy on evaluation data: 9282 / 10000

Epoch 76 training complete
Cost on training data: 0.127360905958
Accuracy on training data: 9964 / 10000
Cost on evaluation data: 0.692850745954
Accuracy on evaluation data: 9296 / 10000

Epoch 77 training complete
Cost on training data: 0.126748093427
Accuracy on training data: 9967 / 10000
Cost on evaluation data: 0.694302723451
Accuracy on evaluation data: 9296 / 10000

Epoch 78 training complete
Cost on training data: 0.126238491599
Accuracy on training data: 9962 / 10000

Cost on evaluation data: 0.69139343052
Accuracy on evaluation data: 9285 / 10000

Epoch 79 training complete
Cost on training data: 0.127248388202
Accuracy on training data: 9965 / 10000
Cost on evaluation data: 0.698555765534
Accuracy on evaluation data: 9273 / 10000

Epoch 80 training complete
Cost on training data: 0.124647853792
Accuracy on training data: 9969 / 10000
Cost on evaluation data: 0.693295175054
Accuracy on evaluation data: 9292 / 10000

Epoch 81 training complete
Cost on training data: 0.124776166638
Accuracy on training data: 9970 / 10000
Cost on evaluation data: 0.694043522338
Accuracy on evaluation data: 9288 / 10000

Epoch 82 training complete
Cost on training data: 0.122269484174
Accuracy on training data: 9970 / 10000
Cost on evaluation data: 0.69276346225
Accuracy on evaluation data: 9288 / 10000

Epoch 83 training complete
Cost on training data: 0.121647931269
Accuracy on training data: 9968 / 10000
Cost on evaluation data: 0.698990783466
Accuracy on evaluation data: 9288 / 10000

Epoch 84 training complete
Cost on training data: 0.119702769233
Accuracy on training data: 9972 / 10000
Cost on evaluation data: 0.692334197772
Accuracy on evaluation data: 9294 / 10000

Epoch 85 training complete
Cost on training data: 0.119733439677
Accuracy on training data: 9972 / 10000
Cost on evaluation data: 0.6936574686
Accuracy on evaluation data: 9286 / 10000

Epoch 86 training complete
Cost on training data: 0.118717512959
Accuracy on training data: 9973 / 10000

Cost on evaluation data: 0.691644198407
Accuracy on evaluation data: 9292 / 10000

Epoch 87 training complete
Cost on training data: 0.117726537404
Accuracy on training data: 9975 / 10000
Cost on evaluation data: 0.688281993184
Accuracy on evaluation data: 9301 / 10000

Epoch 88 training complete
Cost on training data: 0.116771830016
Accuracy on training data: 9974 / 10000
Cost on evaluation data: 0.693190594002
Accuracy on evaluation data: 9293 / 10000

Epoch 89 training complete
Cost on training data: 0.116426767965
Accuracy on training data: 9975 / 10000
Cost on evaluation data: 0.705205733705
Accuracy on evaluation data: 9294 / 10000

Epoch 90 training complete
Cost on training data: 0.119625707353
Accuracy on training data: 9972 / 10000
Cost on evaluation data: 0.691806200279
Accuracy on evaluation data: 9286 / 10000

Epoch 91 training complete
Cost on training data: 0.115052133891
Accuracy on training data: 9978 / 10000
Cost on evaluation data: 0.69638719423
Accuracy on evaluation data: 9297 / 10000

Epoch 92 training complete
Cost on training data: 0.112528728645
Accuracy on training data: 9973 / 10000
Cost on evaluation data: 0.689971011982
Accuracy on evaluation data: 9299 / 10000

Epoch 93 training complete
Cost on training data: 0.113136661543
Accuracy on training data: 9978 / 10000
Cost on evaluation data: 0.69947194093
Accuracy on evaluation data: 9295 / 10000

Epoch 94 training complete
Cost on training data: 0.112133285252
Accuracy on training data: 9980 / 10000

Cost on evaluation data: 0.693292190073
Accuracy on evaluation data: 9305 / 10000

Epoch 95 training complete
Cost on training data: 0.111476086412
Accuracy on training data: 9979 / 10000
Cost on evaluation data: 0.695004368671
Accuracy on evaluation data: 9293 / 10000

Epoch 96 training complete
Cost on training data: 0.110148298349
Accuracy on training data: 9979 / 10000
Cost on evaluation data: 0.69908002184
Accuracy on evaluation data: 9288 / 10000

Epoch 97 training complete
Cost on training data: 0.110544625462
Accuracy on training data: 9977 / 10000
Cost on evaluation data: 0.696317788908
Accuracy on evaluation data: 9294 / 10000

Epoch 98 training complete
Cost on training data: 0.109166087867
Accuracy on training data: 9982 / 10000
Cost on evaluation data: 0.690914121592
Accuracy on evaluation data: 9310 / 10000

Epoch 99 training complete
Cost on training data: 0.109102810881
Accuracy on training data: 9979 / 10000
Cost on evaluation data: 0.694414496065
Accuracy on evaluation data: 9289 / 10000

Epoch 100 training complete
Cost on training data: 0.112874553664
Accuracy on training data: 9973 / 10000
Cost on evaluation data: 0.686503795536
Accuracy on evaluation data: 9317 / 10000

Epoch 101 training complete
Cost on training data: 0.107501618325
Accuracy on training data: 9979 / 10000
Cost on evaluation data: 0.699010383044
Accuracy on evaluation data: 9304 / 10000

Epoch 102 training complete
Cost on training data: 0.106521618276
Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.69014354836
Accuracy on evaluation data: 9300 / 10000

Epoch 103 training complete
Cost on training data: 0.105267145673
Accuracy on training data: 9980 / 10000
Cost on evaluation data: 0.686411399772
Accuracy on evaluation data: 9305 / 10000

Epoch 104 training complete
Cost on training data: 0.104759599153
Accuracy on training data: 9981 / 10000
Cost on evaluation data: 0.700953279642
Accuracy on evaluation data: 9296 / 10000

Epoch 105 training complete
Cost on training data: 0.105375861396
Accuracy on training data: 9981 / 10000
Cost on evaluation data: 0.693401045683
Accuracy on evaluation data: 9282 / 10000

Epoch 106 training complete
Cost on training data: 0.103862378119
Accuracy on training data: 9980 / 10000
Cost on evaluation data: 0.685984353242
Accuracy on evaluation data: 9298 / 10000

Epoch 107 training complete
Cost on training data: 0.102889143369
Accuracy on training data: 9985 / 10000
Cost on evaluation data: 0.686790640348
Accuracy on evaluation data: 9305 / 10000

Epoch 108 training complete
Cost on training data: 0.102340347041
Accuracy on training data: 9982 / 10000
Cost on evaluation data: 0.689199860087
Accuracy on evaluation data: 9299 / 10000

Epoch 109 training complete
Cost on training data: 0.101238095804
Accuracy on training data: 9982 / 10000
Cost on evaluation data: 0.692197905498
Accuracy on evaluation data: 9299 / 10000

Epoch 110 training complete
Cost on training data: 0.100683344425
Accuracy on training data: 9983 / 10000

Cost on evaluation data: 0.690580963264
Accuracy on evaluation data: 9291 / 10000

Epoch 111 training complete
Cost on training data: 0.101119399774
Accuracy on training data: 9983 / 10000
Cost on evaluation data: 0.692517276251
Accuracy on evaluation data: 9304 / 10000

Epoch 112 training complete
Cost on training data: 0.0995870194509
Accuracy on training data: 9984 / 10000
Cost on evaluation data: 0.685800216057
Accuracy on evaluation data: 9305 / 10000

Epoch 113 training complete
Cost on training data: 0.0988203414388
Accuracy on training data: 9984 / 10000
Cost on evaluation data: 0.687767169837
Accuracy on evaluation data: 9314 / 10000

Epoch 114 training complete
Cost on training data: 0.0992456904425
Accuracy on training data: 9983 / 10000
Cost on evaluation data: 0.684973141025
Accuracy on evaluation data: 9310 / 10000

Epoch 115 training complete
Cost on training data: 0.0977769356038
Accuracy on training data: 9984 / 10000
Cost on evaluation data: 0.691736063409
Accuracy on evaluation data: 9302 / 10000

Epoch 116 training complete
Cost on training data: 0.0971422795968
Accuracy on training data: 9983 / 10000
Cost on evaluation data: 0.686034292848
Accuracy on evaluation data: 9297 / 10000

Epoch 117 training complete
Cost on training data: 0.098708721754
Accuracy on training data: 9981 / 10000
Cost on evaluation data: 0.702370206786
Accuracy on evaluation data: 9296 / 10000

Epoch 118 training complete
Cost on training data: 0.0959360111607
Accuracy on training data: 9984 / 10000

Cost on evaluation data: 0.687334263738
Accuracy on evaluation data: 9306 / 10000

Epoch 119 training complete
Cost on training data: 0.0947368448461
Accuracy on training data: 9983 / 10000
Cost on evaluation data: 0.688505567307
Accuracy on evaluation data: 9299 / 10000

Epoch 120 training complete
Cost on training data: 0.0951924259681
Accuracy on training data: 9985 / 10000
Cost on evaluation data: 0.688622574953
Accuracy on evaluation data: 9298 / 10000

Epoch 121 training complete
Cost on training data: 0.0953351096496
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.692977649748
Accuracy on evaluation data: 9294 / 10000

Epoch 122 training complete
Cost on training data: 0.0948892171307
Accuracy on training data: 9983 / 10000
Cost on evaluation data: 0.685417711
Accuracy on evaluation data: 9307 / 10000

Epoch 123 training complete
Cost on training data: 0.0924234008097
Accuracy on training data: 9985 / 10000
Cost on evaluation data: 0.685073130073
Accuracy on evaluation data: 9308 / 10000

Epoch 124 training complete
Cost on training data: 0.0938835263503
Accuracy on training data: 9986 / 10000
Cost on evaluation data: 0.690005386802
Accuracy on evaluation data: 9300 / 10000

Epoch 125 training complete
Cost on training data: 0.0918947141239
Accuracy on training data: 9986 / 10000
Cost on evaluation data: 0.685289532466
Accuracy on evaluation data: 9316 / 10000

Epoch 126 training complete
Cost on training data: 0.0907435921839
Accuracy on training data: 9987 / 10000

Cost on evaluation data: 0.690078293463
Accuracy on evaluation data: 9300 / 10000

Epoch 127 training complete
Cost on training data: 0.0905045105574
Accuracy on training data: 9985 / 10000
Cost on evaluation data: 0.689506531408
Accuracy on evaluation data: 9304 / 10000

Epoch 128 training complete
Cost on training data: 0.0904523181743
Accuracy on training data: 9986 / 10000
Cost on evaluation data: 0.685248458523
Accuracy on evaluation data: 9310 / 10000

Epoch 129 training complete
Cost on training data: 0.0891681459967
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.688975525291
Accuracy on evaluation data: 9305 / 10000

Epoch 130 training complete
Cost on training data: 0.0881300914444
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.688249750904
Accuracy on evaluation data: 9312 / 10000

Epoch 131 training complete
Cost on training data: 0.0879039354836
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.686927269841
Accuracy on evaluation data: 9307 / 10000

Epoch 132 training complete
Cost on training data: 0.0901291684919
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.689488024501
Accuracy on evaluation data: 9300 / 10000

Epoch 133 training complete
Cost on training data: 0.0892604461213
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.691909732311
Accuracy on evaluation data: 9303 / 10000

Epoch 134 training complete
Cost on training data: 0.0865598170227
Accuracy on training data: 9988 / 10000

Cost on evaluation data: 0.6878611441
Accuracy on evaluation data: 9306 / 10000

Epoch 135 training complete
Cost on training data: 0.0866399592137
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.682154163205
Accuracy on evaluation data: 9317 / 10000

Epoch 136 training complete
Cost on training data: 0.0850849227827
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.686403620279
Accuracy on evaluation data: 9316 / 10000

Epoch 137 training complete
Cost on training data: 0.08657470273
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.705031532847
Accuracy on evaluation data: 9276 / 10000

Epoch 138 training complete
Cost on training data: 0.0849701861285
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.68664435131
Accuracy on evaluation data: 9312 / 10000

Epoch 139 training complete
Cost on training data: 0.0848954323471
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.682786846494
Accuracy on evaluation data: 9317 / 10000

Epoch 140 training complete
Cost on training data: 0.0842417111201
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.686553092257
Accuracy on evaluation data: 9297 / 10000

Epoch 141 training complete
Cost on training data: 0.084012170065
Accuracy on training data: 9988 / 10000
Cost on evaluation data: 0.69343699595
Accuracy on evaluation data: 9301 / 10000

Epoch 142 training complete
Cost on training data: 0.0825944457131
Accuracy on training data: 9989 / 10000

Cost on evaluation data: 0.689820039477
Accuracy on evaluation data: 9304 / 10000

Epoch 143 training complete
Cost on training data: 0.0818244255963
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.681205232169
Accuracy on evaluation data: 9305 / 10000

Epoch 144 training complete
Cost on training data: 0.0830152058321
Accuracy on training data: 9987 / 10000
Cost on evaluation data: 0.676522170498
Accuracy on evaluation data: 9319 / 10000

Epoch 145 training complete
Cost on training data: 0.081180755907
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.67826884494
Accuracy on evaluation data: 9315 / 10000

Epoch 146 training complete
Cost on training data: 0.0811411446097
Accuracy on training data: 9989 / 10000
Cost on evaluation data: 0.682009003411
Accuracy on evaluation data: 9321 / 10000

Epoch 147 training complete
Cost on training data: 0.0813766477471
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.679970176103
Accuracy on evaluation data: 9303 / 10000

Epoch 148 training complete
Cost on training data: 0.08125335918
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.684488153515
Accuracy on evaluation data: 9296 / 10000

Epoch 149 training complete
Cost on training data: 0.0797600619146
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.682165446587
Accuracy on evaluation data: 9311 / 10000

Epoch 150 training complete
Cost on training data: 0.0792337653301
Accuracy on training data: 9991 / 10000

Cost on evaluation data: 0.680130373407
Accuracy on evaluation data: 9314 / 10000

Epoch 151 training complete
Cost on training data: 0.0790688640605
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.680693173299
Accuracy on evaluation data: 9315 / 10000

Epoch 152 training complete
Cost on training data: 0.0785312336334
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.671668865852
Accuracy on evaluation data: 9322 / 10000

Epoch 153 training complete
Cost on training data: 0.0802673223025
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.67772254589
Accuracy on evaluation data: 9313 / 10000

Epoch 154 training complete
Cost on training data: 0.0786882444554
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.681917760555
Accuracy on evaluation data: 9326 / 10000

Epoch 155 training complete
Cost on training data: 0.0785967658758
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.680181499679
Accuracy on evaluation data: 9325 / 10000

Epoch 156 training complete
Cost on training data: 0.0769677070327
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.6746249825
Accuracy on evaluation data: 9320 / 10000

Epoch 157 training complete
Cost on training data: 0.0764727421747
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 0.680713593231
Accuracy on evaluation data: 9314 / 10000

Epoch 158 training complete
Cost on training data: 0.0765994132747
Accuracy on training data: 9991 / 10000

Cost on evaluation data: 0.679726429514
Accuracy on evaluation data: 9319 / 10000

Epoch 159 training complete
Cost on training data: 0.0758254587803
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.670413134341
Accuracy on evaluation data: 9324 / 10000

Epoch 160 training complete
Cost on training data: 0.0758470655948
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 0.680638342003
Accuracy on evaluation data: 9305 / 10000

Epoch 161 training complete
Cost on training data: 0.0757546575342
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 0.682492128572
Accuracy on evaluation data: 9310 / 10000

Epoch 162 training complete
Cost on training data: 0.0746830907046
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 0.678752073847
Accuracy on evaluation data: 9322 / 10000

Epoch 163 training complete
Cost on training data: 0.0739877810111
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 0.673706802922
Accuracy on evaluation data: 9332 / 10000

Epoch 164 training complete
Cost on training data: 0.0739760065691
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 0.67523456787
Accuracy on evaluation data: 9319 / 10000

Epoch 165 training complete
Cost on training data: 0.0744299354503
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.676022121197
Accuracy on evaluation data: 9314 / 10000

Epoch 166 training complete
Cost on training data: 0.0728298275962
Accuracy on training data: 9993 / 10000

Cost on evaluation data: 0.679716297183
Accuracy on evaluation data: 9318 / 10000

Epoch 167 training complete
Cost on training data: 0.0725569118654
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 0.673497031046
Accuracy on evaluation data: 9320 / 10000

Epoch 168 training complete
Cost on training data: 0.0723919745099
Accuracy on training data: 9993 / 10000
Cost on evaluation data: 0.674329326664
Accuracy on evaluation data: 9322 / 10000

Epoch 169 training complete
Cost on training data: 0.0726965021934
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 0.68053369127
Accuracy on evaluation data: 9317 / 10000

Epoch 170 training complete
Cost on training data: 0.0720194451227
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.670996912837
Accuracy on evaluation data: 9318 / 10000

Epoch 171 training complete
Cost on training data: 0.0713957621188
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.677782956497
Accuracy on evaluation data: 9320 / 10000

Epoch 172 training complete
Cost on training data: 0.0713855744093
Accuracy on training data: 9994 / 10000
Cost on evaluation data: 0.674655874856
Accuracy on evaluation data: 9317 / 10000

Epoch 173 training complete
Cost on training data: 0.0711430681229
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.675581827361
Accuracy on evaluation data: 9329 / 10000

Epoch 174 training complete
Cost on training data: 0.0707411669977
Accuracy on training data: 9996 / 10000

Cost on evaluation data: 0.670259181616
Accuracy on evaluation data: 9330 / 10000

Epoch 175 training complete
Cost on training data: 0.0704498985711
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 0.669162687428
Accuracy on evaluation data: 9320 / 10000

Epoch 176 training complete
Cost on training data: 0.0700831194216
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.674244159322
Accuracy on evaluation data: 9324 / 10000

Epoch 177 training complete
Cost on training data: 0.0730965429863
Accuracy on training data: 9991 / 10000
Cost on evaluation data: 0.673436754442
Accuracy on evaluation data: 9316 / 10000

Epoch 178 training complete
Cost on training data: 0.0698043790409
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 0.668857899748
Accuracy on evaluation data: 9336 / 10000

Epoch 179 training complete
Cost on training data: 0.0683634022742
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.672678917359
Accuracy on evaluation data: 9322 / 10000

Epoch 180 training complete
Cost on training data: 0.0690697732096
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.672898306717
Accuracy on evaluation data: 9343 / 10000

Epoch 181 training complete
Cost on training data: 0.0684022859808
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.669472229398
Accuracy on evaluation data: 9327 / 10000

Epoch 182 training complete
Cost on training data: 0.0678832254275
Accuracy on training data: 9996 / 10000

Cost on evaluation data: 0.669868611373
Accuracy on evaluation data: 9330 / 10000

Epoch 183 training complete
Cost on training data: 0.0675516650193
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.668983545275
Accuracy on evaluation data: 9340 / 10000

Epoch 184 training complete
Cost on training data: 0.0671011921687
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.671551517666
Accuracy on evaluation data: 9323 / 10000

Epoch 185 training complete
Cost on training data: 0.0701565666136
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.682646060797
Accuracy on evaluation data: 9314 / 10000

Epoch 186 training complete
Cost on training data: 0.199776310262
Accuracy on training data: 9821 / 10000
Cost on evaluation data: 0.845524775458
Accuracy on evaluation data: 9137 / 10000

Epoch 187 training complete
Cost on training data: 0.101525830146
Accuracy on training data: 9960 / 10000
Cost on evaluation data: 0.706544065228
Accuracy on evaluation data: 9292 / 10000

Epoch 188 training complete
Cost on training data: 0.0830817755515
Accuracy on training data: 9990 / 10000
Cost on evaluation data: 0.687883707867
Accuracy on evaluation data: 9310 / 10000

Epoch 189 training complete
Cost on training data: 0.138959724612
Accuracy on training data: 9926 / 10000
Cost on evaluation data: 0.732542315763
Accuracy on evaluation data: 9252 / 10000

Epoch 190 training complete
Cost on training data: 0.079096749378
Accuracy on training data: 9995 / 10000

Cost on evaluation data: 0.671977367162
Accuracy on evaluation data: 9334 / 10000

Epoch 191 training complete
Cost on training data: 0.070050185845
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.66800813494
Accuracy on evaluation data: 9322 / 10000

Epoch 192 training complete
Cost on training data: 0.0683026496346
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 0.666102841909
Accuracy on evaluation data: 9316 / 10000

Epoch 193 training complete
Cost on training data: 0.06695993351
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.672725360969
Accuracy on evaluation data: 9331 / 10000

Epoch 194 training complete
Cost on training data: 0.065847938853
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.662236004512
Accuracy on evaluation data: 9339 / 10000

Epoch 195 training complete
Cost on training data: 0.0662302829553
Accuracy on training data: 9996 / 10000
Cost on evaluation data: 0.659046906743
Accuracy on evaluation data: 9336 / 10000

Epoch 196 training complete
Cost on training data: 0.0661201080907
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.663055963734
Accuracy on evaluation data: 9336 / 10000

Epoch 197 training complete
Cost on training data: 0.0649735454429
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.671549033589
Accuracy on evaluation data: 9339 / 10000

Epoch 198 training complete
Cost on training data: 0.0645385254979
Accuracy on training data: 9997 / 10000

Cost on evaluation data: 0.658792055731
Accuracy on evaluation data: 9345 / 10000

Epoch 199 training complete
Cost on training data: 0.0645483882405
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.660645778144
Accuracy on evaluation data: 9331 / 10000

Epoch 200 training complete
Cost on training data: 0.0642385016916
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.657621085173
Accuracy on evaluation data: 9346 / 10000

Epoch 201 training complete
Cost on training data: 0.0636733039217
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.659859536933
Accuracy on evaluation data: 9337 / 10000

Epoch 202 training complete
Cost on training data: 0.0633646251723
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.655032722323
Accuracy on evaluation data: 9346 / 10000

Epoch 203 training complete
Cost on training data: 0.0634738459505
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.663755437702
Accuracy on evaluation data: 9344 / 10000

Epoch 204 training complete
Cost on training data: 0.0641025126796
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.661695388689
Accuracy on evaluation data: 9344 / 10000

Epoch 205 training complete
Cost on training data: 0.0630910150726
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.664975057118
Accuracy on evaluation data: 9336 / 10000

Epoch 206 training complete
Cost on training data: 0.062535256056
Accuracy on training data: 9998 / 10000

Cost on evaluation data: 0.657557110075
Accuracy on evaluation data: 9337 / 10000

Epoch 207 training complete
Cost on training data: 0.0622746549826
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.65789702535
Accuracy on evaluation data: 9342 / 10000

Epoch 208 training complete
Cost on training data: 0.0620040394863
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.656363597833
Accuracy on evaluation data: 9339 / 10000

Epoch 209 training complete
Cost on training data: 0.0616737036914
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.657573852185
Accuracy on evaluation data: 9331 / 10000

Epoch 210 training complete
Cost on training data: 0.0615276734577
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.652319500855
Accuracy on evaluation data: 9342 / 10000

Epoch 211 training complete
Cost on training data: 0.0621059282163
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.660436122169
Accuracy on evaluation data: 9339 / 10000

Epoch 212 training complete
Cost on training data: 0.0612456919955
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.656417357708
Accuracy on evaluation data: 9345 / 10000

Epoch 213 training complete
Cost on training data: 0.0612269313056
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.647161570113
Accuracy on evaluation data: 9349 / 10000

Epoch 214 training complete
Cost on training data: 0.0606766111004
Accuracy on training data: 9998 / 10000

Cost on evaluation data: 0.6545714673
Accuracy on evaluation data: 9349 / 10000

Epoch 215 training complete
Cost on training data: 0.0609713132575
Accuracy on training data: 9997 / 10000
Cost on evaluation data: 0.656613290322
Accuracy on evaluation data: 9339 / 10000

Epoch 216 training complete
Cost on training data: 0.0601214816279
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.651326975522
Accuracy on evaluation data: 9348 / 10000

Epoch 217 training complete
Cost on training data: 0.0601918748268
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.652071489793
Accuracy on evaluation data: 9341 / 10000

Epoch 218 training complete
Cost on training data: 0.0599261509177
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.648761825528
Accuracy on evaluation data: 9340 / 10000

Epoch 219 training complete
Cost on training data: 0.059738490076
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.646961632677
Accuracy on evaluation data: 9342 / 10000

Epoch 220 training complete
Cost on training data: 0.0654012483529
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.651219893956
Accuracy on evaluation data: 9342 / 10000

Epoch 221 training complete
Cost on training data: 0.0595287676249
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.648635710988
Accuracy on evaluation data: 9340 / 10000

Epoch 222 training complete
Cost on training data: 0.0591655494188
Accuracy on training data: 9999 / 10000

Cost on evaluation data: 0.646204876814
Accuracy on evaluation data: 9342 / 10000

Epoch 223 training complete
Cost on training data: 0.0586355825234
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.647961297891
Accuracy on evaluation data: 9343 / 10000

Epoch 224 training complete
Cost on training data: 0.0585658179187
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.646664509148
Accuracy on evaluation data: 9356 / 10000

Epoch 225 training complete
Cost on training data: 0.058508938061
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.646714328649
Accuracy on evaluation data: 9343 / 10000

Epoch 226 training complete
Cost on training data: 0.0586487432941
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.646442001659
Accuracy on evaluation data: 9340 / 10000

Epoch 227 training complete
Cost on training data: 0.059614998853
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.656954970463
Accuracy on evaluation data: 9329 / 10000

Epoch 228 training complete
Cost on training data: 0.0576839147443
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.643066012114
Accuracy on evaluation data: 9356 / 10000

Epoch 229 training complete
Cost on training data: 0.0577917421604
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.647562907505
Accuracy on evaluation data: 9348 / 10000

Epoch 230 training complete
Cost on training data: 0.0572011051845
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.637097585427
Accuracy on evaluation data: 9350 / 10000

Epoch 231 training complete
Cost on training data: 0.0580672493307
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.638992871996
Accuracy on evaluation data: 9354 / 10000

Epoch 232 training complete
Cost on training data: 0.0573308001341
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.63953324073
Accuracy on evaluation data: 9354 / 10000

Epoch 233 training complete
Cost on training data: 0.0568228443792
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.644563418465
Accuracy on evaluation data: 9363 / 10000

Epoch 234 training complete
Cost on training data: 0.0619370049344
Accuracy on training data: 9998 / 10000
Cost on evaluation data: 0.654400807684
Accuracy on evaluation data: 9334 / 10000

Epoch 235 training complete
Cost on training data: 0.0573058111021
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.645494916762
Accuracy on evaluation data: 9345 / 10000

Epoch 236 training complete
Cost on training data: 0.0566956914772
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.646790618405
Accuracy on evaluation data: 9348 / 10000

Epoch 237 training complete
Cost on training data: 0.0563267209846
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.638686617844
Accuracy on evaluation data: 9358 / 10000

Epoch 238 training complete
Cost on training data: 0.0558033069811
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.637246433866
Accuracy on evaluation data: 9355 / 10000

Epoch 239 training complete
Cost on training data: 0.0561797217411
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.639343168295
Accuracy on evaluation data: 9343 / 10000

Epoch 240 training complete
Cost on training data: 0.0559792784836
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.637395727114
Accuracy on evaluation data: 9345 / 10000

Epoch 241 training complete
Cost on training data: 0.0555896167778
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.636888596621
Accuracy on evaluation data: 9351 / 10000

Epoch 242 training complete
Cost on training data: 0.0554846456507
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.63762513183
Accuracy on evaluation data: 9347 / 10000

Epoch 243 training complete
Cost on training data: 0.0554224434574
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.633330490149
Accuracy on evaluation data: 9360 / 10000

Epoch 244 training complete
Cost on training data: 0.0558125131407
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.643414211117
Accuracy on evaluation data: 9336 / 10000

Epoch 245 training complete
Cost on training data: 0.0552757801412
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.634270892153
Accuracy on evaluation data: 9357 / 10000

Epoch 246 training complete
Cost on training data: 0.0549570857907
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.631276479821
Accuracy on evaluation data: 9364 / 10000

Epoch 247 training complete
Cost on training data: 0.0550727412383
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.634998904774
Accuracy on evaluation data: 9341 / 10000

Epoch 248 training complete
Cost on training data: 0.0549573529767
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.638033959665
Accuracy on evaluation data: 9348 / 10000

Epoch 249 training complete
Cost on training data: 0.0549877051147
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.639352088609
Accuracy on evaluation data: 9342 / 10000

Epoch 250 training complete
Cost on training data: 0.0548281397956
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.635950514505
Accuracy on evaluation data: 9350 / 10000

Epoch 251 training complete
Cost on training data: 0.0545597133909
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.630157609761
Accuracy on evaluation data: 9351 / 10000

Epoch 252 training complete
Cost on training data: 0.0539287806179
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.627978106508
Accuracy on evaluation data: 9345 / 10000

Epoch 253 training complete
Cost on training data: 0.0537820476061
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.629891389183
Accuracy on evaluation data: 9352 / 10000

Epoch 254 training complete
Cost on training data: 0.0539150749149
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.636313587234
Accuracy on evaluation data: 9341 / 10000

Epoch 255 training complete
Cost on training data: 0.0541591636383
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.6348263953
Accuracy on evaluation data: 9358 / 10000

Epoch 256 training complete
Cost on training data: 0.0537610242713
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.630222328223
Accuracy on evaluation data: 9345 / 10000

Epoch 257 training complete
Cost on training data: 0.0535169488164
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.631699533134
Accuracy on evaluation data: 9344 / 10000

Epoch 258 training complete
Cost on training data: 0.0531685669474
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.625392816321
Accuracy on evaluation data: 9355 / 10000

Epoch 259 training complete
Cost on training data: 0.0530519877024
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.624733802402
Accuracy on evaluation data: 9345 / 10000

Epoch 260 training complete
Cost on training data: 0.0527099158468
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.627816397633
Accuracy on evaluation data: 9352 / 10000

Epoch 261 training complete
Cost on training data: 0.0526971269523
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.62232425237
Accuracy on evaluation data: 9355 / 10000

Epoch 262 training complete
Cost on training data: 0.0531383317316
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.635676115048
Accuracy on evaluation data: 9354 / 10000

Epoch 263 training complete
Cost on training data: 0.0545793861537
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.636854561237
Accuracy on evaluation data: 9348 / 10000

Epoch 264 training complete
Cost on training data: 0.052874005029
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.62943957757
Accuracy on evaluation data: 9337 / 10000

Epoch 265 training complete
Cost on training data: 0.0524299165603
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.627563804301
Accuracy on evaluation data: 9351 / 10000

Epoch 266 training complete
Cost on training data: 0.0523559417251
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.621907164958
Accuracy on evaluation data: 9360 / 10000

Epoch 267 training complete
Cost on training data: 0.0530733415675
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.628788989129
Accuracy on evaluation data: 9351 / 10000

Epoch 268 training complete
Cost on training data: 0.0522939166164
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.625540732271
Accuracy on evaluation data: 9340 / 10000

Epoch 269 training complete
Cost on training data: 0.0518993966415
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.627715027908
Accuracy on evaluation data: 9351 / 10000

Epoch 270 training complete
Cost on training data: 0.0518577037518
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.629416352136
Accuracy on evaluation data: 9350 / 10000

Epoch 271 training complete
Cost on training data: 0.0519989484442
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.617552405933
Accuracy on evaluation data: 9348 / 10000

Epoch 272 training complete
Cost on training data: 0.0517950715145
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.623429938323
Accuracy on evaluation data: 9359 / 10000

Epoch 273 training complete
Cost on training data: 0.0518962019463
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.629347299554
Accuracy on evaluation data: 9349 / 10000

Epoch 274 training complete
Cost on training data: 0.0513852846362
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.616598146328
Accuracy on evaluation data: 9355 / 10000

Epoch 275 training complete
Cost on training data: 0.0510689990975
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.619437203491
Accuracy on evaluation data: 9363 / 10000

Epoch 276 training complete
Cost on training data: 0.0511845623614
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.62058465971
Accuracy on evaluation data: 9362 / 10000

Epoch 277 training complete
Cost on training data: 0.0516869260258
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.626045037571
Accuracy on evaluation data: 9344 / 10000

Epoch 278 training complete
Cost on training data: 0.0508328466923
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.62101768003
Accuracy on evaluation data: 9348 / 10000

Epoch 279 training complete
Cost on training data: 0.051582618956
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.618272020664
Accuracy on evaluation data: 9364 / 10000

Epoch 280 training complete
Cost on training data: 0.0510650476346
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.621295208311
Accuracy on evaluation data: 9361 / 10000

Epoch 281 training complete
Cost on training data: 0.0510809832544
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.617933494421
Accuracy on evaluation data: 9353 / 10000

Epoch 282 training complete
Cost on training data: 0.0509939101779
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.617464855359
Accuracy on evaluation data: 9352 / 10000

Epoch 283 training complete
Cost on training data: 0.0508971165721
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.615106540702
Accuracy on evaluation data: 9360 / 10000

Epoch 284 training complete
Cost on training data: 0.0505596477629
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.619908065811
Accuracy on evaluation data: 9353 / 10000

Epoch 285 training complete
Cost on training data: 0.0504631617134
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.616094775497
Accuracy on evaluation data: 9356 / 10000

Epoch 286 training complete
Cost on training data: 0.050317528562
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.615323249438
Accuracy on evaluation data: 9353 / 10000

Epoch 287 training complete
Cost on training data: 0.0503041263956
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.618260111172
Accuracy on evaluation data: 9352 / 10000

Epoch 288 training complete
Cost on training data: 0.0501104229682
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.617787655013
Accuracy on evaluation data: 9341 / 10000

Epoch 289 training complete
Cost on training data: 0.0496373912155
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.615821835336
Accuracy on evaluation data: 9361 / 10000

Epoch 290 training complete
Cost on training data: 0.0498720188254
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.61249783901
Accuracy on evaluation data: 9357 / 10000

Epoch 291 training complete
Cost on training data: 0.0502241531081
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.618282936603
Accuracy on evaluation data: 9350 / 10000

Epoch 292 training complete
Cost on training data: 0.0499301754989
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.61494970705
Accuracy on evaluation data: 9354 / 10000

Epoch 293 training complete
Cost on training data: 0.0497127236196
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.620279419838
Accuracy on evaluation data: 9357 / 10000

Epoch 294 training complete
Cost on training data: 0.0496713880196
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.610421391309
Accuracy on evaluation data: 9361 / 10000

Epoch 295 training complete
Cost on training data: 0.04975822177
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.614482917175
Accuracy on evaluation data: 9371 / 10000

Epoch 296 training complete
Cost on training data: 0.0492332109239
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.611719131975
Accuracy on evaluation data: 9361 / 10000

Epoch 297 training complete
Cost on training data: 0.0492976448381
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.610857074985
Accuracy on evaluation data: 9368 / 10000

Epoch 298 training complete
Cost on training data: 0.0491511290865
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.614241865303
Accuracy on evaluation data: 9365 / 10000

Epoch 299 training complete
Cost on training data: 0.0492957023596
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.615245992907
Accuracy on evaluation data: 9369 / 10000

Epoch 300 training complete
Cost on training data: 0.0491738947505
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.618576073636
Accuracy on evaluation data: 9342 / 10000

Epoch 301 training complete
Cost on training data: 0.0495193889174
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.615138353601
Accuracy on evaluation data: 9364 / 10000

Epoch 302 training complete
Cost on training data: 0.0498946663676
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.61777343938
Accuracy on evaluation data: 9351 / 10000

Epoch 303 training complete
Cost on training data: 0.0485649360727
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.613273958636
Accuracy on evaluation data: 9366 / 10000

Epoch 304 training complete
Cost on training data: 0.0486575417232
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.610688121733
Accuracy on evaluation data: 9351 / 10000

Epoch 305 training complete
Cost on training data: 0.103896909128
Accuracy on training data: 9951 / 10000
Cost on evaluation data: 0.689792049356
Accuracy on evaluation data: 9260 / 10000

Epoch 306 training complete
Cost on training data: 0.189236983114
Accuracy on training data: 9822 / 10000
Cost on evaluation data: 0.733559004734
Accuracy on evaluation data: 9210 / 10000

Epoch 307 training complete
Cost on training data: 0.176003451416
Accuracy on training data: 9842 / 10000
Cost on evaluation data: 0.684298597124
Accuracy on evaluation data: 9257 / 10000

Epoch 308 training complete
Cost on training data: 0.242133666064
Accuracy on training data: 9751 / 10000
Cost on evaluation data: 0.753241567095
Accuracy on evaluation data: 9197 / 10000

Epoch 309 training complete
Cost on training data: 0.15556942856
Accuracy on training data: 9883 / 10000
Cost on evaluation data: 0.67705769794
Accuracy on evaluation data: 9285 / 10000

Epoch 310 training complete
Cost on training data: 0.083219462035
Accuracy on training data: 9974 / 10000

Cost on evaluation data: 0.662112710604
Accuracy on evaluation data: 9318 / 10000

Epoch 311 training complete
Cost on training data: 0.0646261668217
Accuracy on training data: 9995 / 10000
Cost on evaluation data: 0.628140485262
Accuracy on evaluation data: 9344 / 10000

Epoch 312 training complete
Cost on training data: 0.0676193945944
Accuracy on training data: 9992 / 10000
Cost on evaluation data: 0.650710108265
Accuracy on evaluation data: 9330 / 10000

Epoch 313 training complete
Cost on training data: 0.0566843604312
Accuracy on training data: 9999 / 10000
Cost on evaluation data: 0.615916527393
Accuracy on evaluation data: 9353 / 10000

Epoch 314 training complete
Cost on training data: 0.0552431841851
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.62351890745
Accuracy on evaluation data: 9362 / 10000

Epoch 315 training complete
Cost on training data: 0.0536599714753
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.6159543968
Accuracy on evaluation data: 9375 / 10000

Epoch 316 training complete
Cost on training data: 0.053281740322
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.621726673609
Accuracy on evaluation data: 9375 / 10000

Epoch 317 training complete
Cost on training data: 0.0529596495138
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.625736907855
Accuracy on evaluation data: 9371 / 10000

Epoch 318 training complete
Cost on training data: 0.0522751866262
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.61899841324
Accuracy on evaluation data: 9367 / 10000

Epoch 319 training complete
Cost on training data: 0.0519666206346
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.621039145158
Accuracy on evaluation data: 9367 / 10000

Epoch 320 training complete
Cost on training data: 0.0519990243375
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.614360972111
Accuracy on evaluation data: 9370 / 10000

Epoch 321 training complete
Cost on training data: 0.0513215030903
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.618943211104
Accuracy on evaluation data: 9375 / 10000

Epoch 322 training complete
Cost on training data: 0.0510965619521
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.617597854426
Accuracy on evaluation data: 9364 / 10000

Epoch 323 training complete
Cost on training data: 0.0508594493202
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.621954257029
Accuracy on evaluation data: 9372 / 10000

Epoch 324 training complete
Cost on training data: 0.0505892516774
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.617264414572
Accuracy on evaluation data: 9367 / 10000

Epoch 325 training complete
Cost on training data: 0.0503365289872
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.615246392266
Accuracy on evaluation data: 9369 / 10000

Epoch 326 training complete
Cost on training data: 0.0502173612546
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.615812227891
Accuracy on evaluation data: 9363 / 10000

Epoch 327 training complete
Cost on training data: 0.0499005282244
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.616906857779
Accuracy on evaluation data: 9371 / 10000

Epoch 328 training complete
Cost on training data: 0.0497197865651
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.616347994868
Accuracy on evaluation data: 9369 / 10000

Epoch 329 training complete
Cost on training data: 0.0495942470946
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.611175102965
Accuracy on evaluation data: 9368 / 10000

Epoch 330 training complete
Cost on training data: 0.0494998452121
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.618878857524
Accuracy on evaluation data: 9377 / 10000

Epoch 331 training complete
Cost on training data: 0.0492822748266
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.612558484536
Accuracy on evaluation data: 9379 / 10000

Epoch 332 training complete
Cost on training data: 0.0492663593773
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.6164345836
Accuracy on evaluation data: 9369 / 10000

Epoch 333 training complete
Cost on training data: 0.049042046337
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.612722303489
Accuracy on evaluation data: 9365 / 10000

Epoch 334 training complete
Cost on training data: 0.0488225597555
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.615751536687
Accuracy on evaluation data: 9370 / 10000

Epoch 335 training complete
Cost on training data: 0.0485620688239
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.610204637045
Accuracy on evaluation data: 9366 / 10000

Epoch 336 training complete
Cost on training data: 0.048752328361
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.605900299035
Accuracy on evaluation data: 9375 / 10000

Epoch 337 training complete
Cost on training data: 0.0488182742629
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.610144738554
Accuracy on evaluation data: 9357 / 10000

Epoch 338 training complete
Cost on training data: 0.0483720517391
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.60916798968
Accuracy on evaluation data: 9364 / 10000

Epoch 339 training complete
Cost on training data: 0.0482189686254
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.60859802498
Accuracy on evaluation data: 9380 / 10000

Epoch 340 training complete
Cost on training data: 0.0482149754724
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.604508978899
Accuracy on evaluation data: 9374 / 10000

Epoch 341 training complete
Cost on training data: 0.0478575099253
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.609781867231
Accuracy on evaluation data: 9376 / 10000

Epoch 342 training complete
Cost on training data: 0.0477695919408
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.605955612157
Accuracy on evaluation data: 9384 / 10000

Epoch 343 training complete
Cost on training data: 0.0478303006773
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.606462399233
Accuracy on evaluation data: 9373 / 10000

Epoch 344 training complete
Cost on training data: 0.0474456782117
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.605621836411
Accuracy on evaluation data: 9370 / 10000

Epoch 345 training complete
Cost on training data: 0.0474661730048
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.604787944722
Accuracy on evaluation data: 9376 / 10000

Epoch 346 training complete
Cost on training data: 0.0475565150044
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.605571154714
Accuracy on evaluation data: 9377 / 10000

Epoch 347 training complete
Cost on training data: 0.0473245929024
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.607143360587
Accuracy on evaluation data: 9371 / 10000

Epoch 348 training complete
Cost on training data: 0.0470835937568
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.602241969214
Accuracy on evaluation data: 9367 / 10000

Epoch 349 training complete
Cost on training data: 0.0470238702706
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.600517326318
Accuracy on evaluation data: 9375 / 10000

Epoch 350 training complete
Cost on training data: 0.0468351715679
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.604465490752
Accuracy on evaluation data: 9374 / 10000

Epoch 351 training complete
Cost on training data: 0.0468849073061
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.603098152572
Accuracy on evaluation data: 9371 / 10000

Epoch 352 training complete
Cost on training data: 0.0466971447293
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.603623301922
Accuracy on evaluation data: 9368 / 10000

Epoch 353 training complete
Cost on training data: 0.0465469121108
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.598427234915
Accuracy on evaluation data: 9378 / 10000

Epoch 354 training complete
Cost on training data: 0.0465438104835
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.603293992015
Accuracy on evaluation data: 9378 / 10000

Epoch 355 training complete
Cost on training data: 0.0466771302385
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.599740708862
Accuracy on evaluation data: 9373 / 10000

Epoch 356 training complete
Cost on training data: 0.046414374733
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.59897597825
Accuracy on evaluation data: 9374 / 10000

Epoch 357 training complete
Cost on training data: 0.0462406040808
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.59856287903
Accuracy on evaluation data: 9364 / 10000

Epoch 358 training complete
Cost on training data: 0.0462247715094
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.601607409692
Accuracy on evaluation data: 9355 / 10000

Epoch 359 training complete
Cost on training data: 0.0460892516891
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.598983280752
Accuracy on evaluation data: 9368 / 10000

Epoch 360 training complete
Cost on training data: 0.0460240467315
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.597855545261
Accuracy on evaluation data: 9372 / 10000

Epoch 361 training complete
Cost on training data: 0.0462259484521
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.599092210441
Accuracy on evaluation data: 9379 / 10000

Epoch 362 training complete
Cost on training data: 0.0458814429361
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.598391774582
Accuracy on evaluation data: 9366 / 10000

Epoch 363 training complete
Cost on training data: 0.0458175307485
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.599210274869
Accuracy on evaluation data: 9363 / 10000

Epoch 364 training complete
Cost on training data: 0.0459021039475
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.598124112481
Accuracy on evaluation data: 9364 / 10000

Epoch 365 training complete
Cost on training data: 0.0457450459807
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.593446378539
Accuracy on evaluation data: 9379 / 10000

Epoch 366 training complete
Cost on training data: 0.0458704204609
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.59767133345
Accuracy on evaluation data: 9362 / 10000

Epoch 367 training complete
Cost on training data: 0.0456344730013
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.597225141906
Accuracy on evaluation data: 9370 / 10000

Epoch 368 training complete
Cost on training data: 0.0454112773098
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.596479213778
Accuracy on evaluation data: 9379 / 10000

Epoch 369 training complete
Cost on training data: 0.0454573276232
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.59083874942
Accuracy on evaluation data: 9377 / 10000

Epoch 370 training complete
Cost on training data: 0.0459937810817
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.599140394921
Accuracy on evaluation data: 9374 / 10000

Epoch 371 training complete
Cost on training data: 0.0454102503804
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.599538310723
Accuracy on evaluation data: 9365 / 10000

Epoch 372 training complete
Cost on training data: 0.0454393694212
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.591624428897
Accuracy on evaluation data: 9376 / 10000

Epoch 373 training complete
Cost on training data: 0.0452308847858
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.594854351217
Accuracy on evaluation data: 9371 / 10000

Epoch 374 training complete
Cost on training data: 0.0452347480076
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.595037480808
Accuracy on evaluation data: 9382 / 10000

Epoch 375 training complete
Cost on training data: 0.0450369069949
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.593689632396
Accuracy on evaluation data: 9387 / 10000

Epoch 376 training complete
Cost on training data: 0.0449474943217
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.595673913062
Accuracy on evaluation data: 9385 / 10000

Epoch 377 training complete
Cost on training data: 0.0449963348023
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.595262280088
Accuracy on evaluation data: 9375 / 10000

Epoch 378 training complete
Cost on training data: 0.0454076678712
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.592198361262
Accuracy on evaluation data: 9379 / 10000

Epoch 379 training complete
Cost on training data: 0.0446794258485
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.595827889317
Accuracy on evaluation data: 9380 / 10000

Epoch 380 training complete
Cost on training data: 0.0447971560074
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.59206359166
Accuracy on evaluation data: 9375 / 10000

Epoch 381 training complete
Cost on training data: 0.0451190789082
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.589457146474
Accuracy on evaluation data: 9365 / 10000

Epoch 382 training complete
Cost on training data: 0.0446402647453
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.589513522734
Accuracy on evaluation data: 9378 / 10000

Epoch 383 training complete
Cost on training data: 0.0446066827241
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.589257503156
Accuracy on evaluation data: 9373 / 10000

Epoch 384 training complete
Cost on training data: 0.0445583493798
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.591264483568
Accuracy on evaluation data: 9378 / 10000

Epoch 385 training complete
Cost on training data: 0.0445491543536
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.589482578527
Accuracy on evaluation data: 9378 / 10000

Epoch 386 training complete
Cost on training data: 0.0442739760434
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.591340698335
Accuracy on evaluation data: 9378 / 10000

Epoch 387 training complete
Cost on training data: 0.0445176386417
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.59066793811
Accuracy on evaluation data: 9374 / 10000

Epoch 388 training complete
Cost on training data: 0.0442299658551
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.591751415658
Accuracy on evaluation data: 9367 / 10000

Epoch 389 training complete
Cost on training data: 0.0442017798288
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.587729054469
Accuracy on evaluation data: 9379 / 10000

Epoch 390 training complete
Cost on training data: 0.0443077085102
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.589694086745
Accuracy on evaluation data: 9366 / 10000

Epoch 391 training complete
Cost on training data: 0.0442524839059
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.588783126849
Accuracy on evaluation data: 9380 / 10000

Epoch 392 training complete
Cost on training data: 0.0441950635241
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.590155600736
Accuracy on evaluation data: 9364 / 10000

Epoch 393 training complete
Cost on training data: 0.0445421909257
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.589830159012
Accuracy on evaluation data: 9372 / 10000

Epoch 394 training complete
Cost on training data: 0.0440813762138
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.591864368058
Accuracy on evaluation data: 9384 / 10000

Epoch 395 training complete
Cost on training data: 0.0439118868523
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.592822679388
Accuracy on evaluation data: 9378 / 10000

Epoch 396 training complete
Cost on training data: 0.0441793175861
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.586225627977
Accuracy on evaluation data: 9386 / 10000

Epoch 397 training complete
Cost on training data: 0.0440006841744
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.586619053155
Accuracy on evaluation data: 9378 / 10000

Epoch 398 training complete
Cost on training data: 0.0439196533815
Accuracy on training data: 10000 / 10000

Cost on evaluation data: 0.590926350879
Accuracy on evaluation data: 9375 / 10000

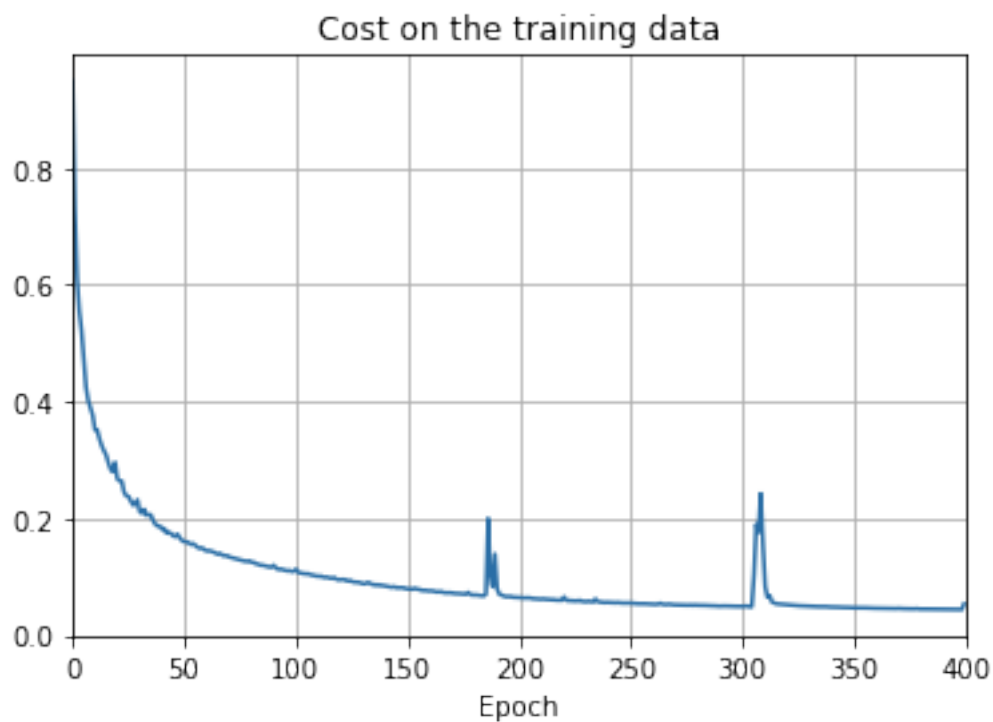
Epoch 399 training complete
Cost on training data: 0.0533728321953
Accuracy on training data: 10000 / 10000
Cost on evaluation data: 0.6173416156
Accuracy on evaluation data: 9342 / 10000

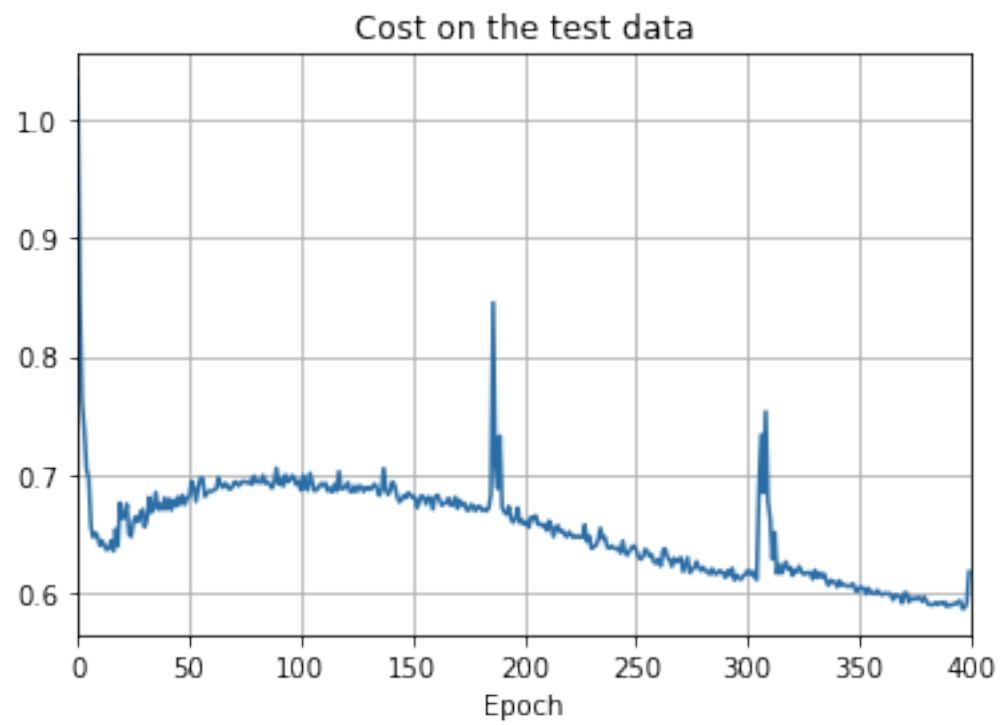
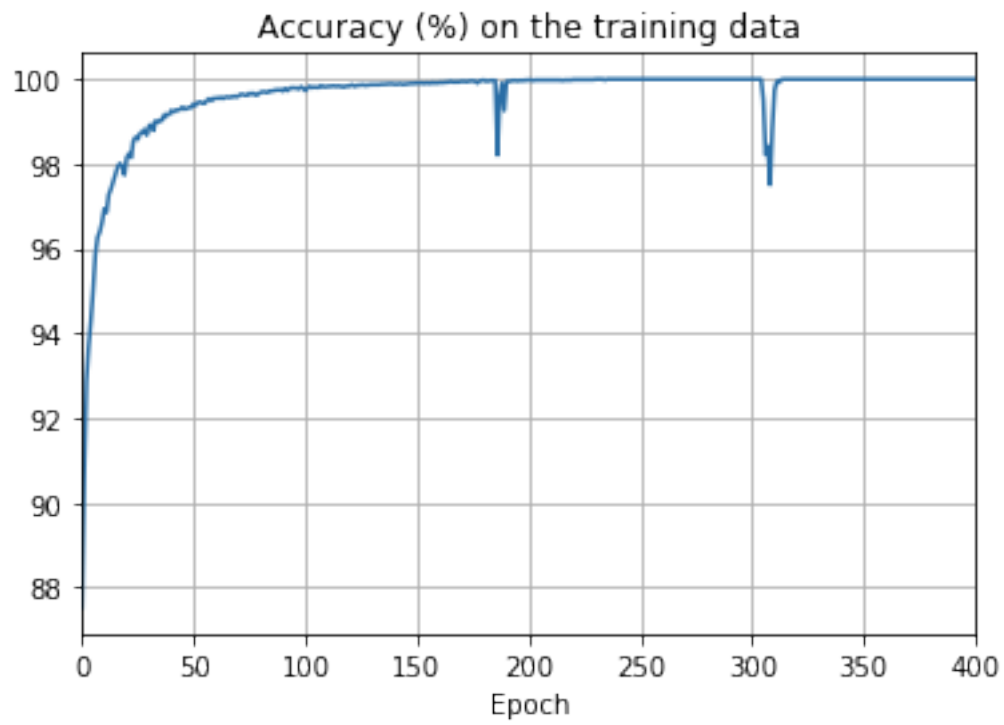
```
In [9]: print evaluation_cost, evaluation_accuracy, training_cost, training_accuracy
```

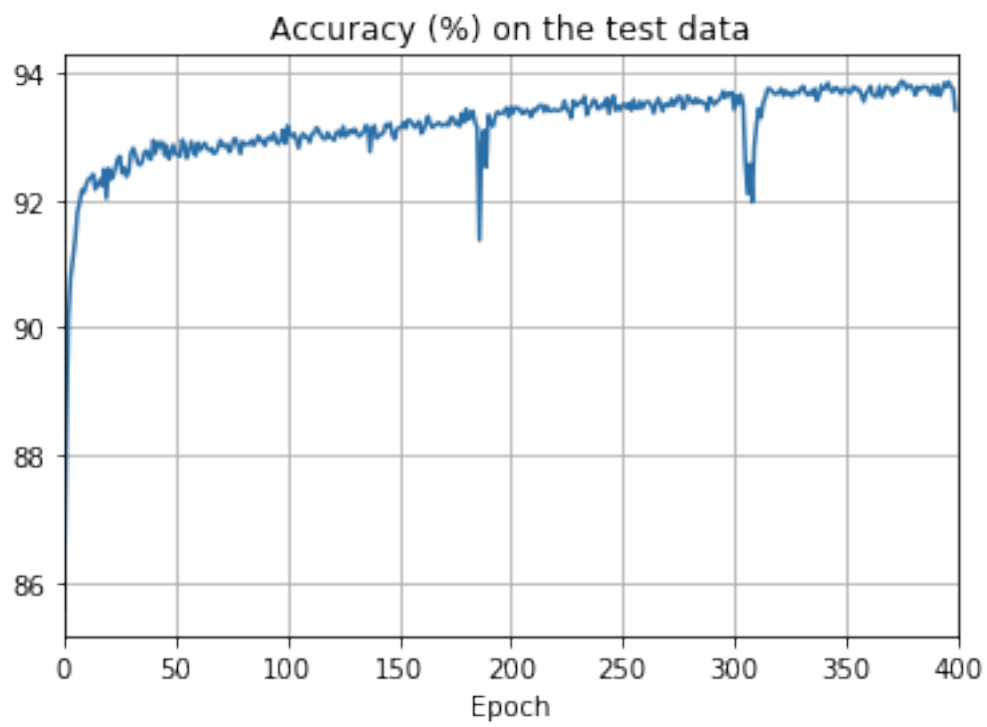
```
[1.0601689632680433, 0.91288121853150872, 0.84015182500425278] [8352, 8731, 8887] [0.9594571660, 0.9594571660, 0.9594571660]
```

```
In [11]: import plot_helper
```

```
In [12]: plot_helper.plot_training_cost(num_epochs=epochs, training_cost=training_cost, training_accuracy=training_accuracy)
plot_helper.plot_training_accuracy(num_epochs=epochs, training_accuracy=training_accuracy)
plot_helper.plot_test_cost(num_epochs=epochs, test_cost=evaluation_cost, test_cost_xm=evaluation_cost_xm)
plot_helper.plot_test_accuracy(num_epochs=epochs, test_accuracy=evaluation_accuracy, test_accuracy_xm=evaluation_accuracy_xm)
```







week_1_solution_11_12

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]: message = """
11. Repeat 8,9 for a lambda=5.0
"""

import network2

net2 = network2.Network([784, 30, 10], cost=network2.CrossEntropyCost)
net2.large_weight_initializer()

epochs = 400

evaluation_cost, evaluation_accuracy, training_cost, training_accuracy = net2.SGD(
    training_data[:10000],
    epochs,
    10,
    0.5,
    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: 4.50533142513
Accuracy on training data: 8786 / 10000
Cost on evaluation data: 4.5685993302

Accuracy on evaluation data: 8666 / 10000

Epoch 1 training complete

Cost on training data: 2.90126955131

Accuracy on training data: 9148 / 10000

Cost on evaluation data: 3.00780579926

Accuracy on evaluation data: 8949 / 10000

Epoch 2 training complete

Cost on training data: 1.93626355674

Accuracy on training data: 9385 / 10000

Cost on evaluation data: 2.05764989022

Accuracy on evaluation data: 9145 / 10000

Epoch 3 training complete

Cost on training data: 1.4138855738

Accuracy on training data: 9415 / 10000

Cost on evaluation data: 1.53211872842

Accuracy on evaluation data: 9173 / 10000

Epoch 4 training complete

Cost on training data: 1.06819567929

Accuracy on training data: 9486 / 10000

Cost on evaluation data: 1.19945578121

Accuracy on evaluation data: 9236 / 10000

Epoch 5 training complete

Cost on training data: 0.929695255527

Accuracy on training data: 9413 / 10000

Cost on evaluation data: 1.0524042615

Accuracy on evaluation data: 9190 / 10000

Epoch 6 training complete

Cost on training data: 0.742287090302

Accuracy on training data: 9586 / 10000

Cost on evaluation data: 0.88077803407

Accuracy on evaluation data: 9279 / 10000

Epoch 7 training complete

Cost on training data: 0.687121398447

Accuracy on training data: 9578 / 10000

Cost on evaluation data: 0.819990238083

Accuracy on evaluation data: 9316 / 10000

Epoch 8 training complete

Cost on training data: 0.629509689846

Accuracy on training data: 9581 / 10000

Cost on evaluation data: 0.767284314723

Accuracy on evaluation data: 9305 / 10000

Epoch 9 training complete

Cost on training data: 0.636271308991

Accuracy on training data: 9540 / 10000

Cost on evaluation data: 0.779310614033

Accuracy on evaluation data: 9251 / 10000

Epoch 10 training complete

Cost on training data: 0.58163391002

Accuracy on training data: 9647 / 10000

Cost on evaluation data: 0.721907869935

Accuracy on evaluation data: 9326 / 10000

Epoch 11 training complete

Cost on training data: 0.579968254929

Accuracy on training data: 9608 / 10000

Cost on evaluation data: 0.722471058639

Accuracy on evaluation data: 9324 / 10000

Epoch 12 training complete

Cost on training data: 0.585001827127

Accuracy on training data: 9609 / 10000

Cost on evaluation data: 0.730027041536

Accuracy on evaluation data: 9291 / 10000

Epoch 13 training complete

Cost on training data: 0.570873925251

Accuracy on training data: 9602 / 10000

Cost on evaluation data: 0.706075873334

Accuracy on evaluation data: 9323 / 10000

Epoch 14 training complete

Cost on training data: 0.57608144219

Accuracy on training data: 9609 / 10000

Cost on evaluation data: 0.726133284985

Accuracy on evaluation data: 9292 / 10000

Epoch 15 training complete

Cost on training data: 0.625570453469

Accuracy on training data: 9517 / 10000

Cost on evaluation data: 0.781869894307

Accuracy on evaluation data: 9180 / 10000

Epoch 16 training complete

Cost on training data: 0.539193645556

Accuracy on training data: 9672 / 10000

Cost on evaluation data: 0.692422746153

Accuracy on evaluation data: 9350 / 10000

Epoch 17 training complete

Cost on training data: 0.555420322284

Accuracy on training data: 9667 / 10000

Cost on evaluation data: 0.698315686709

Accuracy on evaluation data: 9357 / 10000

Epoch 18 training complete

Cost on training data: 0.577759817188

Accuracy on training data: 9648 / 10000

Cost on evaluation data: 0.715212621802

Accuracy on evaluation data: 9329 / 10000

Epoch 19 training complete

Cost on training data: 0.569483728696

Accuracy on training data: 9625 / 10000

Cost on evaluation data: 0.720398834262

Accuracy on evaluation data: 9311 / 10000

Epoch 20 training complete

Cost on training data: 0.538293202476

Accuracy on training data: 9679 / 10000

Cost on evaluation data: 0.683781719091

Accuracy on evaluation data: 9365 / 10000

Epoch 21 training complete

Cost on training data: 0.549614940782

Accuracy on training data: 9665 / 10000

Cost on evaluation data: 0.69600864972

Accuracy on evaluation data: 9371 / 10000

Epoch 22 training complete

Cost on training data: 0.563301162385

Accuracy on training data: 9620 / 10000

Cost on evaluation data: 0.701707491279

Accuracy on evaluation data: 9336 / 10000

Epoch 23 training complete

Cost on training data: 0.573344971577

Accuracy on training data: 9640 / 10000

Cost on evaluation data: 0.715586308488

Accuracy on evaluation data: 9350 / 10000

Epoch 24 training complete

Cost on training data: 0.527317984275

Accuracy on training data: 9700 / 10000

Cost on evaluation data: 0.677499428522

Accuracy on evaluation data: 9374 / 10000

Epoch 25 training complete

Cost on training data: 0.573101710292

Accuracy on training data: 9630 / 10000

Cost on evaluation data: 0.718784058188

Accuracy on evaluation data: 9352 / 10000

Epoch 26 training complete

Cost on training data: 0.539558297994

Accuracy on training data: 9713 / 10000

Cost on evaluation data: 0.690778487039

Accuracy on evaluation data: 9388 / 10000

Epoch 27 training complete

Cost on training data: 0.552963318372

Accuracy on training data: 9659 / 10000

Cost on evaluation data: 0.694078821111

Accuracy on evaluation data: 9331 / 10000

Epoch 28 training complete

Cost on training data: 0.533481832613

Accuracy on training data: 9677 / 10000

Cost on evaluation data: 0.675399250141

Accuracy on evaluation data: 9411 / 10000

Epoch 29 training complete

Cost on training data: 0.581220832668

Accuracy on training data: 9590 / 10000

Cost on evaluation data: 0.725629530736

Accuracy on evaluation data: 9318 / 10000

Epoch 30 training complete

Cost on training data: 0.538930874072

Accuracy on training data: 9659 / 10000

Cost on evaluation data: 0.686612634016

Accuracy on evaluation data: 9359 / 10000

Epoch 31 training complete

Cost on training data: 0.533817311826

Accuracy on training data: 9678 / 10000

Cost on evaluation data: 0.677327201588

Accuracy on evaluation data: 9392 / 10000

Epoch 32 training complete

Cost on training data: 0.560128250549

Accuracy on training data: 9636 / 10000

Cost on evaluation data: 0.71588966995

Accuracy on evaluation data: 9303 / 10000

Epoch 33 training complete

Cost on training data: 0.547847796566

Accuracy on training data: 9691 / 10000

Cost on evaluation data: 0.687959580557

Accuracy on evaluation data: 9370 / 10000

Epoch 34 training complete

Cost on training data: 0.566197131835

Accuracy on training data: 9623 / 10000

Cost on evaluation data: 0.716226586415

Accuracy on evaluation data: 9321 / 10000

Epoch 35 training complete

Cost on training data: 0.579056849862

Accuracy on training data: 9617 / 10000

Cost on evaluation data: 0.721735400907

Accuracy on evaluation data: 9304 / 10000

Epoch 36 training complete

Cost on training data: 0.539971080108

Accuracy on training data: 9681 / 10000

Cost on evaluation data: 0.67631234217

Accuracy on evaluation data: 9411 / 10000

Epoch 37 training complete

Cost on training data: 0.524441376596

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.672174175219

Accuracy on evaluation data: 9380 / 10000

Epoch 38 training complete

Cost on training data: 0.549346012223

Accuracy on training data: 9664 / 10000

Cost on evaluation data: 0.702069681743

Accuracy on evaluation data: 9344 / 10000

Epoch 39 training complete

Cost on training data: 0.531072134676

Accuracy on training data: 9718 / 10000

Cost on evaluation data: 0.674658042574

Accuracy on evaluation data: 9390 / 10000

Epoch 40 training complete

Cost on training data: 0.538841456216

Accuracy on training data: 9680 / 10000

Cost on evaluation data: 0.68877298465

Accuracy on evaluation data: 9367 / 10000

Epoch 41 training complete

Cost on training data: 0.564750714056

Accuracy on training data: 9662 / 10000

Cost on evaluation data: 0.707336144416

Accuracy on evaluation data: 9352 / 10000

Epoch 42 training complete

Cost on training data: 0.592567145421

Accuracy on training data: 9587 / 10000

Cost on evaluation data: 0.745357070166

Accuracy on evaluation data: 9287 / 10000

Epoch 43 training complete

Cost on training data: 0.540897179589

Accuracy on training data: 9694 / 10000

Cost on evaluation data: 0.67790188774

Accuracy on evaluation data: 9387 / 10000

Epoch 44 training complete

Cost on training data: 0.52404028392

Accuracy on training data: 9720 / 10000

Cost on evaluation data: 0.6697728755

Accuracy on evaluation data: 9401 / 10000

Epoch 45 training complete

Cost on training data: 0.579478836748

Accuracy on training data: 9636 / 10000

Cost on evaluation data: 0.715406262876

Accuracy on evaluation data: 9343 / 10000

Epoch 46 training complete

Cost on training data: 0.534824228056

Accuracy on training data: 9709 / 10000

Cost on evaluation data: 0.683230971463

Accuracy on evaluation data: 9401 / 10000

Epoch 47 training complete

Cost on training data: 0.581877847719

Accuracy on training data: 9615 / 10000

Cost on evaluation data: 0.729904389549

Accuracy on evaluation data: 9289 / 10000

Epoch 48 training complete

Cost on training data: 0.53880739459

Accuracy on training data: 9707 / 10000

Cost on evaluation data: 0.676602516024

Accuracy on evaluation data: 9392 / 10000

Epoch 49 training complete

Cost on training data: 0.540635562295

Accuracy on training data: 9708 / 10000

Cost on evaluation data: 0.685119639862

Accuracy on evaluation data: 9367 / 10000

Epoch 50 training complete

Cost on training data: 0.547076417121

Accuracy on training data: 9681 / 10000

Cost on evaluation data: 0.689050200465

Accuracy on evaluation data: 9364 / 10000

Epoch 51 training complete

Cost on training data: 0.540016300309

Accuracy on training data: 9686 / 10000

Cost on evaluation data: 0.684758496183

Accuracy on evaluation data: 9375 / 10000

Epoch 52 training complete

Cost on training data: 0.521183682757

Accuracy on training data: 9737 / 10000

Cost on evaluation data: 0.664244457777

Accuracy on evaluation data: 9394 / 10000

Epoch 53 training complete

Cost on training data: 0.574080521435

Accuracy on training data: 9615 / 10000

Cost on evaluation data: 0.72353242828

Accuracy on evaluation data: 9282 / 10000

Epoch 54 training complete

Cost on training data: 0.543765998565

Accuracy on training data: 9688 / 10000

Cost on evaluation data: 0.693186041467

Accuracy on evaluation data: 9373 / 10000

Epoch 55 training complete

Cost on training data: 0.513633702619

Accuracy on training data: 9724 / 10000

Cost on evaluation data: 0.660565975092

Accuracy on evaluation data: 9411 / 10000

Epoch 56 training complete

Cost on training data: 0.521465958031

Accuracy on training data: 9720 / 10000

Cost on evaluation data: 0.665055500138

Accuracy on evaluation data: 9396 / 10000

Epoch 57 training complete

Cost on training data: 0.533711425398

Accuracy on training data: 9703 / 10000

Cost on evaluation data: 0.678551995146

Accuracy on evaluation data: 9404 / 10000

Epoch 58 training complete

Cost on training data: 0.527682517779

Accuracy on training data: 9693 / 10000

Cost on evaluation data: 0.67088561635

Accuracy on evaluation data: 9414 / 10000

Epoch 59 training complete

Cost on training data: 0.547712749083

Accuracy on training data: 9670 / 10000

Cost on evaluation data: 0.695866513562

Accuracy on evaluation data: 9338 / 10000

Epoch 60 training complete

Cost on training data: 0.551239467587

Accuracy on training data: 9655 / 10000

Cost on evaluation data: 0.702199189253

Accuracy on evaluation data: 9352 / 10000

Epoch 61 training complete

Cost on training data: 0.527140776122

Accuracy on training data: 9710 / 10000

Cost on evaluation data: 0.668699614606

Accuracy on evaluation data: 9411 / 10000

Epoch 62 training complete

Cost on training data: 0.52878749913

Accuracy on training data: 9730 / 10000

Cost on evaluation data: 0.670351278068

Accuracy on evaluation data: 9391 / 10000

Epoch 63 training complete

Cost on training data: 0.577828003716

Accuracy on training data: 9592 / 10000

Cost on evaluation data: 0.71699587618

Accuracy on evaluation data: 9345 / 10000

Epoch 64 training complete

Cost on training data: 0.562033995541

Accuracy on training data: 9675 / 10000

Cost on evaluation data: 0.706603809323

Accuracy on evaluation data: 9358 / 10000

Epoch 65 training complete

Cost on training data: 0.513157558204

Accuracy on training data: 9721 / 10000

Cost on evaluation data: 0.657009149025

Accuracy on evaluation data: 9415 / 10000

Epoch 66 training complete

Cost on training data: 0.55412372229

Accuracy on training data: 9687 / 10000

Cost on evaluation data: 0.696103896126

Accuracy on evaluation data: 9369 / 10000

Epoch 67 training complete

Cost on training data: 0.554995619482

Accuracy on training data: 9666 / 10000

Cost on evaluation data: 0.701794258179

Accuracy on evaluation data: 9349 / 10000

Epoch 68 training complete

Cost on training data: 0.543136544182

Accuracy on training data: 9679 / 10000

Cost on evaluation data: 0.684181150475

Accuracy on evaluation data: 9370 / 10000

Epoch 69 training complete

Cost on training data: 0.526649370914

Accuracy on training data: 9703 / 10000

Cost on evaluation data: 0.659759618999

Accuracy on evaluation data: 9413 / 10000

Epoch 70 training complete

Cost on training data: 0.521218019378

Accuracy on training data: 9710 / 10000

Cost on evaluation data: 0.665934377191

Accuracy on evaluation data: 9391 / 10000

Epoch 71 training complete

Cost on training data: 0.536731613687

Accuracy on training data: 9698 / 10000

Cost on evaluation data: 0.67798406473

Accuracy on evaluation data: 9400 / 10000

Epoch 72 training complete

Cost on training data: 0.519956560717

Accuracy on training data: 9722 / 10000

Cost on evaluation data: 0.66136078514

Accuracy on evaluation data: 9428 / 10000

Epoch 73 training complete

Cost on training data: 0.531233691337

Accuracy on training data: 9703 / 10000

Cost on evaluation data: 0.669586678188

Accuracy on evaluation data: 9394 / 10000

Epoch 74 training complete

Cost on training data: 0.558395607245

Accuracy on training data: 9662 / 10000

Cost on evaluation data: 0.699326719366

Accuracy on evaluation data: 9351 / 10000

Epoch 75 training complete

Cost on training data: 0.532188092699

Accuracy on training data: 9707 / 10000

Cost on evaluation data: 0.669566998106

Accuracy on evaluation data: 9402 / 10000

Epoch 76 training complete

Cost on training data: 0.540276915178

Accuracy on training data: 9682 / 10000

Cost on evaluation data: 0.682335319818

Accuracy on evaluation data: 9357 / 10000

Epoch 77 training complete

Cost on training data: 0.518687760792

Accuracy on training data: 9727 / 10000

Cost on evaluation data: 0.661380693791

Accuracy on evaluation data: 9412 / 10000

Epoch 78 training complete

Cost on training data: 0.554640540471

Accuracy on training data: 9674 / 10000

Cost on evaluation data: 0.688204585235

Accuracy on evaluation data: 9373 / 10000

Epoch 79 training complete

Cost on training data: 0.546005477488

Accuracy on training data: 9671 / 10000

Cost on evaluation data: 0.695274588254

Accuracy on evaluation data: 9337 / 10000

Epoch 80 training complete

Cost on training data: 0.529769714626

Accuracy on training data: 9698 / 10000

Cost on evaluation data: 0.678349791942

Accuracy on evaluation data: 9369 / 10000

Epoch 81 training complete

Cost on training data: 0.577075603268

Accuracy on training data: 9607 / 10000

Cost on evaluation data: 0.724524255115

Accuracy on evaluation data: 9304 / 10000

Epoch 82 training complete

Cost on training data: 0.540536556968

Accuracy on training data: 9693 / 10000

Cost on evaluation data: 0.691788169416

Accuracy on evaluation data: 9363 / 10000

Epoch 83 training complete

Cost on training data: 0.568029741308

Accuracy on training data: 9628 / 10000

Cost on evaluation data: 0.717916971777

Accuracy on evaluation data: 9282 / 10000

Epoch 84 training complete

Cost on training data: 0.576104493497

Accuracy on training data: 9606 / 10000

Cost on evaluation data: 0.716506970933

Accuracy on evaluation data: 9308 / 10000

Epoch 85 training complete

Cost on training data: 0.565694034395

Accuracy on training data: 9642 / 10000

Cost on evaluation data: 0.713177751862

Accuracy on evaluation data: 9328 / 10000

Epoch 86 training complete

Cost on training data: 0.538156360269

Accuracy on training data: 9691 / 10000

Cost on evaluation data: 0.671137879746

Accuracy on evaluation data: 9415 / 10000

Epoch 87 training complete

Cost on training data: 0.529927444736

Accuracy on training data: 9700 / 10000

Cost on evaluation data: 0.66028408237

Accuracy on evaluation data: 9433 / 10000

Epoch 88 training complete

Cost on training data: 0.524839068826

Accuracy on training data: 9719 / 10000

Cost on evaluation data: 0.671638252121

Accuracy on evaluation data: 9403 / 10000

Epoch 89 training complete

Cost on training data: 0.559277104715

Accuracy on training data: 9646 / 10000

Cost on evaluation data: 0.699252601704

Accuracy on evaluation data: 9335 / 10000

Epoch 90 training complete

Cost on training data: 0.527455710856

Accuracy on training data: 9715 / 10000

Cost on evaluation data: 0.664875655526

Accuracy on evaluation data: 9403 / 10000

Epoch 91 training complete

Cost on training data: 0.561481499462

Accuracy on training data: 9647 / 10000

Cost on evaluation data: 0.706340037297

Accuracy on evaluation data: 9316 / 10000

Epoch 92 training complete

Cost on training data: 0.559194748219

Accuracy on training data: 9634 / 10000

Cost on evaluation data: 0.692741053582

Accuracy on evaluation data: 9347 / 10000

Epoch 93 training complete

Cost on training data: 0.569299340751

Accuracy on training data: 9630 / 10000

Cost on evaluation data: 0.71643674487

Accuracy on evaluation data: 9316 / 10000

Epoch 94 training complete

Cost on training data: 0.517082876511

Accuracy on training data: 9716 / 10000

Cost on evaluation data: 0.659805864426

Accuracy on evaluation data: 9416 / 10000

Epoch 95 training complete

Cost on training data: 0.510761265172

Accuracy on training data: 9731 / 10000

Cost on evaluation data: 0.647149378654

Accuracy on evaluation data: 9420 / 10000

Epoch 96 training complete

Cost on training data: 0.522391161855

Accuracy on training data: 9713 / 10000

Cost on evaluation data: 0.657076898273

Accuracy on evaluation data: 9439 / 10000

Epoch 97 training complete

Cost on training data: 0.590839586717

Accuracy on training data: 9572 / 10000

Cost on evaluation data: 0.734076835239

Accuracy on evaluation data: 9280 / 10000

Epoch 98 training complete

Cost on training data: 0.536773666954

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.677310271045

Accuracy on evaluation data: 9400 / 10000

Epoch 99 training complete

Cost on training data: 0.62416584191

Accuracy on training data: 9485 / 10000

Cost on evaluation data: 0.766226597268

Accuracy on evaluation data: 9193 / 10000

Epoch 100 training complete

Cost on training data: 0.513183539364

Accuracy on training data: 9735 / 10000

Cost on evaluation data: 0.652714807195

Accuracy on evaluation data: 9461 / 10000

Epoch 101 training complete

Cost on training data: 0.541487871225

Accuracy on training data: 9681 / 10000

Cost on evaluation data: 0.686691939564

Accuracy on evaluation data: 9376 / 10000

Epoch 102 training complete

Cost on training data: 0.530403630321

Accuracy on training data: 9697 / 10000

Cost on evaluation data: 0.677380231499

Accuracy on evaluation data: 9403 / 10000

Epoch 103 training complete

Cost on training data: 0.54867131973

Accuracy on training data: 9659 / 10000

Cost on evaluation data: 0.688429881979

Accuracy on evaluation data: 9347 / 10000

Epoch 104 training complete

Cost on training data: 0.526111627884

Accuracy on training data: 9718 / 10000

Cost on evaluation data: 0.668641023389

Accuracy on evaluation data: 9407 / 10000

Epoch 105 training complete

Cost on training data: 0.549241888031

Accuracy on training data: 9675 / 10000

Cost on evaluation data: 0.689279997413

Accuracy on evaluation data: 9351 / 10000

Epoch 106 training complete

Cost on training data: 0.54980457533

Accuracy on training data: 9662 / 10000

Cost on evaluation data: 0.6938739713

Accuracy on evaluation data: 9368 / 10000

Epoch 107 training complete

Cost on training data: 0.51073817537

Accuracy on training data: 9732 / 10000

Cost on evaluation data: 0.64918343692

Accuracy on evaluation data: 9456 / 10000

Epoch 108 training complete

Cost on training data: 0.55241496471

Accuracy on training data: 9680 / 10000

Cost on evaluation data: 0.695468447505

Accuracy on evaluation data: 9340 / 10000

Epoch 109 training complete

Cost on training data: 0.561357882843

Accuracy on training data: 9641 / 10000

Cost on evaluation data: 0.721452244581

Accuracy on evaluation data: 9298 / 10000

Epoch 110 training complete

Cost on training data: 0.558867454401

Accuracy on training data: 9656 / 10000

Cost on evaluation data: 0.698268418103

Accuracy on evaluation data: 9361 / 10000

Epoch 111 training complete

Cost on training data: 0.543920512287

Accuracy on training data: 9688 / 10000

Cost on evaluation data: 0.683864303254

Accuracy on evaluation data: 9379 / 10000

Epoch 112 training complete

Cost on training data: 0.516170085742

Accuracy on training data: 9738 / 10000

Cost on evaluation data: 0.650288226402

Accuracy on evaluation data: 9429 / 10000

Epoch 113 training complete

Cost on training data: 0.568978663819

Accuracy on training data: 9675 / 10000

Cost on evaluation data: 0.715718789906

Accuracy on evaluation data: 9336 / 10000

Epoch 114 training complete

Cost on training data: 0.530901894867

Accuracy on training data: 9717 / 10000

Cost on evaluation data: 0.674517344994

Accuracy on evaluation data: 9381 / 10000

Epoch 115 training complete

Cost on training data: 0.532264768792

Accuracy on training data: 9698 / 10000

Cost on evaluation data: 0.674269768827

Accuracy on evaluation data: 9373 / 10000

Epoch 116 training complete

Cost on training data: 0.5193568128

Accuracy on training data: 9718 / 10000

Cost on evaluation data: 0.660977191878

Accuracy on evaluation data: 9410 / 10000

Epoch 117 training complete

Cost on training data: 0.554854751468

Accuracy on training data: 9670 / 10000

Cost on evaluation data: 0.697154054053

Accuracy on evaluation data: 9364 / 10000

Epoch 118 training complete

Cost on training data: 0.589474080605

Accuracy on training data: 9606 / 10000

Cost on evaluation data: 0.743074977455

Accuracy on evaluation data: 9281 / 10000

Epoch 119 training complete

Cost on training data: 0.54179061588

Accuracy on training data: 9673 / 10000

Cost on evaluation data: 0.683470996746

Accuracy on evaluation data: 9405 / 10000

Epoch 120 training complete

Cost on training data: 0.52912865959

Accuracy on training data: 9721 / 10000

Cost on evaluation data: 0.674615551176

Accuracy on evaluation data: 9397 / 10000

Epoch 121 training complete

Cost on training data: 0.523176750562

Accuracy on training data: 9708 / 10000

Cost on evaluation data: 0.664307395408

Accuracy on evaluation data: 9419 / 10000

Epoch 122 training complete

Cost on training data: 0.529321009529

Accuracy on training data: 9692 / 10000

Cost on evaluation data: 0.67361110569

Accuracy on evaluation data: 9386 / 10000

Epoch 123 training complete

Cost on training data: 0.664075446483

Accuracy on training data: 9461 / 10000

Cost on evaluation data: 0.817424450836

Accuracy on evaluation data: 9128 / 10000

Epoch 124 training complete

Cost on training data: 0.565501671745

Accuracy on training data: 9642 / 10000

Cost on evaluation data: 0.713431143897

Accuracy on evaluation data: 9302 / 10000

Epoch 125 training complete

Cost on training data: 0.56444261798

Accuracy on training data: 9649 / 10000

Cost on evaluation data: 0.704936275024

Accuracy on evaluation data: 9343 / 10000

Epoch 126 training complete

Cost on training data: 0.549538111023

Accuracy on training data: 9682 / 10000

Cost on evaluation data: 0.69064385038

Accuracy on evaluation data: 9349 / 10000

Epoch 127 training complete

Cost on training data: 0.513905658096

Accuracy on training data: 9742 / 10000

Cost on evaluation data: 0.653308824721

Accuracy on evaluation data: 9444 / 10000

Epoch 128 training complete

Cost on training data: 0.52270379916

Accuracy on training data: 9704 / 10000

Cost on evaluation data: 0.66103008074

Accuracy on evaluation data: 9413 / 10000

Epoch 129 training complete

Cost on training data: 0.524519324668

Accuracy on training data: 9690 / 10000

Cost on evaluation data: 0.6773170728

Accuracy on evaluation data: 9411 / 10000

Epoch 130 training complete

Cost on training data: 0.549742451691

Accuracy on training data: 9682 / 10000

Cost on evaluation data: 0.687901953967

Accuracy on evaluation data: 9365 / 10000

Epoch 131 training complete

Cost on training data: 0.623365615753

Accuracy on training data: 9491 / 10000

Cost on evaluation data: 0.753389098264

Accuracy on evaluation data: 9224 / 10000

Epoch 132 training complete

Cost on training data: 0.603212956811

Accuracy on training data: 9574 / 10000

Cost on evaluation data: 0.736712551803

Accuracy on evaluation data: 9284 / 10000

Epoch 133 training complete

Cost on training data: 0.553089009343

Accuracy on training data: 9664 / 10000

Cost on evaluation data: 0.698334691264

Accuracy on evaluation data: 9371 / 10000

Epoch 134 training complete

Cost on training data: 0.516631813493

Accuracy on training data: 9748 / 10000

Cost on evaluation data: 0.658670923499

Accuracy on evaluation data: 9416 / 10000

Epoch 135 training complete

Cost on training data: 0.545518496494

Accuracy on training data: 9666 / 10000

Cost on evaluation data: 0.692277873675

Accuracy on evaluation data: 9351 / 10000

Epoch 136 training complete

Cost on training data: 0.560504984522

Accuracy on training data: 9658 / 10000

Cost on evaluation data: 0.707261717708

Accuracy on evaluation data: 9343 / 10000

Epoch 137 training complete

Cost on training data: 0.53289845052

Accuracy on training data: 9726 / 10000

Cost on evaluation data: 0.665784704081

Accuracy on evaluation data: 9428 / 10000

Epoch 138 training complete

Cost on training data: 0.548877703603

Accuracy on training data: 9666 / 10000

Cost on evaluation data: 0.6903331545

Accuracy on evaluation data: 9361 / 10000

Epoch 139 training complete

Cost on training data: 0.536311454612

Accuracy on training data: 9701 / 10000

Cost on evaluation data: 0.672192793208

Accuracy on evaluation data: 9408 / 10000

Epoch 140 training complete

Cost on training data: 0.531998800938

Accuracy on training data: 9696 / 10000

Cost on evaluation data: 0.67353853192

Accuracy on evaluation data: 9385 / 10000

Epoch 141 training complete

Cost on training data: 0.51566404471

Accuracy on training data: 9724 / 10000

Cost on evaluation data: 0.666792905613

Accuracy on evaluation data: 9404 / 10000

Epoch 142 training complete

Cost on training data: 0.514682717651

Accuracy on training data: 9724 / 10000

Cost on evaluation data: 0.650383825484

Accuracy on evaluation data: 9424 / 10000

Epoch 143 training complete

Cost on training data: 0.529402780392

Accuracy on training data: 9705 / 10000

Cost on evaluation data: 0.670317644038

Accuracy on evaluation data: 9420 / 10000

Epoch 144 training complete

Cost on training data: 0.552583583224

Accuracy on training data: 9675 / 10000

Cost on evaluation data: 0.702375436722

Accuracy on evaluation data: 9359 / 10000

Epoch 145 training complete

Cost on training data: 0.521491369583

Accuracy on training data: 9718 / 10000

Cost on evaluation data: 0.658926414015

Accuracy on evaluation data: 9404 / 10000

Epoch 146 training complete

Cost on training data: 0.526728322742

Accuracy on training data: 9696 / 10000

Cost on evaluation data: 0.663065158616

Accuracy on evaluation data: 9384 / 10000

Epoch 147 training complete

Cost on training data: 0.520613871645

Accuracy on training data: 9711 / 10000

Cost on evaluation data: 0.654950184453

Accuracy on evaluation data: 9417 / 10000

Epoch 148 training complete

Cost on training data: 0.528298872844

Accuracy on training data: 9705 / 10000

Cost on evaluation data: 0.669163613096

Accuracy on evaluation data: 9396 / 10000

Epoch 149 training complete

Cost on training data: 0.556921468112

Accuracy on training data: 9636 / 10000

Cost on evaluation data: 0.686906393295

Accuracy on evaluation data: 9359 / 10000

Epoch 150 training complete

Cost on training data: 0.562117095555

Accuracy on training data: 9615 / 10000

Cost on evaluation data: 0.709252383788

Accuracy on evaluation data: 9314 / 10000

Epoch 151 training complete

Cost on training data: 0.518223742488

Accuracy on training data: 9708 / 10000

Cost on evaluation data: 0.657086623677

Accuracy on evaluation data: 9408 / 10000

Epoch 152 training complete

Cost on training data: 0.610610609813

Accuracy on training data: 9513 / 10000

Cost on evaluation data: 0.741064432595

Accuracy on evaluation data: 9261 / 10000

Epoch 153 training complete

Cost on training data: 0.546156437373

Accuracy on training data: 9699 / 10000

Cost on evaluation data: 0.681889581014

Accuracy on evaluation data: 9404 / 10000

Epoch 154 training complete

Cost on training data: 0.531402358672

Accuracy on training data: 9688 / 10000

Cost on evaluation data: 0.673880579678

Accuracy on evaluation data: 9384 / 10000

Epoch 155 training complete

Cost on training data: 0.53860232778

Accuracy on training data: 9697 / 10000

Cost on evaluation data: 0.66968963796

Accuracy on evaluation data: 9401 / 10000

Epoch 156 training complete

Cost on training data: 0.540391012172

Accuracy on training data: 9681 / 10000

Cost on evaluation data: 0.674225698193

Accuracy on evaluation data: 9360 / 10000

Epoch 157 training complete

Cost on training data: 0.525982349779

Accuracy on training data: 9711 / 10000

Cost on evaluation data: 0.657490588463

Accuracy on evaluation data: 9440 / 10000

Epoch 158 training complete

Cost on training data: 0.526320984648

Accuracy on training data: 9712 / 10000

Cost on evaluation data: 0.659722194035

Accuracy on evaluation data: 9440 / 10000

Epoch 159 training complete

Cost on training data: 0.548425014584

Accuracy on training data: 9648 / 10000

Cost on evaluation data: 0.677713323095

Accuracy on evaluation data: 9391 / 10000

Epoch 160 training complete

Cost on training data: 0.56027599772

Accuracy on training data: 9634 / 10000

Cost on evaluation data: 0.704110256987

Accuracy on evaluation data: 9318 / 10000

Epoch 161 training complete

Cost on training data: 0.545526137363

Accuracy on training data: 9674 / 10000

Cost on evaluation data: 0.677129241876

Accuracy on evaluation data: 9380 / 10000

Epoch 162 training complete

Cost on training data: 0.610668864789

Accuracy on training data: 9500 / 10000

Cost on evaluation data: 0.767686468225

Accuracy on evaluation data: 9222 / 10000

Epoch 163 training complete

Cost on training data: 0.540969433712

Accuracy on training data: 9708 / 10000

Cost on evaluation data: 0.680248067212

Accuracy on evaluation data: 9422 / 10000

Epoch 164 training complete

Cost on training data: 0.544213875091

Accuracy on training data: 9682 / 10000

Cost on evaluation data: 0.669446213761

Accuracy on evaluation data: 9396 / 10000

Epoch 165 training complete

Cost on training data: 0.565603534515

Accuracy on training data: 9668 / 10000

Cost on evaluation data: 0.695269742396

Accuracy on evaluation data: 9361 / 10000

Epoch 166 training complete

Cost on training data: 0.528766602402

Accuracy on training data: 9708 / 10000

Cost on evaluation data: 0.66593272015

Accuracy on evaluation data: 9389 / 10000

Epoch 167 training complete

Cost on training data: 0.55225050129

Accuracy on training data: 9699 / 10000

Cost on evaluation data: 0.697481205791

Accuracy on evaluation data: 9386 / 10000

Epoch 168 training complete

Cost on training data: 0.548208942945

Accuracy on training data: 9680 / 10000

Cost on evaluation data: 0.68773693865

Accuracy on evaluation data: 9391 / 10000

Epoch 169 training complete

Cost on training data: 0.537234113232

Accuracy on training data: 9708 / 10000

Cost on evaluation data: 0.670050936597

Accuracy on evaluation data: 9398 / 10000

Epoch 170 training complete

Cost on training data: 0.558462068057

Accuracy on training data: 9641 / 10000

Cost on evaluation data: 0.697493692335

Accuracy on evaluation data: 9359 / 10000

Epoch 171 training complete

Cost on training data: 0.517286183235

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.646422538996

Accuracy on evaluation data: 9433 / 10000

Epoch 172 training complete

Cost on training data: 0.517207276404

Accuracy on training data: 9732 / 10000

Cost on evaluation data: 0.653284921384

Accuracy on evaluation data: 9436 / 10000

Epoch 173 training complete

Cost on training data: 0.529512484905

Accuracy on training data: 9701 / 10000

Cost on evaluation data: 0.671739018441

Accuracy on evaluation data: 9383 / 10000

Epoch 174 training complete

Cost on training data: 0.541201496638

Accuracy on training data: 9699 / 10000

Cost on evaluation data: 0.686280045853

Accuracy on evaluation data: 9395 / 10000

Epoch 175 training complete

Cost on training data: 0.53098763759

Accuracy on training data: 9724 / 10000

Cost on evaluation data: 0.655681519099

Accuracy on evaluation data: 9447 / 10000

Epoch 176 training complete

Cost on training data: 0.509916504315

Accuracy on training data: 9741 / 10000

Cost on evaluation data: 0.647579928043

Accuracy on evaluation data: 9433 / 10000

Epoch 177 training complete

Cost on training data: 0.542800321512

Accuracy on training data: 9681 / 10000

Cost on evaluation data: 0.681324037562

Accuracy on evaluation data: 9403 / 10000

Epoch 178 training complete

Cost on training data: 0.540620411391

Accuracy on training data: 9694 / 10000

Cost on evaluation data: 0.676718001107

Accuracy on evaluation data: 9386 / 10000

Epoch 179 training complete

Cost on training data: 0.53043155123

Accuracy on training data: 9721 / 10000

Cost on evaluation data: 0.663461560732

Accuracy on evaluation data: 9422 / 10000

Epoch 180 training complete

Cost on training data: 0.541670734347

Accuracy on training data: 9677 / 10000

Cost on evaluation data: 0.689442218837

Accuracy on evaluation data: 9360 / 10000

Epoch 181 training complete

Cost on training data: 0.552219535544

Accuracy on training data: 9662 / 10000

Cost on evaluation data: 0.695572630564

Accuracy on evaluation data: 9383 / 10000

Epoch 182 training complete

Cost on training data: 0.538603740522

Accuracy on training data: 9697 / 10000

Cost on evaluation data: 0.683832868675

Accuracy on evaluation data: 9377 / 10000

Epoch 183 training complete

Cost on training data: 0.529000718634

Accuracy on training data: 9722 / 10000

Cost on evaluation data: 0.664258277102

Accuracy on evaluation data: 9419 / 10000

Epoch 184 training complete

Cost on training data: 0.522498843995

Accuracy on training data: 9721 / 10000

Cost on evaluation data: 0.662932899141

Accuracy on evaluation data: 9420 / 10000

Epoch 185 training complete

Cost on training data: 0.538470897115

Accuracy on training data: 9694 / 10000

Cost on evaluation data: 0.667393615775

Accuracy on evaluation data: 9395 / 10000

Epoch 186 training complete

Cost on training data: 0.550643302223

Accuracy on training data: 9658 / 10000

Cost on evaluation data: 0.692758840779

Accuracy on evaluation data: 9338 / 10000

Epoch 187 training complete

Cost on training data: 0.559816766338

Accuracy on training data: 9681 / 10000

Cost on evaluation data: 0.686381311605

Accuracy on evaluation data: 9391 / 10000

Epoch 188 training complete

Cost on training data: 0.574246499569

Accuracy on training data: 9596 / 10000

Cost on evaluation data: 0.729237452512

Accuracy on evaluation data: 9284 / 10000

Epoch 189 training complete

Cost on training data: 0.53555960559

Accuracy on training data: 9695 / 10000

Cost on evaluation data: 0.668319451083

Accuracy on evaluation data: 9391 / 10000

Epoch 190 training complete

Cost on training data: 0.539039606295

Accuracy on training data: 9697 / 10000

Cost on evaluation data: 0.677822364595

Accuracy on evaluation data: 9368 / 10000

Epoch 191 training complete

Cost on training data: 0.592323930099

Accuracy on training data: 9593 / 10000

Cost on evaluation data: 0.731647515882

Accuracy on evaluation data: 9254 / 10000

Epoch 192 training complete

Cost on training data: 0.552801203741

Accuracy on training data: 9682 / 10000

Cost on evaluation data: 0.689546938075

Accuracy on evaluation data: 9403 / 10000

Epoch 193 training complete

Cost on training data: 0.551305376833

Accuracy on training data: 9673 / 10000

Cost on evaluation data: 0.688796258101

Accuracy on evaluation data: 9371 / 10000

Epoch 194 training complete

Cost on training data: 0.511144972144

Accuracy on training data: 9735 / 10000

Cost on evaluation data: 0.650754320055

Accuracy on evaluation data: 9449 / 10000

Epoch 195 training complete

Cost on training data: 0.509170766163

Accuracy on training data: 9745 / 10000

Cost on evaluation data: 0.641426897808

Accuracy on evaluation data: 9460 / 10000

Epoch 196 training complete

Cost on training data: 0.529435156139

Accuracy on training data: 9738 / 10000

Cost on evaluation data: 0.671216805554

Accuracy on evaluation data: 9397 / 10000

Epoch 197 training complete

Cost on training data: 0.551743428567

Accuracy on training data: 9655 / 10000

Cost on evaluation data: 0.695342799702

Accuracy on evaluation data: 9360 / 10000

Epoch 198 training complete

Cost on training data: 0.545207851729

Accuracy on training data: 9658 / 10000

Cost on evaluation data: 0.681273127787

Accuracy on evaluation data: 9377 / 10000

Epoch 199 training complete

Cost on training data: 0.515514592987

Accuracy on training data: 9739 / 10000

Cost on evaluation data: 0.654232577513

Accuracy on evaluation data: 9435 / 10000

Epoch 200 training complete

Cost on training data: 0.533105709961

Accuracy on training data: 9678 / 10000

Cost on evaluation data: 0.669438122505

Accuracy on evaluation data: 9392 / 10000

Epoch 201 training complete

Cost on training data: 0.536122581348

Accuracy on training data: 9685 / 10000

Cost on evaluation data: 0.665572494149

Accuracy on evaluation data: 9413 / 10000

Epoch 202 training complete

Cost on training data: 0.544668074692

Accuracy on training data: 9664 / 10000

Cost on evaluation data: 0.690248307509

Accuracy on evaluation data: 9365 / 10000

Epoch 203 training complete

Cost on training data: 0.529397626605

Accuracy on training data: 9719 / 10000

Cost on evaluation data: 0.666573643402

Accuracy on evaluation data: 9397 / 10000

Epoch 204 training complete

Cost on training data: 0.562767471

Accuracy on training data: 9666 / 10000

Cost on evaluation data: 0.697676774955

Accuracy on evaluation data: 9384 / 10000

Epoch 205 training complete

Cost on training data: 0.531921708777

Accuracy on training data: 9702 / 10000

Cost on evaluation data: 0.665961494193

Accuracy on evaluation data: 9401 / 10000

Epoch 206 training complete

Cost on training data: 0.519163115328

Accuracy on training data: 9720 / 10000

Cost on evaluation data: 0.651317494067

Accuracy on evaluation data: 9451 / 10000

Epoch 207 training complete

Cost on training data: 0.553881529206

Accuracy on training data: 9665 / 10000

Cost on evaluation data: 0.694774135907

Accuracy on evaluation data: 9387 / 10000

Epoch 208 training complete

Cost on training data: 0.52279406458

Accuracy on training data: 9736 / 10000

Cost on evaluation data: 0.663390058715

Accuracy on evaluation data: 9427 / 10000

Epoch 209 training complete

Cost on training data: 0.508375018638

Accuracy on training data: 9745 / 10000

Cost on evaluation data: 0.648618267845

Accuracy on evaluation data: 9423 / 10000

Epoch 210 training complete

Cost on training data: 0.516190412918

Accuracy on training data: 9729 / 10000

Cost on evaluation data: 0.657548730199

Accuracy on evaluation data: 9423 / 10000

Epoch 211 training complete

Cost on training data: 0.553142887996

Accuracy on training data: 9639 / 10000

Cost on evaluation data: 0.688041569771

Accuracy on evaluation data: 9365 / 10000

Epoch 212 training complete

Cost on training data: 0.518313146572

Accuracy on training data: 9711 / 10000

Cost on evaluation data: 0.654503709011

Accuracy on evaluation data: 9425 / 10000

Epoch 213 training complete

Cost on training data: 0.547021152509

Accuracy on training data: 9676 / 10000

Cost on evaluation data: 0.689131668842

Accuracy on evaluation data: 9362 / 10000

Epoch 214 training complete

Cost on training data: 0.524619489821

Accuracy on training data: 9733 / 10000

Cost on evaluation data: 0.656757824548

Accuracy on evaluation data: 9414 / 10000

Epoch 215 training complete

Cost on training data: 0.513570243435

Accuracy on training data: 9740 / 10000

Cost on evaluation data: 0.654503002089

Accuracy on evaluation data: 9444 / 10000

Epoch 216 training complete

Cost on training data: 0.524314448606

Accuracy on training data: 9725 / 10000

Cost on evaluation data: 0.65692664215

Accuracy on evaluation data: 9396 / 10000

Epoch 217 training complete

Cost on training data: 0.552477054885

Accuracy on training data: 9676 / 10000

Cost on evaluation data: 0.686038006069

Accuracy on evaluation data: 9396 / 10000

Epoch 218 training complete

Cost on training data: 0.515193220578

Accuracy on training data: 9739 / 10000

Cost on evaluation data: 0.653280943828

Accuracy on evaluation data: 9416 / 10000

Epoch 219 training complete

Cost on training data: 0.530049404527

Accuracy on training data: 9712 / 10000

Cost on evaluation data: 0.662667990282

Accuracy on evaluation data: 9397 / 10000

Epoch 220 training complete

Cost on training data: 0.523798237187

Accuracy on training data: 9712 / 10000

Cost on evaluation data: 0.660923777671

Accuracy on evaluation data: 9405 / 10000

Epoch 221 training complete

Cost on training data: 0.559997721754

Accuracy on training data: 9647 / 10000

Cost on evaluation data: 0.694785441044

Accuracy on evaluation data: 9379 / 10000

Epoch 222 training complete

Cost on training data: 0.563991049434

Accuracy on training data: 9647 / 10000

Cost on evaluation data: 0.706848212335

Accuracy on evaluation data: 9345 / 10000

Epoch 223 training complete

Cost on training data: 0.524695945253

Accuracy on training data: 9709 / 10000

Cost on evaluation data: 0.657638288764

Accuracy on evaluation data: 9407 / 10000

Epoch 224 training complete

Cost on training data: 0.576414051412

Accuracy on training data: 9589 / 10000

Cost on evaluation data: 0.712990074641

Accuracy on evaluation data: 9322 / 10000

Epoch 225 training complete

Cost on training data: 0.518787340113

Accuracy on training data: 9722 / 10000

Cost on evaluation data: 0.661899369379

Accuracy on evaluation data: 9408 / 10000

Epoch 226 training complete

Cost on training data: 0.515851289006

Accuracy on training data: 9714 / 10000

Cost on evaluation data: 0.655403935063

Accuracy on evaluation data: 9410 / 10000

Epoch 227 training complete

Cost on training data: 0.520691040996

Accuracy on training data: 9722 / 10000

Cost on evaluation data: 0.655348836325

Accuracy on evaluation data: 9412 / 10000

Epoch 228 training complete

Cost on training data: 0.58609768132

Accuracy on training data: 9620 / 10000

Cost on evaluation data: 0.746345335807

Accuracy on evaluation data: 9279 / 10000

Epoch 229 training complete

Cost on training data: 0.511580998613

Accuracy on training data: 9728 / 10000

Cost on evaluation data: 0.653114122064

Accuracy on evaluation data: 9422 / 10000

Epoch 230 training complete

Cost on training data: 0.531045167706

Accuracy on training data: 9693 / 10000

Cost on evaluation data: 0.669935960643

Accuracy on evaluation data: 9397 / 10000

Epoch 231 training complete

Cost on training data: 0.517953317897

Accuracy on training data: 9710 / 10000

Cost on evaluation data: 0.653880810804

Accuracy on evaluation data: 9436 / 10000

Epoch 232 training complete

Cost on training data: 0.571686029536

Accuracy on training data: 9662 / 10000

Cost on evaluation data: 0.710274304869

Accuracy on evaluation data: 9364 / 10000

Epoch 233 training complete

Cost on training data: 0.594008953184

Accuracy on training data: 9555 / 10000

Cost on evaluation data: 0.730984379692

Accuracy on evaluation data: 9260 / 10000

Epoch 234 training complete

Cost on training data: 0.53930075776

Accuracy on training data: 9713 / 10000

Cost on evaluation data: 0.678498883798

Accuracy on evaluation data: 9387 / 10000

Epoch 235 training complete

Cost on training data: 0.51869500939

Accuracy on training data: 9723 / 10000

Cost on evaluation data: 0.658436194645

Accuracy on evaluation data: 9401 / 10000

Epoch 236 training complete

Cost on training data: 0.51808960549

Accuracy on training data: 9736 / 10000

Cost on evaluation data: 0.648191292781

Accuracy on evaluation data: 9440 / 10000

Epoch 237 training complete

Cost on training data: 0.530906252325

Accuracy on training data: 9716 / 10000

Cost on evaluation data: 0.671015162458

Accuracy on evaluation data: 9401 / 10000

Epoch 238 training complete

Cost on training data: 0.514124202623

Accuracy on training data: 9728 / 10000

Cost on evaluation data: 0.642402411058

Accuracy on evaluation data: 9460 / 10000

Epoch 239 training complete

Cost on training data: 0.520077925117

Accuracy on training data: 9726 / 10000

Cost on evaluation data: 0.654643347371

Accuracy on evaluation data: 9417 / 10000

Epoch 240 training complete

Cost on training data: 0.518471848168

Accuracy on training data: 9721 / 10000

Cost on evaluation data: 0.655776326907

Accuracy on evaluation data: 9418 / 10000

Epoch 241 training complete

Cost on training data: 0.548690819238

Accuracy on training data: 9660 / 10000

Cost on evaluation data: 0.692494956836

Accuracy on evaluation data: 9376 / 10000

Epoch 242 training complete

Cost on training data: 0.547308950977

Accuracy on training data: 9702 / 10000

Cost on evaluation data: 0.702071273922

Accuracy on evaluation data: 9345 / 10000

Epoch 243 training complete

Cost on training data: 0.538097706472

Accuracy on training data: 9678 / 10000

Cost on evaluation data: 0.678856802675

Accuracy on evaluation data: 9384 / 10000

Epoch 244 training complete

Cost on training data: 0.528325869166

Accuracy on training data: 9692 / 10000

Cost on evaluation data: 0.677354246389

Accuracy on evaluation data: 9367 / 10000

Epoch 245 training complete

Cost on training data: 0.535429740273

Accuracy on training data: 9714 / 10000

Cost on evaluation data: 0.670670473879

Accuracy on evaluation data: 9409 / 10000

Epoch 246 training complete

Cost on training data: 0.52664089121

Accuracy on training data: 9709 / 10000

Cost on evaluation data: 0.665515769574

Accuracy on evaluation data: 9417 / 10000

Epoch 247 training complete

Cost on training data: 0.522187323437

Accuracy on training data: 9729 / 10000

Cost on evaluation data: 0.656291178697

Accuracy on evaluation data: 9431 / 10000

Epoch 248 training complete

Cost on training data: 0.543670295267

Accuracy on training data: 9693 / 10000

Cost on evaluation data: 0.691546519135

Accuracy on evaluation data: 9363 / 10000

Epoch 249 training complete

Cost on training data: 0.539809768477

Accuracy on training data: 9698 / 10000

Cost on evaluation data: 0.679089295852

Accuracy on evaluation data: 9381 / 10000

Epoch 250 training complete

Cost on training data: 0.551260837283

Accuracy on training data: 9685 / 10000

Cost on evaluation data: 0.690036516105

Accuracy on evaluation data: 9392 / 10000

Epoch 251 training complete

Cost on training data: 0.542729676199

Accuracy on training data: 9675 / 10000

Cost on evaluation data: 0.691472055445

Accuracy on evaluation data: 9366 / 10000

Epoch 252 training complete

Cost on training data: 0.545139283268

Accuracy on training data: 9665 / 10000

Cost on evaluation data: 0.686627456457

Accuracy on evaluation data: 9360 / 10000

Epoch 253 training complete

Cost on training data: 0.5150008738

Accuracy on training data: 9735 / 10000

Cost on evaluation data: 0.648252873528

Accuracy on evaluation data: 9453 / 10000

Epoch 254 training complete

Cost on training data: 0.56264754523

Accuracy on training data: 9635 / 10000

Cost on evaluation data: 0.703635093966

Accuracy on evaluation data: 9332 / 10000

Epoch 255 training complete

Cost on training data: 0.531317433603

Accuracy on training data: 9671 / 10000

Cost on evaluation data: 0.676539503761

Accuracy on evaluation data: 9366 / 10000

Epoch 256 training complete

Cost on training data: 0.54016181965

Accuracy on training data: 9715 / 10000

Cost on evaluation data: 0.681314793656

Accuracy on evaluation data: 9403 / 10000

Epoch 257 training complete

Cost on training data: 0.53784031324

Accuracy on training data: 9696 / 10000

Cost on evaluation data: 0.676152768161

Accuracy on evaluation data: 9389 / 10000

Epoch 258 training complete

Cost on training data: 0.570808810326

Accuracy on training data: 9625 / 10000

Cost on evaluation data: 0.714988498694

Accuracy on evaluation data: 9321 / 10000

Epoch 259 training complete

Cost on training data: 0.527363607049

Accuracy on training data: 9693 / 10000

Cost on evaluation data: 0.668603372171

Accuracy on evaluation data: 9392 / 10000

Epoch 260 training complete

Cost on training data: 0.512603612113

Accuracy on training data: 9746 / 10000

Cost on evaluation data: 0.65426507897

Accuracy on evaluation data: 9444 / 10000

Epoch 261 training complete

Cost on training data: 0.539989421827

Accuracy on training data: 9695 / 10000

Cost on evaluation data: 0.681997479732

Accuracy on evaluation data: 9403 / 10000

Epoch 262 training complete

Cost on training data: 0.550705256924

Accuracy on training data: 9690 / 10000

Cost on evaluation data: 0.694666961757

Accuracy on evaluation data: 9374 / 10000

Epoch 263 training complete

Cost on training data: 0.550902526081

Accuracy on training data: 9691 / 10000

Cost on evaluation data: 0.688645488669

Accuracy on evaluation data: 9364 / 10000

Epoch 264 training complete

Cost on training data: 0.539365840545

Accuracy on training data: 9710 / 10000

Cost on evaluation data: 0.67438707931

Accuracy on evaluation data: 9388 / 10000

Epoch 265 training complete

Cost on training data: 0.543841148289

Accuracy on training data: 9690 / 10000

Cost on evaluation data: 0.687112194949

Accuracy on evaluation data: 9359 / 10000

Epoch 266 training complete

Cost on training data: 0.508330194504

Accuracy on training data: 9733 / 10000

Cost on evaluation data: 0.646489168036

Accuracy on evaluation data: 9418 / 10000

Epoch 267 training complete

Cost on training data: 0.527516304239

Accuracy on training data: 9704 / 10000

Cost on evaluation data: 0.662028201591

Accuracy on evaluation data: 9409 / 10000

Epoch 268 training complete

Cost on training data: 0.517419030923

Accuracy on training data: 9735 / 10000

Cost on evaluation data: 0.664584189247

Accuracy on evaluation data: 9408 / 10000

Epoch 269 training complete

Cost on training data: 0.546320728388

Accuracy on training data: 9691 / 10000

Cost on evaluation data: 0.687149542889

Accuracy on evaluation data: 9374 / 10000

Epoch 270 training complete

Cost on training data: 0.509173044564

Accuracy on training data: 9731 / 10000

Cost on evaluation data: 0.646730016658

Accuracy on evaluation data: 9423 / 10000

Epoch 271 training complete

Cost on training data: 0.551083129343

Accuracy on training data: 9665 / 10000

Cost on evaluation data: 0.697098602782

Accuracy on evaluation data: 9374 / 10000

Epoch 272 training complete

Cost on training data: 0.516142390538

Accuracy on training data: 9740 / 10000

Cost on evaluation data: 0.658186717417

Accuracy on evaluation data: 9418 / 10000

Epoch 273 training complete

Cost on training data: 0.527571261959

Accuracy on training data: 9688 / 10000

Cost on evaluation data: 0.674005494266

Accuracy on evaluation data: 9374 / 10000

Epoch 274 training complete

Cost on training data: 0.559012973362

Accuracy on training data: 9646 / 10000

Cost on evaluation data: 0.70599619441

Accuracy on evaluation data: 9338 / 10000

Epoch 275 training complete

Cost on training data: 0.560692967133

Accuracy on training data: 9671 / 10000

Cost on evaluation data: 0.706163006949

Accuracy on evaluation data: 9364 / 10000

Epoch 276 training complete

Cost on training data: 0.540876027505

Accuracy on training data: 9685 / 10000

Cost on evaluation data: 0.679192577396

Accuracy on evaluation data: 9364 / 10000

Epoch 277 training complete

Cost on training data: 0.507121648921

Accuracy on training data: 9759 / 10000

Cost on evaluation data: 0.639385468092

Accuracy on evaluation data: 9458 / 10000

Epoch 278 training complete

Cost on training data: 0.525448383224

Accuracy on training data: 9714 / 10000

Cost on evaluation data: 0.670958800275

Accuracy on evaluation data: 9402 / 10000

Epoch 279 training complete

Cost on training data: 0.524470265952

Accuracy on training data: 9713 / 10000

Cost on evaluation data: 0.65083752897

Accuracy on evaluation data: 9434 / 10000

Epoch 280 training complete

Cost on training data: 0.520566912246

Accuracy on training data: 9723 / 10000

Cost on evaluation data: 0.666937106923

Accuracy on evaluation data: 9424 / 10000

Epoch 281 training complete

Cost on training data: 0.577048467324

Accuracy on training data: 9619 / 10000

Cost on evaluation data: 0.726866152399

Accuracy on evaluation data: 9278 / 10000

Epoch 282 training complete

Cost on training data: 0.557217607082

Accuracy on training data: 9676 / 10000

Cost on evaluation data: 0.700466750717

Accuracy on evaluation data: 9356 / 10000

Epoch 283 training complete

Cost on training data: 0.544129371459

Accuracy on training data: 9685 / 10000

Cost on evaluation data: 0.683769925706

Accuracy on evaluation data: 9386 / 10000

Epoch 284 training complete

Cost on training data: 0.530340676237

Accuracy on training data: 9696 / 10000

Cost on evaluation data: 0.668439058457

Accuracy on evaluation data: 9406 / 10000

Epoch 285 training complete

Cost on training data: 0.54482004902

Accuracy on training data: 9690 / 10000

Cost on evaluation data: 0.688080311584

Accuracy on evaluation data: 9369 / 10000

Epoch 286 training complete

Cost on training data: 0.519372837039

Accuracy on training data: 9722 / 10000

Cost on evaluation data: 0.663175343582

Accuracy on evaluation data: 9423 / 10000

Epoch 287 training complete

Cost on training data: 0.522993650229

Accuracy on training data: 9733 / 10000

Cost on evaluation data: 0.660880689241

Accuracy on evaluation data: 9409 / 10000

Epoch 288 training complete

Cost on training data: 0.520607379686

Accuracy on training data: 9702 / 10000

Cost on evaluation data: 0.66484653419

Accuracy on evaluation data: 9402 / 10000

Epoch 289 training complete

Cost on training data: 0.538840559719

Accuracy on training data: 9702 / 10000

Cost on evaluation data: 0.693846529094

Accuracy on evaluation data: 9371 / 10000

Epoch 290 training complete

Cost on training data: 0.533502419761

Accuracy on training data: 9700 / 10000

Cost on evaluation data: 0.677287223208

Accuracy on evaluation data: 9372 / 10000

Epoch 291 training complete

Cost on training data: 0.533681535822

Accuracy on training data: 9699 / 10000

Cost on evaluation data: 0.672500354378

Accuracy on evaluation data: 9406 / 10000

Epoch 292 training complete

Cost on training data: 0.517529811064

Accuracy on training data: 9727 / 10000

Cost on evaluation data: 0.658205749314

Accuracy on evaluation data: 9432 / 10000

Epoch 293 training complete

Cost on training data: 0.544181507796

Accuracy on training data: 9673 / 10000

Cost on evaluation data: 0.691547730449

Accuracy on evaluation data: 9347 / 10000

Epoch 294 training complete

Cost on training data: 0.535471230785

Accuracy on training data: 9711 / 10000

Cost on evaluation data: 0.682284996948

Accuracy on evaluation data: 9405 / 10000

Epoch 295 training complete

Cost on training data: 0.510963463947

Accuracy on training data: 9743 / 10000

Cost on evaluation data: 0.652875195882

Accuracy on evaluation data: 9438 / 10000

Epoch 296 training complete

Cost on training data: 0.610292451978

Accuracy on training data: 9549 / 10000

Cost on evaluation data: 0.760652148584

Accuracy on evaluation data: 9249 / 10000

Epoch 297 training complete

Cost on training data: 0.583744884028

Accuracy on training data: 9618 / 10000

Cost on evaluation data: 0.741741052294

Accuracy on evaluation data: 9256 / 10000

Epoch 298 training complete

Cost on training data: 0.527883805023

Accuracy on training data: 9733 / 10000

Cost on evaluation data: 0.659642770389

Accuracy on evaluation data: 9404 / 10000

Epoch 299 training complete

Cost on training data: 0.544869952265

Accuracy on training data: 9699 / 10000

Cost on evaluation data: 0.687173955752

Accuracy on evaluation data: 9386 / 10000

Epoch 300 training complete

Cost on training data: 0.522217907328

Accuracy on training data: 9701 / 10000

Cost on evaluation data: 0.659927214393

Accuracy on evaluation data: 9399 / 10000

Epoch 301 training complete

Cost on training data: 0.525980207776

Accuracy on training data: 9742 / 10000

Cost on evaluation data: 0.667934029465

Accuracy on evaluation data: 9416 / 10000

Epoch 302 training complete

Cost on training data: 0.532947506905

Accuracy on training data: 9693 / 10000

Cost on evaluation data: 0.671475465704

Accuracy on evaluation data: 9393 / 10000

Epoch 303 training complete

Cost on training data: 0.54305264381

Accuracy on training data: 9705 / 10000

Cost on evaluation data: 0.67999179167

Accuracy on evaluation data: 9376 / 10000

Epoch 304 training complete

Cost on training data: 0.537107645058

Accuracy on training data: 9690 / 10000

Cost on evaluation data: 0.67947981279

Accuracy on evaluation data: 9353 / 10000

Epoch 305 training complete

Cost on training data: 0.615593291678

Accuracy on training data: 9489 / 10000

Cost on evaluation data: 0.761547353471

Accuracy on evaluation data: 9206 / 10000

Epoch 306 training complete

Cost on training data: 0.507261466042

Accuracy on training data: 9738 / 10000

Cost on evaluation data: 0.639987486802

Accuracy on evaluation data: 9456 / 10000

Epoch 307 training complete

Cost on training data: 0.529894401448

Accuracy on training data: 9712 / 10000

Cost on evaluation data: 0.670625464385

Accuracy on evaluation data: 9396 / 10000

Epoch 308 training complete

Cost on training data: 0.534010927002

Accuracy on training data: 9699 / 10000

Cost on evaluation data: 0.673849067704

Accuracy on evaluation data: 9414 / 10000

Epoch 309 training complete

Cost on training data: 0.526892616345

Accuracy on training data: 9705 / 10000

Cost on evaluation data: 0.672413643989

Accuracy on evaluation data: 9403 / 10000

Epoch 310 training complete

Cost on training data: 0.555983362104

Accuracy on training data: 9645 / 10000

Cost on evaluation data: 0.691518614034

Accuracy on evaluation data: 9369 / 10000

Epoch 311 training complete

Cost on training data: 0.546886236309

Accuracy on training data: 9688 / 10000

Cost on evaluation data: 0.693151853469

Accuracy on evaluation data: 9384 / 10000

Epoch 312 training complete

Cost on training data: 0.503694906396

Accuracy on training data: 9733 / 10000

Cost on evaluation data: 0.641487176609

Accuracy on evaluation data: 9440 / 10000

Epoch 313 training complete

Cost on training data: 0.51976478907

Accuracy on training data: 9760 / 10000

Cost on evaluation data: 0.654495947618

Accuracy on evaluation data: 9436 / 10000

Epoch 314 training complete

Cost on training data: 0.522780413734

Accuracy on training data: 9726 / 10000

Cost on evaluation data: 0.657445206764

Accuracy on evaluation data: 9431 / 10000

Epoch 315 training complete

Cost on training data: 0.50504925434

Accuracy on training data: 9749 / 10000

Cost on evaluation data: 0.642542655447

Accuracy on evaluation data: 9436 / 10000

Epoch 316 training complete

Cost on training data: 0.514615353118

Accuracy on training data: 9709 / 10000

Cost on evaluation data: 0.649713774625

Accuracy on evaluation data: 9426 / 10000

Epoch 317 training complete

Cost on training data: 0.524268454626

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.664827343743

Accuracy on evaluation data: 9398 / 10000

Epoch 318 training complete

Cost on training data: 0.613737100002

Accuracy on training data: 9515 / 10000

Cost on evaluation data: 0.770399930622

Accuracy on evaluation data: 9207 / 10000

Epoch 319 training complete

Cost on training data: 0.545431571197

Accuracy on training data: 9720 / 10000

Cost on evaluation data: 0.675125302251

Accuracy on evaluation data: 9408 / 10000

Epoch 320 training complete

Cost on training data: 0.535956442694

Accuracy on training data: 9694 / 10000

Cost on evaluation data: 0.68326138114

Accuracy on evaluation data: 9381 / 10000

Epoch 321 training complete

Cost on training data: 0.518913587964

Accuracy on training data: 9722 / 10000

Cost on evaluation data: 0.673610237324

Accuracy on evaluation data: 9406 / 10000

Epoch 322 training complete

Cost on training data: 0.524699935655

Accuracy on training data: 9744 / 10000

Cost on evaluation data: 0.677260574768

Accuracy on evaluation data: 9396 / 10000

Epoch 323 training complete

Cost on training data: 0.51196438843

Accuracy on training data: 9755 / 10000

Cost on evaluation data: 0.65002443948

Accuracy on evaluation data: 9439 / 10000

Epoch 324 training complete

Cost on training data: 0.564237621721

Accuracy on training data: 9653 / 10000

Cost on evaluation data: 0.699917645894

Accuracy on evaluation data: 9362 / 10000

Epoch 325 training complete

Cost on training data: 0.547845054476

Accuracy on training data: 9649 / 10000

Cost on evaluation data: 0.700202765143

Accuracy on evaluation data: 9338 / 10000

Epoch 326 training complete

Cost on training data: 0.519974109351

Accuracy on training data: 9709 / 10000

Cost on evaluation data: 0.660751162967

Accuracy on evaluation data: 9410 / 10000

Epoch 327 training complete

Cost on training data: 0.530256944315

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.672017569762

Accuracy on evaluation data: 9413 / 10000

Epoch 328 training complete

Cost on training data: 0.531283489941

Accuracy on training data: 9688 / 10000

Cost on evaluation data: 0.681535478481

Accuracy on evaluation data: 9369 / 10000

Epoch 329 training complete

Cost on training data: 0.537079008674

Accuracy on training data: 9675 / 10000

Cost on evaluation data: 0.670828339067

Accuracy on evaluation data: 9388 / 10000

Epoch 330 training complete

Cost on training data: 0.536267598516

Accuracy on training data: 9708 / 10000

Cost on evaluation data: 0.684606356461

Accuracy on evaluation data: 9388 / 10000

Epoch 331 training complete

Cost on training data: 0.533772261091

Accuracy on training data: 9701 / 10000

Cost on evaluation data: 0.677488928862

Accuracy on evaluation data: 9365 / 10000

Epoch 332 training complete

Cost on training data: 0.519619480215

Accuracy on training data: 9718 / 10000

Cost on evaluation data: 0.662740213743

Accuracy on evaluation data: 9416 / 10000

Epoch 333 training complete

Cost on training data: 0.520821020987

Accuracy on training data: 9705 / 10000

Cost on evaluation data: 0.666279864357

Accuracy on evaluation data: 9418 / 10000

Epoch 334 training complete

Cost on training data: 0.524361617568

Accuracy on training data: 9747 / 10000

Cost on evaluation data: 0.66926690049

Accuracy on evaluation data: 9398 / 10000

Epoch 335 training complete

Cost on training data: 0.534615691822

Accuracy on training data: 9700 / 10000

Cost on evaluation data: 0.680820412345

Accuracy on evaluation data: 9381 / 10000

Epoch 336 training complete

Cost on training data: 0.52718334008

Accuracy on training data: 9716 / 10000

Cost on evaluation data: 0.664659640084

Accuracy on evaluation data: 9415 / 10000

Epoch 337 training complete

Cost on training data: 0.560630667933

Accuracy on training data: 9632 / 10000

Cost on evaluation data: 0.707984920743

Accuracy on evaluation data: 9321 / 10000

Epoch 338 training complete

Cost on training data: 0.547989682506

Accuracy on training data: 9674 / 10000

Cost on evaluation data: 0.683275321518

Accuracy on evaluation data: 9375 / 10000

Epoch 339 training complete

Cost on training data: 0.559032402937

Accuracy on training data: 9643 / 10000

Cost on evaluation data: 0.699236107838

Accuracy on evaluation data: 9352 / 10000

Epoch 340 training complete

Cost on training data: 0.49888102221

Accuracy on training data: 9771 / 10000

Cost on evaluation data: 0.637189432027

Accuracy on evaluation data: 9455 / 10000

Epoch 341 training complete

Cost on training data: 0.549678782909

Accuracy on training data: 9670 / 10000

Cost on evaluation data: 0.691323828968

Accuracy on evaluation data: 9372 / 10000

Epoch 342 training complete

Cost on training data: 0.553705960432

Accuracy on training data: 9642 / 10000

Cost on evaluation data: 0.706677094921

Accuracy on evaluation data: 9333 / 10000

Epoch 343 training complete

Cost on training data: 0.509576224879

Accuracy on training data: 9738 / 10000

Cost on evaluation data: 0.656323074918

Accuracy on evaluation data: 9436 / 10000

Epoch 344 training complete

Cost on training data: 0.516656568764

Accuracy on training data: 9718 / 10000

Cost on evaluation data: 0.658969907985

Accuracy on evaluation data: 9407 / 10000

Epoch 345 training complete

Cost on training data: 0.537938695197

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.667705414401

Accuracy on evaluation data: 9412 / 10000

Epoch 346 training complete

Cost on training data: 0.512773617661

Accuracy on training data: 9711 / 10000

Cost on evaluation data: 0.654394689672

Accuracy on evaluation data: 9418 / 10000

Epoch 347 training complete

Cost on training data: 0.605999922625

Accuracy on training data: 9494 / 10000

Cost on evaluation data: 0.760480405497

Accuracy on evaluation data: 9198 / 10000

Epoch 348 training complete

Cost on training data: 0.528236803079

Accuracy on training data: 9704 / 10000

Cost on evaluation data: 0.665268694499

Accuracy on evaluation data: 9399 / 10000

Epoch 349 training complete

Cost on training data: 0.506143482739

Accuracy on training data: 9750 / 10000

Cost on evaluation data: 0.648486010295

Accuracy on evaluation data: 9429 / 10000

Epoch 350 training complete

Cost on training data: 0.512702610271

Accuracy on training data: 9749 / 10000

Cost on evaluation data: 0.657608750044

Accuracy on evaluation data: 9421 / 10000

Epoch 351 training complete

Cost on training data: 0.525089906643

Accuracy on training data: 9717 / 10000

Cost on evaluation data: 0.674358602085

Accuracy on evaluation data: 9385 / 10000

Epoch 352 training complete

Cost on training data: 0.513390572431

Accuracy on training data: 9729 / 10000

Cost on evaluation data: 0.649047058503

Accuracy on evaluation data: 9419 / 10000

Epoch 353 training complete

Cost on training data: 0.519765031303

Accuracy on training data: 9724 / 10000

Cost on evaluation data: 0.66470216395

Accuracy on evaluation data: 9410 / 10000

Epoch 354 training complete

Cost on training data: 0.540436274848

Accuracy on training data: 9669 / 10000

Cost on evaluation data: 0.683656313623

Accuracy on evaluation data: 9380 / 10000

Epoch 355 training complete

Cost on training data: 0.531164227365

Accuracy on training data: 9711 / 10000

Cost on evaluation data: 0.67125664762

Accuracy on evaluation data: 9401 / 10000

Epoch 356 training complete

Cost on training data: 0.523187064696

Accuracy on training data: 9717 / 10000

Cost on evaluation data: 0.662039071309

Accuracy on evaluation data: 9422 / 10000

Epoch 357 training complete

Cost on training data: 0.534935267957

Accuracy on training data: 9689 / 10000

Cost on evaluation data: 0.680600787445

Accuracy on evaluation data: 9382 / 10000

Epoch 358 training complete

Cost on training data: 0.52468925814

Accuracy on training data: 9727 / 10000

Cost on evaluation data: 0.663027874193

Accuracy on evaluation data: 9429 / 10000

Epoch 359 training complete

Cost on training data: 0.564618556691

Accuracy on training data: 9611 / 10000

Cost on evaluation data: 0.707680952079

Accuracy on evaluation data: 9320 / 10000

Epoch 360 training complete

Cost on training data: 0.511366128652

Accuracy on training data: 9729 / 10000

Cost on evaluation data: 0.646481933932

Accuracy on evaluation data: 9434 / 10000

Epoch 361 training complete

Cost on training data: 0.524577523298

Accuracy on training data: 9717 / 10000

Cost on evaluation data: 0.654437722704

Accuracy on evaluation data: 9427 / 10000

Epoch 362 training complete

Cost on training data: 0.511869510638

Accuracy on training data: 9732 / 10000

Cost on evaluation data: 0.642318067737

Accuracy on evaluation data: 9433 / 10000

Epoch 363 training complete

Cost on training data: 0.528871333278

Accuracy on training data: 9724 / 10000

Cost on evaluation data: 0.664900488329

Accuracy on evaluation data: 9443 / 10000

Epoch 364 training complete

Cost on training data: 0.539910165611

Accuracy on training data: 9685 / 10000

Cost on evaluation data: 0.688304271815

Accuracy on evaluation data: 9367 / 10000

Epoch 365 training complete

Cost on training data: 0.524053431449

Accuracy on training data: 9687 / 10000

Cost on evaluation data: 0.666717737668

Accuracy on evaluation data: 9364 / 10000

Epoch 366 training complete

Cost on training data: 0.523860938919

Accuracy on training data: 9699 / 10000

Cost on evaluation data: 0.67267879301

Accuracy on evaluation data: 9372 / 10000

Epoch 367 training complete

Cost on training data: 0.504958416397

Accuracy on training data: 9752 / 10000

Cost on evaluation data: 0.644542756753

Accuracy on evaluation data: 9434 / 10000

Epoch 368 training complete

Cost on training data: 0.52202508117

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.660675204638

Accuracy on evaluation data: 9403 / 10000

Epoch 369 training complete

Cost on training data: 0.537056058483

Accuracy on training data: 9711 / 10000

Cost on evaluation data: 0.671892541347

Accuracy on evaluation data: 9399 / 10000

Epoch 370 training complete

Cost on training data: 0.559798538158

Accuracy on training data: 9657 / 10000

Cost on evaluation data: 0.704096699785

Accuracy on evaluation data: 9342 / 10000

Epoch 371 training complete

Cost on training data: 0.545649600742

Accuracy on training data: 9691 / 10000

Cost on evaluation data: 0.694556406326

Accuracy on evaluation data: 9354 / 10000

Epoch 372 training complete

Cost on training data: 0.540593989036

Accuracy on training data: 9676 / 10000

Cost on evaluation data: 0.689242034655

Accuracy on evaluation data: 9348 / 10000

Epoch 373 training complete

Cost on training data: 0.542145249451

Accuracy on training data: 9707 / 10000

Cost on evaluation data: 0.688359817946

Accuracy on evaluation data: 9401 / 10000

Epoch 374 training complete

Cost on training data: 0.6144671284

Accuracy on training data: 9521 / 10000

Cost on evaluation data: 0.753385216347

Accuracy on evaluation data: 9237 / 10000

Epoch 375 training complete

Cost on training data: 0.526059502523

Accuracy on training data: 9728 / 10000

Cost on evaluation data: 0.664409595906

Accuracy on evaluation data: 9445 / 10000

Epoch 376 training complete

Cost on training data: 0.528182958362

Accuracy on training data: 9706 / 10000

Cost on evaluation data: 0.68311486266

Accuracy on evaluation data: 9353 / 10000

Epoch 377 training complete

Cost on training data: 0.520091587363

Accuracy on training data: 9710 / 10000

Cost on evaluation data: 0.661884585285

Accuracy on evaluation data: 9414 / 10000

Epoch 378 training complete

Cost on training data: 0.524152307096

Accuracy on training data: 9722 / 10000

Cost on evaluation data: 0.665744837987

Accuracy on evaluation data: 9400 / 10000

Epoch 379 training complete

Cost on training data: 0.525630828879

Accuracy on training data: 9729 / 10000

Cost on evaluation data: 0.66670209474

Accuracy on evaluation data: 9416 / 10000

Epoch 380 training complete

Cost on training data: 0.549678239321

Accuracy on training data: 9689 / 10000

Cost on evaluation data: 0.695966873208

Accuracy on evaluation data: 9371 / 10000

Epoch 381 training complete

Cost on training data: 0.52666868922

Accuracy on training data: 9718 / 10000

Cost on evaluation data: 0.667298808231

Accuracy on evaluation data: 9396 / 10000

Epoch 382 training complete

Cost on training data: 0.529151664082

Accuracy on training data: 9704 / 10000

Cost on evaluation data: 0.666179091723

Accuracy on evaluation data: 9416 / 10000

Epoch 383 training complete

Cost on training data: 0.521333736225

Accuracy on training data: 9732 / 10000

Cost on evaluation data: 0.661117940713

Accuracy on evaluation data: 9406 / 10000

Epoch 384 training complete

Cost on training data: 0.541517995965

Accuracy on training data: 9665 / 10000

Cost on evaluation data: 0.684298341678

Accuracy on evaluation data: 9353 / 10000

Epoch 385 training complete

Cost on training data: 0.530555011457

Accuracy on training data: 9695 / 10000

Cost on evaluation data: 0.681473331455

Accuracy on evaluation data: 9380 / 10000

Epoch 386 training complete

Cost on training data: 0.553137626613

Accuracy on training data: 9682 / 10000

Cost on evaluation data: 0.688934624098

Accuracy on evaluation data: 9390 / 10000

Epoch 387 training complete

Cost on training data: 0.56045094688

Accuracy on training data: 9656 / 10000

Cost on evaluation data: 0.70662332104

Accuracy on evaluation data: 9336 / 10000

Epoch 388 training complete

Cost on training data: 0.595556784249

Accuracy on training data: 9629 / 10000

Cost on evaluation data: 0.744136615804

Accuracy on evaluation data: 9314 / 10000

Epoch 389 training complete

Cost on training data: 0.566123226847

Accuracy on training data: 9631 / 10000

Cost on evaluation data: 0.720176963045

Accuracy on evaluation data: 9332 / 10000

Epoch 390 training complete

Cost on training data: 0.521311874562

Accuracy on training data: 9749 / 10000

Cost on evaluation data: 0.672939679983

Accuracy on evaluation data: 9394 / 10000

Epoch 391 training complete

Cost on training data: 0.568309850812

Accuracy on training data: 9630 / 10000

Cost on evaluation data: 0.707758241752

Accuracy on evaluation data: 9330 / 10000

Epoch 392 training complete

Cost on training data: 0.532054314948

Accuracy on training data: 9695 / 10000

Cost on evaluation data: 0.675565983353

Accuracy on evaluation data: 9371 / 10000

Epoch 393 training complete

Cost on training data: 0.535527287977

Accuracy on training data: 9710 / 10000

Cost on evaluation data: 0.680372158497

Accuracy on evaluation data: 9386 / 10000

Epoch 394 training complete

Cost on training data: 0.530359108192

Accuracy on training data: 9700 / 10000

Cost on evaluation data: 0.675971313968

Accuracy on evaluation data: 9385 / 10000

Epoch 395 training complete

Cost on training data: 0.553715496307

Accuracy on training data: 9652 / 10000

Cost on evaluation data: 0.710823523643

Accuracy on evaluation data: 9316 / 10000

Epoch 396 training complete

Cost on training data: 0.539900767368

Accuracy on training data: 9657 / 10000

Cost on evaluation data: 0.6854107159

Accuracy on evaluation data: 9374 / 10000

Epoch 397 training complete

Cost on training data: 0.569822549901

Accuracy on training data: 9633 / 10000

Cost on evaluation data: 0.705971913703

Accuracy on evaluation data: 9334 / 10000

Epoch 398 training complete

Cost on training data: 0.563681215698

Accuracy on training data: 9655 / 10000

Cost on evaluation data: 0.707730090582

Accuracy on evaluation data: 9353 / 10000

Epoch 399 training complete

Cost on training data: 0.531255832331

Accuracy on training data: 9723 / 10000

Cost on evaluation data: 0.66876006733

Accuracy on evaluation data: 9421 / 10000

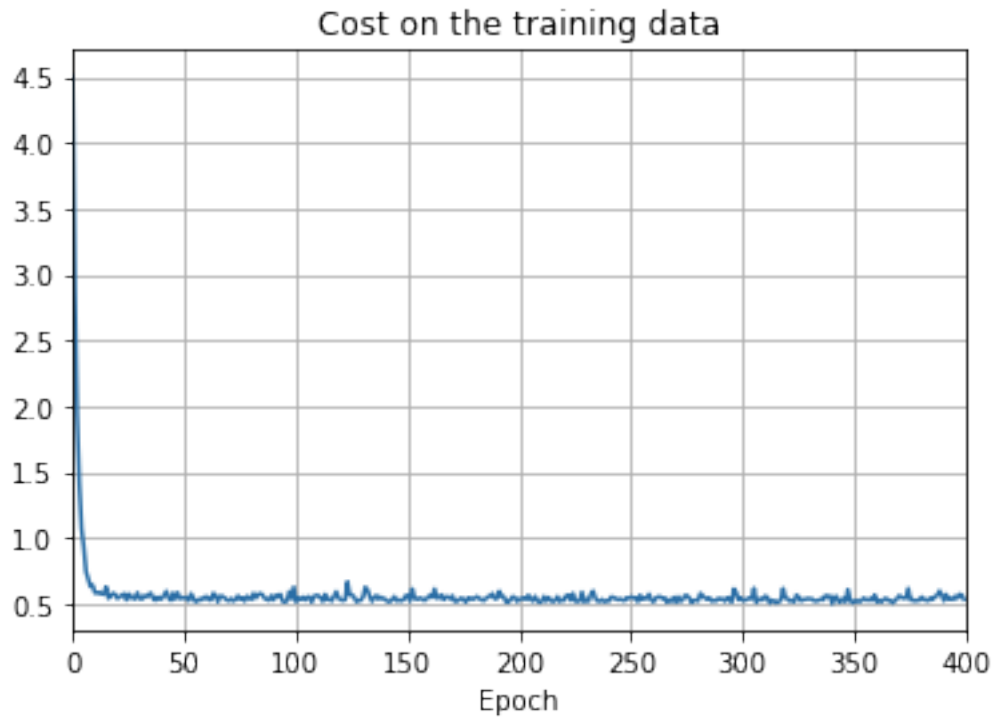
```
In [18]: import plot_helper
```

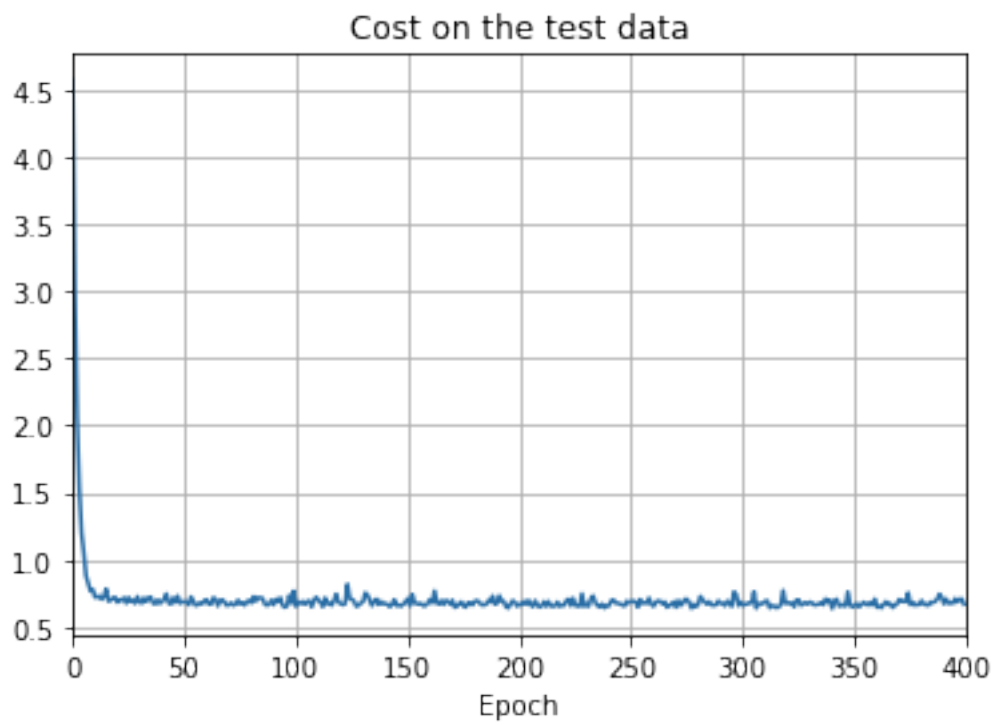
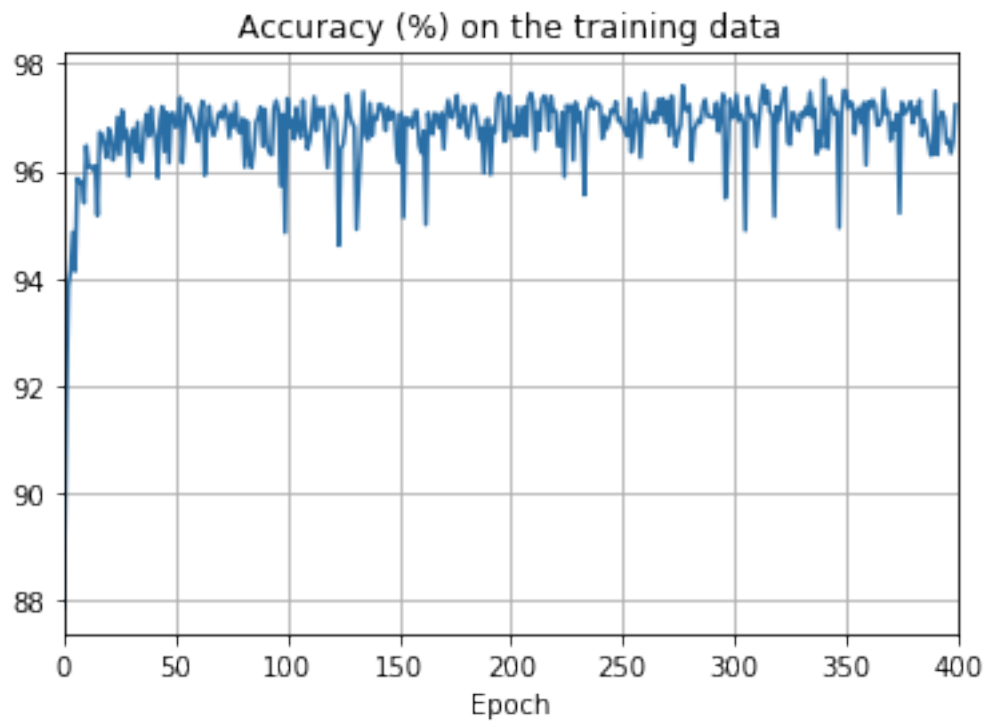
```
In [21]: plot_helper.plot_training_cost(num_epochs=epochs, training_cost=training_cost, trainin
```

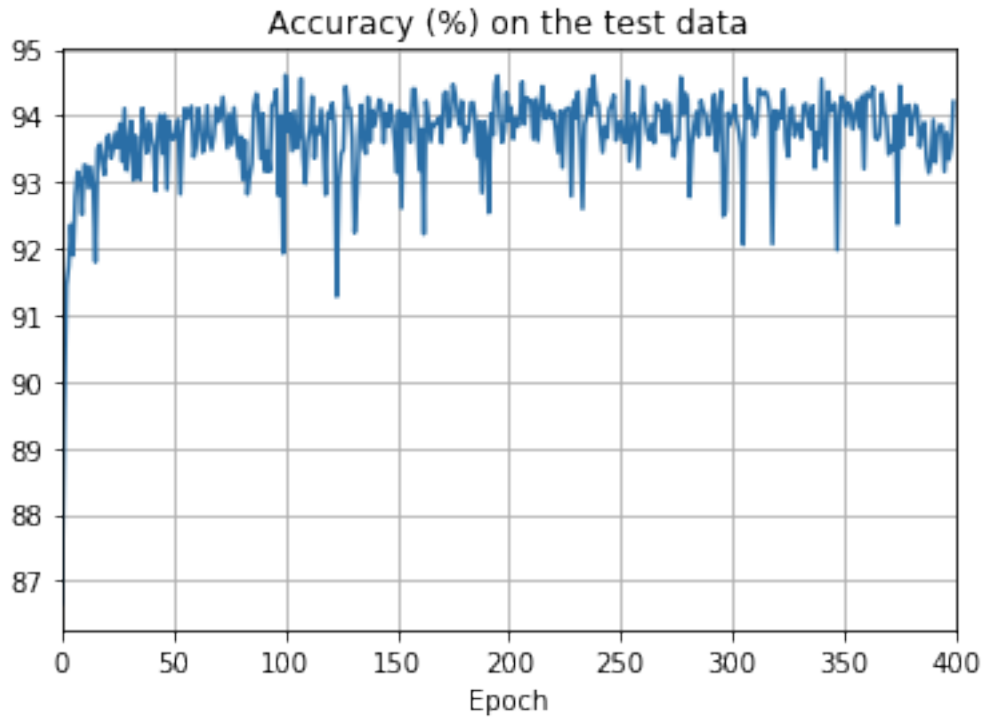
```
plot_helper.plot_training_accuracy(num_epochs=epochs, training_accuracy=training_accu
```

```
plot_helper.plot_test_cost(num_epochs=epochs, test_cost=evaluation_cost, test_cost_xm
```

```
plot_helper.plot_test_accuracy(num_epochs=epochs, test_accuracy=evaluation_accuracy, t
```







```
In [3]: import network2
net2_all_train = network2.Network([784, 100, 10], cost=network2.CrossEntropyCost)
net2_all_train.large_weight_initializer()

epochs = 30

evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
    training_data,
    epochs,
    10,
    0.5,
    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: 2.82672129051
Accuracy on training data: 47233 / 50000
Cost on evaluation data: 12.5757665523
Accuracy on evaluation data: 9410 / 10000
```


Epoch 1 training complete
Cost on training data: 1.87238494386
Accuracy on training data: 47430 / 50000
Cost on evaluation data: 7.97602784226
Accuracy on evaluation data: 9395 / 10000

Epoch 2 training complete
Cost on training data: 1.21885165955
Accuracy on training data: 48335 / 50000
Cost on evaluation data: 5.11661906748
Accuracy on evaluation data: 9595 / 10000

Epoch 3 training complete
Cost on training data: 0.850523075602
Accuracy on training data: 48570 / 50000
Cost on evaluation data: 3.42957618148
Accuracy on evaluation data: 9629 / 10000

Epoch 4 training complete
Cost on training data: 0.646245604174
Accuracy on training data: 48692 / 50000
Cost on evaluation data: 2.42618074499
Accuracy on evaluation data: 9641 / 10000

Epoch 5 training complete
Cost on training data: 0.50850051722
Accuracy on training data: 48771 / 50000
Cost on evaluation data: 1.84275332874
Accuracy on evaluation data: 9627 / 10000

Epoch 6 training complete
Cost on training data: 0.404384098785
Accuracy on training data: 49079 / 50000
Cost on evaluation data: 1.45600748916
Accuracy on evaluation data: 9684 / 10000

Epoch 7 training complete
Cost on training data: 0.349831634146
Accuracy on training data: 49148 / 50000
Cost on evaluation data: 1.23725840284
Accuracy on evaluation data: 9708 / 10000

Epoch 8 training complete
Cost on training data: 0.348229479236
Accuracy on training data: 48983 / 50000
Cost on evaluation data: 1.13204983354
Accuracy on evaluation data: 9693 / 10000

Epoch 9 training complete
Cost on training data: 0.303323674088
Accuracy on training data: 49213 / 50000
Cost on evaluation data: 1.03314922901
Accuracy on evaluation data: 9724 / 10000

Epoch 10 training complete
Cost on training data: 0.30521272809
Accuracy on training data: 49171 / 50000
Cost on evaluation data: 0.99572275402
Accuracy on evaluation data: 9716 / 10000

Epoch 11 training complete
Cost on training data: 0.298147093506
Accuracy on training data: 49202 / 50000
Cost on evaluation data: 0.960908371339
Accuracy on evaluation data: 9734 / 10000

Epoch 12 training complete
Cost on training data: 0.290034898436
Accuracy on training data: 49194 / 50000
Cost on evaluation data: 0.950825276325
Accuracy on evaluation data: 9722 / 10000

Epoch 13 training complete
Cost on training data: 0.288153004097
Accuracy on training data: 49255 / 50000
Cost on evaluation data: 0.942688877001
Accuracy on evaluation data: 9728 / 10000

Epoch 14 training complete
Cost on training data: 0.263899680115
Accuracy on training data: 49368 / 50000
Cost on evaluation data: 0.912578749945
Accuracy on evaluation data: 9750 / 10000

Epoch 15 training complete
Cost on training data: 0.281154092188
Accuracy on training data: 49211 / 50000
Cost on evaluation data: 0.924217681396
Accuracy on evaluation data: 9721 / 10000

Epoch 16 training complete
Cost on training data: 0.275855477853
Accuracy on training data: 49322 / 50000
Cost on evaluation data: 0.920732894021
Accuracy on evaluation data: 9740 / 10000

Epoch 17 training complete
Cost on training data: 0.287786533881
Accuracy on training data: 49150 / 50000
Cost on evaluation data: 0.932325385164
Accuracy on evaluation data: 9709 / 10000

Epoch 18 training complete
Cost on training data: 0.276388763384
Accuracy on training data: 49253 / 50000
Cost on evaluation data: 0.926396607099
Accuracy on evaluation data: 9734 / 10000

Epoch 19 training complete
Cost on training data: 0.299068504239
Accuracy on training data: 49165 / 50000
Cost on evaluation data: 0.938525470175
Accuracy on evaluation data: 9716 / 10000

Epoch 20 training complete
Cost on training data: 0.286049474544
Accuracy on training data: 49233 / 50000
Cost on evaluation data: 0.935580191048
Accuracy on evaluation data: 9702 / 10000

Epoch 21 training complete
Cost on training data: 0.264621532118
Accuracy on training data: 49345 / 50000
Cost on evaluation data: 0.898980814099
Accuracy on evaluation data: 9756 / 10000

Epoch 22 training complete
Cost on training data: 0.260207055025
Accuracy on training data: 49390 / 50000
Cost on evaluation data: 0.904141303966
Accuracy on evaluation data: 9747 / 10000

Epoch 23 training complete
Cost on training data: 0.270795417376
Accuracy on training data: 49322 / 50000
Cost on evaluation data: 0.910342341653
Accuracy on evaluation data: 9764 / 10000

Epoch 24 training complete
Cost on training data: 0.287209547787
Accuracy on training data: 49221 / 50000
Cost on evaluation data: 0.929717261715
Accuracy on evaluation data: 9724 / 10000

Epoch 25 training complete
Cost on training data: 0.265568143307
Accuracy on training data: 49358 / 50000
Cost on evaluation data: 0.904527462136
Accuracy on evaluation data: 9765 / 10000

Epoch 26 training complete
Cost on training data: 0.283897528859
Accuracy on training data: 49294 / 50000
Cost on evaluation data: 0.923053442592
Accuracy on evaluation data: 9736 / 10000

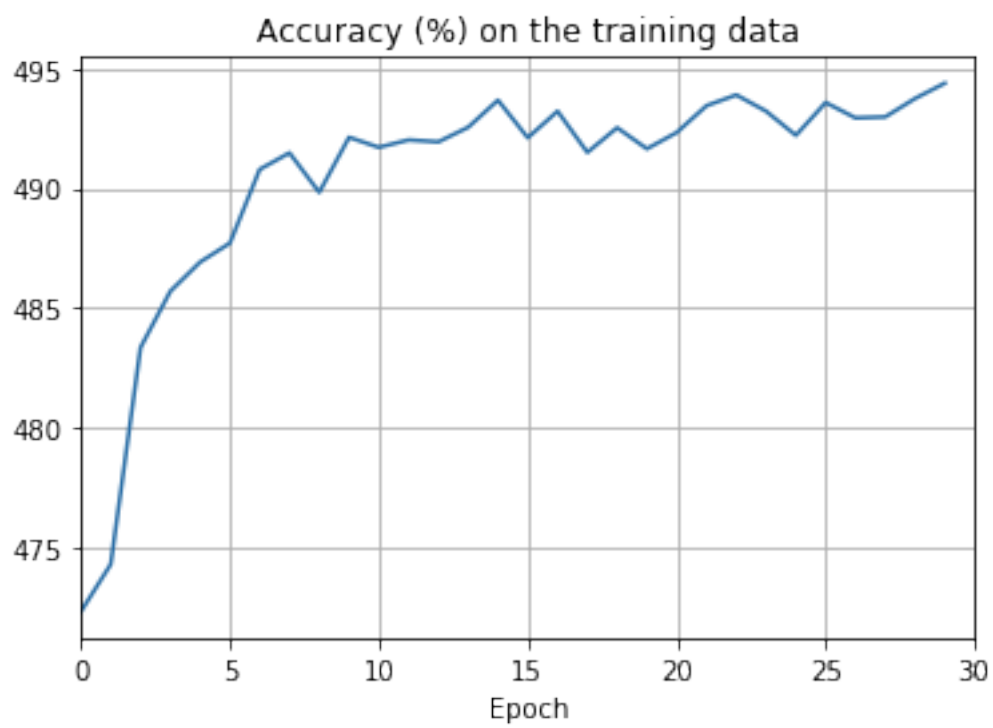
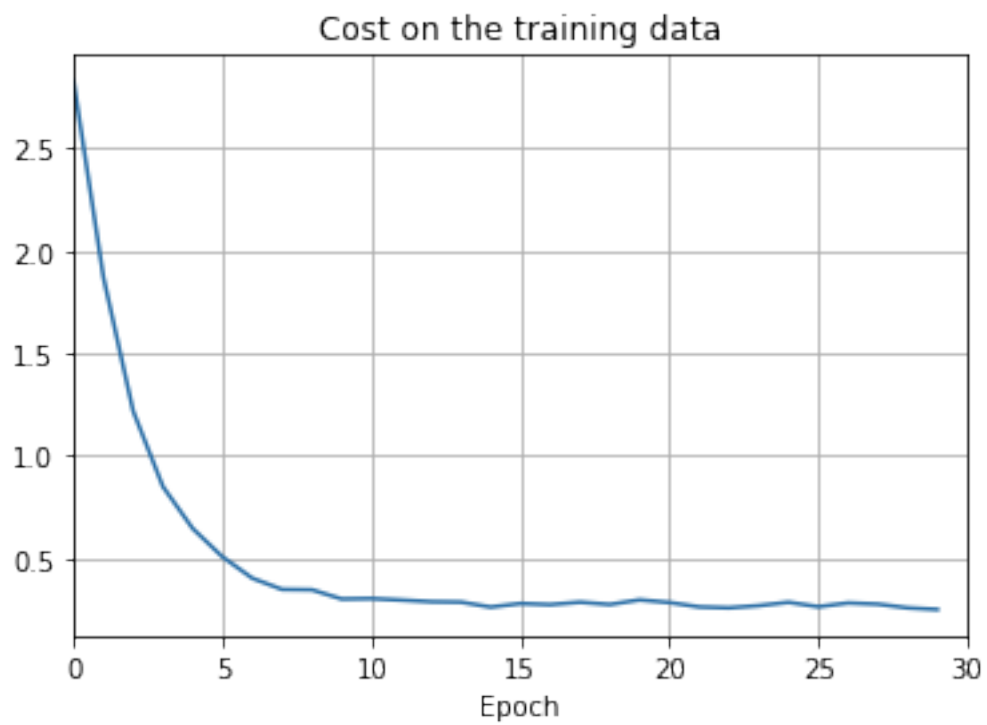
Epoch 27 training complete
Cost on training data: 0.278051644006
Accuracy on training data: 49298 / 50000
Cost on evaluation data: 0.91562689152
Accuracy on evaluation data: 9737 / 10000

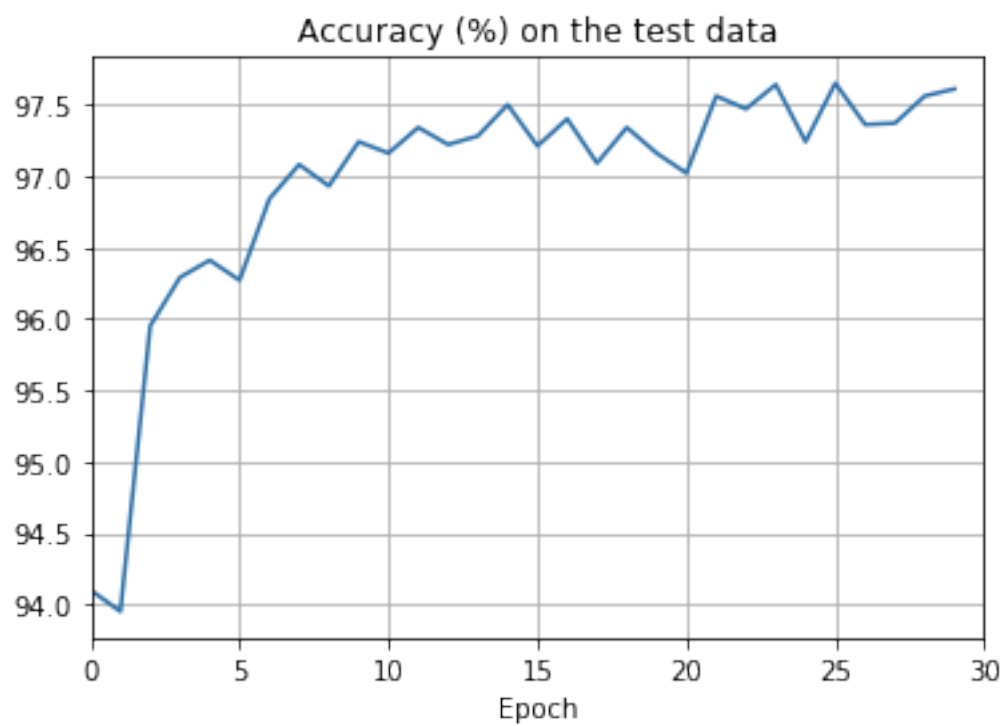
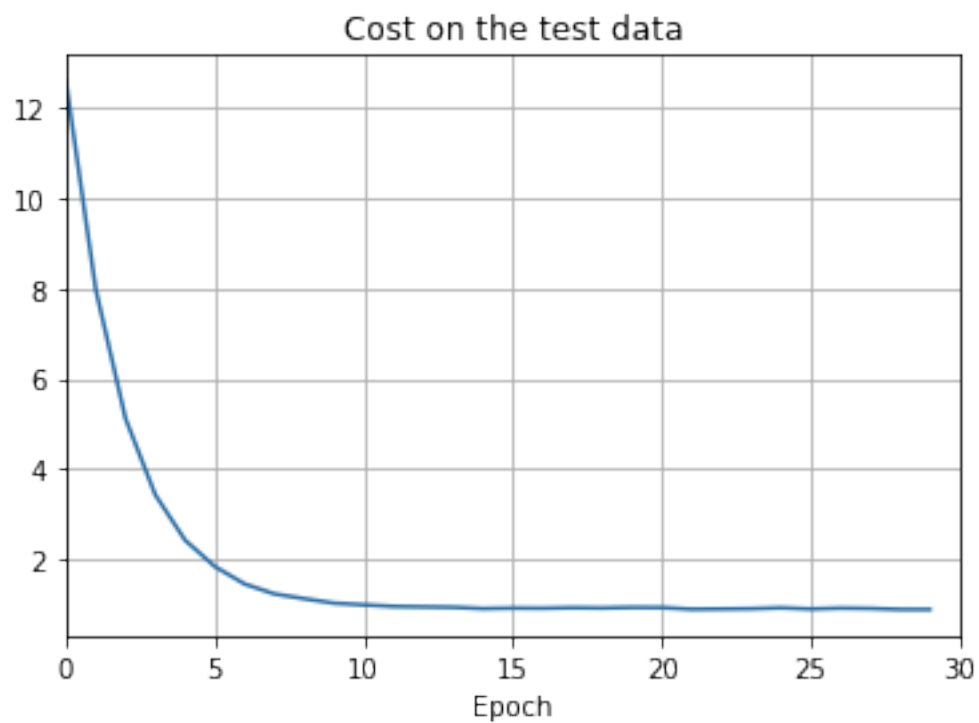
Epoch 28 training complete
Cost on training data: 0.259888585859
Accuracy on training data: 49375 / 50000
Cost on evaluation data: 0.894448477245
Accuracy on evaluation data: 9756 / 10000

Epoch 29 training complete
Cost on training data: 0.252169973489
Accuracy on training data: 49439 / 50000
Cost on evaluation data: 0.893286445876
Accuracy on evaluation data: 9761 / 10000

```
In [5]: import plot_helper
        plot_helper.plot_training_cost(num_epochs=epochs, training_cost=training_cost_all_train, test_cost=evaluation_cost_all_train)
        plot_helper.plot_training_accuracy(num_epochs=epochs, training_accuracy=training_accuracy_all_train, test_accuracy=evaluation_accuracy_all_train)

        plot_helper.plot_test_cost(num_epochs=epochs, test_cost=evaluation_cost_all_train, test_accuracy=evaluation_accuracy_all_train)
        plot_helper.plot_test_accuracy(num_epochs=epochs, test_accuracy=evaluation_accuracy_all_train, test_cost=evaluation_cost_all_train)
```





week_1_solution_13

March 15, 2018

```
In [2]: 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 [3]: print("13. Repeat 12 for a deep network with two hidden layers, with 30 neuron in each")
```

13. Repeat 12 for a deep network with two hidden layers, with 30 neuron in each.

```
In [5]: import network2
net2_all_train = network2.Network([784, 30, 30, 10], cost=network2.CrossEntropyCost)
net2_all_train.large_weight_initializer()

epochs = 400

evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
    training_data,
    epochs,
    10,
    0.5,
    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: 1.32221800774

Accuracy on training data: 45769 / 50000

Cost on evaluation data: 4.49026165537

Accuracy on evaluation data: 9188 / 10000

Epoch 1 training complete

Cost on training data: 0.95114024397

Accuracy on training data: 46678 / 50000

Cost on evaluation data: 3.10866726151

Accuracy on evaluation data: 9331 / 10000

Epoch 2 training complete

Cost on training data: 0.703653926467

Accuracy on training data: 47586 / 50000

Cost on evaluation data: 2.28468588117

Accuracy on evaluation data: 9419 / 10000

Epoch 3 training complete

Cost on training data: 0.610544002164

Accuracy on training data: 47559 / 50000

Cost on evaluation data: 1.82264665944

Accuracy on evaluation data: 9432 / 10000

Epoch 4 training complete

Cost on training data: 0.529902280075

Accuracy on training data: 47791 / 50000

Cost on evaluation data: 1.53200522981

Accuracy on evaluation data: 9485 / 10000

Epoch 5 training complete

Cost on training data: 0.461520124785

Accuracy on training data: 48112 / 50000

Cost on evaluation data: 1.35085443574

Accuracy on evaluation data: 9524 / 10000

Epoch 6 training complete

Cost on training data: 0.481431462824

Accuracy on training data: 47845 / 50000

Cost on evaluation data: 1.30574861403

Accuracy on evaluation data: 9465 / 10000

Epoch 7 training complete

Cost on training data: 0.439734948895

Accuracy on training data: 48006 / 50000

Cost on evaluation data: 1.21605575003

Accuracy on evaluation data: 9530 / 10000

Epoch 8 training complete

Cost on training data: 0.409268592373

Accuracy on training data: 48313 / 50000

Cost on evaluation data: 1.1562868553

Accuracy on evaluation data: 9580 / 10000

Epoch 9 training complete

Cost on training data: 0.403858467397

Accuracy on training data: 48273 / 50000

Cost on evaluation data: 1.14835804175

Accuracy on evaluation data: 9572 / 10000

Epoch 10 training complete

Cost on training data: 0.38217714905

Accuracy on training data: 48397 / 50000

Cost on evaluation data: 1.11778456491

Accuracy on evaluation data: 9591 / 10000

Epoch 11 training complete

Cost on training data: 0.409327844266

Accuracy on training data: 48154 / 50000

Cost on evaluation data: 1.13916499873

Accuracy on evaluation data: 9554 / 10000

Epoch 12 training complete

Cost on training data: 0.472786960778

Accuracy on training data: 47604 / 50000

Cost on evaluation data: 1.20841199341

Accuracy on evaluation data: 9441 / 10000

Epoch 13 training complete

Cost on training data: 0.387396410092

Accuracy on training data: 48355 / 50000

Cost on evaluation data: 1.10685326394

Accuracy on evaluation data: 9579 / 10000

Epoch 14 training complete

Cost on training data: 0.386721681747

Accuracy on training data: 48363 / 50000

Cost on evaluation data: 1.10895746946

Accuracy on evaluation data: 9599 / 10000

Epoch 15 training complete

Cost on training data: 0.394075652408

Accuracy on training data: 48277 / 50000

Cost on evaluation data: 1.12888150918

Accuracy on evaluation data: 9549 / 10000

Epoch 16 training complete

Cost on training data: 0.40687553358

Accuracy on training data: 48179 / 50000

Cost on evaluation data: 1.12162263624

Accuracy on evaluation data: 9556 / 10000

Epoch 17 training complete

Cost on training data: 0.436259761092

Accuracy on training data: 47836 / 50000

Cost on evaluation data: 1.15325904146

Accuracy on evaluation data: 9482 / 10000

Epoch 18 training complete

Cost on training data: 0.387562144153

Accuracy on training data: 48378 / 50000

Cost on evaluation data: 1.0942802406

Accuracy on evaluation data: 9603 / 10000

Epoch 19 training complete

Cost on training data: 0.412090911431

Accuracy on training data: 48077 / 50000

Cost on evaluation data: 1.12871344784

Accuracy on evaluation data: 9523 / 10000

Epoch 20 training complete

Cost on training data: 0.383678819839

Accuracy on training data: 48358 / 50000

Cost on evaluation data: 1.10361305092

Accuracy on evaluation data: 9588 / 10000

Epoch 21 training complete

Cost on training data: 0.394725239772

Accuracy on training data: 48280 / 50000

Cost on evaluation data: 1.13166915245

Accuracy on evaluation data: 9530 / 10000

Epoch 22 training complete

Cost on training data: 0.423056953406

Accuracy on training data: 48060 / 50000

Cost on evaluation data: 1.13742744109

Accuracy on evaluation data: 9529 / 10000

Epoch 23 training complete

Cost on training data: 0.410488076481

Accuracy on training data: 48136 / 50000

Cost on evaluation data: 1.12746287213

Accuracy on evaluation data: 9568 / 10000

Epoch 24 training complete

Cost on training data: 0.373272529725

Accuracy on training data: 48413 / 50000

Cost on evaluation data: 1.10227899786

Accuracy on evaluation data: 9584 / 10000

Epoch 25 training complete

Cost on training data: 0.382706343173

Accuracy on training data: 48386 / 50000

Cost on evaluation data: 1.11600266313

Accuracy on evaluation data: 9570 / 10000

Epoch 26 training complete

Cost on training data: 0.405077823548

Accuracy on training data: 48283 / 50000

Cost on evaluation data: 1.13396682567

Accuracy on evaluation data: 9541 / 10000

Epoch 27 training complete

Cost on training data: 0.405952138076

Accuracy on training data: 48149 / 50000

Cost on evaluation data: 1.13308089301

Accuracy on evaluation data: 9548 / 10000

Epoch 28 training complete

Cost on training data: 0.366280661975

Accuracy on training data: 48578 / 50000

Cost on evaluation data: 1.10125767989

Accuracy on evaluation data: 9596 / 10000

Epoch 29 training complete

Cost on training data: 0.359640637601

Accuracy on training data: 48635 / 50000

Cost on evaluation data: 1.08728241182

Accuracy on evaluation data: 9629 / 10000

Epoch 30 training complete

Cost on training data: 0.401439450098

Accuracy on training data: 48193 / 50000

Cost on evaluation data: 1.11431956843

Accuracy on evaluation data: 9554 / 10000

Epoch 31 training complete

Cost on training data: 0.375875954392

Accuracy on training data: 48400 / 50000

Cost on evaluation data: 1.09803654772

Accuracy on evaluation data: 9579 / 10000

Epoch 32 training complete

Cost on training data: 0.358196332801

Accuracy on training data: 48508 / 50000

Cost on evaluation data: 1.08472907102

Accuracy on evaluation data: 9621 / 10000

Epoch 33 training complete

Cost on training data: 0.426370251522

Accuracy on training data: 47945 / 50000

Cost on evaluation data: 1.14375706048

Accuracy on evaluation data: 9492 / 10000

Epoch 34 training complete

Cost on training data: 0.377138575253

Accuracy on training data: 48478 / 50000

Cost on evaluation data: 1.11054183391

Accuracy on evaluation data: 9583 / 10000

Epoch 35 training complete

Cost on training data: 0.403388538801

Accuracy on training data: 48132 / 50000

Cost on evaluation data: 1.13002218766

Accuracy on evaluation data: 9529 / 10000

Epoch 36 training complete

Cost on training data: 0.36668063314

Accuracy on training data: 48520 / 50000

Cost on evaluation data: 1.09968456765

Accuracy on evaluation data: 9582 / 10000

Epoch 37 training complete

Cost on training data: 0.371988392202

Accuracy on training data: 48473 / 50000

Cost on evaluation data: 1.084824155

Accuracy on evaluation data: 9626 / 10000

Epoch 38 training complete

Cost on training data: 0.376786783032

Accuracy on training data: 48420 / 50000

Cost on evaluation data: 1.09829617323

Accuracy on evaluation data: 9587 / 10000

Epoch 39 training complete

Cost on training data: 0.397979390229

Accuracy on training data: 48252 / 50000

Cost on evaluation data: 1.12924793785

Accuracy on evaluation data: 9539 / 10000

Epoch 40 training complete

Cost on training data: 0.386638274406

Accuracy on training data: 48370 / 50000

Cost on evaluation data: 1.11046921796

Accuracy on evaluation data: 9598 / 10000

Epoch 41 training complete

Cost on training data: 0.380669539547

Accuracy on training data: 48376 / 50000

Cost on evaluation data: 1.10321878245

Accuracy on evaluation data: 9610 / 10000

Epoch 42 training complete

Cost on training data: 0.384395205827

Accuracy on training data: 48408 / 50000

Cost on evaluation data: 1.11568198347

Accuracy on evaluation data: 9586 / 10000

Epoch 43 training complete

Cost on training data: 0.381334340332

Accuracy on training data: 48370 / 50000

Cost on evaluation data: 1.10913298865

Accuracy on evaluation data: 9599 / 10000

Epoch 44 training complete

Cost on training data: 0.386648420156

Accuracy on training data: 48322 / 50000

Cost on evaluation data: 1.11486601125

Accuracy on evaluation data: 9577 / 10000

Epoch 45 training complete

Cost on training data: 0.368285500224

Accuracy on training data: 48481 / 50000

Cost on evaluation data: 1.0974279752

Accuracy on evaluation data: 9622 / 10000

Epoch 46 training complete

Cost on training data: 0.371561599382

Accuracy on training data: 48496 / 50000

Cost on evaluation data: 1.10364705298

Accuracy on evaluation data: 9583 / 10000

Epoch 47 training complete

Cost on training data: 0.382891055303

Accuracy on training data: 48435 / 50000

Cost on evaluation data: 1.10250833701

Accuracy on evaluation data: 9608 / 10000

Epoch 48 training complete

Cost on training data: 0.346832480003

Accuracy on training data: 48648 / 50000

Cost on evaluation data: 1.07328304995

Accuracy on evaluation data: 9628 / 10000

Epoch 49 training complete

Cost on training data: 0.39411639961

Accuracy on training data: 48232 / 50000

Cost on evaluation data: 1.11542798791

Accuracy on evaluation data: 9556 / 10000

Epoch 50 training complete

Cost on training data: 0.40228665181

Accuracy on training data: 48149 / 50000

Cost on evaluation data: 1.1248923583

Accuracy on evaluation data: 9555 / 10000

Epoch 51 training complete

Cost on training data: 0.393436943284

Accuracy on training data: 48272 / 50000

Cost on evaluation data: 1.11235889655

Accuracy on evaluation data: 9564 / 10000

Epoch 52 training complete

Cost on training data: 0.380163247693

Accuracy on training data: 48437 / 50000

Cost on evaluation data: 1.08959030951

Accuracy on evaluation data: 9596 / 10000

Epoch 53 training complete

Cost on training data: 0.356742082208

Accuracy on training data: 48614 / 50000

Cost on evaluation data: 1.07567438553

Accuracy on evaluation data: 9655 / 10000

Epoch 54 training complete

Cost on training data: 0.462746011689

Accuracy on training data: 47583 / 50000

Cost on evaluation data: 1.17777996189

Accuracy on evaluation data: 9430 / 10000

Epoch 55 training complete

Cost on training data: 0.35611931148

Accuracy on training data: 48681 / 50000

Cost on evaluation data: 1.08321679964

Accuracy on evaluation data: 9628 / 10000

Epoch 56 training complete

Cost on training data: 0.376373400727

Accuracy on training data: 48365 / 50000

Cost on evaluation data: 1.10646659817

Accuracy on evaluation data: 9595 / 10000

Epoch 57 training complete

Cost on training data: 0.356483658989

Accuracy on training data: 48600 / 50000

Cost on evaluation data: 1.06957309982

Accuracy on evaluation data: 9635 / 10000

Epoch 58 training complete

Cost on training data: 0.352021007669

Accuracy on training data: 48681 / 50000

Cost on evaluation data: 1.07197855716

Accuracy on evaluation data: 9623 / 10000

Epoch 59 training complete

Cost on training data: 0.359460629489

Accuracy on training data: 48593 / 50000

Cost on evaluation data: 1.07693309276

Accuracy on evaluation data: 9617 / 10000

Epoch 60 training complete

Cost on training data: 0.338315778275

Accuracy on training data: 48769 / 50000

Cost on evaluation data: 1.06574752832

Accuracy on evaluation data: 9659 / 10000

Epoch 61 training complete

Cost on training data: 0.356922487464

Accuracy on training data: 48626 / 50000

Cost on evaluation data: 1.08264637044

Accuracy on evaluation data: 9623 / 10000

Epoch 62 training complete

Cost on training data: 0.379646983118

Accuracy on training data: 48448 / 50000

Cost on evaluation data: 1.10328569889

Accuracy on evaluation data: 9594 / 10000

Epoch 63 training complete

Cost on training data: 0.347814835184

Accuracy on training data: 48692 / 50000

Cost on evaluation data: 1.0681374148

Accuracy on evaluation data: 9629 / 10000

Epoch 64 training complete

Cost on training data: 0.402477159927

Accuracy on training data: 48224 / 50000

Cost on evaluation data: 1.11967112131

Accuracy on evaluation data: 9551 / 10000

Epoch 65 training complete

Cost on training data: 0.346012010292

Accuracy on training data: 48669 / 50000

Cost on evaluation data: 1.07527967129

Accuracy on evaluation data: 9623 / 10000

Epoch 66 training complete

Cost on training data: 0.352500562295

Accuracy on training data: 48600 / 50000

Cost on evaluation data: 1.08400406392

Accuracy on evaluation data: 9595 / 10000

Epoch 67 training complete

Cost on training data: 0.360389428112

Accuracy on training data: 48575 / 50000

Cost on evaluation data: 1.08045340143

Accuracy on evaluation data: 9633 / 10000

Epoch 68 training complete

Cost on training data: 0.364614490374

Accuracy on training data: 48521 / 50000

Cost on evaluation data: 1.09652493964

Accuracy on evaluation data: 9588 / 10000

Epoch 69 training complete

Cost on training data: 0.357680927996

Accuracy on training data: 48543 / 50000

Cost on evaluation data: 1.09479855631

Accuracy on evaluation data: 9622 / 10000

Epoch 70 training complete

Cost on training data: 0.356450812479

Accuracy on training data: 48596 / 50000

Cost on evaluation data: 1.08721162695

Accuracy on evaluation data: 9596 / 10000

Epoch 71 training complete

Cost on training data: 0.347739170063

Accuracy on training data: 48654 / 50000

Cost on evaluation data: 1.07390724313

Accuracy on evaluation data: 9625 / 10000

Epoch 72 training complete

Cost on training data: 0.361942187696

Accuracy on training data: 48570 / 50000

Cost on evaluation data: 1.08881821418

Accuracy on evaluation data: 9602 / 10000

Epoch 73 training complete

Cost on training data: 0.353325079435

Accuracy on training data: 48564 / 50000

Cost on evaluation data: 1.07242074061

Accuracy on evaluation data: 9618 / 10000

Epoch 74 training complete

Cost on training data: 0.402355072725

Accuracy on training data: 48226 / 50000

Cost on evaluation data: 1.11007145819

Accuracy on evaluation data: 9564 / 10000

Epoch 75 training complete

Cost on training data: 0.36342417651

Accuracy on training data: 48539 / 50000

Cost on evaluation data: 1.08137889871

Accuracy on evaluation data: 9604 / 10000

Epoch 76 training complete

Cost on training data: 0.354566200396

Accuracy on training data: 48592 / 50000

Cost on evaluation data: 1.06818972786

Accuracy on evaluation data: 9626 / 10000

Epoch 77 training complete

Cost on training data: 0.348644751825

Accuracy on training data: 48705 / 50000

Cost on evaluation data: 1.07836137946

Accuracy on evaluation data: 9638 / 10000

Epoch 78 training complete

Cost on training data: 0.359057785949

Accuracy on training data: 48568 / 50000

Cost on evaluation data: 1.08890876334

Accuracy on evaluation data: 9637 / 10000

Epoch 79 training complete

Cost on training data: 0.32894145905

Accuracy on training data: 48805 / 50000

Cost on evaluation data: 1.05502595549

Accuracy on evaluation data: 9671 / 10000

Epoch 80 training complete

Cost on training data: 0.398648890237

Accuracy on training data: 48202 / 50000

Cost on evaluation data: 1.12754946509

Accuracy on evaluation data: 9549 / 10000

Epoch 81 training complete

Cost on training data: 0.3349877906

Accuracy on training data: 48829 / 50000

Cost on evaluation data: 1.0666817923

Accuracy on evaluation data: 9649 / 10000

Epoch 82 training complete

Cost on training data: 0.367021002742

Accuracy on training data: 48446 / 50000

Cost on evaluation data: 1.09216901375

Accuracy on evaluation data: 9595 / 10000

Epoch 83 training complete

Cost on training data: 0.367241448918

Accuracy on training data: 48492 / 50000

Cost on evaluation data: 1.08278262043

Accuracy on evaluation data: 9607 / 10000

Epoch 84 training complete

Cost on training data: 0.364453515438

Accuracy on training data: 48509 / 50000

Cost on evaluation data: 1.08690233463

Accuracy on evaluation data: 9591 / 10000

Epoch 85 training complete

Cost on training data: 0.499847462635

Accuracy on training data: 47267 / 50000

Cost on evaluation data: 1.21460788279

Accuracy on evaluation data: 9392 / 10000

Epoch 86 training complete

Cost on training data: 0.361864268697

Accuracy on training data: 48531 / 50000

Cost on evaluation data: 1.09350265938

Accuracy on evaluation data: 9609 / 10000

Epoch 87 training complete

Cost on training data: 0.364153844539

Accuracy on training data: 48523 / 50000

Cost on evaluation data: 1.07751697957

Accuracy on evaluation data: 9620 / 10000

Epoch 88 training complete

Cost on training data: 0.35141914992

Accuracy on training data: 48614 / 50000

Cost on evaluation data: 1.07003494107

Accuracy on evaluation data: 9616 / 10000

Epoch 89 training complete

Cost on training data: 0.345776313742

Accuracy on training data: 48672 / 50000

Cost on evaluation data: 1.0771157448

Accuracy on evaluation data: 9615 / 10000

Epoch 90 training complete

Cost on training data: 0.383884015025

Accuracy on training data: 48298 / 50000

Cost on evaluation data: 1.09178623636

Accuracy on evaluation data: 9586 / 10000

Epoch 91 training complete

Cost on training data: 0.397958441292

Accuracy on training data: 48173 / 50000

Cost on evaluation data: 1.12174774282

Accuracy on evaluation data: 9524 / 10000

Epoch 92 training complete

Cost on training data: 0.328581380981

Accuracy on training data: 48817 / 50000

Cost on evaluation data: 1.0441089489

Accuracy on evaluation data: 9670 / 10000

Epoch 93 training complete

Cost on training data: 0.357597141739

Accuracy on training data: 48563 / 50000

Cost on evaluation data: 1.08107061698

Accuracy on evaluation data: 9610 / 10000

Epoch 94 training complete

Cost on training data: 0.3375306095

Accuracy on training data: 48785 / 50000

Cost on evaluation data: 1.06852085051

Accuracy on evaluation data: 9639 / 10000

Epoch 95 training complete

Cost on training data: 0.396901593805

Accuracy on training data: 48249 / 50000

Cost on evaluation data: 1.1246351378

Accuracy on evaluation data: 9539 / 10000

Epoch 96 training complete

Cost on training data: 0.388190835977

Accuracy on training data: 48251 / 50000

Cost on evaluation data: 1.11835792243

Accuracy on evaluation data: 9570 / 10000

Epoch 97 training complete

Cost on training data: 0.347742679028

Accuracy on training data: 48673 / 50000

Cost on evaluation data: 1.06496776536

Accuracy on evaluation data: 9662 / 10000

Epoch 98 training complete

Cost on training data: 0.342025485347

Accuracy on training data: 48722 / 50000

Cost on evaluation data: 1.05911572494

Accuracy on evaluation data: 9652 / 10000

Epoch 99 training complete

Cost on training data: 0.335643723619

Accuracy on training data: 48751 / 50000

Cost on evaluation data: 1.04723820478

Accuracy on evaluation data: 9667 / 10000

Epoch 100 training complete

Cost on training data: 0.371776916031

Accuracy on training data: 48490 / 50000

Cost on evaluation data: 1.10705153334

Accuracy on evaluation data: 9594 / 10000

Epoch 101 training complete

Cost on training data: 0.379030521243

Accuracy on training data: 48403 / 50000

Cost on evaluation data: 1.10095684639

Accuracy on evaluation data: 9562 / 10000

Epoch 102 training complete

Cost on training data: 0.366847109798

Accuracy on training data: 48526 / 50000

Cost on evaluation data: 1.08986516017

Accuracy on evaluation data: 9607 / 10000

Epoch 103 training complete

Cost on training data: 0.350265479065

Accuracy on training data: 48670 / 50000

Cost on evaluation data: 1.07128595791

Accuracy on evaluation data: 9618 / 10000

Epoch 104 training complete

Cost on training data: 0.333405323217

Accuracy on training data: 48827 / 50000

Cost on evaluation data: 1.0501729331

Accuracy on evaluation data: 9666 / 10000

Epoch 105 training complete

Cost on training data: 0.372042510736

Accuracy on training data: 48377 / 50000

Cost on evaluation data: 1.08890989672

Accuracy on evaluation data: 9578 / 10000

Epoch 106 training complete

Cost on training data: 0.358804939831

Accuracy on training data: 48595 / 50000

Cost on evaluation data: 1.08335652507

Accuracy on evaluation data: 9609 / 10000

Epoch 107 training complete

Cost on training data: 0.363740425521

Accuracy on training data: 48551 / 50000

Cost on evaluation data: 1.08800031137

Accuracy on evaluation data: 9603 / 10000

Epoch 108 training complete

Cost on training data: 0.345523149567

Accuracy on training data: 48689 / 50000

Cost on evaluation data: 1.06429883491

Accuracy on evaluation data: 9664 / 10000

Epoch 109 training complete

Cost on training data: 0.423421567387

Accuracy on training data: 48049 / 50000

Cost on evaluation data: 1.1343067759

Accuracy on evaluation data: 9536 / 10000

Epoch 110 training complete

Cost on training data: 0.376684724345

Accuracy on training data: 48406 / 50000

Cost on evaluation data: 1.09873129778

Accuracy on evaluation data: 9598 / 10000

Epoch 111 training complete

Cost on training data: 0.345742728515

Accuracy on training data: 48653 / 50000

Cost on evaluation data: 1.06435026323

Accuracy on evaluation data: 9636 / 10000

Epoch 112 training complete

Cost on training data: 0.345671842773

Accuracy on training data: 48649 / 50000

Cost on evaluation data: 1.05624727881

Accuracy on evaluation data: 9664 / 10000

Epoch 113 training complete

Cost on training data: 0.342327072884

Accuracy on training data: 48672 / 50000

Cost on evaluation data: 1.06381527908

Accuracy on evaluation data: 9631 / 10000

Epoch 114 training complete

Cost on training data: 0.366129687783

Accuracy on training data: 48488 / 50000

Cost on evaluation data: 1.09494344729

Accuracy on evaluation data: 9603 / 10000

Epoch 115 training complete

Cost on training data: 0.35176089823

Accuracy on training data: 48659 / 50000

Cost on evaluation data: 1.072043895

Accuracy on evaluation data: 9632 / 10000

Epoch 116 training complete

Cost on training data: 0.374068045265

Accuracy on training data: 48468 / 50000

Cost on evaluation data: 1.10320072999

Accuracy on evaluation data: 9586 / 10000

Epoch 117 training complete

Cost on training data: 0.432802365245

Accuracy on training data: 47864 / 50000

Cost on evaluation data: 1.14863806056

Accuracy on evaluation data: 9498 / 10000

Epoch 118 training complete

Cost on training data: 0.390282912965

Accuracy on training data: 48267 / 50000

Cost on evaluation data: 1.11432194928

Accuracy on evaluation data: 9544 / 10000

Epoch 119 training complete

Cost on training data: 0.349751497502

Accuracy on training data: 48623 / 50000

Cost on evaluation data: 1.06279840418

Accuracy on evaluation data: 9632 / 10000

Epoch 120 training complete

Cost on training data: 0.341197707053

Accuracy on training data: 48761 / 50000

Cost on evaluation data: 1.04924367739

Accuracy on evaluation data: 9659 / 10000

Epoch 121 training complete

Cost on training data: 0.360393226852

Accuracy on training data: 48559 / 50000

Cost on evaluation data: 1.07670701405

Accuracy on evaluation data: 9623 / 10000

Epoch 122 training complete

Cost on training data: 0.362391015772

Accuracy on training data: 48583 / 50000

Cost on evaluation data: 1.06998853515

Accuracy on evaluation data: 9627 / 10000

Epoch 123 training complete

Cost on training data: 0.37525078652

Accuracy on training data: 48459 / 50000

Cost on evaluation data: 1.08477751209

Accuracy on evaluation data: 9608 / 10000

Epoch 124 training complete

Cost on training data: 0.368672133292

Accuracy on training data: 48439 / 50000

Cost on evaluation data: 1.09419253946

Accuracy on evaluation data: 9592 / 10000

Epoch 125 training complete

Cost on training data: 0.367732190049

Accuracy on training data: 48476 / 50000

Cost on evaluation data: 1.09022290817

Accuracy on evaluation data: 9598 / 10000

Epoch 126 training complete

Cost on training data: 0.333336799778

Accuracy on training data: 48778 / 50000

Cost on evaluation data: 1.05525711492

Accuracy on evaluation data: 9656 / 10000

Epoch 127 training complete

Cost on training data: 0.347516034254

Accuracy on training data: 48657 / 50000

Cost on evaluation data: 1.07362058065

Accuracy on evaluation data: 9657 / 10000

Epoch 128 training complete

Cost on training data: 0.398336898236

Accuracy on training data: 48274 / 50000

Cost on evaluation data: 1.12000697814

Accuracy on evaluation data: 9569 / 10000

Epoch 129 training complete

Cost on training data: 0.366207054031

Accuracy on training data: 48508 / 50000

Cost on evaluation data: 1.09099942208

Accuracy on evaluation data: 9621 / 10000

Epoch 130 training complete

Cost on training data: 0.379190319668

Accuracy on training data: 48343 / 50000

Cost on evaluation data: 1.117797446

Accuracy on evaluation data: 9564 / 10000

Epoch 131 training complete

Cost on training data: 0.374599335868

Accuracy on training data: 48464 / 50000

Cost on evaluation data: 1.09428309443

Accuracy on evaluation data: 9604 / 10000

Epoch 132 training complete

Cost on training data: 0.344419862114

Accuracy on training data: 48721 / 50000

Cost on evaluation data: 1.0734257639

Accuracy on evaluation data: 9632 / 10000

Epoch 133 training complete

Cost on training data: 0.353353018841

Accuracy on training data: 48654 / 50000

Cost on evaluation data: 1.08039349205

Accuracy on evaluation data: 9613 / 10000

Epoch 134 training complete

Cost on training data: 0.333466123844

Accuracy on training data: 48772 / 50000

Cost on evaluation data: 1.05781493424

Accuracy on evaluation data: 9644 / 10000

Epoch 135 training complete

Cost on training data: 0.358620177758

Accuracy on training data: 48509 / 50000

Cost on evaluation data: 1.07502901367

Accuracy on evaluation data: 9624 / 10000

Epoch 136 training complete

Cost on training data: 0.352369879073

Accuracy on training data: 48673 / 50000

Cost on evaluation data: 1.07452231831

Accuracy on evaluation data: 9624 / 10000

Epoch 137 training complete

Cost on training data: 0.345518901295

Accuracy on training data: 48674 / 50000

Cost on evaluation data: 1.06974858453

Accuracy on evaluation data: 9622 / 10000

Epoch 138 training complete

Cost on training data: 0.360105963724

Accuracy on training data: 48534 / 50000

Cost on evaluation data: 1.08814392539

Accuracy on evaluation data: 9582 / 10000

Epoch 139 training complete

Cost on training data: 0.353295529284

Accuracy on training data: 48615 / 50000

Cost on evaluation data: 1.07002788392

Accuracy on evaluation data: 9615 / 10000

Epoch 140 training complete

Cost on training data: 0.341501762811

Accuracy on training data: 48760 / 50000

Cost on evaluation data: 1.06314960098

Accuracy on evaluation data: 9643 / 10000

Epoch 141 training complete

Cost on training data: 0.330944773363

Accuracy on training data: 48789 / 50000

Cost on evaluation data: 1.04797682294

Accuracy on evaluation data: 9669 / 10000

Epoch 142 training complete

Cost on training data: 0.343544232849

Accuracy on training data: 48709 / 50000

Cost on evaluation data: 1.06848026799

Accuracy on evaluation data: 9634 / 10000

Epoch 143 training complete

Cost on training data: 0.339738883567

Accuracy on training data: 48756 / 50000

Cost on evaluation data: 1.06960936328

Accuracy on evaluation data: 9638 / 10000

Epoch 144 training complete

Cost on training data: 0.394869461089

Accuracy on training data: 48244 / 50000

Cost on evaluation data: 1.12827970833

Accuracy on evaluation data: 9580 / 10000

Epoch 145 training complete

Cost on training data: 0.490773903905

Accuracy on training data: 47376 / 50000

Cost on evaluation data: 1.20511984835

Accuracy on evaluation data: 9383 / 10000

Epoch 146 training complete

Cost on training data: 0.350144153456

Accuracy on training data: 48650 / 50000

Cost on evaluation data: 1.07592126477

Accuracy on evaluation data: 9655 / 10000

Epoch 147 training complete

Cost on training data: 0.348351618503

Accuracy on training data: 48614 / 50000

Cost on evaluation data: 1.06984197377

Accuracy on evaluation data: 9624 / 10000

Epoch 148 training complete

Cost on training data: 0.405426741551

Accuracy on training data: 48152 / 50000

Cost on evaluation data: 1.13588393552

Accuracy on evaluation data: 9560 / 10000

Epoch 149 training complete

Cost on training data: 0.352744115133

Accuracy on training data: 48591 / 50000

Cost on evaluation data: 1.06096480112

Accuracy on evaluation data: 9657 / 10000

Epoch 150 training complete

Cost on training data: 0.365338281448

Accuracy on training data: 48502 / 50000

Cost on evaluation data: 1.08442424391

Accuracy on evaluation data: 9620 / 10000

Epoch 151 training complete

Cost on training data: 0.389857680198

Accuracy on training data: 48362 / 50000

Cost on evaluation data: 1.10388649535

Accuracy on evaluation data: 9583 / 10000

Epoch 152 training complete

Cost on training data: 0.427245129299

Accuracy on training data: 47917 / 50000

Cost on evaluation data: 1.1602127127

Accuracy on evaluation data: 9476 / 10000

Epoch 153 training complete

Cost on training data: 0.338238581072

Accuracy on training data: 48709 / 50000

Cost on evaluation data: 1.06209876488

Accuracy on evaluation data: 9653 / 10000

Epoch 154 training complete

Cost on training data: 0.336411821456

Accuracy on training data: 48770 / 50000

Cost on evaluation data: 1.06564019869

Accuracy on evaluation data: 9652 / 10000

Epoch 155 training complete

Cost on training data: 0.324275206779

Accuracy on training data: 48888 / 50000

Cost on evaluation data: 1.06303256533

Accuracy on evaluation data: 9660 / 10000

Epoch 156 training complete

Cost on training data: 0.342991625981

Accuracy on training data: 48746 / 50000

Cost on evaluation data: 1.06730720335

Accuracy on evaluation data: 9655 / 10000

Epoch 157 training complete

Cost on training data: 0.346992238101

Accuracy on training data: 48656 / 50000

Cost on evaluation data: 1.07777979174

Accuracy on evaluation data: 9628 / 10000

Epoch 158 training complete

Cost on training data: 0.353696251098

Accuracy on training data: 48638 / 50000

Cost on evaluation data: 1.09503769634

Accuracy on evaluation data: 9607 / 10000

Epoch 159 training complete

Cost on training data: 0.377940973901

Accuracy on training data: 48391 / 50000

Cost on evaluation data: 1.09782240298

Accuracy on evaluation data: 9591 / 10000

Epoch 160 training complete

Cost on training data: 0.341993815963

Accuracy on training data: 48729 / 50000

Cost on evaluation data: 1.06513808398

Accuracy on evaluation data: 9655 / 10000

Epoch 161 training complete

Cost on training data: 0.397492860721

Accuracy on training data: 48201 / 50000

Cost on evaluation data: 1.11933967895

Accuracy on evaluation data: 9553 / 10000

Epoch 162 training complete

Cost on training data: 0.353517967289

Accuracy on training data: 48567 / 50000

Cost on evaluation data: 1.07701270987

Accuracy on evaluation data: 9613 / 10000

Epoch 163 training complete

Cost on training data: 0.37256071726

Accuracy on training data: 48478 / 50000

Cost on evaluation data: 1.1015318597

Accuracy on evaluation data: 9576 / 10000

Epoch 164 training complete

Cost on training data: 0.349997703191

Accuracy on training data: 48614 / 50000

Cost on evaluation data: 1.07057278065

Accuracy on evaluation data: 9616 / 10000

Epoch 165 training complete

Cost on training data: 0.337719320824

Accuracy on training data: 48766 / 50000

Cost on evaluation data: 1.06087744731

Accuracy on evaluation data: 9639 / 10000

Epoch 166 training complete

Cost on training data: 0.372670088269

Accuracy on training data: 48429 / 50000

Cost on evaluation data: 1.09808224958

Accuracy on evaluation data: 9583 / 10000

Epoch 167 training complete

Cost on training data: 0.349466398542

Accuracy on training data: 48610 / 50000

Cost on evaluation data: 1.08722392984

Accuracy on evaluation data: 9616 / 10000

Epoch 168 training complete

Cost on training data: 0.367742604462

Accuracy on training data: 48519 / 50000

Cost on evaluation data: 1.09105084641

Accuracy on evaluation data: 9614 / 10000

Epoch 169 training complete

Cost on training data: 0.380369060157

Accuracy on training data: 48381 / 50000

Cost on evaluation data: 1.10561930529

Accuracy on evaluation data: 9592 / 10000

Epoch 170 training complete

Cost on training data: 0.345670268876

Accuracy on training data: 48710 / 50000

Cost on evaluation data: 1.07368763249

Accuracy on evaluation data: 9647 / 10000

Epoch 171 training complete

Cost on training data: 0.335116712287

Accuracy on training data: 48771 / 50000

Cost on evaluation data: 1.05742909833

Accuracy on evaluation data: 9677 / 10000

Epoch 172 training complete

Cost on training data: 0.344532470445

Accuracy on training data: 48713 / 50000

Cost on evaluation data: 1.06797800741

Accuracy on evaluation data: 9658 / 10000

Epoch 173 training complete

Cost on training data: 0.37455825366

Accuracy on training data: 48424 / 50000

Cost on evaluation data: 1.08203990672

Accuracy on evaluation data: 9609 / 10000

Epoch 174 training complete

Cost on training data: 0.348552819066

Accuracy on training data: 48657 / 50000

Cost on evaluation data: 1.07138833587

Accuracy on evaluation data: 9647 / 10000

Epoch 175 training complete

Cost on training data: 0.354316903362

Accuracy on training data: 48640 / 50000

Cost on evaluation data: 1.07869463597

Accuracy on evaluation data: 9622 / 10000

Epoch 176 training complete

Cost on training data: 0.356185333453

Accuracy on training data: 48618 / 50000

Cost on evaluation data: 1.07186929418

Accuracy on evaluation data: 9631 / 10000

Epoch 177 training complete

Cost on training data: 0.358716413823

Accuracy on training data: 48503 / 50000

Cost on evaluation data: 1.08091047657

Accuracy on evaluation data: 9628 / 10000

Epoch 178 training complete

Cost on training data: 0.333656394579

Accuracy on training data: 48781 / 50000

Cost on evaluation data: 1.06181057553

Accuracy on evaluation data: 9662 / 10000

Epoch 179 training complete

Cost on training data: 0.357396390513

Accuracy on training data: 48581 / 50000

Cost on evaluation data: 1.09534252024

Accuracy on evaluation data: 9617 / 10000

Epoch 180 training complete

Cost on training data: 0.408581825577

Accuracy on training data: 48113 / 50000

Cost on evaluation data: 1.13231406152

Accuracy on evaluation data: 9524 / 10000

Epoch 181 training complete

Cost on training data: 0.364589377998

Accuracy on training data: 48489 / 50000

Cost on evaluation data: 1.08950178214

Accuracy on evaluation data: 9585 / 10000

Epoch 182 training complete

Cost on training data: 0.343456933859

Accuracy on training data: 48711 / 50000

Cost on evaluation data: 1.071655013

Accuracy on evaluation data: 9643 / 10000

Epoch 183 training complete

Cost on training data: 0.364869036459

Accuracy on training data: 48480 / 50000

Cost on evaluation data: 1.094805206

Accuracy on evaluation data: 9585 / 10000

Epoch 184 training complete

Cost on training data: 0.379061225847

Accuracy on training data: 48387 / 50000

Cost on evaluation data: 1.11699233721

Accuracy on evaluation data: 9582 / 10000

Epoch 185 training complete

Cost on training data: 0.364483576219

Accuracy on training data: 48526 / 50000

Cost on evaluation data: 1.09438181864

Accuracy on evaluation data: 9594 / 10000

Epoch 186 training complete

Cost on training data: 0.370700969376

Accuracy on training data: 48462 / 50000

Cost on evaluation data: 1.08558442153

Accuracy on evaluation data: 9604 / 10000

Epoch 187 training complete

Cost on training data: 0.3474855364

Accuracy on training data: 48660 / 50000

Cost on evaluation data: 1.07771696022

Accuracy on evaluation data: 9635 / 10000

Epoch 188 training complete

Cost on training data: 0.389763232265

Accuracy on training data: 48212 / 50000

Cost on evaluation data: 1.10591607669

Accuracy on evaluation data: 9579 / 10000

Epoch 189 training complete

Cost on training data: 0.372551781928

Accuracy on training data: 48464 / 50000

Cost on evaluation data: 1.09779119147

Accuracy on evaluation data: 9593 / 10000

Epoch 190 training complete

Cost on training data: 0.349455037792

Accuracy on training data: 48667 / 50000

Cost on evaluation data: 1.07477883423

Accuracy on evaluation data: 9644 / 10000

Epoch 191 training complete

Cost on training data: 0.379895347378

Accuracy on training data: 48390 / 50000

Cost on evaluation data: 1.11549573988

Accuracy on evaluation data: 9577 / 10000

Epoch 192 training complete

Cost on training data: 0.388557877987

Accuracy on training data: 48358 / 50000

Cost on evaluation data: 1.11728754701

Accuracy on evaluation data: 9603 / 10000

Epoch 193 training complete

Cost on training data: 0.379986629679

Accuracy on training data: 48427 / 50000

Cost on evaluation data: 1.10369884901

Accuracy on evaluation data: 9595 / 10000

Epoch 194 training complete

Cost on training data: 0.41566292029

Accuracy on training data: 48033 / 50000

Cost on evaluation data: 1.149596164

Accuracy on evaluation data: 9531 / 10000

Epoch 195 training complete

Cost on training data: 0.350243979848

Accuracy on training data: 48664 / 50000

Cost on evaluation data: 1.07663951035

Accuracy on evaluation data: 9625 / 10000

Epoch 196 training complete

Cost on training data: 0.336790141482

Accuracy on training data: 48714 / 50000

Cost on evaluation data: 1.06035065291

Accuracy on evaluation data: 9652 / 10000

Epoch 197 training complete

Cost on training data: 0.366697174222

Accuracy on training data: 48528 / 50000

Cost on evaluation data: 1.0946152546

Accuracy on evaluation data: 9620 / 10000

Epoch 198 training complete

Cost on training data: 0.365559533067

Accuracy on training data: 48556 / 50000

Cost on evaluation data: 1.10438115187

Accuracy on evaluation data: 9574 / 10000

Epoch 199 training complete

Cost on training data: 0.377656346047

Accuracy on training data: 48408 / 50000

Cost on evaluation data: 1.1018904178

Accuracy on evaluation data: 9587 / 10000

Epoch 200 training complete

Cost on training data: 0.332562231191

Accuracy on training data: 48804 / 50000

Cost on evaluation data: 1.05806483963

Accuracy on evaluation data: 9665 / 10000

Epoch 201 training complete

Cost on training data: 0.360001319204

Accuracy on training data: 48608 / 50000

Cost on evaluation data: 1.09545130895

Accuracy on evaluation data: 9580 / 10000

Epoch 202 training complete

Cost on training data: 0.349128288971

Accuracy on training data: 48583 / 50000

Cost on evaluation data: 1.06272787352

Accuracy on evaluation data: 9649 / 10000

Epoch 203 training complete

Cost on training data: 0.336913837865

Accuracy on training data: 48768 / 50000

Cost on evaluation data: 1.05726456536

Accuracy on evaluation data: 9657 / 10000

Epoch 204 training complete

Cost on training data: 0.387269070116

Accuracy on training data: 48264 / 50000

Cost on evaluation data: 1.10896177134

Accuracy on evaluation data: 9563 / 10000

Epoch 205 training complete

Cost on training data: 0.413616215157

Accuracy on training data: 48078 / 50000

Cost on evaluation data: 1.1195109893

Accuracy on evaluation data: 9570 / 10000

Epoch 206 training complete

Cost on training data: 0.397894455176

Accuracy on training data: 48241 / 50000

Cost on evaluation data: 1.12412498496

Accuracy on evaluation data: 9546 / 10000

Epoch 207 training complete

Cost on training data: 0.352709734539

Accuracy on training data: 48596 / 50000

Cost on evaluation data: 1.06464188026

Accuracy on evaluation data: 9639 / 10000

Epoch 208 training complete

Cost on training data: 0.346060112252

Accuracy on training data: 48663 / 50000

Cost on evaluation data: 1.06367787576

Accuracy on evaluation data: 9649 / 10000

Epoch 209 training complete

Cost on training data: 0.359527664459

Accuracy on training data: 48552 / 50000

Cost on evaluation data: 1.07158817004

Accuracy on evaluation data: 9637 / 10000

Epoch 210 training complete

Cost on training data: 0.337040912702

Accuracy on training data: 48732 / 50000

Cost on evaluation data: 1.05553884976

Accuracy on evaluation data: 9657 / 10000

Epoch 211 training complete

Cost on training data: 0.360443392299

Accuracy on training data: 48605 / 50000

Cost on evaluation data: 1.08784166289

Accuracy on evaluation data: 9607 / 10000

Epoch 212 training complete

Cost on training data: 0.352864520529

Accuracy on training data: 48580 / 50000

Cost on evaluation data: 1.07491957279

Accuracy on evaluation data: 9628 / 10000

Epoch 213 training complete

Cost on training data: 0.345594998672

Accuracy on training data: 48671 / 50000

Cost on evaluation data: 1.08046942883

Accuracy on evaluation data: 9641 / 10000

Epoch 214 training complete

Cost on training data: 0.357989135055

Accuracy on training data: 48559 / 50000

Cost on evaluation data: 1.08116633447

Accuracy on evaluation data: 9623 / 10000

Epoch 215 training complete

Cost on training data: 0.34758702905

Accuracy on training data: 48661 / 50000

Cost on evaluation data: 1.07375644015

Accuracy on evaluation data: 9650 / 10000

Epoch 216 training complete

Cost on training data: 0.381744508615

Accuracy on training data: 48371 / 50000

Cost on evaluation data: 1.10631031927

Accuracy on evaluation data: 9593 / 10000

Epoch 217 training complete

Cost on training data: 0.369033548899

Accuracy on training data: 48443 / 50000

Cost on evaluation data: 1.10063889259

Accuracy on evaluation data: 9597 / 10000

Epoch 218 training complete

Cost on training data: 0.403879729363

Accuracy on training data: 48137 / 50000

Cost on evaluation data: 1.13831475541

Accuracy on evaluation data: 9518 / 10000

Epoch 219 training complete

Cost on training data: 0.382221478391

Accuracy on training data: 48393 / 50000

Cost on evaluation data: 1.11361478851

Accuracy on evaluation data: 9565 / 10000

Epoch 220 training complete

Cost on training data: 0.370794460715

Accuracy on training data: 48467 / 50000

Cost on evaluation data: 1.10209694939

Accuracy on evaluation data: 9620 / 10000

Epoch 221 training complete

Cost on training data: 0.36914409223

Accuracy on training data: 48405 / 50000

Cost on evaluation data: 1.102572911

Accuracy on evaluation data: 9575 / 10000

Epoch 222 training complete

Cost on training data: 0.353663705664

Accuracy on training data: 48611 / 50000

Cost on evaluation data: 1.08329313486

Accuracy on evaluation data: 9646 / 10000

Epoch 223 training complete

Cost on training data: 0.351274627275

Accuracy on training data: 48689 / 50000

Cost on evaluation data: 1.07576597516

Accuracy on evaluation data: 9660 / 10000

Epoch 224 training complete

Cost on training data: 0.331781509099

Accuracy on training data: 48788 / 50000

Cost on evaluation data: 1.05233448121

Accuracy on evaluation data: 9663 / 10000

Epoch 225 training complete

Cost on training data: 0.345815018963

Accuracy on training data: 48673 / 50000

Cost on evaluation data: 1.07212538723

Accuracy on evaluation data: 9631 / 10000

Epoch 226 training complete

Cost on training data: 0.33554405057

Accuracy on training data: 48777 / 50000

Cost on evaluation data: 1.05215916802

Accuracy on evaluation data: 9689 / 10000

Epoch 227 training complete

Cost on training data: 0.371399412386

Accuracy on training data: 48486 / 50000

Cost on evaluation data: 1.1050445835

Accuracy on evaluation data: 9576 / 10000

Epoch 228 training complete

Cost on training data: 0.355460531387

Accuracy on training data: 48568 / 50000

Cost on evaluation data: 1.07531205804

Accuracy on evaluation data: 9629 / 10000

Epoch 229 training complete

Cost on training data: 0.335234091239

Accuracy on training data: 48755 / 50000

Cost on evaluation data: 1.06662844131

Accuracy on evaluation data: 9663 / 10000

Epoch 230 training complete

Cost on training data: 0.360872290117

Accuracy on training data: 48587 / 50000

Cost on evaluation data: 1.08595573754

Accuracy on evaluation data: 9630 / 10000

Epoch 231 training complete

Cost on training data: 0.320120069476

Accuracy on training data: 48920 / 50000

Cost on evaluation data: 1.04383021505

Accuracy on evaluation data: 9691 / 10000

Epoch 232 training complete

Cost on training data: 0.384379342916

Accuracy on training data: 48308 / 50000

Cost on evaluation data: 1.11482108597

Accuracy on evaluation data: 9574 / 10000

Epoch 233 training complete

Cost on training data: 0.388052093324

Accuracy on training data: 48336 / 50000

Cost on evaluation data: 1.11231621909

Accuracy on evaluation data: 9598 / 10000

Epoch 234 training complete

Cost on training data: 0.350877244791

Accuracy on training data: 48668 / 50000

Cost on evaluation data: 1.08695993321

Accuracy on evaluation data: 9624 / 10000

Epoch 235 training complete

Cost on training data: 0.356079616128

Accuracy on training data: 48579 / 50000

Cost on evaluation data: 1.07086766293

Accuracy on evaluation data: 9628 / 10000

Epoch 236 training complete

Cost on training data: 0.385254412063

Accuracy on training data: 48346 / 50000

Cost on evaluation data: 1.10215076765

Accuracy on evaluation data: 9588 / 10000

Epoch 237 training complete

Cost on training data: 0.361553189473

Accuracy on training data: 48575 / 50000

Cost on evaluation data: 1.08466168688

Accuracy on evaluation data: 9633 / 10000

Epoch 238 training complete

Cost on training data: 0.387617138232

Accuracy on training data: 48327 / 50000

Cost on evaluation data: 1.11024605024

Accuracy on evaluation data: 9591 / 10000

Epoch 239 training complete

Cost on training data: 0.350876105942

Accuracy on training data: 48630 / 50000

Cost on evaluation data: 1.06409477482

Accuracy on evaluation data: 9648 / 10000

Epoch 240 training complete

Cost on training data: 0.371448934218

Accuracy on training data: 48478 / 50000

Cost on evaluation data: 1.0921195442

Accuracy on evaluation data: 9649 / 10000

Epoch 241 training complete

Cost on training data: 0.367606277684

Accuracy on training data: 48490 / 50000

Cost on evaluation data: 1.08940839353

Accuracy on evaluation data: 9632 / 10000

Epoch 242 training complete

Cost on training data: 0.393492396158

Accuracy on training data: 48183 / 50000

Cost on evaluation data: 1.1241897566

Accuracy on evaluation data: 9568 / 10000

Epoch 243 training complete

Cost on training data: 0.36349021557

Accuracy on training data: 48553 / 50000

Cost on evaluation data: 1.0869747123

Accuracy on evaluation data: 9610 / 10000

Epoch 244 training complete

Cost on training data: 0.35484739665

Accuracy on training data: 48587 / 50000

Cost on evaluation data: 1.07629716698

Accuracy on evaluation data: 9631 / 10000

Epoch 245 training complete

Cost on training data: 0.374814742934

Accuracy on training data: 48373 / 50000

Cost on evaluation data: 1.0932139331

Accuracy on evaluation data: 9598 / 10000

Epoch 246 training complete

Cost on training data: 0.36888276912

Accuracy on training data: 48440 / 50000

Cost on evaluation data: 1.08967857073

Accuracy on evaluation data: 9592 / 10000

Epoch 247 training complete

Cost on training data: 0.36020655462

Accuracy on training data: 48567 / 50000

Cost on evaluation data: 1.07809604781

Accuracy on evaluation data: 9629 / 10000

Epoch 248 training complete

Cost on training data: 0.370613595029

Accuracy on training data: 48458 / 50000

Cost on evaluation data: 1.09481115052

Accuracy on evaluation data: 9600 / 10000

Epoch 249 training complete

Cost on training data: 0.354217648006

Accuracy on training data: 48651 / 50000

Cost on evaluation data: 1.0827472882

Accuracy on evaluation data: 9620 / 10000

Epoch 250 training complete

Cost on training data: 0.379385018339

Accuracy on training data: 48401 / 50000

Cost on evaluation data: 1.10814659125

Accuracy on evaluation data: 9597 / 10000

Epoch 251 training complete

Cost on training data: 0.387708869525

Accuracy on training data: 48283 / 50000

Cost on evaluation data: 1.10728097961

Accuracy on evaluation data: 9556 / 10000

Epoch 252 training complete

Cost on training data: 0.383734434964

Accuracy on training data: 48348 / 50000

Cost on evaluation data: 1.11173141644

Accuracy on evaluation data: 9560 / 10000

Epoch 253 training complete

Cost on training data: 0.38358671788

Accuracy on training data: 48407 / 50000

Cost on evaluation data: 1.0863266131

Accuracy on evaluation data: 9621 / 10000

Epoch 254 training complete

Cost on training data: 0.366537385168

Accuracy on training data: 48533 / 50000

Cost on evaluation data: 1.08975440067

Accuracy on evaluation data: 9629 / 10000

Epoch 255 training complete

Cost on training data: 0.36747345403

Accuracy on training data: 48485 / 50000

Cost on evaluation data: 1.09491857597

Accuracy on evaluation data: 9604 / 10000

Epoch 256 training complete

Cost on training data: 0.343870634615

Accuracy on training data: 48709 / 50000

Cost on evaluation data: 1.07157113041

Accuracy on evaluation data: 9644 / 10000

Epoch 257 training complete

Cost on training data: 0.342520862214

Accuracy on training data: 48721 / 50000

Cost on evaluation data: 1.07532132228

Accuracy on evaluation data: 9643 / 10000

Epoch 258 training complete

Cost on training data: 0.349870388147

Accuracy on training data: 48613 / 50000

Cost on evaluation data: 1.07886143848

Accuracy on evaluation data: 9628 / 10000

Epoch 259 training complete

Cost on training data: 0.360784459052

Accuracy on training data: 48606 / 50000

Cost on evaluation data: 1.09785988669

Accuracy on evaluation data: 9607 / 10000

Epoch 260 training complete

Cost on training data: 0.340404010104

Accuracy on training data: 48710 / 50000

Cost on evaluation data: 1.07257775648

Accuracy on evaluation data: 9628 / 10000

Epoch 261 training complete

Cost on training data: 0.369703479397

Accuracy on training data: 48535 / 50000

Cost on evaluation data: 1.10041471412

Accuracy on evaluation data: 9613 / 10000

Epoch 262 training complete

Cost on training data: 0.389323395026

Accuracy on training data: 48274 / 50000

Cost on evaluation data: 1.11337291417

Accuracy on evaluation data: 9567 / 10000

Epoch 263 training complete

Cost on training data: 0.369476394677

Accuracy on training data: 48456 / 50000

Cost on evaluation data: 1.09635238639

Accuracy on evaluation data: 9585 / 10000

Epoch 264 training complete

Cost on training data: 0.359569756105

Accuracy on training data: 48552 / 50000

Cost on evaluation data: 1.08420902133

Accuracy on evaluation data: 9614 / 10000

Epoch 265 training complete

Cost on training data: 0.343861291746

Accuracy on training data: 48671 / 50000

Cost on evaluation data: 1.06489896519

Accuracy on evaluation data: 9657 / 10000

Epoch 266 training complete

Cost on training data: 0.355101178141

Accuracy on training data: 48604 / 50000

Cost on evaluation data: 1.08296564702

Accuracy on evaluation data: 9614 / 10000

Epoch 267 training complete

Cost on training data: 0.346742243546

Accuracy on training data: 48657 / 50000

Cost on evaluation data: 1.07281886276

Accuracy on evaluation data: 9633 / 10000

Epoch 268 training complete

Cost on training data: 0.348950419541

Accuracy on training data: 48645 / 50000

Cost on evaluation data: 1.08708537916

Accuracy on evaluation data: 9609 / 10000

Epoch 269 training complete

Cost on training data: 0.372979824165

Accuracy on training data: 48420 / 50000

Cost on evaluation data: 1.10110170092

Accuracy on evaluation data: 9583 / 10000

Epoch 270 training complete

Cost on training data: 0.356060708872

Accuracy on training data: 48608 / 50000

Cost on evaluation data: 1.0812464878

Accuracy on evaluation data: 9627 / 10000

Epoch 271 training complete

Cost on training data: 0.354691111137

Accuracy on training data: 48583 / 50000

Cost on evaluation data: 1.08147931455

Accuracy on evaluation data: 9612 / 10000

Epoch 272 training complete

Cost on training data: 0.371351945595

Accuracy on training data: 48465 / 50000

Cost on evaluation data: 1.09540674664

Accuracy on evaluation data: 9580 / 10000

Epoch 273 training complete

Cost on training data: 0.365972904522

Accuracy on training data: 48478 / 50000

Cost on evaluation data: 1.09488098465

Accuracy on evaluation data: 9591 / 10000

Epoch 274 training complete

Cost on training data: 0.334815863088

Accuracy on training data: 48861 / 50000

Cost on evaluation data: 1.05973498983

Accuracy on evaluation data: 9689 / 10000

Epoch 275 training complete

Cost on training data: 0.387460955252

Accuracy on training data: 48315 / 50000

Cost on evaluation data: 1.1043972348

Accuracy on evaluation data: 9589 / 10000

Epoch 276 training complete

Cost on training data: 0.394573941832

Accuracy on training data: 48281 / 50000

Cost on evaluation data: 1.1152000307

Accuracy on evaluation data: 9590 / 10000

Epoch 277 training complete

Cost on training data: 0.388827769685

Accuracy on training data: 48318 / 50000

Cost on evaluation data: 1.10839168794

Accuracy on evaluation data: 9593 / 10000

Epoch 278 training complete

Cost on training data: 0.341274039536

Accuracy on training data: 48693 / 50000

Cost on evaluation data: 1.06980739596

Accuracy on evaluation data: 9648 / 10000

Epoch 279 training complete

Cost on training data: 0.342948102956

Accuracy on training data: 48732 / 50000

Cost on evaluation data: 1.07520680347

Accuracy on evaluation data: 9640 / 10000

Epoch 280 training complete

Cost on training data: 0.339709628539

Accuracy on training data: 48758 / 50000

Cost on evaluation data: 1.06233640575

Accuracy on evaluation data: 9666 / 10000

Epoch 281 training complete

Cost on training data: 0.438503171853

Accuracy on training data: 47900 / 50000

Cost on evaluation data: 1.16905905611

Accuracy on evaluation data: 9505 / 10000

Epoch 282 training complete

Cost on training data: 0.338605576103

Accuracy on training data: 48774 / 50000

Cost on evaluation data: 1.06467447126

Accuracy on evaluation data: 9647 / 10000

Epoch 283 training complete

Cost on training data: 0.342132354306

Accuracy on training data: 48679 / 50000

Cost on evaluation data: 1.05968083562

Accuracy on evaluation data: 9663 / 10000

Epoch 284 training complete

Cost on training data: 0.34538383456

Accuracy on training data: 48696 / 50000

Cost on evaluation data: 1.0848962905

Accuracy on evaluation data: 9629 / 10000

Epoch 285 training complete

Cost on training data: 0.3421450113

Accuracy on training data: 48693 / 50000

Cost on evaluation data: 1.08191858304

Accuracy on evaluation data: 9625 / 10000

Epoch 286 training complete

Cost on training data: 0.390462449148

Accuracy on training data: 48251 / 50000

Cost on evaluation data: 1.1199920422

Accuracy on evaluation data: 9541 / 10000

Epoch 287 training complete

Cost on training data: 0.335546365929

Accuracy on training data: 48740 / 50000

Cost on evaluation data: 1.06445417834

Accuracy on evaluation data: 9635 / 10000

Epoch 288 training complete

Cost on training data: 0.405249246602

Accuracy on training data: 48141 / 50000

Cost on evaluation data: 1.12865857839

Accuracy on evaluation data: 9528 / 10000

Epoch 289 training complete

Cost on training data: 0.386702610448

Accuracy on training data: 48333 / 50000

Cost on evaluation data: 1.10450569677

Accuracy on evaluation data: 9553 / 10000

Epoch 290 training complete

Cost on training data: 0.386520437268

Accuracy on training data: 48354 / 50000

Cost on evaluation data: 1.11223037134

Accuracy on evaluation data: 9623 / 10000

Epoch 291 training complete

Cost on training data: 0.372633213924

Accuracy on training data: 48478 / 50000

Cost on evaluation data: 1.09923943506

Accuracy on evaluation data: 9608 / 10000

Epoch 292 training complete

Cost on training data: 0.336270609223

Accuracy on training data: 48790 / 50000

Cost on evaluation data: 1.06462862297

Accuracy on evaluation data: 9636 / 10000

Epoch 293 training complete

Cost on training data: 0.336453276273

Accuracy on training data: 48799 / 50000

Cost on evaluation data: 1.06119627797

Accuracy on evaluation data: 9666 / 10000

Epoch 294 training complete

Cost on training data: 0.335372288091

Accuracy on training data: 48802 / 50000

Cost on evaluation data: 1.06864287032

Accuracy on evaluation data: 9646 / 10000

Epoch 295 training complete

Cost on training data: 0.396423284896

Accuracy on training data: 48228 / 50000

Cost on evaluation data: 1.12987961005

Accuracy on evaluation data: 9532 / 10000

Epoch 296 training complete

Cost on training data: 0.359868419032

Accuracy on training data: 48601 / 50000

Cost on evaluation data: 1.09137040399

Accuracy on evaluation data: 9620 / 10000

Epoch 297 training complete

Cost on training data: 0.34037907012

Accuracy on training data: 48777 / 50000

Cost on evaluation data: 1.06109388073

Accuracy on evaluation data: 9659 / 10000

Epoch 298 training complete

Cost on training data: 0.352894456019

Accuracy on training data: 48686 / 50000

Cost on evaluation data: 1.08318392343

Accuracy on evaluation data: 9636 / 10000

Epoch 299 training complete

Cost on training data: 0.3481901494

Accuracy on training data: 48725 / 50000

Cost on evaluation data: 1.07592605222

Accuracy on evaluation data: 9653 / 10000

Epoch 300 training complete

Cost on training data: 0.360327134351

Accuracy on training data: 48574 / 50000

Cost on evaluation data: 1.08217177879

Accuracy on evaluation data: 9649 / 10000

Epoch 301 training complete

Cost on training data: 0.375698431221

Accuracy on training data: 48484 / 50000

Cost on evaluation data: 1.10051046598

Accuracy on evaluation data: 9612 / 10000

Epoch 302 training complete

Cost on training data: 0.350340635892

Accuracy on training data: 48694 / 50000

Cost on evaluation data: 1.0875162689

Accuracy on evaluation data: 9604 / 10000

Epoch 303 training complete

Cost on training data: 0.411304295133

Accuracy on training data: 48109 / 50000

Cost on evaluation data: 1.14582057342

Accuracy on evaluation data: 9531 / 10000

Epoch 304 training complete

Cost on training data: 0.362227898715

Accuracy on training data: 48570 / 50000

Cost on evaluation data: 1.0949322979

Accuracy on evaluation data: 9609 / 10000

Epoch 305 training complete

Cost on training data: 0.338803887113

Accuracy on training data: 48751 / 50000

Cost on evaluation data: 1.06814248044

Accuracy on evaluation data: 9647 / 10000

Epoch 306 training complete

Cost on training data: 0.361362487264

Accuracy on training data: 48562 / 50000

Cost on evaluation data: 1.09515400895

Accuracy on evaluation data: 9614 / 10000

Epoch 307 training complete

Cost on training data: 0.379872215577

Accuracy on training data: 48393 / 50000

Cost on evaluation data: 1.11095186031

Accuracy on evaluation data: 9589 / 10000

Epoch 308 training complete

Cost on training data: 0.354454601442

Accuracy on training data: 48650 / 50000

Cost on evaluation data: 1.09349275256

Accuracy on evaluation data: 9621 / 10000

Epoch 309 training complete

Cost on training data: 0.360173428482

Accuracy on training data: 48580 / 50000

Cost on evaluation data: 1.0945912586

Accuracy on evaluation data: 9624 / 10000

Epoch 310 training complete

Cost on training data: 0.373805107091

Accuracy on training data: 48449 / 50000

Cost on evaluation data: 1.10930992294

Accuracy on evaluation data: 9577 / 10000

Epoch 311 training complete

Cost on training data: 0.394066954012

Accuracy on training data: 48233 / 50000

Cost on evaluation data: 1.12478516011

Accuracy on evaluation data: 9551 / 10000

Epoch 312 training complete

Cost on training data: 0.380906621104

Accuracy on training data: 48343 / 50000

Cost on evaluation data: 1.11360851777

Accuracy on evaluation data: 9568 / 10000

Epoch 313 training complete

Cost on training data: 0.369494817317

Accuracy on training data: 48489 / 50000

Cost on evaluation data: 1.10610138255

Accuracy on evaluation data: 9569 / 10000

Epoch 314 training complete

Cost on training data: 0.343126585962

Accuracy on training data: 48748 / 50000

Cost on evaluation data: 1.06874051703

Accuracy on evaluation data: 9645 / 10000

Epoch 315 training complete

Cost on training data: 0.360193040223

Accuracy on training data: 48589 / 50000

Cost on evaluation data: 1.08657501412

Accuracy on evaluation data: 9621 / 10000

Epoch 316 training complete

Cost on training data: 0.348260813428

Accuracy on training data: 48697 / 50000

Cost on evaluation data: 1.07675455677

Accuracy on evaluation data: 9642 / 10000

Epoch 317 training complete

Cost on training data: 0.363585420318

Accuracy on training data: 48517 / 50000

Cost on evaluation data: 1.1069050984

Accuracy on evaluation data: 9579 / 10000

Epoch 318 training complete

Cost on training data: 0.348566853843

Accuracy on training data: 48662 / 50000

Cost on evaluation data: 1.08429456522

Accuracy on evaluation data: 9631 / 10000

Epoch 319 training complete

Cost on training data: 0.330248759376

Accuracy on training data: 48792 / 50000

Cost on evaluation data: 1.04602179662

Accuracy on evaluation data: 9660 / 10000

Epoch 320 training complete

Cost on training data: 0.383782911136

Accuracy on training data: 48401 / 50000

Cost on evaluation data: 1.11028669393

Accuracy on evaluation data: 9584 / 10000

Epoch 321 training complete

Cost on training data: 0.357371661087

Accuracy on training data: 48595 / 50000

Cost on evaluation data: 1.07160980966

Accuracy on evaluation data: 9629 / 10000

Epoch 322 training complete

Cost on training data: 0.357659732661

Accuracy on training data: 48570 / 50000

Cost on evaluation data: 1.0898415206

Accuracy on evaluation data: 9601 / 10000

Epoch 323 training complete

Cost on training data: 0.34146165883

Accuracy on training data: 48761 / 50000

Cost on evaluation data: 1.06765265038

Accuracy on evaluation data: 9640 / 10000

Epoch 324 training complete

Cost on training data: 0.375773473892

Accuracy on training data: 48410 / 50000

Cost on evaluation data: 1.09043026958

Accuracy on evaluation data: 9600 / 10000

Epoch 325 training complete

Cost on training data: 0.358737401619

Accuracy on training data: 48577 / 50000

Cost on evaluation data: 1.0862536655

Accuracy on evaluation data: 9620 / 10000

Epoch 326 training complete

Cost on training data: 0.345348105564

Accuracy on training data: 48675 / 50000

Cost on evaluation data: 1.06920215463

Accuracy on evaluation data: 9638 / 10000

Epoch 327 training complete

Cost on training data: 0.36068567808

Accuracy on training data: 48538 / 50000

Cost on evaluation data: 1.09343282625

Accuracy on evaluation data: 9603 / 10000

Epoch 328 training complete

Cost on training data: 0.363184523924

Accuracy on training data: 48533 / 50000

Cost on evaluation data: 1.08973093159

Accuracy on evaluation data: 9616 / 10000

Epoch 329 training complete

Cost on training data: 0.398687047758

Accuracy on training data: 48244 / 50000

Cost on evaluation data: 1.11147754516

Accuracy on evaluation data: 9584 / 10000

Epoch 330 training complete

Cost on training data: 0.385050344133

Accuracy on training data: 48321 / 50000

Cost on evaluation data: 1.10910025773

Accuracy on evaluation data: 9587 / 10000

Epoch 331 training complete

Cost on training data: 0.348289860794

Accuracy on training data: 48665 / 50000

Cost on evaluation data: 1.08637878776

Accuracy on evaluation data: 9623 / 10000

Epoch 332 training complete

Cost on training data: 0.350667937926

Accuracy on training data: 48652 / 50000

Cost on evaluation data: 1.08434939435

Accuracy on evaluation data: 9620 / 10000

Epoch 333 training complete

Cost on training data: 0.386523398978

Accuracy on training data: 48377 / 50000

Cost on evaluation data: 1.10705452798

Accuracy on evaluation data: 9586 / 10000

Epoch 334 training complete

Cost on training data: 0.357373384253

Accuracy on training data: 48630 / 50000

Cost on evaluation data: 1.08548553427

Accuracy on evaluation data: 9615 / 10000

Epoch 335 training complete

Cost on training data: 0.332762509197

Accuracy on training data: 48817 / 50000

Cost on evaluation data: 1.06356797893

Accuracy on evaluation data: 9659 / 10000

Epoch 336 training complete

Cost on training data: 0.349679807524

Accuracy on training data: 48645 / 50000

Cost on evaluation data: 1.07020761648

Accuracy on evaluation data: 9654 / 10000

Epoch 337 training complete

Cost on training data: 0.395504904231

Accuracy on training data: 48298 / 50000

Cost on evaluation data: 1.12194554068

Accuracy on evaluation data: 9583 / 10000

Epoch 338 training complete

Cost on training data: 0.358853349881

Accuracy on training data: 48597 / 50000

Cost on evaluation data: 1.09715718164

Accuracy on evaluation data: 9600 / 10000

Epoch 339 training complete

Cost on training data: 0.349926791855

Accuracy on training data: 48663 / 50000

Cost on evaluation data: 1.08201574207

Accuracy on evaluation data: 9628 / 10000

Epoch 340 training complete

Cost on training data: 0.353188231703

Accuracy on training data: 48594 / 50000

Cost on evaluation data: 1.08632888143

Accuracy on evaluation data: 9623 / 10000

Epoch 341 training complete

Cost on training data: 0.38938952477

Accuracy on training data: 48329 / 50000

Cost on evaluation data: 1.11526185059

Accuracy on evaluation data: 9567 / 10000

Epoch 342 training complete

Cost on training data: 0.377462701037

Accuracy on training data: 48431 / 50000

Cost on evaluation data: 1.10795406801

Accuracy on evaluation data: 9601 / 10000

Epoch 343 training complete

Cost on training data: 0.365977324355

Accuracy on training data: 48491 / 50000

Cost on evaluation data: 1.10160712006

Accuracy on evaluation data: 9577 / 10000

Epoch 344 training complete

Cost on training data: 0.336085065692

Accuracy on training data: 48767 / 50000

Cost on evaluation data: 1.06534265226

Accuracy on evaluation data: 9662 / 10000

Epoch 345 training complete

Cost on training data: 0.409969454603

Accuracy on training data: 48155 / 50000

Cost on evaluation data: 1.14731162887

Accuracy on evaluation data: 9514 / 10000

Epoch 346 training complete

Cost on training data: 0.339094214986

Accuracy on training data: 48714 / 50000

Cost on evaluation data: 1.07188289468

Accuracy on evaluation data: 9637 / 10000

Epoch 347 training complete

Cost on training data: 0.350088893861

Accuracy on training data: 48673 / 50000

Cost on evaluation data: 1.0868734699

Accuracy on evaluation data: 9622 / 10000

Epoch 348 training complete

Cost on training data: 0.41329833114

Accuracy on training data: 48226 / 50000

Cost on evaluation data: 1.13016837769

Accuracy on evaluation data: 9556 / 10000

Epoch 349 training complete

Cost on training data: 0.349011592464

Accuracy on training data: 48663 / 50000

Cost on evaluation data: 1.08634984731

Accuracy on evaluation data: 9626 / 10000

Epoch 350 training complete

Cost on training data: 0.369741031731

Accuracy on training data: 48455 / 50000

Cost on evaluation data: 1.09634989417

Accuracy on evaluation data: 9595 / 10000

Epoch 351 training complete

Cost on training data: 0.363959736166

Accuracy on training data: 48529 / 50000

Cost on evaluation data: 1.09314380665

Accuracy on evaluation data: 9611 / 10000

Epoch 352 training complete

Cost on training data: 0.368784782312

Accuracy on training data: 48550 / 50000

Cost on evaluation data: 1.10404577056

Accuracy on evaluation data: 9610 / 10000

Epoch 353 training complete

Cost on training data: 0.357225761251

Accuracy on training data: 48593 / 50000

Cost on evaluation data: 1.095191491

Accuracy on evaluation data: 9614 / 10000

Epoch 354 training complete

Cost on training data: 0.335580264157

Accuracy on training data: 48814 / 50000

Cost on evaluation data: 1.0629784718

Accuracy on evaluation data: 9670 / 10000

Epoch 355 training complete

Cost on training data: 0.417403465603

Accuracy on training data: 48055 / 50000

Cost on evaluation data: 1.15684096938

Accuracy on evaluation data: 9528 / 10000

Epoch 356 training complete

Cost on training data: 0.361288011775

Accuracy on training data: 48556 / 50000

Cost on evaluation data: 1.10097082294

Accuracy on evaluation data: 9593 / 10000

Epoch 357 training complete

Cost on training data: 0.388149987193

Accuracy on training data: 48354 / 50000

Cost on evaluation data: 1.11952856278

Accuracy on evaluation data: 9565 / 10000

Epoch 358 training complete

Cost on training data: 0.349460917928

Accuracy on training data: 48673 / 50000

Cost on evaluation data: 1.08906766628

Accuracy on evaluation data: 9629 / 10000

Epoch 359 training complete

Cost on training data: 0.338673047848

Accuracy on training data: 48750 / 50000

Cost on evaluation data: 1.06332000523

Accuracy on evaluation data: 9658 / 10000

Epoch 360 training complete

Cost on training data: 0.360318614292

Accuracy on training data: 48513 / 50000

Cost on evaluation data: 1.09691771517

Accuracy on evaluation data: 9591 / 10000

Epoch 361 training complete

Cost on training data: 0.364823425027

Accuracy on training data: 48555 / 50000

Cost on evaluation data: 1.10171912656

Accuracy on evaluation data: 9617 / 10000

Epoch 362 training complete

Cost on training data: 0.366087674219

Accuracy on training data: 48502 / 50000

Cost on evaluation data: 1.10372574134

Accuracy on evaluation data: 9578 / 10000

Epoch 363 training complete

Cost on training data: 0.38418437382

Accuracy on training data: 48341 / 50000

Cost on evaluation data: 1.10784617731

Accuracy on evaluation data: 9589 / 10000

Epoch 364 training complete

Cost on training data: 0.344754448465

Accuracy on training data: 48719 / 50000

Cost on evaluation data: 1.08407786993

Accuracy on evaluation data: 9634 / 10000

Epoch 365 training complete

Cost on training data: 0.34609368992

Accuracy on training data: 48689 / 50000

Cost on evaluation data: 1.06667208471

Accuracy on evaluation data: 9662 / 10000

Epoch 366 training complete

Cost on training data: 0.3418698954

Accuracy on training data: 48706 / 50000

Cost on evaluation data: 1.08307306202

Accuracy on evaluation data: 9625 / 10000

Epoch 367 training complete

Cost on training data: 0.368586619782

Accuracy on training data: 48456 / 50000

Cost on evaluation data: 1.09845752407

Accuracy on evaluation data: 9605 / 10000

Epoch 368 training complete

Cost on training data: 0.341695164829

Accuracy on training data: 48680 / 50000

Cost on evaluation data: 1.07143048082

Accuracy on evaluation data: 9646 / 10000

Epoch 369 training complete

Cost on training data: 0.39526755904

Accuracy on training data: 48235 / 50000

Cost on evaluation data: 1.13556613251

Accuracy on evaluation data: 9540 / 10000

Epoch 370 training complete

Cost on training data: 0.38401885474

Accuracy on training data: 48401 / 50000

Cost on evaluation data: 1.10464843612

Accuracy on evaluation data: 9582 / 10000

Epoch 371 training complete

Cost on training data: 0.353827869188

Accuracy on training data: 48590 / 50000

Cost on evaluation data: 1.06268224728

Accuracy on evaluation data: 9650 / 10000

Epoch 372 training complete

Cost on training data: 0.362510601775

Accuracy on training data: 48540 / 50000

Cost on evaluation data: 1.09229487094

Accuracy on evaluation data: 9613 / 10000

Epoch 373 training complete

Cost on training data: 0.343651999902

Accuracy on training data: 48706 / 50000

Cost on evaluation data: 1.07275359266

Accuracy on evaluation data: 9647 / 10000

Epoch 374 training complete

Cost on training data: 0.408844963312

Accuracy on training data: 48183 / 50000

Cost on evaluation data: 1.13951789436

Accuracy on evaluation data: 9531 / 10000

Epoch 375 training complete

Cost on training data: 0.352901159648

Accuracy on training data: 48617 / 50000

Cost on evaluation data: 1.07867470719

Accuracy on evaluation data: 9617 / 10000

Epoch 376 training complete

Cost on training data: 0.378953346118

Accuracy on training data: 48412 / 50000

Cost on evaluation data: 1.09970923919

Accuracy on evaluation data: 9601 / 10000

Epoch 377 training complete

Cost on training data: 0.336118526632

Accuracy on training data: 48797 / 50000

Cost on evaluation data: 1.06481505827

Accuracy on evaluation data: 9651 / 10000

Epoch 378 training complete

Cost on training data: 0.374707318505

Accuracy on training data: 48459 / 50000

Cost on evaluation data: 1.10165178401

Accuracy on evaluation data: 9597 / 10000

Epoch 379 training complete

Cost on training data: 0.364646037044

Accuracy on training data: 48510 / 50000

Cost on evaluation data: 1.08782054286

Accuracy on evaluation data: 9624 / 10000

Epoch 380 training complete

Cost on training data: 0.348159609616

Accuracy on training data: 48647 / 50000

Cost on evaluation data: 1.07472685616

Accuracy on evaluation data: 9618 / 10000

Epoch 381 training complete

Cost on training data: 0.355254966635

Accuracy on training data: 48632 / 50000

Cost on evaluation data: 1.07146838168

Accuracy on evaluation data: 9621 / 10000

Epoch 382 training complete

Cost on training data: 0.333063667602

Accuracy on training data: 48800 / 50000

Cost on evaluation data: 1.06269719724

Accuracy on evaluation data: 9644 / 10000

Epoch 383 training complete

Cost on training data: 0.342146544843

Accuracy on training data: 48691 / 50000

Cost on evaluation data: 1.06503172574

Accuracy on evaluation data: 9670 / 10000

Epoch 384 training complete

Cost on training data: 0.354845694002

Accuracy on training data: 48594 / 50000

Cost on evaluation data: 1.08549745215

Accuracy on evaluation data: 9626 / 10000

Epoch 385 training complete

Cost on training data: 0.352718165896

Accuracy on training data: 48605 / 50000

Cost on evaluation data: 1.08766088087

Accuracy on evaluation data: 9600 / 10000

Epoch 386 training complete

Cost on training data: 0.362902196413

Accuracy on training data: 48557 / 50000

Cost on evaluation data: 1.09168191577

Accuracy on evaluation data: 9608 / 10000

Epoch 387 training complete

Cost on training data: 0.384765009775

Accuracy on training data: 48347 / 50000

Cost on evaluation data: 1.10562825135

Accuracy on evaluation data: 9587 / 10000

Epoch 388 training complete

Cost on training data: 0.36743987023

Accuracy on training data: 48543 / 50000

Cost on evaluation data: 1.0939727365

Accuracy on evaluation data: 9616 / 10000

Epoch 389 training complete

Cost on training data: 0.384149185768

Accuracy on training data: 48387 / 50000

Cost on evaluation data: 1.11482732023

Accuracy on evaluation data: 9567 / 10000

Epoch 390 training complete

Cost on training data: 0.370269617102

Accuracy on training data: 48499 / 50000

Cost on evaluation data: 1.10828055727

Accuracy on evaluation data: 9592 / 10000

Epoch 391 training complete

Cost on training data: 0.351669882985

Accuracy on training data: 48668 / 50000

Cost on evaluation data: 1.09093148334

Accuracy on evaluation data: 9624 / 10000

Epoch 392 training complete

Cost on training data: 0.344255024699

Accuracy on training data: 48674 / 50000

Cost on evaluation data: 1.07318276734

Accuracy on evaluation data: 9653 / 10000

Epoch 393 training complete

Cost on training data: 0.348395485364

Accuracy on training data: 48651 / 50000

Cost on evaluation data: 1.07546304839

Accuracy on evaluation data: 9638 / 10000

Epoch 394 training complete

Cost on training data: 0.427304898925

Accuracy on training data: 47917 / 50000

Cost on evaluation data: 1.14838394828

Accuracy on evaluation data: 9495 / 10000

Epoch 395 training complete

Cost on training data: 0.342646866426

Accuracy on training data: 48722 / 50000

Cost on evaluation data: 1.08225990802

Accuracy on evaluation data: 9612 / 10000

Epoch 396 training complete

Cost on training data: 0.352607513756

Accuracy on training data: 48633 / 50000

Cost on evaluation data: 1.0832840042

Accuracy on evaluation data: 9634 / 10000

Epoch 397 training complete

Cost on training data: 0.348843682658

Accuracy on training data: 48666 / 50000

Cost on evaluation data: 1.06684858141

Accuracy on evaluation data: 9656 / 10000

Epoch 398 training complete

Cost on training data: 0.351048409009

Accuracy on training data: 48652 / 50000

Cost on evaluation data: 1.08109793796

Accuracy on evaluation data: 9638 / 10000

Epoch 399 training complete

Cost on training data: 0.410649134412

Accuracy on training data: 48094 / 50000

Cost on evaluation data: 1.14460120848

Accuracy on evaluation data: 9535 / 10000

week_1_solution_14

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]: print("14. Repeat 12 for a deep network with three hidden layers, with 30 neuron in ea
```

14. Repeat 12 for a deep network with three hidden layers, with 30 neuron in each.

```
In [3]: import network2
net2_all_train = network2.Network([784, 30, 30, 30, 10], cost=network2.CrossEntropyCost,
net2_all_train.large_weight_initializer()

epochs = 400

evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
    training_data,
    epochs,
    10,
    0.5,
    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: 1.35470700202
Accuracy on training data: 45885 / 50000
Cost on evaluation data: 4.7731181301

Accuracy on evaluation data: 9161 / 10000

Epoch 1 training complete

Cost on training data: 0.977238185234

Accuracy on training data: 46808 / 50000

Cost on evaluation data: 3.3413493973

Accuracy on evaluation data: 9298 / 10000

Epoch 2 training complete

Cost on training data: 0.783991961857

Accuracy on training data: 47070 / 50000

Cost on evaluation data: 2.48929308517

Accuracy on evaluation data: 9393 / 10000

Epoch 3 training complete

Cost on training data: 0.661731907293

Accuracy on training data: 47062 / 50000

Cost on evaluation data: 1.99874702098

Accuracy on evaluation data: 9350 / 10000

Epoch 4 training complete

Cost on training data: 0.539353112243

Accuracy on training data: 47832 / 50000

Cost on evaluation data: 1.66086387002

Accuracy on evaluation data: 9504 / 10000

Epoch 5 training complete

Cost on training data: 0.494589574392

Accuracy on training data: 47997 / 50000

Cost on evaluation data: 1.48986604345

Accuracy on evaluation data: 9510 / 10000

Epoch 6 training complete

Cost on training data: 0.514594425065

Accuracy on training data: 47566 / 50000

Cost on evaluation data: 1.42262887343

Accuracy on evaluation data: 9451 / 10000

Epoch 7 training complete

Cost on training data: 0.502757825841

Accuracy on training data: 47639 / 50000

Cost on evaluation data: 1.37879919567

Accuracy on evaluation data: 9432 / 10000

Epoch 8 training complete

Cost on training data: 0.509498140458

Accuracy on training data: 47454 / 50000

Cost on evaluation data: 1.34174790261

Accuracy on evaluation data: 9425 / 10000

Epoch 9 training complete

Cost on training data: 0.509880935687

Accuracy on training data: 47535 / 50000

Cost on evaluation data: 1.336085973

Accuracy on evaluation data: 9444 / 10000

Epoch 10 training complete

Cost on training data: 0.485878125735

Accuracy on training data: 47575 / 50000

Cost on evaluation data: 1.30019460932

Accuracy on evaluation data: 9469 / 10000

Epoch 11 training complete

Cost on training data: 0.418428624918

Accuracy on training data: 48263 / 50000

Cost on evaluation data: 1.22747325987

Accuracy on evaluation data: 9582 / 10000

Epoch 12 training complete

Cost on training data: 0.46108954249

Accuracy on training data: 47776 / 50000

Cost on evaluation data: 1.272688251

Accuracy on evaluation data: 9499 / 10000

Epoch 13 training complete

Cost on training data: 0.520268989926

Accuracy on training data: 47178 / 50000

Cost on evaluation data: 1.32541995441

Accuracy on evaluation data: 9394 / 10000

Epoch 14 training complete

Cost on training data: 0.454690410336

Accuracy on training data: 47854 / 50000

Cost on evaluation data: 1.29022804664

Accuracy on evaluation data: 9480 / 10000

Epoch 15 training complete

Cost on training data: 0.433326613227

Accuracy on training data: 48081 / 50000

Cost on evaluation data: 1.25568100053

Accuracy on evaluation data: 9516 / 10000

Epoch 16 training complete

Cost on training data: 0.420366502776

Accuracy on training data: 48180 / 50000

Cost on evaluation data: 1.26498467264

Accuracy on evaluation data: 9535 / 10000

Epoch 17 training complete

Cost on training data: 0.427975913774

Accuracy on training data: 48138 / 50000

Cost on evaluation data: 1.25251622444

Accuracy on evaluation data: 9513 / 10000

Epoch 18 training complete

Cost on training data: 0.425913232624

Accuracy on training data: 48122 / 50000

Cost on evaluation data: 1.24069723621

Accuracy on evaluation data: 9549 / 10000

Epoch 19 training complete

Cost on training data: 0.416687290406

Accuracy on training data: 48173 / 50000

Cost on evaluation data: 1.23354999524

Accuracy on evaluation data: 9567 / 10000

Epoch 20 training complete

Cost on training data: 0.403098133317

Accuracy on training data: 48293 / 50000

Cost on evaluation data: 1.21534641463

Accuracy on evaluation data: 9564 / 10000

Epoch 21 training complete

Cost on training data: 0.400788076316

Accuracy on training data: 48361 / 50000

Cost on evaluation data: 1.20740931961

Accuracy on evaluation data: 9588 / 10000

Epoch 22 training complete

Cost on training data: 0.398736901111

Accuracy on training data: 48367 / 50000

Cost on evaluation data: 1.20848188071

Accuracy on evaluation data: 9581 / 10000

Epoch 23 training complete

Cost on training data: 0.432218770818

Accuracy on training data: 48071 / 50000

Cost on evaluation data: 1.23829744837

Accuracy on evaluation data: 9530 / 10000

Epoch 24 training complete

Cost on training data: 0.417935565873

Accuracy on training data: 48126 / 50000

Cost on evaluation data: 1.22713330481

Accuracy on evaluation data: 9557 / 10000

Epoch 25 training complete

Cost on training data: 0.40367604357

Accuracy on training data: 48329 / 50000

Cost on evaluation data: 1.21792038293

Accuracy on evaluation data: 9569 / 10000

Epoch 26 training complete

Cost on training data: 0.399052006505

Accuracy on training data: 48410 / 50000

Cost on evaluation data: 1.20858221073

Accuracy on evaluation data: 9610 / 10000

Epoch 27 training complete

Cost on training data: 0.425039983992

Accuracy on training data: 48114 / 50000

Cost on evaluation data: 1.24270973782

Accuracy on evaluation data: 9543 / 10000

Epoch 28 training complete

Cost on training data: 0.394921622975

Accuracy on training data: 48360 / 50000

Cost on evaluation data: 1.21204820443

Accuracy on evaluation data: 9597 / 10000

Epoch 29 training complete

Cost on training data: 0.443985843788

Accuracy on training data: 47901 / 50000

Cost on evaluation data: 1.26224529265

Accuracy on evaluation data: 9494 / 10000

Epoch 30 training complete

Cost on training data: 0.429103556391

Accuracy on training data: 48091 / 50000

Cost on evaluation data: 1.24611427638

Accuracy on evaluation data: 9546 / 10000

Epoch 31 training complete

Cost on training data: 0.474356989721

Accuracy on training data: 47692 / 50000

Cost on evaluation data: 1.29108028208

Accuracy on evaluation data: 9449 / 10000

Epoch 32 training complete

Cost on training data: 0.429838635335

Accuracy on training data: 48105 / 50000

Cost on evaluation data: 1.23179360625

Accuracy on evaluation data: 9568 / 10000

Epoch 33 training complete

Cost on training data: 0.501476217356

Accuracy on training data: 47401 / 50000

Cost on evaluation data: 1.30515079563

Accuracy on evaluation data: 9429 / 10000

Epoch 34 training complete

Cost on training data: 0.408226997936

Accuracy on training data: 48312 / 50000

Cost on evaluation data: 1.22387767179

Accuracy on evaluation data: 9573 / 10000

Epoch 35 training complete

Cost on training data: 0.422065878789

Accuracy on training data: 48111 / 50000

Cost on evaluation data: 1.26331938108

Accuracy on evaluation data: 9496 / 10000

Epoch 36 training complete

Cost on training data: 0.389761641698

Accuracy on training data: 48405 / 50000

Cost on evaluation data: 1.20793068156

Accuracy on evaluation data: 9595 / 10000

Epoch 37 training complete

Cost on training data: 0.415751899657

Accuracy on training data: 48143 / 50000

Cost on evaluation data: 1.23398251062

Accuracy on evaluation data: 9552 / 10000

Epoch 38 training complete

Cost on training data: 0.411205429258

Accuracy on training data: 48221 / 50000

Cost on evaluation data: 1.21850741223

Accuracy on evaluation data: 9596 / 10000

Epoch 39 training complete

Cost on training data: 0.373949703961

Accuracy on training data: 48542 / 50000

Cost on evaluation data: 1.19849168953

Accuracy on evaluation data: 9599 / 10000

Epoch 40 training complete

Cost on training data: 0.425544167372

Accuracy on training data: 48200 / 50000

Cost on evaluation data: 1.24591080509

Accuracy on evaluation data: 9554 / 10000

Epoch 41 training complete

Cost on training data: 0.401268480078

Accuracy on training data: 48301 / 50000

Cost on evaluation data: 1.22098063281

Accuracy on evaluation data: 9590 / 10000

Epoch 42 training complete

Cost on training data: 0.455963110622

Accuracy on training data: 47777 / 50000

Cost on evaluation data: 1.27397054973

Accuracy on evaluation data: 9475 / 10000

Epoch 43 training complete

Cost on training data: 0.410763700792

Accuracy on training data: 48214 / 50000

Cost on evaluation data: 1.24821349953

Accuracy on evaluation data: 9546 / 10000

Epoch 44 training complete

Cost on training data: 0.420232693614

Accuracy on training data: 48134 / 50000

Cost on evaluation data: 1.2411094894

Accuracy on evaluation data: 9531 / 10000

Epoch 45 training complete

Cost on training data: 0.365515891203

Accuracy on training data: 48634 / 50000

Cost on evaluation data: 1.17712388119

Accuracy on evaluation data: 9645 / 10000

Epoch 46 training complete

Cost on training data: 0.379046655039

Accuracy on training data: 48547 / 50000

Cost on evaluation data: 1.19431897448

Accuracy on evaluation data: 9624 / 10000

Epoch 47 training complete

Cost on training data: 0.437650190253

Accuracy on training data: 47956 / 50000

Cost on evaluation data: 1.2534170177

Accuracy on evaluation data: 9517 / 10000

Epoch 48 training complete

Cost on training data: 0.388575985762

Accuracy on training data: 48425 / 50000

Cost on evaluation data: 1.20418511444

Accuracy on evaluation data: 9590 / 10000

Epoch 49 training complete

Cost on training data: 0.377348793006

Accuracy on training data: 48535 / 50000

Cost on evaluation data: 1.19885427453

Accuracy on evaluation data: 9633 / 10000

Epoch 50 training complete

Cost on training data: 0.458090968283

Accuracy on training data: 47842 / 50000

Cost on evaluation data: 1.267650162

Accuracy on evaluation data: 9499 / 10000

Epoch 51 training complete

Cost on training data: 0.405370023034

Accuracy on training data: 48198 / 50000

Cost on evaluation data: 1.21810983646

Accuracy on evaluation data: 9575 / 10000

Epoch 52 training complete

Cost on training data: 0.389553633911

Accuracy on training data: 48376 / 50000

Cost on evaluation data: 1.21096679935

Accuracy on evaluation data: 9577 / 10000

Epoch 53 training complete

Cost on training data: 0.396213851884

Accuracy on training data: 48332 / 50000

Cost on evaluation data: 1.2241386717

Accuracy on evaluation data: 9572 / 10000

Epoch 54 training complete

Cost on training data: 0.446467217681

Accuracy on training data: 47825 / 50000

Cost on evaluation data: 1.25370160914

Accuracy on evaluation data: 9482 / 10000

Epoch 55 training complete

Cost on training data: 0.405406938911

Accuracy on training data: 48243 / 50000

Cost on evaluation data: 1.21614640689

Accuracy on evaluation data: 9553 / 10000

Epoch 56 training complete

Cost on training data: 0.384098841337

Accuracy on training data: 48471 / 50000

Cost on evaluation data: 1.19331647081

Accuracy on evaluation data: 9616 / 10000

Epoch 57 training complete

Cost on training data: 0.377619606854

Accuracy on training data: 48534 / 50000

Cost on evaluation data: 1.20154576007

Accuracy on evaluation data: 9623 / 10000

Epoch 58 training complete

Cost on training data: 0.42837850132

Accuracy on training data: 48041 / 50000

Cost on evaluation data: 1.25199206652

Accuracy on evaluation data: 9537 / 10000

Epoch 59 training complete

Cost on training data: 0.427389248484

Accuracy on training data: 48120 / 50000

Cost on evaluation data: 1.24182347685

Accuracy on evaluation data: 9526 / 10000

Epoch 60 training complete

Cost on training data: 0.414820581383

Accuracy on training data: 48196 / 50000

Cost on evaluation data: 1.23162226736

Accuracy on evaluation data: 9557 / 10000

Epoch 61 training complete

Cost on training data: 0.414632010524

Accuracy on training data: 48223 / 50000

Cost on evaluation data: 1.23735658242

Accuracy on evaluation data: 9555 / 10000

Epoch 62 training complete

Cost on training data: 0.401260650667

Accuracy on training data: 48324 / 50000

Cost on evaluation data: 1.21772469862

Accuracy on evaluation data: 9598 / 10000

Epoch 63 training complete

Cost on training data: 0.385811771619

Accuracy on training data: 48485 / 50000

Cost on evaluation data: 1.20522560177

Accuracy on evaluation data: 9609 / 10000

Epoch 64 training complete

Cost on training data: 0.39989590362

Accuracy on training data: 48329 / 50000

Cost on evaluation data: 1.20588868072

Accuracy on evaluation data: 9601 / 10000

Epoch 65 training complete

Cost on training data: 0.451905209346

Accuracy on training data: 47817 / 50000

Cost on evaluation data: 1.26121835363

Accuracy on evaluation data: 9470 / 10000

Epoch 66 training complete

Cost on training data: 0.375499956353

Accuracy on training data: 48531 / 50000

Cost on evaluation data: 1.20067260042

Accuracy on evaluation data: 9615 / 10000

Epoch 67 training complete

Cost on training data: 0.394073520716

Accuracy on training data: 48344 / 50000

Cost on evaluation data: 1.22000719099

Accuracy on evaluation data: 9588 / 10000

Epoch 68 training complete

Cost on training data: 0.437078747849

Accuracy on training data: 48027 / 50000

Cost on evaluation data: 1.28027847602

Accuracy on evaluation data: 9474 / 10000

Epoch 69 training complete

Cost on training data: 0.383146690154

Accuracy on training data: 48469 / 50000

Cost on evaluation data: 1.22265352466

Accuracy on evaluation data: 9557 / 10000

Epoch 70 training complete

Cost on training data: 0.381511306793

Accuracy on training data: 48480 / 50000

Cost on evaluation data: 1.19342445752

Accuracy on evaluation data: 9617 / 10000

Epoch 71 training complete

Cost on training data: 0.390511615295

Accuracy on training data: 48381 / 50000

Cost on evaluation data: 1.22611298809

Accuracy on evaluation data: 9575 / 10000

Epoch 72 training complete

Cost on training data: 0.462389442485

Accuracy on training data: 47725 / 50000

Cost on evaluation data: 1.29410019919

Accuracy on evaluation data: 9467 / 10000

Epoch 73 training complete

Cost on training data: 0.394220029647

Accuracy on training data: 48400 / 50000

Cost on evaluation data: 1.21420340057

Accuracy on evaluation data: 9616 / 10000

Epoch 74 training complete

Cost on training data: 0.445857325616

Accuracy on training data: 47882 / 50000

Cost on evaluation data: 1.26321098341

Accuracy on evaluation data: 9501 / 10000

Epoch 75 training complete

Cost on training data: 0.436644809329

Accuracy on training data: 48109 / 50000

Cost on evaluation data: 1.25154815864

Accuracy on evaluation data: 9552 / 10000

Epoch 76 training complete

Cost on training data: 0.410616153951

Accuracy on training data: 48253 / 50000

Cost on evaluation data: 1.25063555875

Accuracy on evaluation data: 9552 / 10000

Epoch 77 training complete

Cost on training data: 0.420597307797

Accuracy on training data: 48195 / 50000

Cost on evaluation data: 1.24779924353

Accuracy on evaluation data: 9545 / 10000

Epoch 78 training complete

Cost on training data: 0.441094608233

Accuracy on training data: 47978 / 50000

Cost on evaluation data: 1.27665234698

Accuracy on evaluation data: 9496 / 10000

Epoch 79 training complete

Cost on training data: 0.408090604836

Accuracy on training data: 48321 / 50000

Cost on evaluation data: 1.23569169652

Accuracy on evaluation data: 9562 / 10000

Epoch 80 training complete

Cost on training data: 0.377407188464

Accuracy on training data: 48584 / 50000

Cost on evaluation data: 1.21134704418

Accuracy on evaluation data: 9601 / 10000

Epoch 81 training complete

Cost on training data: 0.41188864926

Accuracy on training data: 48172 / 50000

Cost on evaluation data: 1.24574549886

Accuracy on evaluation data: 9548 / 10000

Epoch 82 training complete

Cost on training data: 0.393507828387

Accuracy on training data: 48375 / 50000

Cost on evaluation data: 1.21516863158

Accuracy on evaluation data: 9610 / 10000

Epoch 83 training complete

Cost on training data: 0.418544769086

Accuracy on training data: 48237 / 50000

Cost on evaluation data: 1.24972300006

Accuracy on evaluation data: 9554 / 10000

Epoch 84 training complete

Cost on training data: 0.383125770944

Accuracy on training data: 48516 / 50000

Cost on evaluation data: 1.20191287385

Accuracy on evaluation data: 9602 / 10000

Epoch 85 training complete

Cost on training data: 0.432861391856

Accuracy on training data: 48071 / 50000

Cost on evaluation data: 1.24241913866

Accuracy on evaluation data: 9567 / 10000

Epoch 86 training complete

Cost on training data: 0.387002502089

Accuracy on training data: 48438 / 50000

Cost on evaluation data: 1.21606963109

Accuracy on evaluation data: 9583 / 10000

Epoch 87 training complete

Cost on training data: 0.416030308742

Accuracy on training data: 48165 / 50000

Cost on evaluation data: 1.24364178983

Accuracy on evaluation data: 9537 / 10000

Epoch 88 training complete

Cost on training data: 0.388390839081

Accuracy on training data: 48464 / 50000

Cost on evaluation data: 1.21916671324

Accuracy on evaluation data: 9590 / 10000

Epoch 89 training complete

Cost on training data: 0.441292029123

Accuracy on training data: 47965 / 50000

Cost on evaluation data: 1.26037904364

Accuracy on evaluation data: 9519 / 10000

Epoch 90 training complete

Cost on training data: 0.384729756144

Accuracy on training data: 48534 / 50000

Cost on evaluation data: 1.20434919783

Accuracy on evaluation data: 9596 / 10000

Epoch 91 training complete

Cost on training data: 0.383072565622

Accuracy on training data: 48509 / 50000

Cost on evaluation data: 1.20898971324

Accuracy on evaluation data: 9599 / 10000

Epoch 92 training complete

Cost on training data: 0.398129574625

Accuracy on training data: 48387 / 50000

Cost on evaluation data: 1.23185128421

Accuracy on evaluation data: 9596 / 10000

Epoch 93 training complete

Cost on training data: 0.40177671102

Accuracy on training data: 48325 / 50000

Cost on evaluation data: 1.2289538882

Accuracy on evaluation data: 9602 / 10000

Epoch 94 training complete

Cost on training data: 0.40938547317

Accuracy on training data: 48255 / 50000

Cost on evaluation data: 1.22595205586

Accuracy on evaluation data: 9595 / 10000

Epoch 95 training complete

Cost on training data: 0.413239625537

Accuracy on training data: 48226 / 50000

Cost on evaluation data: 1.23531027406

Accuracy on evaluation data: 9559 / 10000

Epoch 96 training complete

Cost on training data: 0.387336894759

Accuracy on training data: 48481 / 50000

Cost on evaluation data: 1.20937950056

Accuracy on evaluation data: 9607 / 10000

Epoch 97 training complete

Cost on training data: 0.428867561422

Accuracy on training data: 48109 / 50000

Cost on evaluation data: 1.25707034565

Accuracy on evaluation data: 9530 / 10000

Epoch 98 training complete

Cost on training data: 0.439317278613

Accuracy on training data: 48016 / 50000

Cost on evaluation data: 1.27938709543

Accuracy on evaluation data: 9497 / 10000

Epoch 99 training complete

Cost on training data: 0.461483231354

Accuracy on training data: 47802 / 50000

Cost on evaluation data: 1.29542248208

Accuracy on evaluation data: 9462 / 10000

Epoch 100 training complete

Cost on training data: 0.373105624577

Accuracy on training data: 48574 / 50000

Cost on evaluation data: 1.20863109362

Accuracy on evaluation data: 9599 / 10000

Epoch 101 training complete

Cost on training data: 0.381303825252

Accuracy on training data: 48523 / 50000

Cost on evaluation data: 1.20801912055

Accuracy on evaluation data: 9618 / 10000

Epoch 102 training complete

Cost on training data: 0.373610789333

Accuracy on training data: 48598 / 50000

Cost on evaluation data: 1.20276754385

Accuracy on evaluation data: 9608 / 10000

Epoch 103 training complete

Cost on training data: 0.358572678411

Accuracy on training data: 48754 / 50000

Cost on evaluation data: 1.19661865811

Accuracy on evaluation data: 9623 / 10000

Epoch 104 training complete

Cost on training data: 0.415122805046

Accuracy on training data: 48148 / 50000

Cost on evaluation data: 1.23642610736

Accuracy on evaluation data: 9559 / 10000

Epoch 105 training complete

Cost on training data: 0.424052518427

Accuracy on training data: 48090 / 50000

Cost on evaluation data: 1.25496671768

Accuracy on evaluation data: 9505 / 10000

Epoch 106 training complete

Cost on training data: 0.412464483072

Accuracy on training data: 48203 / 50000

Cost on evaluation data: 1.23931268304

Accuracy on evaluation data: 9566 / 10000

Epoch 107 training complete

Cost on training data: 0.375877363552

Accuracy on training data: 48544 / 50000

Cost on evaluation data: 1.19788015021

Accuracy on evaluation data: 9622 / 10000

Epoch 108 training complete

Cost on training data: 0.501500414787

Accuracy on training data: 47426 / 50000

Cost on evaluation data: 1.30447485417

Accuracy on evaluation data: 9429 / 10000

Epoch 109 training complete

Cost on training data: 0.432213793749

Accuracy on training data: 48038 / 50000

Cost on evaluation data: 1.25046568168

Accuracy on evaluation data: 9512 / 10000

Epoch 110 training complete

Cost on training data: 0.458321804208

Accuracy on training data: 47797 / 50000

Cost on evaluation data: 1.28784325402

Accuracy on evaluation data: 9464 / 10000

Epoch 111 training complete

Cost on training data: 0.491671347105

Accuracy on training data: 47488 / 50000

Cost on evaluation data: 1.31683671945

Accuracy on evaluation data: 9407 / 10000

Epoch 112 training complete

Cost on training data: 0.446227248768

Accuracy on training data: 47945 / 50000

Cost on evaluation data: 1.27120591745

Accuracy on evaluation data: 9509 / 10000

Epoch 113 training complete

Cost on training data: 0.373118020653

Accuracy on training data: 48549 / 50000

Cost on evaluation data: 1.19532791849

Accuracy on evaluation data: 9616 / 10000

Epoch 114 training complete

Cost on training data: 0.387789158778

Accuracy on training data: 48417 / 50000

Cost on evaluation data: 1.20957283897

Accuracy on evaluation data: 9589 / 10000

Epoch 115 training complete

Cost on training data: 0.395123253851

Accuracy on training data: 48355 / 50000

Cost on evaluation data: 1.21636781588

Accuracy on evaluation data: 9597 / 10000

Epoch 116 training complete

Cost on training data: 0.452018256395

Accuracy on training data: 47871 / 50000

Cost on evaluation data: 1.26432993436

Accuracy on evaluation data: 9478 / 10000

Epoch 117 training complete

Cost on training data: 0.431449987297

Accuracy on training data: 48041 / 50000

Cost on evaluation data: 1.24517504014

Accuracy on evaluation data: 9528 / 10000

Epoch 118 training complete

Cost on training data: 0.360356767751

Accuracy on training data: 48714 / 50000

Cost on evaluation data: 1.18120898999

Accuracy on evaluation data: 9654 / 10000

Epoch 119 training complete

Cost on training data: 0.415244875294

Accuracy on training data: 48186 / 50000

Cost on evaluation data: 1.23762215085

Accuracy on evaluation data: 9559 / 10000

Epoch 120 training complete

Cost on training data: 0.486217311817

Accuracy on training data: 47524 / 50000

Cost on evaluation data: 1.28493118442

Accuracy on evaluation data: 9481 / 10000

Epoch 121 training complete

Cost on training data: 0.407914717242

Accuracy on training data: 48247 / 50000

Cost on evaluation data: 1.22950613691

Accuracy on evaluation data: 9567 / 10000

Epoch 122 training complete

Cost on training data: 0.393407041436

Accuracy on training data: 48392 / 50000

Cost on evaluation data: 1.20736794176

Accuracy on evaluation data: 9607 / 10000

Epoch 123 training complete

Cost on training data: 0.495919803173

Accuracy on training data: 47412 / 50000

Cost on evaluation data: 1.31552758598

Accuracy on evaluation data: 9402 / 10000

Epoch 124 training complete

Cost on training data: 0.372455134838

Accuracy on training data: 48617 / 50000

Cost on evaluation data: 1.19522471928

Accuracy on evaluation data: 9620 / 10000

Epoch 125 training complete

Cost on training data: 0.417381863667

Accuracy on training data: 48175 / 50000

Cost on evaluation data: 1.24506945007

Accuracy on evaluation data: 9527 / 10000

Epoch 126 training complete

Cost on training data: 0.408134508137

Accuracy on training data: 48304 / 50000

Cost on evaluation data: 1.24344808396

Accuracy on evaluation data: 9578 / 10000

Epoch 127 training complete

Cost on training data: 0.401558112235

Accuracy on training data: 48263 / 50000

Cost on evaluation data: 1.21689384712

Accuracy on evaluation data: 9574 / 10000

Epoch 128 training complete

Cost on training data: 0.395899510545

Accuracy on training data: 48312 / 50000

Cost on evaluation data: 1.21231268596

Accuracy on evaluation data: 9586 / 10000

Epoch 129 training complete

Cost on training data: 0.377831753055

Accuracy on training data: 48496 / 50000

Cost on evaluation data: 1.19291098069

Accuracy on evaluation data: 9635 / 10000

Epoch 130 training complete

Cost on training data: 0.375457934434

Accuracy on training data: 48536 / 50000

Cost on evaluation data: 1.20784480777

Accuracy on evaluation data: 9582 / 10000

Epoch 131 training complete

Cost on training data: 0.360750841473

Accuracy on training data: 48704 / 50000

Cost on evaluation data: 1.1935532229

Accuracy on evaluation data: 9639 / 10000

Epoch 132 training complete

Cost on training data: 0.388290949054

Accuracy on training data: 48442 / 50000

Cost on evaluation data: 1.21434092874

Accuracy on evaluation data: 9586 / 10000

Epoch 133 training complete

Cost on training data: 0.442777765231

Accuracy on training data: 48009 / 50000

Cost on evaluation data: 1.27765774221

Accuracy on evaluation data: 9494 / 10000

Epoch 134 training complete

Cost on training data: 0.3564806212

Accuracy on training data: 48719 / 50000

Cost on evaluation data: 1.17838556204

Accuracy on evaluation data: 9640 / 10000

Epoch 135 training complete

Cost on training data: 0.393726925591

Accuracy on training data: 48390 / 50000

Cost on evaluation data: 1.22421698199

Accuracy on evaluation data: 9568 / 10000

Epoch 136 training complete

Cost on training data: 0.374281628468

Accuracy on training data: 48555 / 50000

Cost on evaluation data: 1.2003916353

Accuracy on evaluation data: 9610 / 10000

Epoch 137 training complete

Cost on training data: 0.384006973704

Accuracy on training data: 48420 / 50000

Cost on evaluation data: 1.21140222778

Accuracy on evaluation data: 9583 / 10000

Epoch 138 training complete

Cost on training data: 0.416788153551

Accuracy on training data: 48182 / 50000

Cost on evaluation data: 1.23523555504

Accuracy on evaluation data: 9536 / 10000

Epoch 139 training complete

Cost on training data: 0.401396845641

Accuracy on training data: 48297 / 50000

Cost on evaluation data: 1.20628199764

Accuracy on evaluation data: 9588 / 10000

Epoch 140 training complete

Cost on training data: 0.436382400125

Accuracy on training data: 47993 / 50000

Cost on evaluation data: 1.25826656739

Accuracy on evaluation data: 9507 / 10000

Epoch 141 training complete

Cost on training data: 0.435016515698

Accuracy on training data: 48000 / 50000

Cost on evaluation data: 1.26213364529

Accuracy on evaluation data: 9482 / 10000

Epoch 142 training complete

Cost on training data: 0.375584146193

Accuracy on training data: 48519 / 50000

Cost on evaluation data: 1.19161705173

Accuracy on evaluation data: 9636 / 10000

Epoch 143 training complete

Cost on training data: 0.379863385253

Accuracy on training data: 48492 / 50000

Cost on evaluation data: 1.20262734483

Accuracy on evaluation data: 9603 / 10000

Epoch 144 training complete

Cost on training data: 0.404693765821

Accuracy on training data: 48292 / 50000

Cost on evaluation data: 1.22770510012

Accuracy on evaluation data: 9584 / 10000

Epoch 145 training complete

Cost on training data: 0.395722132083

Accuracy on training data: 48372 / 50000

Cost on evaluation data: 1.20583773457

Accuracy on evaluation data: 9604 / 10000

Epoch 146 training complete

Cost on training data: 0.384708461366

Accuracy on training data: 48424 / 50000

Cost on evaluation data: 1.20113622935

Accuracy on evaluation data: 9612 / 10000

Epoch 147 training complete

Cost on training data: 0.367489886151

Accuracy on training data: 48628 / 50000

Cost on evaluation data: 1.1828956584

Accuracy on evaluation data: 9627 / 10000

Epoch 148 training complete

Cost on training data: 0.416319612511

Accuracy on training data: 48202 / 50000

Cost on evaluation data: 1.24624280206

Accuracy on evaluation data: 9532 / 10000

Epoch 149 training complete

Cost on training data: 0.384431549316

Accuracy on training data: 48434 / 50000

Cost on evaluation data: 1.19327034649

Accuracy on evaluation data: 9617 / 10000

Epoch 150 training complete

Cost on training data: 0.40090405378

Accuracy on training data: 48334 / 50000

Cost on evaluation data: 1.21984532142

Accuracy on evaluation data: 9584 / 10000

Epoch 151 training complete

Cost on training data: 0.425996913416

Accuracy on training data: 48082 / 50000

Cost on evaluation data: 1.25355139729

Accuracy on evaluation data: 9526 / 10000

Epoch 152 training complete

Cost on training data: 0.36340390721

Accuracy on training data: 48611 / 50000

Cost on evaluation data: 1.19378413352

Accuracy on evaluation data: 9604 / 10000

Epoch 153 training complete

Cost on training data: 0.388370260246

Accuracy on training data: 48445 / 50000

Cost on evaluation data: 1.20617172381

Accuracy on evaluation data: 9592 / 10000

Epoch 154 training complete

Cost on training data: 0.422043323468

Accuracy on training data: 48192 / 50000

Cost on evaluation data: 1.22459831324

Accuracy on evaluation data: 9577 / 10000

Epoch 155 training complete

Cost on training data: 0.368277315683

Accuracy on training data: 48598 / 50000

Cost on evaluation data: 1.19295910397

Accuracy on evaluation data: 9630 / 10000

Epoch 156 training complete

Cost on training data: 0.423375873632

Accuracy on training data: 48093 / 50000

Cost on evaluation data: 1.25751294159

Accuracy on evaluation data: 9495 / 10000

Epoch 157 training complete

Cost on training data: 0.415671841253

Accuracy on training data: 48178 / 50000

Cost on evaluation data: 1.21870262216

Accuracy on evaluation data: 9594 / 10000

Epoch 158 training complete

Cost on training data: 0.373199248514

Accuracy on training data: 48547 / 50000

Cost on evaluation data: 1.1998090676

Accuracy on evaluation data: 9608 / 10000

Epoch 159 training complete

Cost on training data: 0.39418899394

Accuracy on training data: 48357 / 50000

Cost on evaluation data: 1.21126134841

Accuracy on evaluation data: 9604 / 10000

Epoch 160 training complete

Cost on training data: 0.395488784827

Accuracy on training data: 48416 / 50000

Cost on evaluation data: 1.20044117743

Accuracy on evaluation data: 9614 / 10000

Epoch 161 training complete

Cost on training data: 0.409875119677

Accuracy on training data: 48253 / 50000

Cost on evaluation data: 1.23595009829

Accuracy on evaluation data: 9533 / 10000

Epoch 162 training complete

Cost on training data: 0.369194270963

Accuracy on training data: 48625 / 50000

Cost on evaluation data: 1.19620478936

Accuracy on evaluation data: 9637 / 10000

Epoch 163 training complete

Cost on training data: 0.386009032246

Accuracy on training data: 48449 / 50000

Cost on evaluation data: 1.2014320616

Accuracy on evaluation data: 9611 / 10000

Epoch 164 training complete

Cost on training data: 0.374188318522

Accuracy on training data: 48553 / 50000

Cost on evaluation data: 1.19893150111

Accuracy on evaluation data: 9586 / 10000

Epoch 165 training complete

Cost on training data: 0.48592862887

Accuracy on training data: 47434 / 50000

Cost on evaluation data: 1.30237370044

Accuracy on evaluation data: 9467 / 10000

Epoch 166 training complete

Cost on training data: 0.366935978392

Accuracy on training data: 48616 / 50000

Cost on evaluation data: 1.18938447187

Accuracy on evaluation data: 9610 / 10000

Epoch 167 training complete

Cost on training data: 0.398357144473

Accuracy on training data: 48333 / 50000

Cost on evaluation data: 1.21036311335

Accuracy on evaluation data: 9600 / 10000

Epoch 168 training complete

Cost on training data: 0.354580827091

Accuracy on training data: 48735 / 50000

Cost on evaluation data: 1.16872706257

Accuracy on evaluation data: 9657 / 10000

Epoch 169 training complete

Cost on training data: 0.429592367473

Accuracy on training data: 47978 / 50000

Cost on evaluation data: 1.23470949305

Accuracy on evaluation data: 9531 / 10000

Epoch 170 training complete

Cost on training data: 0.381170024598

Accuracy on training data: 48468 / 50000

Cost on evaluation data: 1.19345387842

Accuracy on evaluation data: 9605 / 10000

Epoch 171 training complete

Cost on training data: 0.364384652287

Accuracy on training data: 48642 / 50000

Cost on evaluation data: 1.17606849968

Accuracy on evaluation data: 9621 / 10000

Epoch 172 training complete

Cost on training data: 0.393264863118

Accuracy on training data: 48368 / 50000

Cost on evaluation data: 1.19987544924

Accuracy on evaluation data: 9611 / 10000

Epoch 173 training complete

Cost on training data: 0.379869617067

Accuracy on training data: 48524 / 50000

Cost on evaluation data: 1.19073136268

Accuracy on evaluation data: 9614 / 10000

Epoch 174 training complete

Cost on training data: 0.459944820353

Accuracy on training data: 47773 / 50000

Cost on evaluation data: 1.29030655669

Accuracy on evaluation data: 9457 / 10000

Epoch 175 training complete

Cost on training data: 0.369920216914

Accuracy on training data: 48574 / 50000

Cost on evaluation data: 1.18655091666

Accuracy on evaluation data: 9632 / 10000

Epoch 176 training complete

Cost on training data: 0.372843259409

Accuracy on training data: 48535 / 50000

Cost on evaluation data: 1.18540903535

Accuracy on evaluation data: 9627 / 10000

Epoch 177 training complete

Cost on training data: 0.362294546555

Accuracy on training data: 48639 / 50000

Cost on evaluation data: 1.16132724311

Accuracy on evaluation data: 9665 / 10000

Epoch 178 training complete

Cost on training data: 0.448657007934

Accuracy on training data: 47935 / 50000

Cost on evaluation data: 1.25974533999

Accuracy on evaluation data: 9500 / 10000

Epoch 179 training complete

Cost on training data: 0.392703033328

Accuracy on training data: 48386 / 50000

Cost on evaluation data: 1.21781499525

Accuracy on evaluation data: 9572 / 10000

Epoch 180 training complete

Cost on training data: 0.447078333652

Accuracy on training data: 47928 / 50000

Cost on evaluation data: 1.25633931654

Accuracy on evaluation data: 9512 / 10000

Epoch 181 training complete

Cost on training data: 0.441046903197

Accuracy on training data: 47998 / 50000

Cost on evaluation data: 1.24978109309

Accuracy on evaluation data: 9521 / 10000

Epoch 182 training complete

Cost on training data: 0.382492456238

Accuracy on training data: 48497 / 50000

Cost on evaluation data: 1.198081316

Accuracy on evaluation data: 9593 / 10000

Epoch 183 training complete

Cost on training data: 0.405210855171

Accuracy on training data: 48307 / 50000

Cost on evaluation data: 1.22107769551

Accuracy on evaluation data: 9538 / 10000

Epoch 184 training complete

Cost on training data: 0.410562938437

Accuracy on training data: 48188 / 50000

Cost on evaluation data: 1.22824907593

Accuracy on evaluation data: 9557 / 10000

Epoch 185 training complete

Cost on training data: 0.374465990859

Accuracy on training data: 48593 / 50000

Cost on evaluation data: 1.19041862397

Accuracy on evaluation data: 9624 / 10000

Epoch 186 training complete

Cost on training data: 0.436510581392

Accuracy on training data: 48058 / 50000

Cost on evaluation data: 1.24718187267

Accuracy on evaluation data: 9540 / 10000

Epoch 187 training complete

Cost on training data: 0.378476900024

Accuracy on training data: 48513 / 50000

Cost on evaluation data: 1.17901642253

Accuracy on evaluation data: 9619 / 10000

Epoch 188 training complete

Cost on training data: 0.389870635067

Accuracy on training data: 48553 / 50000

Cost on evaluation data: 1.21404770395

Accuracy on evaluation data: 9602 / 10000

Epoch 189 training complete

Cost on training data: 0.368064747068

Accuracy on training data: 48634 / 50000

Cost on evaluation data: 1.19737370969

Accuracy on evaluation data: 9600 / 10000

Epoch 190 training complete

Cost on training data: 0.376478088198

Accuracy on training data: 48529 / 50000

Cost on evaluation data: 1.19771969614

Accuracy on evaluation data: 9621 / 10000

Epoch 191 training complete

Cost on training data: 0.41313102125

Accuracy on training data: 48191 / 50000

Cost on evaluation data: 1.22268759687

Accuracy on evaluation data: 9547 / 10000

Epoch 192 training complete

Cost on training data: 0.559793311439

Accuracy on training data: 46843 / 50000

Cost on evaluation data: 1.39338200339

Accuracy on evaluation data: 9281 / 10000

Epoch 193 training complete

Cost on training data: 0.400846534439

Accuracy on training data: 48312 / 50000

Cost on evaluation data: 1.22682198125

Accuracy on evaluation data: 9568 / 10000

Epoch 194 training complete

Cost on training data: 0.406103238965

Accuracy on training data: 48270 / 50000

Cost on evaluation data: 1.222751917

Accuracy on evaluation data: 9574 / 10000

Epoch 195 training complete

Cost on training data: 0.439103682042

Accuracy on training data: 47942 / 50000

Cost on evaluation data: 1.26378157611

Accuracy on evaluation data: 9505 / 10000

Epoch 196 training complete

Cost on training data: 0.411146043677

Accuracy on training data: 48187 / 50000

Cost on evaluation data: 1.23518178007

Accuracy on evaluation data: 9549 / 10000

Epoch 197 training complete

Cost on training data: 0.354873782169

Accuracy on training data: 48724 / 50000

Cost on evaluation data: 1.17996577661

Accuracy on evaluation data: 9637 / 10000

Epoch 198 training complete

Cost on training data: 0.394172992572

Accuracy on training data: 48369 / 50000

Cost on evaluation data: 1.21652231038

Accuracy on evaluation data: 9587 / 10000

Epoch 199 training complete

Cost on training data: 0.380471710655

Accuracy on training data: 48488 / 50000

Cost on evaluation data: 1.20915259984

Accuracy on evaluation data: 9592 / 10000

Epoch 200 training complete

Cost on training data: 0.432017107299

Accuracy on training data: 48025 / 50000

Cost on evaluation data: 1.25069233528

Accuracy on evaluation data: 9518 / 10000

Epoch 201 training complete

Cost on training data: 0.394109230879

Accuracy on training data: 48367 / 50000

Cost on evaluation data: 1.20826003831

Accuracy on evaluation data: 9591 / 10000

Epoch 202 training complete

Cost on training data: 0.38751420584

Accuracy on training data: 48407 / 50000

Cost on evaluation data: 1.20471479057

Accuracy on evaluation data: 9599 / 10000

Epoch 203 training complete

Cost on training data: 0.372351429779

Accuracy on training data: 48597 / 50000

Cost on evaluation data: 1.19026578842

Accuracy on evaluation data: 9629 / 10000

Epoch 204 training complete

Cost on training data: 0.471827537456

Accuracy on training data: 47656 / 50000

Cost on evaluation data: 1.28242943261

Accuracy on evaluation data: 9483 / 10000

Epoch 205 training complete

Cost on training data: 0.377390193817

Accuracy on training data: 48533 / 50000

Cost on evaluation data: 1.19356290391

Accuracy on evaluation data: 9633 / 10000

Epoch 206 training complete

Cost on training data: 0.403704757018

Accuracy on training data: 48241 / 50000

Cost on evaluation data: 1.22438802235

Accuracy on evaluation data: 9560 / 10000

Epoch 207 training complete

Cost on training data: 0.371183983498

Accuracy on training data: 48588 / 50000

Cost on evaluation data: 1.18420385059

Accuracy on evaluation data: 9635 / 10000

Epoch 208 training complete

Cost on training data: 0.375858043929

Accuracy on training data: 48534 / 50000

Cost on evaluation data: 1.20149228654

Accuracy on evaluation data: 9605 / 10000

Epoch 209 training complete

Cost on training data: 0.436846460598

Accuracy on training data: 47989 / 50000

Cost on evaluation data: 1.25351676116

Accuracy on evaluation data: 9539 / 10000

Epoch 210 training complete

Cost on training data: 0.370115310026

Accuracy on training data: 48656 / 50000

Cost on evaluation data: 1.19676087751

Accuracy on evaluation data: 9641 / 10000

Epoch 211 training complete

Cost on training data: 0.372739129378

Accuracy on training data: 48616 / 50000

Cost on evaluation data: 1.18127200413

Accuracy on evaluation data: 9639 / 10000

Epoch 212 training complete

Cost on training data: 0.447992767164

Accuracy on training data: 47886 / 50000

Cost on evaluation data: 1.27290243506

Accuracy on evaluation data: 9476 / 10000

Epoch 213 training complete

Cost on training data: 0.371628611005

Accuracy on training data: 48617 / 50000

Cost on evaluation data: 1.20239344341

Accuracy on evaluation data: 9600 / 10000

Epoch 214 training complete

Cost on training data: 0.45420782836

Accuracy on training data: 47823 / 50000

Cost on evaluation data: 1.25434135629

Accuracy on evaluation data: 9511 / 10000

Epoch 215 training complete

Cost on training data: 0.438238308313

Accuracy on training data: 47928 / 50000

Cost on evaluation data: 1.25950856944

Accuracy on evaluation data: 9489 / 10000

Epoch 216 training complete

Cost on training data: 0.364527390231

Accuracy on training data: 48646 / 50000

Cost on evaluation data: 1.19046631738

Accuracy on evaluation data: 9623 / 10000

Epoch 217 training complete

Cost on training data: 0.36877585602

Accuracy on training data: 48668 / 50000

Cost on evaluation data: 1.18699161736

Accuracy on evaluation data: 9644 / 10000

Epoch 218 training complete

Cost on training data: 0.462938013323

Accuracy on training data: 47712 / 50000

Cost on evaluation data: 1.29036593029

Accuracy on evaluation data: 9446 / 10000

Epoch 219 training complete

Cost on training data: 0.37795867513

Accuracy on training data: 48515 / 50000

Cost on evaluation data: 1.20039839812

Accuracy on evaluation data: 9605 / 10000

Epoch 220 training complete

Cost on training data: 0.351450935105

Accuracy on training data: 48722 / 50000

Cost on evaluation data: 1.15873089436

Accuracy on evaluation data: 9658 / 10000

Epoch 221 training complete

Cost on training data: 0.424302104836

Accuracy on training data: 48108 / 50000

Cost on evaluation data: 1.22756005545

Accuracy on evaluation data: 9544 / 10000

Epoch 222 training complete

Cost on training data: 0.369477591611

Accuracy on training data: 48582 / 50000

Cost on evaluation data: 1.18439386892

Accuracy on evaluation data: 9634 / 10000

Epoch 223 training complete

Cost on training data: 0.383836947655

Accuracy on training data: 48463 / 50000

Cost on evaluation data: 1.1965380464

Accuracy on evaluation data: 9619 / 10000

Epoch 224 training complete

Cost on training data: 0.385436158433

Accuracy on training data: 48484 / 50000

Cost on evaluation data: 1.20565775615

Accuracy on evaluation data: 9594 / 10000

Epoch 225 training complete

Cost on training data: 0.388650434019

Accuracy on training data: 48378 / 50000

Cost on evaluation data: 1.20083745274

Accuracy on evaluation data: 9622 / 10000

Epoch 226 training complete

Cost on training data: 0.406942562288

Accuracy on training data: 48204 / 50000

Cost on evaluation data: 1.2137766956

Accuracy on evaluation data: 9558 / 10000

Epoch 227 training complete

Cost on training data: 0.378980331741

Accuracy on training data: 48497 / 50000

Cost on evaluation data: 1.19378988103

Accuracy on evaluation data: 9608 / 10000

Epoch 228 training complete

Cost on training data: 0.395599949846

Accuracy on training data: 48396 / 50000

Cost on evaluation data: 1.2190323494

Accuracy on evaluation data: 9587 / 10000

Epoch 229 training complete

Cost on training data: 0.373828653431

Accuracy on training data: 48532 / 50000

Cost on evaluation data: 1.20555217333

Accuracy on evaluation data: 9599 / 10000

Epoch 230 training complete

Cost on training data: 0.38180624524

Accuracy on training data: 48468 / 50000

Cost on evaluation data: 1.20095285397

Accuracy on evaluation data: 9593 / 10000

Epoch 231 training complete

Cost on training data: 0.388763562577

Accuracy on training data: 48415 / 50000

Cost on evaluation data: 1.22216433669

Accuracy on evaluation data: 9562 / 10000

Epoch 232 training complete

Cost on training data: 0.418294305781

Accuracy on training data: 48189 / 50000

Cost on evaluation data: 1.23465449607

Accuracy on evaluation data: 9556 / 10000

Epoch 233 training complete

Cost on training data: 0.404070357197

Accuracy on training data: 48249 / 50000

Cost on evaluation data: 1.20246727235

Accuracy on evaluation data: 9604 / 10000

Epoch 234 training complete

Cost on training data: 0.37375409101

Accuracy on training data: 48545 / 50000

Cost on evaluation data: 1.18507708163

Accuracy on evaluation data: 9639 / 10000

Epoch 235 training complete

Cost on training data: 0.430964627071

Accuracy on training data: 47956 / 50000

Cost on evaluation data: 1.25087646902

Accuracy on evaluation data: 9507 / 10000

Epoch 236 training complete

Cost on training data: 0.43509638024

Accuracy on training data: 48007 / 50000

Cost on evaluation data: 1.26470039903

Accuracy on evaluation data: 9509 / 10000

Epoch 237 training complete

Cost on training data: 0.382169098844

Accuracy on training data: 48540 / 50000

Cost on evaluation data: 1.21364202668

Accuracy on evaluation data: 9571 / 10000

Epoch 238 training complete

Cost on training data: 0.412885740008

Accuracy on training data: 48207 / 50000

Cost on evaluation data: 1.216859619

Accuracy on evaluation data: 9583 / 10000

Epoch 239 training complete

Cost on training data: 0.439123795957

Accuracy on training data: 47922 / 50000

Cost on evaluation data: 1.24402311838

Accuracy on evaluation data: 9502 / 10000

Epoch 240 training complete

Cost on training data: 0.368408955249

Accuracy on training data: 48658 / 50000

Cost on evaluation data: 1.17748352309

Accuracy on evaluation data: 9623 / 10000

Epoch 241 training complete

Cost on training data: 0.368948975317

Accuracy on training data: 48577 / 50000

Cost on evaluation data: 1.17352883309

Accuracy on evaluation data: 9633 / 10000

Epoch 242 training complete

Cost on training data: 0.372379033155

Accuracy on training data: 48554 / 50000

Cost on evaluation data: 1.18695211202

Accuracy on evaluation data: 9634 / 10000

Epoch 243 training complete

Cost on training data: 0.441748697603

Accuracy on training data: 47999 / 50000

Cost on evaluation data: 1.25972593724

Accuracy on evaluation data: 9505 / 10000

Epoch 244 training complete

Cost on training data: 0.41985227221

Accuracy on training data: 48132 / 50000

Cost on evaluation data: 1.22514865427

Accuracy on evaluation data: 9555 / 10000

Epoch 245 training complete

Cost on training data: 0.388436213191

Accuracy on training data: 48407 / 50000

Cost on evaluation data: 1.21748653939

Accuracy on evaluation data: 9596 / 10000

Epoch 246 training complete

Cost on training data: 0.375628672907

Accuracy on training data: 48543 / 50000

Cost on evaluation data: 1.17455997431

Accuracy on evaluation data: 9647 / 10000

Epoch 247 training complete

Cost on training data: 0.365890747009

Accuracy on training data: 48609 / 50000

Cost on evaluation data: 1.183576858

Accuracy on evaluation data: 9620 / 10000

Epoch 248 training complete

Cost on training data: 0.433036882375

Accuracy on training data: 47961 / 50000

Cost on evaluation data: 1.23675067297

Accuracy on evaluation data: 9535 / 10000

Epoch 249 training complete

Cost on training data: 0.374331973518

Accuracy on training data: 48581 / 50000

Cost on evaluation data: 1.19104942323

Accuracy on evaluation data: 9620 / 10000

Epoch 250 training complete

Cost on training data: 0.428894008933

Accuracy on training data: 48052 / 50000

Cost on evaluation data: 1.2275641978

Accuracy on evaluation data: 9540 / 10000

Epoch 251 training complete

Cost on training data: 0.36481062109

Accuracy on training data: 48660 / 50000

Cost on evaluation data: 1.18797998483

Accuracy on evaluation data: 9626 / 10000

Epoch 252 training complete

Cost on training data: 0.383381866186

Accuracy on training data: 48459 / 50000

Cost on evaluation data: 1.20016929244

Accuracy on evaluation data: 9587 / 10000

Epoch 253 training complete

Cost on training data: 0.367077533116

Accuracy on training data: 48625 / 50000

Cost on evaluation data: 1.17942387876

Accuracy on evaluation data: 9634 / 10000

Epoch 254 training complete

Cost on training data: 0.399701935168

Accuracy on training data: 48377 / 50000

Cost on evaluation data: 1.22481242341

Accuracy on evaluation data: 9566 / 10000

Epoch 255 training complete

Cost on training data: 0.361461993626

Accuracy on training data: 48681 / 50000

Cost on evaluation data: 1.19459559935

Accuracy on evaluation data: 9599 / 10000

Epoch 256 training complete

Cost on training data: 0.410997289946

Accuracy on training data: 48272 / 50000

Cost on evaluation data: 1.23126281638

Accuracy on evaluation data: 9570 / 10000

Epoch 257 training complete

Cost on training data: 0.368264499293

Accuracy on training data: 48593 / 50000

Cost on evaluation data: 1.19047771036

Accuracy on evaluation data: 9641 / 10000

Epoch 258 training complete

Cost on training data: 0.42452410573

Accuracy on training data: 48169 / 50000

Cost on evaluation data: 1.23883849636

Accuracy on evaluation data: 9543 / 10000

Epoch 259 training complete

Cost on training data: 0.388545026014

Accuracy on training data: 48401 / 50000

Cost on evaluation data: 1.20461553735

Accuracy on evaluation data: 9583 / 10000

Epoch 260 training complete

Cost on training data: 0.448296209404

Accuracy on training data: 47912 / 50000

Cost on evaluation data: 1.26320156316

Accuracy on evaluation data: 9518 / 10000

Epoch 261 training complete

Cost on training data: 0.379319497209

Accuracy on training data: 48491 / 50000

Cost on evaluation data: 1.18835642785

Accuracy on evaluation data: 9633 / 10000

Epoch 262 training complete

Cost on training data: 0.393857057526

Accuracy on training data: 48420 / 50000

Cost on evaluation data: 1.19877700545

Accuracy on evaluation data: 9621 / 10000

Epoch 263 training complete

Cost on training data: 0.382934158246

Accuracy on training data: 48489 / 50000

Cost on evaluation data: 1.20198333007

Accuracy on evaluation data: 9587 / 10000

Epoch 264 training complete

Cost on training data: 0.361242972721

Accuracy on training data: 48634 / 50000

Cost on evaluation data: 1.17636079515

Accuracy on evaluation data: 9633 / 10000

Epoch 265 training complete

Cost on training data: 0.369591606272

Accuracy on training data: 48596 / 50000

Cost on evaluation data: 1.17683253166

Accuracy on evaluation data: 9619 / 10000

Epoch 266 training complete

Cost on training data: 0.36702616497

Accuracy on training data: 48633 / 50000

Cost on evaluation data: 1.18619489954

Accuracy on evaluation data: 9647 / 10000

Epoch 267 training complete

Cost on training data: 0.420044874448

Accuracy on training data: 48175 / 50000

Cost on evaluation data: 1.24769982948

Accuracy on evaluation data: 9506 / 10000

Epoch 268 training complete

Cost on training data: 0.435697871238

Accuracy on training data: 47986 / 50000

Cost on evaluation data: 1.24904903547

Accuracy on evaluation data: 9503 / 10000

Epoch 269 training complete

Cost on training data: 0.408034097926

Accuracy on training data: 48237 / 50000

Cost on evaluation data: 1.22305535525

Accuracy on evaluation data: 9572 / 10000

Epoch 270 training complete

Cost on training data: 0.412815747005

Accuracy on training data: 48181 / 50000

Cost on evaluation data: 1.2222104452

Accuracy on evaluation data: 9518 / 10000

Epoch 271 training complete

Cost on training data: 0.361534105171

Accuracy on training data: 48664 / 50000

Cost on evaluation data: 1.18079117248

Accuracy on evaluation data: 9630 / 10000

Epoch 272 training complete

Cost on training data: 0.365734739529

Accuracy on training data: 48676 / 50000

Cost on evaluation data: 1.18776125718

Accuracy on evaluation data: 9632 / 10000

Epoch 273 training complete

Cost on training data: 0.379365432955

Accuracy on training data: 48559 / 50000

Cost on evaluation data: 1.19909862243

Accuracy on evaluation data: 9611 / 10000

Epoch 274 training complete

Cost on training data: 0.44348592176

Accuracy on training data: 47896 / 50000

Cost on evaluation data: 1.23739002593

Accuracy on evaluation data: 9529 / 10000

Epoch 275 training complete

Cost on training data: 0.479239861563

Accuracy on training data: 47596 / 50000

Cost on evaluation data: 1.27688965539

Accuracy on evaluation data: 9468 / 10000

Epoch 276 training complete

Cost on training data: 0.386987133868

Accuracy on training data: 48429 / 50000

Cost on evaluation data: 1.21442920153

Accuracy on evaluation data: 9563 / 10000

Epoch 277 training complete

Cost on training data: 0.407426274909

Accuracy on training data: 48315 / 50000

Cost on evaluation data: 1.24006300671

Accuracy on evaluation data: 9540 / 10000

Epoch 278 training complete

Cost on training data: 0.452188609531

Accuracy on training data: 47925 / 50000

Cost on evaluation data: 1.27405363264

Accuracy on evaluation data: 9492 / 10000

Epoch 279 training complete

Cost on training data: 0.465033353795

Accuracy on training data: 47741 / 50000

Cost on evaluation data: 1.27926170032

Accuracy on evaluation data: 9466 / 10000

Epoch 280 training complete

Cost on training data: 0.377225998099

Accuracy on training data: 48478 / 50000

Cost on evaluation data: 1.19611637871

Accuracy on evaluation data: 9619 / 10000

Epoch 281 training complete

Cost on training data: 0.403429536655

Accuracy on training data: 48272 / 50000

Cost on evaluation data: 1.22775459139

Accuracy on evaluation data: 9543 / 10000

Epoch 282 training complete

Cost on training data: 0.42314093454

Accuracy on training data: 48090 / 50000

Cost on evaluation data: 1.23584158108

Accuracy on evaluation data: 9536 / 10000

Epoch 283 training complete

Cost on training data: 0.373771978988

Accuracy on training data: 48501 / 50000

Cost on evaluation data: 1.20031377649

Accuracy on evaluation data: 9588 / 10000

Epoch 284 training complete

Cost on training data: 0.384932914165

Accuracy on training data: 48493 / 50000

Cost on evaluation data: 1.20226219779

Accuracy on evaluation data: 9609 / 10000

Epoch 285 training complete

Cost on training data: 0.405980241415

Accuracy on training data: 48183 / 50000

Cost on evaluation data: 1.21339294

Accuracy on evaluation data: 9548 / 10000

Epoch 286 training complete

Cost on training data: 0.380709166823

Accuracy on training data: 48442 / 50000

Cost on evaluation data: 1.19817107159

Accuracy on evaluation data: 9592 / 10000

Epoch 287 training complete

Cost on training data: 0.361201505786

Accuracy on training data: 48615 / 50000

Cost on evaluation data: 1.17496720695

Accuracy on evaluation data: 9637 / 10000

Epoch 288 training complete

Cost on training data: 0.42932808248

Accuracy on training data: 48069 / 50000

Cost on evaluation data: 1.25298977717

Accuracy on evaluation data: 9498 / 10000

Epoch 289 training complete

Cost on training data: 0.37865364806

Accuracy on training data: 48472 / 50000

Cost on evaluation data: 1.18602283287

Accuracy on evaluation data: 9617 / 10000

Epoch 290 training complete

Cost on training data: 0.403107647542

Accuracy on training data: 48301 / 50000

Cost on evaluation data: 1.21226759426

Accuracy on evaluation data: 9583 / 10000

Epoch 291 training complete

Cost on training data: 0.383053788975

Accuracy on training data: 48419 / 50000

Cost on evaluation data: 1.1960332075

Accuracy on evaluation data: 9591 / 10000

Epoch 292 training complete

Cost on training data: 0.405364975933

Accuracy on training data: 48219 / 50000

Cost on evaluation data: 1.20864455756

Accuracy on evaluation data: 9577 / 10000

Epoch 293 training complete

Cost on training data: 0.378875826101

Accuracy on training data: 48536 / 50000

Cost on evaluation data: 1.18581321704

Accuracy on evaluation data: 9611 / 10000

Epoch 294 training complete

Cost on training data: 0.404197053071

Accuracy on training data: 48273 / 50000

Cost on evaluation data: 1.23121767046

Accuracy on evaluation data: 9543 / 10000

Epoch 295 training complete

Cost on training data: 0.380477198117

Accuracy on training data: 48471 / 50000

Cost on evaluation data: 1.21440085133

Accuracy on evaluation data: 9567 / 10000

Epoch 296 training complete

Cost on training data: 0.373386278309

Accuracy on training data: 48576 / 50000

Cost on evaluation data: 1.20122514565

Accuracy on evaluation data: 9597 / 10000

Epoch 297 training complete

Cost on training data: 0.385978166746

Accuracy on training data: 48432 / 50000

Cost on evaluation data: 1.19179140758

Accuracy on evaluation data: 9595 / 10000

Epoch 298 training complete

Cost on training data: 0.371879339223

Accuracy on training data: 48540 / 50000

Cost on evaluation data: 1.18563201955

Accuracy on evaluation data: 9615 / 10000

Epoch 299 training complete

Cost on training data: 0.416144273717

Accuracy on training data: 48126 / 50000

Cost on evaluation data: 1.23121402778

Accuracy on evaluation data: 9546 / 10000

Epoch 300 training complete

Cost on training data: 0.371563370816

Accuracy on training data: 48571 / 50000

Cost on evaluation data: 1.16922488013

Accuracy on evaluation data: 9633 / 10000

Epoch 301 training complete

Cost on training data: 0.354511221981

Accuracy on training data: 48696 / 50000

Cost on evaluation data: 1.16093633989

Accuracy on evaluation data: 9656 / 10000

Epoch 302 training complete

Cost on training data: 0.425453746065

Accuracy on training data: 48065 / 50000

Cost on evaluation data: 1.25567890099

Accuracy on evaluation data: 9519 / 10000

Epoch 303 training complete

Cost on training data: 0.429801546517

Accuracy on training data: 48071 / 50000

Cost on evaluation data: 1.25268720769

Accuracy on evaluation data: 9533 / 10000

Epoch 304 training complete

Cost on training data: 0.381560927973

Accuracy on training data: 48418 / 50000

Cost on evaluation data: 1.17982075997

Accuracy on evaluation data: 9644 / 10000

Epoch 305 training complete

Cost on training data: 0.369087354882

Accuracy on training data: 48585 / 50000

Cost on evaluation data: 1.17591501649

Accuracy on evaluation data: 9645 / 10000

Epoch 306 training complete

Cost on training data: 0.37010439304

Accuracy on training data: 48526 / 50000

Cost on evaluation data: 1.16574450848

Accuracy on evaluation data: 9629 / 10000

Epoch 307 training complete

Cost on training data: 0.398413107394

Accuracy on training data: 48349 / 50000

Cost on evaluation data: 1.22421056997

Accuracy on evaluation data: 9575 / 10000

Epoch 308 training complete

Cost on training data: 0.407816290136

Accuracy on training data: 48284 / 50000

Cost on evaluation data: 1.21946608505

Accuracy on evaluation data: 9548 / 10000

Epoch 309 training complete

Cost on training data: 0.4380950338

Accuracy on training data: 47968 / 50000

Cost on evaluation data: 1.27029786758

Accuracy on evaluation data: 9513 / 10000

Epoch 310 training complete

Cost on training data: 0.3893058441

Accuracy on training data: 48370 / 50000

Cost on evaluation data: 1.21220265904

Accuracy on evaluation data: 9560 / 10000

Epoch 311 training complete

Cost on training data: 0.397266362515

Accuracy on training data: 48327 / 50000

Cost on evaluation data: 1.19892882992

Accuracy on evaluation data: 9595 / 10000

Epoch 312 training complete

Cost on training data: 0.37763978288

Accuracy on training data: 48502 / 50000

Cost on evaluation data: 1.17534090539

Accuracy on evaluation data: 9628 / 10000

Epoch 313 training complete

Cost on training data: 0.382134012233

Accuracy on training data: 48439 / 50000

Cost on evaluation data: 1.19089365575

Accuracy on evaluation data: 9602 / 10000

Epoch 314 training complete

Cost on training data: 0.393449182816

Accuracy on training data: 48388 / 50000

Cost on evaluation data: 1.20187357638

Accuracy on evaluation data: 9599 / 10000

Epoch 315 training complete

Cost on training data: 0.408256505356

Accuracy on training data: 48323 / 50000

Cost on evaluation data: 1.22486340122

Accuracy on evaluation data: 9552 / 10000

Epoch 316 training complete

Cost on training data: 0.355672274328

Accuracy on training data: 48675 / 50000

Cost on evaluation data: 1.15888111216

Accuracy on evaluation data: 9651 / 10000

Epoch 317 training complete

Cost on training data: 0.434491763001

Accuracy on training data: 48002 / 50000

Cost on evaluation data: 1.22116138275

Accuracy on evaluation data: 9550 / 10000

Epoch 318 training complete

Cost on training data: 0.3938998621

Accuracy on training data: 48370 / 50000

Cost on evaluation data: 1.19939101698

Accuracy on evaluation data: 9591 / 10000

Epoch 319 training complete

Cost on training data: 0.382743596934

Accuracy on training data: 48452 / 50000

Cost on evaluation data: 1.18818428874

Accuracy on evaluation data: 9599 / 10000

Epoch 320 training complete

Cost on training data: 0.375482235583

Accuracy on training data: 48546 / 50000

Cost on evaluation data: 1.19185540292

Accuracy on evaluation data: 9614 / 10000

Epoch 321 training complete

Cost on training data: 0.380678319986

Accuracy on training data: 48502 / 50000

Cost on evaluation data: 1.18388589931

Accuracy on evaluation data: 9612 / 10000

Epoch 322 training complete

Cost on training data: 0.386771606347

Accuracy on training data: 48396 / 50000

Cost on evaluation data: 1.20201852272

Accuracy on evaluation data: 9561 / 10000

Epoch 323 training complete

Cost on training data: 0.394080078946

Accuracy on training data: 48402 / 50000

Cost on evaluation data: 1.20934112695

Accuracy on evaluation data: 9576 / 10000

Epoch 324 training complete

Cost on training data: 0.467209044565

Accuracy on training data: 47733 / 50000

Cost on evaluation data: 1.25869864359

Accuracy on evaluation data: 9483 / 10000

Epoch 325 training complete

Cost on training data: 0.39266510035

Accuracy on training data: 48401 / 50000

Cost on evaluation data: 1.20608726208

Accuracy on evaluation data: 9579 / 10000

Epoch 326 training complete

Cost on training data: 0.433233742611

Accuracy on training data: 48070 / 50000

Cost on evaluation data: 1.24428509417

Accuracy on evaluation data: 9520 / 10000

Epoch 327 training complete

Cost on training data: 0.37587178062

Accuracy on training data: 48541 / 50000

Cost on evaluation data: 1.1766430732

Accuracy on evaluation data: 9632 / 10000

Epoch 328 training complete

Cost on training data: 0.375877632755

Accuracy on training data: 48532 / 50000

Cost on evaluation data: 1.17414009368

Accuracy on evaluation data: 9642 / 10000

Epoch 329 training complete

Cost on training data: 0.412213926568

Accuracy on training data: 48228 / 50000

Cost on evaluation data: 1.21069686956

Accuracy on evaluation data: 9580 / 10000

Epoch 330 training complete

Cost on training data: 0.398966561008

Accuracy on training data: 48324 / 50000

Cost on evaluation data: 1.21535339933

Accuracy on evaluation data: 9561 / 10000

Epoch 331 training complete

Cost on training data: 0.385011872614

Accuracy on training data: 48457 / 50000

Cost on evaluation data: 1.1929752551

Accuracy on evaluation data: 9614 / 10000

Epoch 332 training complete

Cost on training data: 0.389615581184

Accuracy on training data: 48373 / 50000

Cost on evaluation data: 1.19224949852

Accuracy on evaluation data: 9622 / 10000

Epoch 333 training complete

Cost on training data: 0.374205579696

Accuracy on training data: 48521 / 50000

Cost on evaluation data: 1.17579297135

Accuracy on evaluation data: 9623 / 10000

Epoch 334 training complete

Cost on training data: 0.408161644114

Accuracy on training data: 48234 / 50000

Cost on evaluation data: 1.23046151185

Accuracy on evaluation data: 9557 / 10000

Epoch 335 training complete

Cost on training data: 0.37726154306

Accuracy on training data: 48507 / 50000

Cost on evaluation data: 1.19874090868

Accuracy on evaluation data: 9597 / 10000

Epoch 336 training complete

Cost on training data: 0.36653104

Accuracy on training data: 48659 / 50000

Cost on evaluation data: 1.17402611549

Accuracy on evaluation data: 9623 / 10000

Epoch 337 training complete

Cost on training data: 0.3932585791

Accuracy on training data: 48363 / 50000

Cost on evaluation data: 1.18802572015

Accuracy on evaluation data: 9607 / 10000

Epoch 338 training complete

Cost on training data: 0.359454168894

Accuracy on training data: 48672 / 50000

Cost on evaluation data: 1.18111463632

Accuracy on evaluation data: 9629 / 10000

Epoch 339 training complete

Cost on training data: 0.400061247208

Accuracy on training data: 48299 / 50000

Cost on evaluation data: 1.20697514896

Accuracy on evaluation data: 9577 / 10000

Epoch 340 training complete

Cost on training data: 0.369196257661

Accuracy on training data: 48585 / 50000

Cost on evaluation data: 1.17728414189

Accuracy on evaluation data: 9617 / 10000

Epoch 341 training complete

Cost on training data: 0.388616157891

Accuracy on training data: 48401 / 50000

Cost on evaluation data: 1.20541981295

Accuracy on evaluation data: 9594 / 10000

Epoch 342 training complete

Cost on training data: 0.445266537084

Accuracy on training data: 47883 / 50000

Cost on evaluation data: 1.24136107559

Accuracy on evaluation data: 9540 / 10000

Epoch 343 training complete

Cost on training data: 0.391351845622

Accuracy on training data: 48397 / 50000

Cost on evaluation data: 1.2064199413

Accuracy on evaluation data: 9586 / 10000

Epoch 344 training complete

Cost on training data: 0.376111011423

Accuracy on training data: 48513 / 50000

Cost on evaluation data: 1.19574232308

Accuracy on evaluation data: 9594 / 10000

Epoch 345 training complete

Cost on training data: 0.379807917946

Accuracy on training data: 48462 / 50000

Cost on evaluation data: 1.1771546748

Accuracy on evaluation data: 9606 / 10000

Epoch 346 training complete

Cost on training data: 0.400235730074

Accuracy on training data: 48260 / 50000

Cost on evaluation data: 1.20454183401

Accuracy on evaluation data: 9568 / 10000

Epoch 347 training complete

Cost on training data: 0.367184865415

Accuracy on training data: 48594 / 50000

Cost on evaluation data: 1.16758958852

Accuracy on evaluation data: 9665 / 10000

Epoch 348 training complete

Cost on training data: 0.381881583789

Accuracy on training data: 48443 / 50000

Cost on evaluation data: 1.1969392782

Accuracy on evaluation data: 9600 / 10000

Epoch 349 training complete

Cost on training data: 0.364934126379

Accuracy on training data: 48629 / 50000

Cost on evaluation data: 1.17666309405

Accuracy on evaluation data: 9644 / 10000

Epoch 350 training complete

Cost on training data: 0.394494867168

Accuracy on training data: 48346 / 50000

Cost on evaluation data: 1.20838492798

Accuracy on evaluation data: 9591 / 10000

Epoch 351 training complete

Cost on training data: 0.369563216245

Accuracy on training data: 48594 / 50000

Cost on evaluation data: 1.18832494165

Accuracy on evaluation data: 9607 / 10000

Epoch 352 training complete

Cost on training data: 0.386820586151

Accuracy on training data: 48370 / 50000

Cost on evaluation data: 1.20208907023

Accuracy on evaluation data: 9597 / 10000

Epoch 353 training complete

Cost on training data: 0.38832737003

Accuracy on training data: 48447 / 50000

Cost on evaluation data: 1.20470153349

Accuracy on evaluation data: 9602 / 10000

Epoch 354 training complete

Cost on training data: 0.377013473917

Accuracy on training data: 48485 / 50000

Cost on evaluation data: 1.18536815819

Accuracy on evaluation data: 9630 / 10000

Epoch 355 training complete

Cost on training data: 0.397662037342

Accuracy on training data: 48339 / 50000

Cost on evaluation data: 1.21458659602

Accuracy on evaluation data: 9608 / 10000

Epoch 356 training complete

Cost on training data: 0.385996966739

Accuracy on training data: 48472 / 50000

Cost on evaluation data: 1.18871909472

Accuracy on evaluation data: 9591 / 10000

Epoch 357 training complete

Cost on training data: 0.367301167494

Accuracy on training data: 48619 / 50000

Cost on evaluation data: 1.18756535994

Accuracy on evaluation data: 9616 / 10000

Epoch 358 training complete

Cost on training data: 0.385676906988

Accuracy on training data: 48426 / 50000

Cost on evaluation data: 1.19636510257

Accuracy on evaluation data: 9585 / 10000

Epoch 359 training complete

Cost on training data: 0.360908162735

Accuracy on training data: 48648 / 50000

Cost on evaluation data: 1.16750155676

Accuracy on evaluation data: 9615 / 10000

Epoch 360 training complete

Cost on training data: 0.357310939635

Accuracy on training data: 48716 / 50000

Cost on evaluation data: 1.17206407496

Accuracy on evaluation data: 9652 / 10000

Epoch 361 training complete

Cost on training data: 0.39504281961

Accuracy on training data: 48330 / 50000

Cost on evaluation data: 1.21088803402

Accuracy on evaluation data: 9572 / 10000

Epoch 362 training complete

Cost on training data: 0.39100627341

Accuracy on training data: 48416 / 50000

Cost on evaluation data: 1.18996176371

Accuracy on evaluation data: 9593 / 10000

Epoch 363 training complete

Cost on training data: 0.371682739198

Accuracy on training data: 48593 / 50000

Cost on evaluation data: 1.18894758765

Accuracy on evaluation data: 9642 / 10000

Epoch 364 training complete

Cost on training data: 0.389757548655

Accuracy on training data: 48451 / 50000

Cost on evaluation data: 1.19804300864

Accuracy on evaluation data: 9606 / 10000

Epoch 365 training complete

Cost on training data: 0.38081659718

Accuracy on training data: 48464 / 50000

Cost on evaluation data: 1.20008500804

Accuracy on evaluation data: 9633 / 10000

Epoch 366 training complete

Cost on training data: 0.395711075951

Accuracy on training data: 48397 / 50000

Cost on evaluation data: 1.20084815182

Accuracy on evaluation data: 9603 / 10000

Epoch 367 training complete

Cost on training data: 0.384585458337

Accuracy on training data: 48453 / 50000

Cost on evaluation data: 1.20850079349

Accuracy on evaluation data: 9585 / 10000

Epoch 368 training complete

Cost on training data: 0.422506433936

Accuracy on training data: 48052 / 50000

Cost on evaluation data: 1.22900671863

Accuracy on evaluation data: 9535 / 10000

Epoch 369 training complete

Cost on training data: 0.39180616473

Accuracy on training data: 48403 / 50000

Cost on evaluation data: 1.20885013058

Accuracy on evaluation data: 9588 / 10000

Epoch 370 training complete

Cost on training data: 0.385667728255

Accuracy on training data: 48460 / 50000

Cost on evaluation data: 1.19629739238

Accuracy on evaluation data: 9602 / 10000

Epoch 371 training complete

Cost on training data: 0.377209061231

Accuracy on training data: 48524 / 50000

Cost on evaluation data: 1.17703900468

Accuracy on evaluation data: 9629 / 10000

Epoch 372 training complete

Cost on training data: 0.407798516206

Accuracy on training data: 48152 / 50000

Cost on evaluation data: 1.20170323359

Accuracy on evaluation data: 9581 / 10000

Epoch 373 training complete

Cost on training data: 0.396382456149

Accuracy on training data: 48311 / 50000

Cost on evaluation data: 1.20867676594

Accuracy on evaluation data: 9580 / 10000

Epoch 374 training complete

Cost on training data: 0.413774031333

Accuracy on training data: 48214 / 50000

Cost on evaluation data: 1.2357442679

Accuracy on evaluation data: 9522 / 10000

Epoch 375 training complete

Cost on training data: 0.445281212716

Accuracy on training data: 47902 / 50000

Cost on evaluation data: 1.25564647718

Accuracy on evaluation data: 9503 / 10000

Epoch 376 training complete

Cost on training data: 0.379507909824

Accuracy on training data: 48504 / 50000

Cost on evaluation data: 1.18865703433

Accuracy on evaluation data: 9603 / 10000

Epoch 377 training complete

Cost on training data: 0.390527227007

Accuracy on training data: 48386 / 50000

Cost on evaluation data: 1.21084543792

Accuracy on evaluation data: 9587 / 10000

Epoch 378 training complete

Cost on training data: 0.403145658624

Accuracy on training data: 48338 / 50000

Cost on evaluation data: 1.2207532175

Accuracy on evaluation data: 9591 / 10000

Epoch 379 training complete

Cost on training data: 0.379946538172

Accuracy on training data: 48480 / 50000

Cost on evaluation data: 1.20339636612

Accuracy on evaluation data: 9607 / 10000

Epoch 380 training complete

Cost on training data: 0.366577595745

Accuracy on training data: 48600 / 50000

Cost on evaluation data: 1.19035841855

Accuracy on evaluation data: 9585 / 10000

Epoch 381 training complete

Cost on training data: 0.380987998181

Accuracy on training data: 48446 / 50000

Cost on evaluation data: 1.18476001531

Accuracy on evaluation data: 9631 / 10000

Epoch 382 training complete

Cost on training data: 0.389108350814

Accuracy on training data: 48345 / 50000

Cost on evaluation data: 1.19508077369

Accuracy on evaluation data: 9591 / 10000

Epoch 383 training complete

Cost on training data: 0.369233832936

Accuracy on training data: 48570 / 50000

Cost on evaluation data: 1.17491986832

Accuracy on evaluation data: 9641 / 10000

Epoch 384 training complete

Cost on training data: 0.365350085405

Accuracy on training data: 48678 / 50000

Cost on evaluation data: 1.1688382969

Accuracy on evaluation data: 9667 / 10000

Epoch 385 training complete

Cost on training data: 0.381308911271

Accuracy on training data: 48535 / 50000

Cost on evaluation data: 1.19695607146

Accuracy on evaluation data: 9612 / 10000

Epoch 386 training complete

Cost on training data: 0.397443539603

Accuracy on training data: 48312 / 50000

Cost on evaluation data: 1.21336032163

Accuracy on evaluation data: 9580 / 10000

Epoch 387 training complete

Cost on training data: 0.363323786285

Accuracy on training data: 48653 / 50000

Cost on evaluation data: 1.17353932808

Accuracy on evaluation data: 9642 / 10000

Epoch 388 training complete

Cost on training data: 0.429184854516

Accuracy on training data: 48036 / 50000

Cost on evaluation data: 1.22660293418

Accuracy on evaluation data: 9547 / 10000

Epoch 389 training complete

Cost on training data: 0.388040015498

Accuracy on training data: 48382 / 50000

Cost on evaluation data: 1.18679463449

Accuracy on evaluation data: 9612 / 10000

Epoch 390 training complete

Cost on training data: 0.397283068235

Accuracy on training data: 48335 / 50000

Cost on evaluation data: 1.21222895869

Accuracy on evaluation data: 9564 / 10000

Epoch 391 training complete

Cost on training data: 0.387507758047

Accuracy on training data: 48410 / 50000

Cost on evaluation data: 1.20325036345

Accuracy on evaluation data: 9609 / 10000

Epoch 392 training complete

Cost on training data: 0.390494489066

Accuracy on training data: 48401 / 50000

Cost on evaluation data: 1.20196957287

Accuracy on evaluation data: 9607 / 10000

Epoch 393 training complete

Cost on training data: 0.398982535445

Accuracy on training data: 48279 / 50000

Cost on evaluation data: 1.21198079888

Accuracy on evaluation data: 9576 / 10000

Epoch 394 training complete

Cost on training data: 0.385185013068

Accuracy on training data: 48421 / 50000

Cost on evaluation data: 1.19380244098

Accuracy on evaluation data: 9608 / 10000

Epoch 395 training complete

Cost on training data: 0.38356132983

Accuracy on training data: 48449 / 50000

Cost on evaluation data: 1.20101749606

Accuracy on evaluation data: 9581 / 10000

Epoch 396 training complete

Cost on training data: 0.37036296388

Accuracy on training data: 48633 / 50000

Cost on evaluation data: 1.18438699151

Accuracy on evaluation data: 9614 / 10000

Epoch 397 training complete

Cost on training data: 0.416864988458

Accuracy on training data: 48116 / 50000

Cost on evaluation data: 1.23234256762

Accuracy on evaluation data: 9530 / 10000

Epoch 398 training complete

Cost on training data: 0.38256710956

Accuracy on training data: 48463 / 50000

Cost on evaluation data: 1.1956651202

Accuracy on evaluation data: 9598 / 10000

Epoch 399 training complete

Cost on training data: 0.378665922385

Accuracy on training data: 48518 / 50000

Cost on evaluation data: 1.185638162

Accuracy on evaluation data: 9646 / 10000

week_1_solution_15

March 15, 2018

```
In [2]: 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 [3]: print("15. Repeat 12 for a deep network with four hidden layers, with 30 neuron in each")
```

15. Repeat 12 for a deep network with four hidden layers, with 30 neuron in each.

```
In [4]: import network2
net2_all_train = network2.Network([784, 30, 30, 30, 30, 10], cost=network2.CrossEntropy,
net2_all_train.large_weight_initializer()

epochs = 30

evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
    training_data,
    epochs,
    10,
    0.5,
    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: 1.44657434606

Accuracy on training data: 45579 / 50000

Cost on evaluation data: 5.07364038108

Accuracy on evaluation data: 9138 / 10000

Epoch 1 training complete

Cost on training data: 1.08592073967

Accuracy on training data: 46323 / 50000

Cost on evaluation data: 3.62337116737

Accuracy on evaluation data: 9219 / 10000

Epoch 2 training complete

Cost on training data: 0.825739990345

Accuracy on training data: 47043 / 50000

Cost on evaluation data: 2.69165018341

Accuracy on evaluation data: 9390 / 10000

Epoch 3 training complete

Cost on training data: 0.692453820495

Accuracy on training data: 47379 / 50000

Cost on evaluation data: 2.16554209789

Accuracy on evaluation data: 9419 / 10000

Epoch 4 training complete

Cost on training data: 0.601228547243

Accuracy on training data: 47575 / 50000

Cost on evaluation data: 1.84981541158

Accuracy on evaluation data: 9454 / 10000

Epoch 5 training complete

Cost on training data: 0.550159724657

Accuracy on training data: 47734 / 50000

Cost on evaluation data: 1.66239914358

Accuracy on evaluation data: 9465 / 10000

Epoch 6 training complete

Cost on training data: 0.501271190217

Accuracy on training data: 47930 / 50000

Cost on evaluation data: 1.52239506956

Accuracy on evaluation data: 9500 / 10000

Epoch 7 training complete

Cost on training data: 0.518429976985

Accuracy on training data: 47800 / 50000

Cost on evaluation data: 1.50856877644

Accuracy on evaluation data: 9491 / 10000

Epoch 8 training complete

Cost on training data: 0.54855359401

Accuracy on training data: 47357 / 50000

Cost on evaluation data: 1.498837195

Accuracy on evaluation data: 9429 / 10000

Epoch 9 training complete

Cost on training data: 0.550150830471

Accuracy on training data: 47309 / 50000

Cost on evaluation data: 1.49457924808

Accuracy on evaluation data: 9403 / 10000

Epoch 10 training complete

Cost on training data: 0.489974953908

Accuracy on training data: 47844 / 50000

Cost on evaluation data: 1.39647648275

Accuracy on evaluation data: 9517 / 10000

Epoch 11 training complete

Cost on training data: 0.481178063442

Accuracy on training data: 47885 / 50000

Cost on evaluation data: 1.40231636253

Accuracy on evaluation data: 9518 / 10000

Epoch 12 training complete

Cost on training data: 0.490345815979

Accuracy on training data: 47906 / 50000

Cost on evaluation data: 1.4139500828

Accuracy on evaluation data: 9497 / 10000

Epoch 13 training complete

Cost on training data: 0.429120010084

Accuracy on training data: 48296 / 50000

Cost on evaluation data: 1.35483185191

Accuracy on evaluation data: 9570 / 10000

Epoch 14 training complete

Cost on training data: 0.477667825781

Accuracy on training data: 47882 / 50000

Cost on evaluation data: 1.39309009387

Accuracy on evaluation data: 9508 / 10000

Epoch 15 training complete

Cost on training data: 0.423424653658

Accuracy on training data: 48323 / 50000

Cost on evaluation data: 1.34904405286

Accuracy on evaluation data: 9587 / 10000

Epoch 16 training complete

Cost on training data: 0.433961957357

Accuracy on training data: 48293 / 50000

Cost on evaluation data: 1.35496642652

Accuracy on evaluation data: 9559 / 10000

Epoch 17 training complete

Cost on training data: 0.49463828859

Accuracy on training data: 47771 / 50000

Cost on evaluation data: 1.40640661418

Accuracy on evaluation data: 9485 / 10000

Epoch 18 training complete

Cost on training data: 0.47418356412

Accuracy on training data: 47954 / 50000

Cost on evaluation data: 1.38230292131

Accuracy on evaluation data: 9509 / 10000

Epoch 19 training complete

Cost on training data: 0.434654964562

Accuracy on training data: 48299 / 50000

Cost on evaluation data: 1.35471332568

Accuracy on evaluation data: 9580 / 10000

Epoch 20 training complete

Cost on training data: 0.506512518681

Accuracy on training data: 47654 / 50000

Cost on evaluation data: 1.40626969239

Accuracy on evaluation data: 9488 / 10000

Epoch 21 training complete

Cost on training data: 0.510337314168

Accuracy on training data: 47596 / 50000

Cost on evaluation data: 1.40316408044

Accuracy on evaluation data: 9488 / 10000

Epoch 22 training complete

Cost on training data: 0.441234675356

Accuracy on training data: 48181 / 50000

Cost on evaluation data: 1.3548347108

Accuracy on evaluation data: 9580 / 10000

Epoch 23 training complete

Cost on training data: 0.448269893166

Accuracy on training data: 48153 / 50000

Cost on evaluation data: 1.37145518795

Accuracy on evaluation data: 9552 / 10000

Epoch 24 training complete

Cost on training data: 0.447195473394

Accuracy on training data: 48126 / 50000

Cost on evaluation data: 1.36927339388

Accuracy on evaluation data: 9566 / 10000

Epoch 25 training complete

Cost on training data: 0.509774110993

Accuracy on training data: 47637 / 50000

Cost on evaluation data: 1.41576545279

Accuracy on evaluation data: 9464 / 10000

Epoch 26 training complete

Cost on training data: 0.421152982337

Accuracy on training data: 48315 / 50000

Cost on evaluation data: 1.33600603477

Accuracy on evaluation data: 9593 / 10000

Epoch 27 training complete

Cost on training data: 0.454280588156

Accuracy on training data: 48066 / 50000

Cost on evaluation data: 1.3724223521

Accuracy on evaluation data: 9568 / 10000

Epoch 28 training complete

Cost on training data: 0.442168885164

Accuracy on training data: 48220 / 50000

Cost on evaluation data: 1.36025924121

Accuracy on evaluation data: 9573 / 10000

Epoch 29 training complete

Cost on training data: 0.450619561148

Accuracy on training data: 48118 / 50000

Cost on evaluation data: 1.37293766914

Accuracy on evaluation data: 9562 / 10000

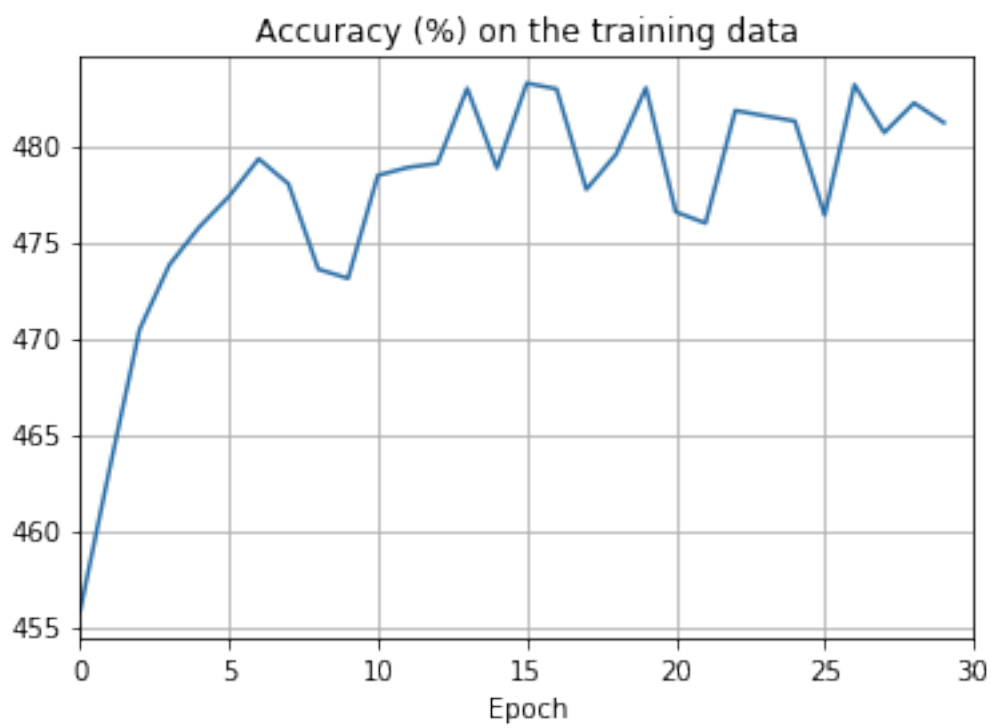
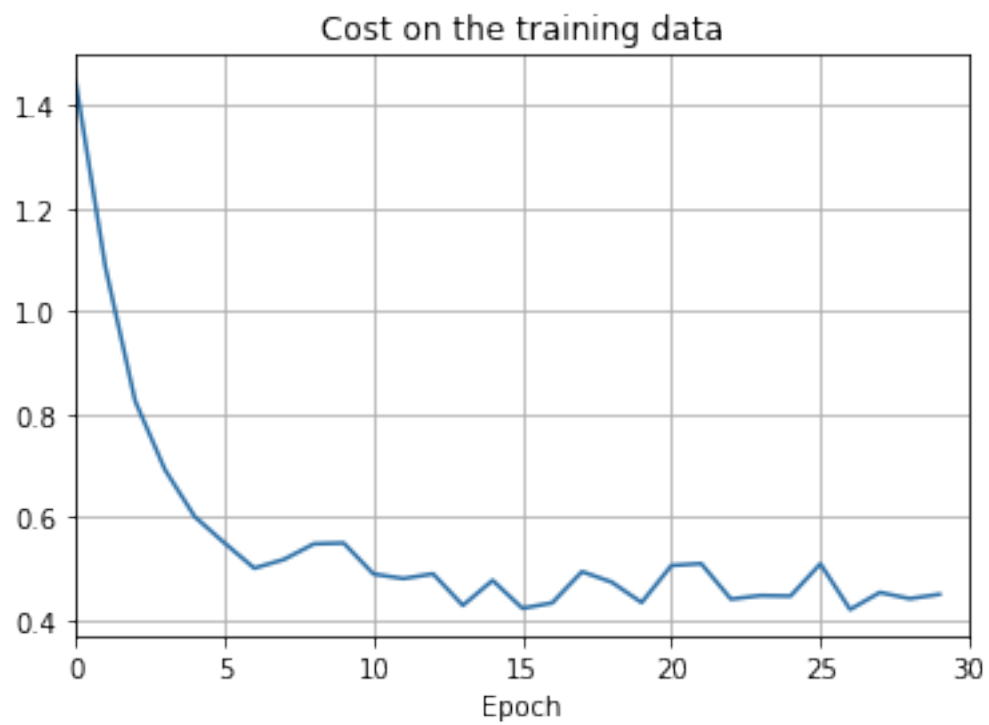
```
In [6]: import plot_helper
```

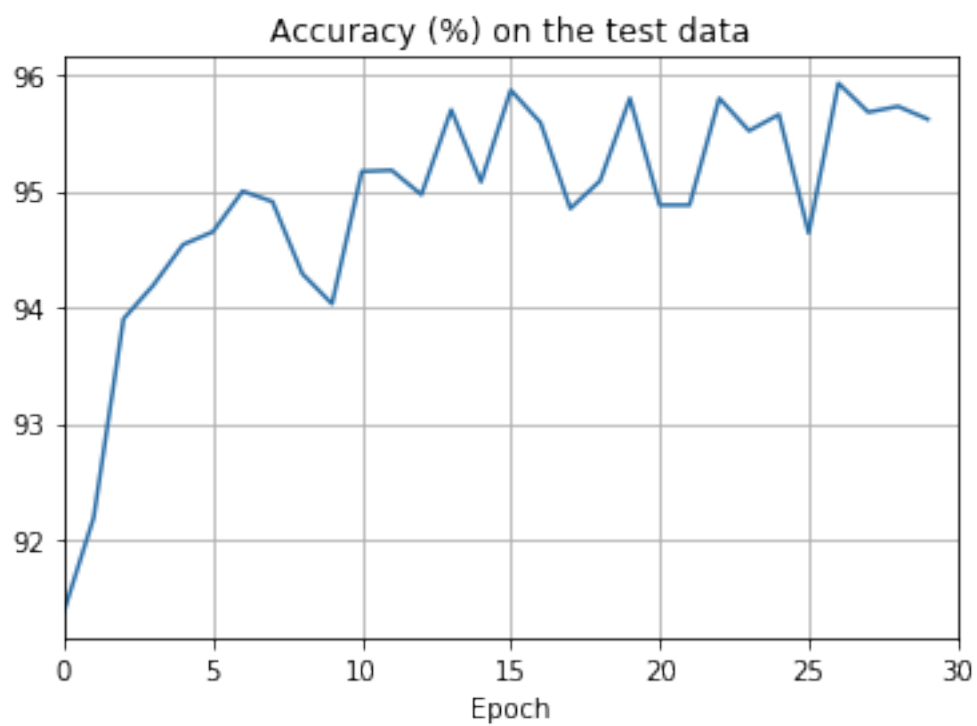
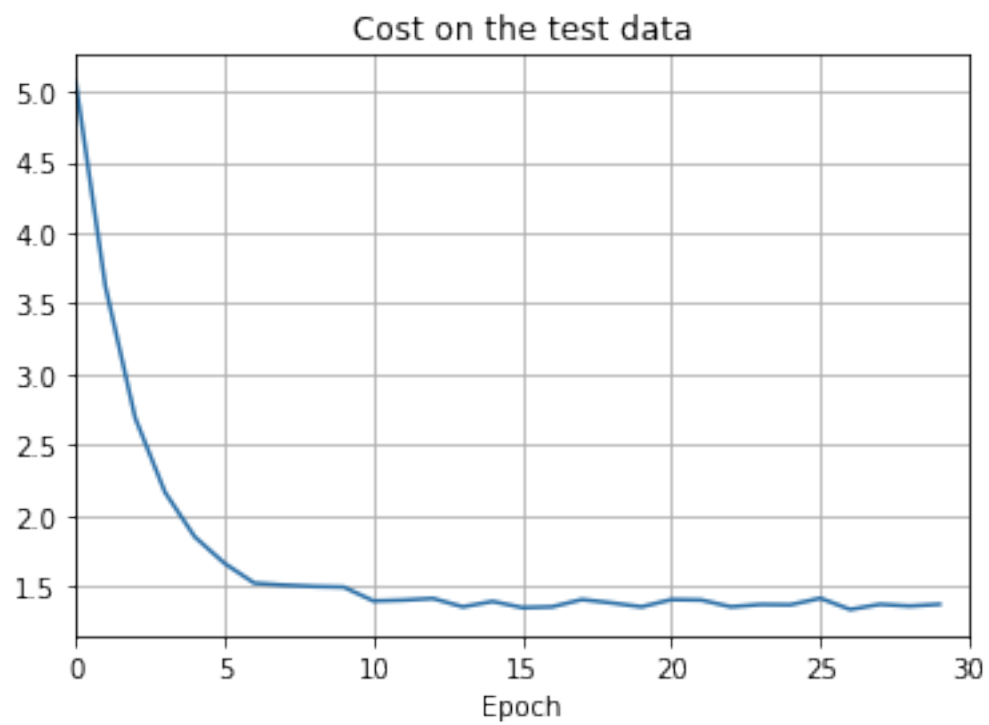
```
plot_helper.plot_training_cost(num_epochs=epochs, training_cost=training_cost_all_train,
```

```
plot_helper.plot_training_accuracy(num_epochs=epochs, training_accuracy=training_accuracy_all_train,
```

```
plot_helper.plot_test_cost(num_epochs=epochs, test_cost=evaluation_cost_all_train, test_cost=evaluation_cost_all_test,
```

```
plot_helper.plot_test_accuracy(num_epochs=epochs, test_accuracy=evaluation_accuracy_all_train, test_accuracy=evaluation_accuracy_all_test,
```





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.train(
    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

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

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,
    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: 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

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

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

week_1_solution_17_3

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, 30, 30, 10], cost=network2.CrossEntropy)
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: 6.02309787696
Accuracy on training data: 12095 / 50000
Cost on evaluation data: 10.8759260913
Accuracy on evaluation data: 2450 / 10000
```

Epoch 1 training complete
Cost on training data: 4.21948388712
Accuracy on training data: 10179 / 50000
Cost on evaluation data: 8.6092242796
Accuracy on evaluation data: 2041 / 10000

Epoch 2 training complete
Cost on training data: 3.77018981364
Accuracy on training data: 21438 / 50000
Cost on evaluation data: 7.74776708012
Accuracy on evaluation data: 4324 / 10000

Epoch 3 training complete
Cost on training data: 3.25747867169
Accuracy on training data: 21164 / 50000
Cost on evaluation data: 6.84827410508
Accuracy on evaluation data: 4228 / 10000

Epoch 4 training complete
Cost on training data: 2.72920451265
Accuracy on training data: 31683 / 50000
Cost on evaluation data: 5.99967997739
Accuracy on evaluation data: 6222 / 10000

Epoch 5 training complete
Cost on training data: 2.37274214928
Accuracy on training data: 36780 / 50000
Cost on evaluation data: 5.3459488555
Accuracy on evaluation data: 7351 / 10000

Epoch 6 training complete
Cost on training data: 2.2784198537
Accuracy on training data: 37323 / 50000
Cost on evaluation data: 4.98096238339
Accuracy on evaluation data: 7433 / 10000

Epoch 7 training complete
Cost on training data: 2.17993979677
Accuracy on training data: 36078 / 50000
Cost on evaluation data: 4.62180733593
Accuracy on evaluation data: 7161 / 10000

Epoch 8 training complete
Cost on training data: 1.59548871389
Accuracy on training data: 41057 / 50000
Cost on evaluation data: 3.83261920077
Accuracy on evaluation data: 8197 / 10000

Epoch 9 training complete
Cost on training data: 1.70128854645
Accuracy on training data: 41472 / 50000
Cost on evaluation data: 3.73070578306
Accuracy on evaluation data: 8270 / 10000

Epoch 10 training complete
Cost on training data: 1.40463731589
Accuracy on training data: 43311 / 50000
Cost on evaluation data: 3.24147397423
Accuracy on evaluation data: 8666 / 10000

Epoch 11 training complete
Cost on training data: 1.20039313587
Accuracy on training data: 43658 / 50000
Cost on evaluation data: 2.89492740348
Accuracy on evaluation data: 8677 / 10000

Epoch 12 training complete
Cost on training data: 1.4073851066
Accuracy on training data: 43525 / 50000
Cost on evaluation data: 2.9306808364
Accuracy on evaluation data: 8650 / 10000

Epoch 13 training complete
Cost on training data: 1.20541043315
Accuracy on training data: 44674 / 50000
Cost on evaluation data: 2.58263133999
Accuracy on evaluation data: 8911 / 10000

Epoch 14 training complete
Cost on training data: 1.17412796465
Accuracy on training data: 44931 / 50000
Cost on evaluation data: 2.44869473642
Accuracy on evaluation data: 8945 / 10000

Epoch 15 training complete
Cost on training data: 0.898369913654
Accuracy on training data: 45307 / 50000
Cost on evaluation data: 2.06604845545
Accuracy on evaluation data: 9025 / 10000

Epoch 16 training complete
Cost on training data: 0.969400147238
Accuracy on training data: 45728 / 50000
Cost on evaluation data: 2.02590546826
Accuracy on evaluation data: 9106 / 10000

Epoch 17 training complete
Cost on training data: 0.96428222255
Accuracy on training data: 45391 / 50000
Cost on evaluation data: 1.92172680998
Accuracy on evaluation data: 9007 / 10000

Epoch 18 training complete
Cost on training data: 0.841769967827
Accuracy on training data: 45690 / 50000
Cost on evaluation data: 1.73173008112
Accuracy on evaluation data: 9077 / 10000

Epoch 19 training complete
Cost on training data: 0.884552639162
Accuracy on training data: 45823 / 50000
Cost on evaluation data: 1.71278731318
Accuracy on evaluation data: 9112 / 10000

Epoch 20 training complete
Cost on training data: 0.6637538688
Accuracy on training data: 46226 / 50000
Cost on evaluation data: 1.4085682489
Accuracy on evaluation data: 9184 / 10000

Epoch 21 training complete
Cost on training data: 0.597835805147
Accuracy on training data: 46658 / 50000
Cost on evaluation data: 1.303582312
Accuracy on evaluation data: 9233 / 10000

Epoch 22 training complete
Cost on training data: 0.635375365816
Accuracy on training data: 46706 / 50000
Cost on evaluation data: 1.28018669345
Accuracy on evaluation data: 9276 / 10000

Epoch 23 training complete
Cost on training data: 0.564795757264
Accuracy on training data: 46693 / 50000
Cost on evaluation data: 1.15485030172
Accuracy on evaluation data: 9266 / 10000

Epoch 24 training complete
Cost on training data: 0.710891786415
Accuracy on training data: 46663 / 50000
Cost on evaluation data: 1.25424327464
Accuracy on evaluation data: 9287 / 10000

Epoch 25 training complete
Cost on training data: 0.719402155454
Accuracy on training data: 46670 / 50000
Cost on evaluation data: 1.22576278985
Accuracy on evaluation data: 9249 / 10000

Epoch 26 training complete
Cost on training data: 0.677451185215
Accuracy on training data: 46626 / 50000
Cost on evaluation data: 1.15666502753
Accuracy on evaluation data: 9221 / 10000

Epoch 27 training complete
Cost on training data: 0.606850946676
Accuracy on training data: 47104 / 50000
Cost on evaluation data: 1.04669687733
Accuracy on evaluation data: 9353 / 10000

Epoch 28 training complete
Cost on training data: 0.581026413968
Accuracy on training data: 47277 / 50000
Cost on evaluation data: 0.982280329274
Accuracy on evaluation data: 9367 / 10000

Epoch 29 training complete
Cost on training data: 0.476099205135
Accuracy on training data: 47404 / 50000
Cost on evaluation data: 0.869928056478
Accuracy on evaluation data: 9398 / 10000

week_1_solution_18_19_1

March 15, 2018

```
In [14]: 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 [18]: import network2
network2 = reload(network2)

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

evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, training_accuracy_all_train = network2.evaluate_network(
    training_data=training_data,
    epochs=30,
    mini_batch_size=10,
    eta=0.0001,
    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: 4.40284341451

Accuracy on training data: 7260 / 50000

Cost on evaluation data: 20.1677906477

Accuracy on evaluation data: 1414 / 10000

Epoch 1 training complete

Cost on training data: 4.51385082674

Accuracy on training data: 8282 / 50000
Cost on evaluation data: 20.2553782192
Accuracy on evaluation data: 1662 / 10000

Epoch 2 training complete
Cost on training data: 4.63656893423
Accuracy on training data: 8638 / 50000
Cost on evaluation data: 20.3394556165
Accuracy on evaluation data: 1722 / 10000

Epoch 3 training complete
Cost on training data: 4.76735701798
Accuracy on training data: 8792 / 50000
Cost on evaluation data: 20.4671514245
Accuracy on evaluation data: 1728 / 10000

Epoch 4 training complete
Cost on training data: 4.90147774232
Accuracy on training data: 8803 / 50000
Cost on evaluation data: 20.6110467273
Accuracy on evaluation data: 1753 / 10000

Epoch 5 training complete
Cost on training data: 5.08205568213
Accuracy on training data: 8890 / 50000
Cost on evaluation data: 20.760133332
Accuracy on evaluation data: 1798 / 10000

Epoch 6 training complete
Cost on training data: 5.27244473911
Accuracy on training data: 8905 / 50000
Cost on evaluation data: 20.9592348797
Accuracy on evaluation data: 1824 / 10000

Epoch 7 training complete
Cost on training data: 5.49538732246
Accuracy on training data: 9014 / 50000
Cost on evaluation data: 21.1849161746
Accuracy on evaluation data: 1837 / 10000

Epoch 8 training complete
Cost on training data: 5.76613353233
Accuracy on training data: 9144 / 50000
Cost on evaluation data: 21.4347508861
Accuracy on evaluation data: 1850 / 10000

Epoch 9 training complete
Cost on training data: 6.05029746252

Accuracy on training data: 9479 / 50000
Cost on evaluation data: 21.7051325387
Accuracy on evaluation data: 1917 / 10000

Epoch 10 training complete
Cost on training data: 6.35851485146
Accuracy on training data: 9831 / 50000
Cost on evaluation data: 22.0357348786
Accuracy on evaluation data: 1989 / 10000

Epoch 11 training complete
Cost on training data: 6.65126868719
Accuracy on training data: 10248 / 50000
Cost on evaluation data: 22.3236636726
Accuracy on evaluation data: 2069 / 10000

Epoch 12 training complete
Cost on training data: 6.90026007017
Accuracy on training data: 10912 / 50000
Cost on evaluation data: 22.5754189357
Accuracy on evaluation data: 2229 / 10000

Epoch 13 training complete
Cost on training data: 7.08334820588
Accuracy on training data: 11636 / 50000
Cost on evaluation data: 22.789240336
Accuracy on evaluation data: 2366 / 10000

Epoch 14 training complete
Cost on training data: 7.15591229534
Accuracy on training data: 12525 / 50000
Cost on evaluation data: 22.8090629046
Accuracy on evaluation data: 2564 / 10000

Epoch 15 training complete
Cost on training data: 7.15160962082
Accuracy on training data: 13662 / 50000
Cost on evaluation data: 22.7828993943
Accuracy on evaluation data: 2839 / 10000

Epoch 16 training complete
Cost on training data: 7.05356373529
Accuracy on training data: 14729 / 50000
Cost on evaluation data: 22.6824963115
Accuracy on evaluation data: 3035 / 10000

Epoch 17 training complete
Cost on training data: 7.03253014965

Accuracy on training data: 16110 / 50000
Cost on evaluation data: 22.6428446717
Accuracy on evaluation data: 3310 / 10000

Epoch 18 training complete
Cost on training data: 6.8454381184
Accuracy on training data: 17343 / 50000
Cost on evaluation data: 22.4132540261
Accuracy on evaluation data: 3583 / 10000

Epoch 19 training complete
Cost on training data: 6.8235985582
Accuracy on training data: 18666 / 50000
Cost on evaluation data: 22.3772701083
Accuracy on evaluation data: 3818 / 10000

Epoch 20 training complete
Cost on training data: 6.73881870796
Accuracy on training data: 19999 / 50000
Cost on evaluation data: 22.3032946312
Accuracy on evaluation data: 4080 / 10000

Epoch 21 training complete
Cost on training data: 6.68199869134
Accuracy on training data: 21179 / 50000
Cost on evaluation data: 22.2218686471
Accuracy on evaluation data: 4347 / 10000

Epoch 22 training complete
Cost on training data: 6.6055394845
Accuracy on training data: 22090 / 50000
Cost on evaluation data: 22.1481124598
Accuracy on evaluation data: 4548 / 10000

Epoch 23 training complete
Cost on training data: 6.51261109742
Accuracy on training data: 23268 / 50000
Cost on evaluation data: 22.0425468177
Accuracy on evaluation data: 4805 / 10000

Epoch 24 training complete
Cost on training data: 6.45839883941
Accuracy on training data: 23726 / 50000
Cost on evaluation data: 21.9895405994
Accuracy on evaluation data: 4891 / 10000

Epoch 25 training complete
Cost on training data: 6.4033041359

Accuracy on training data: 24660 / 50000
Cost on evaluation data: 21.94254791
Accuracy on evaluation data: 5062 / 10000

Epoch 26 training complete
Cost on training data: 6.33721147395
Accuracy on training data: 25371 / 50000
Cost on evaluation data: 21.8621680366
Accuracy on evaluation data: 5199 / 10000

Epoch 27 training complete
Cost on training data: 6.3514314454
Accuracy on training data: 25990 / 50000
Cost on evaluation data: 21.8708532664
Accuracy on evaluation data: 5348 / 10000

Epoch 28 training complete
Cost on training data: 6.25234946929
Accuracy on training data: 26537 / 50000
Cost on evaluation data: 21.7675961533
Accuracy on evaluation data: 5436 / 10000

Epoch 29 training complete
Cost on training data: 6.23038307832
Accuracy on training data: 27095 / 50000
Cost on evaluation data: 21.741749438
Accuracy on evaluation data: 5529 / 10000

```
In [19]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
        training_data=training_data,
        epochs=30,
        mini_batch_size=10,
        eta=0.0001,
        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: 6.2417828399
Accuracy on training data: 27514 / 50000
Cost on evaluation data: 21.7685391017
Accuracy on evaluation data: 5637 / 10000

Epoch 1 training complete
Cost on training data: 6.19719850212
Accuracy on training data: 28125 / 50000
Cost on evaluation data: 21.7211730106
Accuracy on evaluation data: 5743 / 10000

Epoch 2 training complete
Cost on training data: 6.15422727506
Accuracy on training data: 28583 / 50000
Cost on evaluation data: 21.6755053818
Accuracy on evaluation data: 5873 / 10000

Epoch 3 training complete
Cost on training data: 6.12850897522
Accuracy on training data: 28818 / 50000
Cost on evaluation data: 21.6407264116
Accuracy on evaluation data: 5870 / 10000

Epoch 4 training complete
Cost on training data: 6.11152084645
Accuracy on training data: 28998 / 50000
Cost on evaluation data: 21.6240318896
Accuracy on evaluation data: 5916 / 10000

Epoch 5 training complete
Cost on training data: 6.1046457249
Accuracy on training data: 29459 / 50000
Cost on evaluation data: 21.6109982744
Accuracy on evaluation data: 6009 / 10000

Epoch 6 training complete
Cost on training data: 6.07120694667
Accuracy on training data: 29827 / 50000
Cost on evaluation data: 21.577161613
Accuracy on evaluation data: 6089 / 10000

Epoch 7 training complete
Cost on training data: 6.07566603996
Accuracy on training data: 29836 / 50000
Cost on evaluation data: 21.5837528187
Accuracy on evaluation data: 6111 / 10000

Epoch 8 training complete
Cost on training data: 6.04601628133
Accuracy on training data: 30075 / 50000
Cost on evaluation data: 21.5580356624
Accuracy on evaluation data: 6160 / 10000

Epoch 9 training complete
Cost on training data: 6.04309410736
Accuracy on training data: 30215 / 50000
Cost on evaluation data: 21.5500607984
Accuracy on evaluation data: 6211 / 10000

Epoch 10 training complete
Cost on training data: 6.02958215772
Accuracy on training data: 30400 / 50000
Cost on evaluation data: 21.5363995077
Accuracy on evaluation data: 6220 / 10000

Epoch 11 training complete
Cost on training data: 6.03682804456
Accuracy on training data: 30661 / 50000
Cost on evaluation data: 21.536048423
Accuracy on evaluation data: 6289 / 10000

Epoch 12 training complete
Cost on training data: 5.98265390941
Accuracy on training data: 30715 / 50000
Cost on evaluation data: 21.4810276743
Accuracy on evaluation data: 6280 / 10000

Epoch 13 training complete
Cost on training data: 5.98993077176
Accuracy on training data: 30985 / 50000
Cost on evaluation data: 21.490536831
Accuracy on evaluation data: 6323 / 10000

Epoch 14 training complete
Cost on training data: 5.96893030731
Accuracy on training data: 31184 / 50000
Cost on evaluation data: 21.4720577073
Accuracy on evaluation data: 6378 / 10000

Epoch 15 training complete
Cost on training data: 5.97342725097
Accuracy on training data: 31277 / 50000
Cost on evaluation data: 21.4700027806
Accuracy on evaluation data: 6386 / 10000

Epoch 16 training complete
Cost on training data: 5.96888347755
Accuracy on training data: 31253 / 50000
Cost on evaluation data: 21.4660116227
Accuracy on evaluation data: 6422 / 10000

Epoch 17 training complete
Cost on training data: 5.95598167037
Accuracy on training data: 31555 / 50000
Cost on evaluation data: 21.4540323832
Accuracy on evaluation data: 6433 / 10000

Epoch 18 training complete
Cost on training data: 5.93870029972
Accuracy on training data: 31685 / 50000
Cost on evaluation data: 21.4324490984
Accuracy on evaluation data: 6480 / 10000

Epoch 19 training complete
Cost on training data: 5.95209354455
Accuracy on training data: 31783 / 50000
Cost on evaluation data: 21.4459333477
Accuracy on evaluation data: 6485 / 10000

Epoch 20 training complete
Cost on training data: 5.95509913456
Accuracy on training data: 31674 / 50000
Cost on evaluation data: 21.4484347032
Accuracy on evaluation data: 6479 / 10000

Epoch 21 training complete
Cost on training data: 5.93231986277
Accuracy on training data: 31706 / 50000
Cost on evaluation data: 21.430491987
Accuracy on evaluation data: 6497 / 10000

Epoch 22 training complete
Cost on training data: 5.92268446545
Accuracy on training data: 32069 / 50000
Cost on evaluation data: 21.4132298039
Accuracy on evaluation data: 6564 / 10000

Epoch 23 training complete
Cost on training data: 5.93311248627
Accuracy on training data: 32021 / 50000
Cost on evaluation data: 21.420344028
Accuracy on evaluation data: 6542 / 10000

Epoch 24 training complete
Cost on training data: 5.90541340386
Accuracy on training data: 32263 / 50000
Cost on evaluation data: 21.3982963101
Accuracy on evaluation data: 6591 / 10000

Epoch 25 training complete
Cost on training data: 5.92392655358
Accuracy on training data: 32249 / 50000
Cost on evaluation data: 21.4115830468
Accuracy on evaluation data: 6544 / 10000

Epoch 26 training complete
Cost on training data: 5.90041426277
Accuracy on training data: 32229 / 50000
Cost on evaluation data: 21.3907450007
Accuracy on evaluation data: 6552 / 10000

Epoch 27 training complete
Cost on training data: 5.89933218511
Accuracy on training data: 32352 / 50000
Cost on evaluation data: 21.3834931271
Accuracy on evaluation data: 6609 / 10000

Epoch 28 training complete
Cost on training data: 5.89655380292
Accuracy on training data: 32438 / 50000
Cost on evaluation data: 21.3802263269
Accuracy on evaluation data: 6617 / 10000

Epoch 29 training complete
Cost on training data: 5.91334907584
Accuracy on training data: 32428 / 50000
Cost on evaluation data: 21.3980874854
Accuracy on evaluation data: 6646 / 10000

```
In [21]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tr
        training_data=training_data,
        epochs=50,
        mini_batch_size=10,
        eta=0.001,
        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: 5.86418380255

Accuracy on training data: 32067 / 50000
Cost on evaluation data: 21.3202098458
Accuracy on evaluation data: 6544 / 10000

Epoch 1 training complete
Cost on training data: 5.88446848528
Accuracy on training data: 32613 / 50000
Cost on evaluation data: 21.3231166057
Accuracy on evaluation data: 6658 / 10000

Epoch 2 training complete
Cost on training data: 5.825515199
Accuracy on training data: 33187 / 50000
Cost on evaluation data: 21.2543085198
Accuracy on evaluation data: 6715 / 10000

Epoch 3 training complete
Cost on training data: 5.80075238273
Accuracy on training data: 33543 / 50000
Cost on evaluation data: 21.2110359332
Accuracy on evaluation data: 6850 / 10000

Epoch 4 training complete
Cost on training data: 5.79282763853
Accuracy on training data: 33142 / 50000
Cost on evaluation data: 21.193069232
Accuracy on evaluation data: 6703 / 10000

Epoch 5 training complete
Cost on training data: 5.78461969103
Accuracy on training data: 33342 / 50000
Cost on evaluation data: 21.1727282255
Accuracy on evaluation data: 6774 / 10000

Epoch 6 training complete
Cost on training data: 5.79222516038
Accuracy on training data: 33021 / 50000
Cost on evaluation data: 21.1605646982
Accuracy on evaluation data: 6693 / 10000

Epoch 7 training complete
Cost on training data: 5.74662873078
Accuracy on training data: 33517 / 50000
Cost on evaluation data: 21.1037842338
Accuracy on evaluation data: 6791 / 10000

Epoch 8 training complete
Cost on training data: 5.7569717178

Accuracy on training data: 33846 / 50000
Cost on evaluation data: 21.0942095001
Accuracy on evaluation data: 6883 / 10000

Epoch 9 training complete
Cost on training data: 5.73924622545
Accuracy on training data: 34170 / 50000
Cost on evaluation data: 21.0621095219
Accuracy on evaluation data: 6937 / 10000

Epoch 10 training complete
Cost on training data: 5.74474496666
Accuracy on training data: 33410 / 50000
Cost on evaluation data: 21.0544553865
Accuracy on evaluation data: 6781 / 10000

Epoch 11 training complete
Cost on training data: 5.71234408108
Accuracy on training data: 34212 / 50000
Cost on evaluation data: 21.0022209187
Accuracy on evaluation data: 6961 / 10000

Epoch 12 training complete
Cost on training data: 5.73394413314
Accuracy on training data: 33654 / 50000
Cost on evaluation data: 21.0083478851
Accuracy on evaluation data: 6842 / 10000

Epoch 13 training complete
Cost on training data: 5.72100027425
Accuracy on training data: 34589 / 50000
Cost on evaluation data: 20.9812720893
Accuracy on evaluation data: 7046 / 10000

Epoch 14 training complete
Cost on training data: 5.67591449401
Accuracy on training data: 34898 / 50000
Cost on evaluation data: 20.9207298138
Accuracy on evaluation data: 7073 / 10000

Epoch 15 training complete
Cost on training data: 5.65634441202
Accuracy on training data: 34373 / 50000
Cost on evaluation data: 20.8837477015
Accuracy on evaluation data: 6991 / 10000

Epoch 16 training complete
Cost on training data: 5.68135610327

Accuracy on training data: 33999 / 50000
Cost on evaluation data: 20.9015290377
Accuracy on evaluation data: 6862 / 10000

Epoch 17 training complete
Cost on training data: 5.67835331664
Accuracy on training data: 34253 / 50000
Cost on evaluation data: 20.8819513512
Accuracy on evaluation data: 6915 / 10000

Epoch 18 training complete
Cost on training data: 5.65980533322
Accuracy on training data: 34265 / 50000
Cost on evaluation data: 20.8469664729
Accuracy on evaluation data: 6959 / 10000

Epoch 19 training complete
Cost on training data: 5.65800356321
Accuracy on training data: 34206 / 50000
Cost on evaluation data: 20.8270463387
Accuracy on evaluation data: 6960 / 10000

Epoch 20 training complete
Cost on training data: 5.66826225855
Accuracy on training data: 33720 / 50000
Cost on evaluation data: 20.8306020191
Accuracy on evaluation data: 6817 / 10000

Epoch 21 training complete
Cost on training data: 5.64848513553
Accuracy on training data: 34473 / 50000
Cost on evaluation data: 20.7870218128
Accuracy on evaluation data: 7000 / 10000

Epoch 22 training complete
Cost on training data: 5.63486633673
Accuracy on training data: 34691 / 50000
Cost on evaluation data: 20.7579130716
Accuracy on evaluation data: 7031 / 10000

Epoch 23 training complete
Cost on training data: 5.66724202367
Accuracy on training data: 33312 / 50000
Cost on evaluation data: 20.7727938583
Accuracy on evaluation data: 6770 / 10000

Epoch 24 training complete
Cost on training data: 5.62247450386

Accuracy on training data: 34262 / 50000
Cost on evaluation data: 20.7190038951
Accuracy on evaluation data: 6933 / 10000

Epoch 25 training complete
Cost on training data: 5.64059845796
Accuracy on training data: 34805 / 50000
Cost on evaluation data: 20.7186623009
Accuracy on evaluation data: 7052 / 10000

Epoch 26 training complete
Cost on training data: 5.60151354798
Accuracy on training data: 34834 / 50000
Cost on evaluation data: 20.6663041646
Accuracy on evaluation data: 7076 / 10000

Epoch 27 training complete
Cost on training data: 5.59112100084
Accuracy on training data: 34498 / 50000
Cost on evaluation data: 20.6426274684
Accuracy on evaluation data: 6990 / 10000

Epoch 28 training complete
Cost on training data: 5.59965756856
Accuracy on training data: 34896 / 50000
Cost on evaluation data: 20.636223855
Accuracy on evaluation data: 7100 / 10000

Epoch 29 training complete
Cost on training data: 5.59575571968
Accuracy on training data: 34628 / 50000
Cost on evaluation data: 20.6142172975
Accuracy on evaluation data: 7010 / 10000

Epoch 30 training complete
Cost on training data: 5.59024287194
Accuracy on training data: 34610 / 50000
Cost on evaluation data: 20.6006748217
Accuracy on evaluation data: 6998 / 10000

Epoch 31 training complete
Cost on training data: 5.57390484474
Accuracy on training data: 34578 / 50000
Cost on evaluation data: 20.5563348219
Accuracy on evaluation data: 7034 / 10000

Epoch 32 training complete
Cost on training data: 5.56915632847

Accuracy on training data: 34901 / 50000
Cost on evaluation data: 20.5408212718
Accuracy on evaluation data: 7094 / 10000

Epoch 33 training complete
Cost on training data: 5.56077952909
Accuracy on training data: 34915 / 50000
Cost on evaluation data: 20.5149721879
Accuracy on evaluation data: 7117 / 10000

Epoch 34 training complete
Cost on training data: 5.55521726558
Accuracy on training data: 34946 / 50000
Cost on evaluation data: 20.4984881153
Accuracy on evaluation data: 7080 / 10000

Epoch 35 training complete
Cost on training data: 5.55311862008
Accuracy on training data: 35010 / 50000
Cost on evaluation data: 20.4850601451
Accuracy on evaluation data: 7071 / 10000

Epoch 36 training complete
Cost on training data: 5.54093537601
Accuracy on training data: 35024 / 50000
Cost on evaluation data: 20.4567885951
Accuracy on evaluation data: 7049 / 10000

Epoch 37 training complete
Cost on training data: 5.53789789783
Accuracy on training data: 35042 / 50000
Cost on evaluation data: 20.4350544815
Accuracy on evaluation data: 7087 / 10000

Epoch 38 training complete
Cost on training data: 5.53273436305
Accuracy on training data: 35117 / 50000
Cost on evaluation data: 20.4197416981
Accuracy on evaluation data: 7109 / 10000

Epoch 39 training complete
Cost on training data: 5.53118050444
Accuracy on training data: 35160 / 50000
Cost on evaluation data: 20.400821426
Accuracy on evaluation data: 7113 / 10000

Epoch 40 training complete
Cost on training data: 5.52343686861

Accuracy on training data: 34940 / 50000
Cost on evaluation data: 20.3819736986
Accuracy on evaluation data: 7031 / 10000

Epoch 41 training complete
Cost on training data: 5.52439987367
Accuracy on training data: 35019 / 50000
Cost on evaluation data: 20.3620089821
Accuracy on evaluation data: 7079 / 10000

Epoch 42 training complete
Cost on training data: 5.52346963135
Accuracy on training data: 34856 / 50000
Cost on evaluation data: 20.3519049589
Accuracy on evaluation data: 7010 / 10000

Epoch 43 training complete
Cost on training data: 5.51385053325
Accuracy on training data: 35169 / 50000
Cost on evaluation data: 20.3210347583
Accuracy on evaluation data: 7102 / 10000

Epoch 44 training complete
Cost on training data: 5.50014220662
Accuracy on training data: 34957 / 50000
Cost on evaluation data: 20.2920572342
Accuracy on evaluation data: 7046 / 10000

Epoch 45 training complete
Cost on training data: 5.47835788652
Accuracy on training data: 35091 / 50000
Cost on evaluation data: 20.2555791775
Accuracy on evaluation data: 7025 / 10000

Epoch 46 training complete
Cost on training data: 5.47021725784
Accuracy on training data: 35269 / 50000
Cost on evaluation data: 20.2350585117
Accuracy on evaluation data: 7122 / 10000

Epoch 47 training complete
Cost on training data: 5.48487844639
Accuracy on training data: 35129 / 50000
Cost on evaluation data: 20.2352386425
Accuracy on evaluation data: 7080 / 10000

Epoch 48 training complete
Cost on training data: 5.47846441493

Accuracy on training data: 35133 / 50000
Cost on evaluation data: 20.2104821535
Accuracy on evaluation data: 7115 / 10000

Epoch 49 training complete
Cost on training data: 5.4761995872
Accuracy on training data: 35217 / 50000
Cost on evaluation data: 20.1894875531
Accuracy on evaluation data: 7097 / 10000

```
In [22]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tr
        training_data=training_data,
        epochs=50,
        mini_batch_size=10,
        eta=0.001,
        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: 5.48317485007
Accuracy on training data: 34980 / 50000
Cost on evaluation data: 20.1887229329
Accuracy on evaluation data: 7093 / 10000

Epoch 1 training complete
Cost on training data: 5.45913287016
Accuracy on training data: 35457 / 50000
Cost on evaluation data: 20.1452007092
Accuracy on evaluation data: 7143 / 10000

Epoch 2 training complete
Cost on training data: 5.45781593938
Accuracy on training data: 35321 / 50000
Cost on evaluation data: 20.1319403693
Accuracy on evaluation data: 7143 / 10000

Epoch 3 training complete
Cost on training data: 5.42829921661
Accuracy on training data: 35200 / 50000
Cost on evaluation data: 20.0861229009
Accuracy on evaluation data: 7076 / 10000

Epoch 4 training complete
Cost on training data: 5.44272000476
Accuracy on training data: 35588 / 50000
Cost on evaluation data: 20.0899550119
Accuracy on evaluation data: 7195 / 10000

Epoch 5 training complete
Cost on training data: 5.43820851325
Accuracy on training data: 35319 / 50000
Cost on evaluation data: 20.0672279299
Accuracy on evaluation data: 7100 / 10000

Epoch 6 training complete
Cost on training data: 5.42588702969
Accuracy on training data: 35518 / 50000
Cost on evaluation data: 20.0399462801
Accuracy on evaluation data: 7150 / 10000

Epoch 7 training complete
Cost on training data: 5.4216747967
Accuracy on training data: 35004 / 50000
Cost on evaluation data: 20.0245178617
Accuracy on evaluation data: 7051 / 10000

Epoch 8 training complete
Cost on training data: 5.42548858882
Accuracy on training data: 35197 / 50000
Cost on evaluation data: 20.0108374566
Accuracy on evaluation data: 7092 / 10000

Epoch 9 training complete
Cost on training data: 5.42727121159
Accuracy on training data: 35140 / 50000
Cost on evaluation data: 19.9971965973
Accuracy on evaluation data: 7118 / 10000

Epoch 10 training complete
Cost on training data: 5.41147808091
Accuracy on training data: 35674 / 50000
Cost on evaluation data: 19.9636377917
Accuracy on evaluation data: 7161 / 10000

Epoch 11 training complete
Cost on training data: 5.41809841536
Accuracy on training data: 35335 / 50000
Cost on evaluation data: 19.959389149
Accuracy on evaluation data: 7162 / 10000

Epoch 12 training complete
Cost on training data: 5.41532576803
Accuracy on training data: 35812 / 50000
Cost on evaluation data: 19.943346232
Accuracy on evaluation data: 7228 / 10000

Epoch 13 training complete
Cost on training data: 5.39317598156
Accuracy on training data: 35619 / 50000
Cost on evaluation data: 19.9123620416
Accuracy on evaluation data: 7131 / 10000

Epoch 14 training complete
Cost on training data: 5.34876427625
Accuracy on training data: 35985 / 50000
Cost on evaluation data: 19.8458598706
Accuracy on evaluation data: 7272 / 10000

Epoch 15 training complete
Cost on training data: 5.39705576201
Accuracy on training data: 35429 / 50000
Cost on evaluation data: 19.8830296511
Accuracy on evaluation data: 7123 / 10000

Epoch 16 training complete
Cost on training data: 5.39118247517
Accuracy on training data: 35389 / 50000
Cost on evaluation data: 19.8545532003
Accuracy on evaluation data: 7161 / 10000

Epoch 17 training complete
Cost on training data: 5.36854310336
Accuracy on training data: 35723 / 50000
Cost on evaluation data: 19.8236891379
Accuracy on evaluation data: 7174 / 10000

Epoch 18 training complete
Cost on training data: 5.36072672917
Accuracy on training data: 35953 / 50000
Cost on evaluation data: 19.8049783052
Accuracy on evaluation data: 7237 / 10000

Epoch 19 training complete
Cost on training data: 5.3581768429
Accuracy on training data: 35956 / 50000
Cost on evaluation data: 19.7808611273
Accuracy on evaluation data: 7249 / 10000

Epoch 20 training complete
Cost on training data: 5.36479566082
Accuracy on training data: 35897 / 50000
Cost on evaluation data: 19.7761263189
Accuracy on evaluation data: 7252 / 10000

Epoch 21 training complete
Cost on training data: 5.36434576474
Accuracy on training data: 35477 / 50000
Cost on evaluation data: 19.7605149585
Accuracy on evaluation data: 7146 / 10000

Epoch 22 training complete
Cost on training data: 5.3565099676
Accuracy on training data: 35315 / 50000
Cost on evaluation data: 19.7435024513
Accuracy on evaluation data: 7090 / 10000

Epoch 23 training complete
Cost on training data: 5.34884897446
Accuracy on training data: 36031 / 50000
Cost on evaluation data: 19.71801597
Accuracy on evaluation data: 7244 / 10000

Epoch 24 training complete
Cost on training data: 5.33378239633
Accuracy on training data: 35425 / 50000
Cost on evaluation data: 19.6833500772
Accuracy on evaluation data: 7133 / 10000

Epoch 25 training complete
Cost on training data: 5.33385831625
Accuracy on training data: 35897 / 50000
Cost on evaluation data: 19.6718381384
Accuracy on evaluation data: 7237 / 10000

Epoch 26 training complete
Cost on training data: 5.3360746279
Accuracy on training data: 35769 / 50000
Cost on evaluation data: 19.657314605
Accuracy on evaluation data: 7187 / 10000

Epoch 27 training complete
Cost on training data: 5.31979586149
Accuracy on training data: 35858 / 50000
Cost on evaluation data: 19.6285776326
Accuracy on evaluation data: 7260 / 10000

Epoch 28 training complete
Cost on training data: 5.31627702805
Accuracy on training data: 35984 / 50000
Cost on evaluation data: 19.6096344314
Accuracy on evaluation data: 7256 / 10000

Epoch 29 training complete
Cost on training data: 5.32186484478
Accuracy on training data: 36189 / 50000
Cost on evaluation data: 19.6021564871
Accuracy on evaluation data: 7325 / 10000

Epoch 30 training complete
Cost on training data: 5.30142174374
Accuracy on training data: 35827 / 50000
Cost on evaluation data: 19.5644064046
Accuracy on evaluation data: 7224 / 10000

Epoch 31 training complete
Cost on training data: 5.30185592274
Accuracy on training data: 35958 / 50000
Cost on evaluation data: 19.5541898376
Accuracy on evaluation data: 7259 / 10000

Epoch 32 training complete
Cost on training data: 5.28615550398
Accuracy on training data: 36261 / 50000
Cost on evaluation data: 19.5225597692
Accuracy on evaluation data: 7347 / 10000

Epoch 33 training complete
Cost on training data: 5.28686172636
Accuracy on training data: 36035 / 50000
Cost on evaluation data: 19.5162800571
Accuracy on evaluation data: 7308 / 10000

Epoch 34 training complete
Cost on training data: 5.28842797891
Accuracy on training data: 35957 / 50000
Cost on evaluation data: 19.4996645851
Accuracy on evaluation data: 7253 / 10000

Epoch 35 training complete
Cost on training data: 5.29513284269
Accuracy on training data: 36068 / 50000
Cost on evaluation data: 19.4967758816
Accuracy on evaluation data: 7273 / 10000

Epoch 36 training complete
Cost on training data: 5.27524340161
Accuracy on training data: 35924 / 50000
Cost on evaluation data: 19.4548881844
Accuracy on evaluation data: 7226 / 10000

Epoch 37 training complete
Cost on training data: 5.26265769537
Accuracy on training data: 36261 / 50000
Cost on evaluation data: 19.4282962709
Accuracy on evaluation data: 7300 / 10000

Epoch 38 training complete
Cost on training data: 5.2659598038
Accuracy on training data: 36259 / 50000
Cost on evaluation data: 19.4239872573
Accuracy on evaluation data: 7287 / 10000

Epoch 39 training complete
Cost on training data: 5.2720251313
Accuracy on training data: 35985 / 50000
Cost on evaluation data: 19.4133057886
Accuracy on evaluation data: 7244 / 10000

Epoch 40 training complete
Cost on training data: 5.2605199427
Accuracy on training data: 35982 / 50000
Cost on evaluation data: 19.38639426
Accuracy on evaluation data: 7281 / 10000

Epoch 41 training complete
Cost on training data: 5.25597591931
Accuracy on training data: 36250 / 50000
Cost on evaluation data: 19.3678298511
Accuracy on evaluation data: 7353 / 10000

Epoch 42 training complete
Cost on training data: 5.23551422581
Accuracy on training data: 36166 / 50000
Cost on evaluation data: 19.3327572824
Accuracy on evaluation data: 7286 / 10000

Epoch 43 training complete
Cost on training data: 5.23438584541
Accuracy on training data: 36034 / 50000
Cost on evaluation data: 19.31358028
Accuracy on evaluation data: 7282 / 10000

Epoch 44 training complete
Cost on training data: 5.22719637715
Accuracy on training data: 36474 / 50000
Cost on evaluation data: 19.2953358965
Accuracy on evaluation data: 7342 / 10000

Epoch 45 training complete
Cost on training data: 5.2296736899
Accuracy on training data: 36262 / 50000
Cost on evaluation data: 19.2866871827
Accuracy on evaluation data: 7294 / 10000

Epoch 46 training complete
Cost on training data: 5.21921699538
Accuracy on training data: 36362 / 50000
Cost on evaluation data: 19.2549669128
Accuracy on evaluation data: 7361 / 10000

Epoch 47 training complete
Cost on training data: 5.22251553114
Accuracy on training data: 36294 / 50000
Cost on evaluation data: 19.2503389905
Accuracy on evaluation data: 7341 / 10000

Epoch 48 training complete
Cost on training data: 5.20783383003
Accuracy on training data: 36538 / 50000
Cost on evaluation data: 19.2219603652
Accuracy on evaluation data: 7372 / 10000

Epoch 49 training complete
Cost on training data: 5.19089013194
Accuracy on training data: 36485 / 50000
Cost on evaluation data: 19.1909993695
Accuracy on evaluation data: 7340 / 10000

```
In [23]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tr
         training_data=training_data,
         epochs=30,
         mini_batch_size=10,
         eta=0.01,
         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: 6.89060993892

Accuracy on training data: 20580 / 50000

Cost on evaluation data: 20.7467119318

Accuracy on evaluation data: 4112 / 10000

Epoch 1 training complete

Cost on training data: 6.35556463523

Accuracy on training data: 19817 / 50000

Cost on evaluation data: 20.0999336164

Accuracy on evaluation data: 3969 / 10000

Epoch 2 training complete

Cost on training data: 5.99223215635

Accuracy on training data: 22426 / 50000

Cost on evaluation data: 19.5842546748

Accuracy on evaluation data: 4527 / 10000

Epoch 3 training complete

Cost on training data: 6.07466779728

Accuracy on training data: 23714 / 50000

Cost on evaluation data: 19.5386614427

Accuracy on evaluation data: 4781 / 10000

Epoch 4 training complete

Cost on training data: 5.3696611814

Accuracy on training data: 29875 / 50000

Cost on evaluation data: 18.6789488152

Accuracy on evaluation data: 6102 / 10000

Epoch 5 training complete

Cost on training data: 5.15534127188

Accuracy on training data: 32924 / 50000

Cost on evaluation data: 18.3545670805

Accuracy on evaluation data: 6668 / 10000

Epoch 6 training complete

Cost on training data: 5.53185933527

Accuracy on training data: 28946 / 50000

Cost on evaluation data: 18.5984492676

Accuracy on evaluation data: 5844 / 10000

Epoch 7 training complete

Cost on training data: 5.2123493616

Accuracy on training data: 33296 / 50000
Cost on evaluation data: 18.130258166
Accuracy on evaluation data: 6788 / 10000

Epoch 8 training complete
Cost on training data: 5.29976555089
Accuracy on training data: 29486 / 50000
Cost on evaluation data: 18.0916338136
Accuracy on evaluation data: 5962 / 10000

Epoch 9 training complete
Cost on training data: 5.27126869138
Accuracy on training data: 27120 / 50000
Cost on evaluation data: 17.9494998288
Accuracy on evaluation data: 5436 / 10000

Epoch 10 training complete
Cost on training data: 5.4124248881
Accuracy on training data: 26635 / 50000
Cost on evaluation data: 17.9364950668
Accuracy on evaluation data: 5428 / 10000

Epoch 11 training complete
Cost on training data: 5.13980346846
Accuracy on training data: 32057 / 50000
Cost on evaluation data: 17.5643582345
Accuracy on evaluation data: 6474 / 10000

Epoch 12 training complete
Cost on training data: 5.25237216096
Accuracy on training data: 28222 / 50000
Cost on evaluation data: 17.5771005818
Accuracy on evaluation data: 5696 / 10000

Epoch 13 training complete
Cost on training data: 5.27231115783
Accuracy on training data: 28221 / 50000
Cost on evaluation data: 17.4319165878
Accuracy on evaluation data: 5685 / 10000

Epoch 14 training complete
Cost on training data: 5.08312361205
Accuracy on training data: 30704 / 50000
Cost on evaluation data: 17.1311076418
Accuracy on evaluation data: 6258 / 10000

Epoch 15 training complete
Cost on training data: 4.95880364105

Accuracy on training data: 30575 / 50000
Cost on evaluation data: 16.8752058829
Accuracy on evaluation data: 6203 / 10000

Epoch 16 training complete
Cost on training data: 5.11130247381
Accuracy on training data: 32383 / 50000
Cost on evaluation data: 16.9187123085
Accuracy on evaluation data: 6504 / 10000

Epoch 17 training complete
Cost on training data: 4.73128727841
Accuracy on training data: 35444 / 50000
Cost on evaluation data: 16.4280924574
Accuracy on evaluation data: 7171 / 10000

Epoch 18 training complete
Cost on training data: 4.64317175776
Accuracy on training data: 35908 / 50000
Cost on evaluation data: 16.2116858799
Accuracy on evaluation data: 7214 / 10000

Epoch 19 training complete
Cost on training data: 4.6525590318
Accuracy on training data: 35961 / 50000
Cost on evaluation data: 16.100868139
Accuracy on evaluation data: 7260 / 10000

Epoch 20 training complete
Cost on training data: 4.75859591428
Accuracy on training data: 34602 / 50000
Cost on evaluation data: 16.1073030024
Accuracy on evaluation data: 7031 / 10000

Epoch 21 training complete
Cost on training data: 4.89431913311
Accuracy on training data: 28595 / 50000
Cost on evaluation data: 16.1177894131
Accuracy on evaluation data: 5825 / 10000

Epoch 22 training complete
Cost on training data: 5.17932216727
Accuracy on training data: 24494 / 50000
Cost on evaluation data: 16.3064777896
Accuracy on evaluation data: 4923 / 10000

Epoch 23 training complete
Cost on training data: 4.68145208978

Accuracy on training data: 34065 / 50000
Cost on evaluation data: 15.6827102626
Accuracy on evaluation data: 6905 / 10000

Epoch 24 training complete
Cost on training data: 4.44971494234
Accuracy on training data: 35061 / 50000
Cost on evaluation data: 15.3596684405
Accuracy on evaluation data: 7074 / 10000

Epoch 25 training complete
Cost on training data: 4.48750875503
Accuracy on training data: 36009 / 50000
Cost on evaluation data: 15.2759961788
Accuracy on evaluation data: 7340 / 10000

Epoch 26 training complete
Cost on training data: 4.44786840865
Accuracy on training data: 35161 / 50000
Cost on evaluation data: 15.1303569609
Accuracy on evaluation data: 7095 / 10000

Epoch 27 training complete
Cost on training data: 4.2856049154
Accuracy on training data: 37316 / 50000
Cost on evaluation data: 14.8597009189
Accuracy on evaluation data: 7525 / 10000

Epoch 28 training complete
Cost on training data: 4.51119299328
Accuracy on training data: 35102 / 50000
Cost on evaluation data: 14.9935707233
Accuracy on evaluation data: 7089 / 10000

Epoch 29 training complete
Cost on training data: 4.13808964518
Accuracy on training data: 39083 / 50000
Cost on evaluation data: 14.4947473584
Accuracy on evaluation data: 7873 / 10000

```
In [25]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
         training_data=training_data,
         epochs=30,
         mini_batch_size=10,
         eta=0.001,
         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: 3.66499125911

Accuracy on training data: 41592 / 50000

Cost on evaluation data: 12.3496310096

Accuracy on evaluation data: 8389 / 10000

Epoch 1 training complete

Cost on training data: 3.65343994635

Accuracy on training data: 41879 / 50000

Cost on evaluation data: 12.3341561497

Accuracy on evaluation data: 8459 / 10000

Epoch 2 training complete

Cost on training data: 3.64871734738

Accuracy on training data: 41860 / 50000

Cost on evaluation data: 12.3165654591

Accuracy on evaluation data: 8479 / 10000

Epoch 3 training complete

Cost on training data: 3.64196765297

Accuracy on training data: 41874 / 50000

Cost on evaluation data: 12.3017094901

Accuracy on evaluation data: 8466 / 10000

Epoch 4 training complete

Cost on training data: 3.6386352019

Accuracy on training data: 41922 / 50000

Cost on evaluation data: 12.287400793

Accuracy on evaluation data: 8452 / 10000

Epoch 5 training complete

Cost on training data: 3.63450285264

Accuracy on training data: 41694 / 50000

Cost on evaluation data: 12.2757665336

Accuracy on evaluation data: 8441 / 10000

Epoch 6 training complete

Cost on training data: 3.63588950588

Accuracy on training data: 41908 / 50000

Cost on evaluation data: 12.2684592045

Accuracy on evaluation data: 8457 / 10000

Epoch 7 training complete
Cost on training data: 3.63803413351
Accuracy on training data: 42047 / 50000
Cost on evaluation data: 12.2608982165
Accuracy on evaluation data: 8485 / 10000

Epoch 8 training complete
Cost on training data: 3.63684563053
Accuracy on training data: 41718 / 50000
Cost on evaluation data: 12.2527973873
Accuracy on evaluation data: 8452 / 10000

Epoch 9 training complete
Cost on training data: 3.62737828412
Accuracy on training data: 41999 / 50000
Cost on evaluation data: 12.2364288014
Accuracy on evaluation data: 8510 / 10000

Epoch 10 training complete
Cost on training data: 3.62267869365
Accuracy on training data: 41735 / 50000
Cost on evaluation data: 12.2199012043
Accuracy on evaluation data: 8450 / 10000

Epoch 11 training complete
Cost on training data: 3.62437708857
Accuracy on training data: 41839 / 50000
Cost on evaluation data: 12.2153037265
Accuracy on evaluation data: 8473 / 10000

Epoch 12 training complete
Cost on training data: 3.62320167618
Accuracy on training data: 41700 / 50000
Cost on evaluation data: 12.2023744928
Accuracy on evaluation data: 8420 / 10000

Epoch 13 training complete
Cost on training data: 3.61564400382
Accuracy on training data: 41897 / 50000
Cost on evaluation data: 12.1911288079
Accuracy on evaluation data: 8489 / 10000

Epoch 14 training complete
Cost on training data: 3.61491209637
Accuracy on training data: 42136 / 50000
Cost on evaluation data: 12.1773088381
Accuracy on evaluation data: 8534 / 10000

Epoch 15 training complete
Cost on training data: 3.6118231792
Accuracy on training data: 41923 / 50000
Cost on evaluation data: 12.1695497328
Accuracy on evaluation data: 8489 / 10000

Epoch 16 training complete
Cost on training data: 3.61018632051
Accuracy on training data: 41831 / 50000
Cost on evaluation data: 12.1611901773
Accuracy on evaluation data: 8437 / 10000

Epoch 17 training complete
Cost on training data: 3.61273386357
Accuracy on training data: 41722 / 50000
Cost on evaluation data: 12.1525356195
Accuracy on evaluation data: 8441 / 10000

Epoch 18 training complete
Cost on training data: 3.60951605664
Accuracy on training data: 41865 / 50000
Cost on evaluation data: 12.1424701443
Accuracy on evaluation data: 8473 / 10000

Epoch 19 training complete
Cost on training data: 3.59995072498
Accuracy on training data: 41870 / 50000
Cost on evaluation data: 12.1202289067
Accuracy on evaluation data: 8466 / 10000

Epoch 20 training complete
Cost on training data: 3.60093756016
Accuracy on training data: 41840 / 50000
Cost on evaluation data: 12.1154293615
Accuracy on evaluation data: 8445 / 10000

Epoch 21 training complete
Cost on training data: 3.59977931562
Accuracy on training data: 42103 / 50000
Cost on evaluation data: 12.1037900256
Accuracy on evaluation data: 8498 / 10000

Epoch 22 training complete
Cost on training data: 3.59862893339
Accuracy on training data: 41864 / 50000
Cost on evaluation data: 12.102388354
Accuracy on evaluation data: 8485 / 10000

Epoch 23 training complete
Cost on training data: 3.5901720042
Accuracy on training data: 41783 / 50000
Cost on evaluation data: 12.0764426796
Accuracy on evaluation data: 8449 / 10000

Epoch 24 training complete
Cost on training data: 3.59011396676
Accuracy on training data: 41929 / 50000
Cost on evaluation data: 12.0708150974
Accuracy on evaluation data: 8507 / 10000

Epoch 25 training complete
Cost on training data: 3.59645579025
Accuracy on training data: 42054 / 50000
Cost on evaluation data: 12.0716017906
Accuracy on evaluation data: 8503 / 10000

Epoch 26 training complete
Cost on training data: 3.59259392854
Accuracy on training data: 42019 / 50000
Cost on evaluation data: 12.0502595968
Accuracy on evaluation data: 8510 / 10000

Epoch 27 training complete
Cost on training data: 3.584267807
Accuracy on training data: 41719 / 50000
Cost on evaluation data: 12.0385443405
Accuracy on evaluation data: 8442 / 10000

Epoch 28 training complete
Cost on training data: 3.57861535824
Accuracy on training data: 41690 / 50000
Cost on evaluation data: 12.025302844
Accuracy on evaluation data: 8432 / 10000

Epoch 29 training complete
Cost on training data: 3.58001560708
Accuracy on training data: 41820 / 50000
Cost on evaluation data: 12.017989728
Accuracy on evaluation data: 8443 / 10000

In [26]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tra
 training_data=training_data,
 epochs=30,

```
        mini_batch_size=10,  
        eta=0.001,  
        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: 3.57423249908

Accuracy on training data: 41732 / 50000

Cost on evaluation data: 12.0022392424

Accuracy on evaluation data: 8449 / 10000

Epoch 1 training complete

Cost on training data: 3.57773707119

Accuracy on training data: 42036 / 50000

Cost on evaluation data: 11.9997675144

Accuracy on evaluation data: 8515 / 10000

Epoch 2 training complete

Cost on training data: 3.57069042962

Accuracy on training data: 41896 / 50000

Cost on evaluation data: 11.9824642884

Accuracy on evaluation data: 8491 / 10000

Epoch 3 training complete

Cost on training data: 3.57068802939

Accuracy on training data: 42064 / 50000

Cost on evaluation data: 11.9771597902

Accuracy on evaluation data: 8493 / 10000

Epoch 4 training complete

Cost on training data: 3.57187489637

Accuracy on training data: 41844 / 50000

Cost on evaluation data: 11.9714282267

Accuracy on evaluation data: 8462 / 10000

Epoch 5 training complete

Cost on training data: 3.57148478914

Accuracy on training data: 41941 / 50000

Cost on evaluation data: 11.95521875

Accuracy on evaluation data: 8484 / 10000

Epoch 6 training complete

Cost on training data: 3.56496675771

Accuracy on training data: 42165 / 50000
Cost on evaluation data: 11.9428736683
Accuracy on evaluation data: 8508 / 10000

Epoch 7 training complete
Cost on training data: 3.56437675085
Accuracy on training data: 41833 / 50000
Cost on evaluation data: 11.939080157
Accuracy on evaluation data: 8423 / 10000

Epoch 8 training complete
Cost on training data: 3.55767762808
Accuracy on training data: 42087 / 50000
Cost on evaluation data: 11.9186962286
Accuracy on evaluation data: 8502 / 10000

Epoch 9 training complete
Cost on training data: 3.54981321792
Accuracy on training data: 42038 / 50000
Cost on evaluation data: 11.9040516004
Accuracy on evaluation data: 8493 / 10000

Epoch 10 training complete
Cost on training data: 3.55211615219
Accuracy on training data: 42099 / 50000
Cost on evaluation data: 11.8976092688
Accuracy on evaluation data: 8526 / 10000

Epoch 11 training complete
Cost on training data: 3.55213589291
Accuracy on training data: 41805 / 50000
Cost on evaluation data: 11.8894621972
Accuracy on evaluation data: 8423 / 10000

Epoch 12 training complete
Cost on training data: 3.54941712655
Accuracy on training data: 41731 / 50000
Cost on evaluation data: 11.8785834059
Accuracy on evaluation data: 8396 / 10000

Epoch 13 training complete
Cost on training data: 3.54233912039
Accuracy on training data: 41939 / 50000
Cost on evaluation data: 11.8623788381
Accuracy on evaluation data: 8488 / 10000

Epoch 14 training complete
Cost on training data: 3.544207473

Accuracy on training data: 42065 / 50000
Cost on evaluation data: 11.8511030934
Accuracy on evaluation data: 8514 / 10000

Epoch 15 training complete
Cost on training data: 3.53904472637
Accuracy on training data: 41901 / 50000
Cost on evaluation data: 11.844827671
Accuracy on evaluation data: 8456 / 10000

Epoch 16 training complete
Cost on training data: 3.53893138858
Accuracy on training data: 41888 / 50000
Cost on evaluation data: 11.8330477184
Accuracy on evaluation data: 8454 / 10000

Epoch 17 training complete
Cost on training data: 3.5327390885
Accuracy on training data: 41911 / 50000
Cost on evaluation data: 11.8163684461
Accuracy on evaluation data: 8475 / 10000

Epoch 18 training complete
Cost on training data: 3.53400313938
Accuracy on training data: 42004 / 50000
Cost on evaluation data: 11.812008337
Accuracy on evaluation data: 8487 / 10000

Epoch 19 training complete
Cost on training data: 3.54071051156
Accuracy on training data: 42070 / 50000
Cost on evaluation data: 11.8096965921
Accuracy on evaluation data: 8514 / 10000

Epoch 20 training complete
Cost on training data: 3.52459860405
Accuracy on training data: 41990 / 50000
Cost on evaluation data: 11.7864269192
Accuracy on evaluation data: 8491 / 10000

Epoch 21 training complete
Cost on training data: 3.525730358
Accuracy on training data: 42178 / 50000
Cost on evaluation data: 11.7810900319
Accuracy on evaluation data: 8526 / 10000

Epoch 22 training complete
Cost on training data: 3.51889471487

Accuracy on training data: 42016 / 50000
Cost on evaluation data: 11.7661896107
Accuracy on evaluation data: 8477 / 10000

Epoch 23 training complete
Cost on training data: 3.52738349344
Accuracy on training data: 42122 / 50000
Cost on evaluation data: 11.765968284
Accuracy on evaluation data: 8501 / 10000

Epoch 24 training complete
Cost on training data: 3.52187908052
Accuracy on training data: 42018 / 50000
Cost on evaluation data: 11.7514878809
Accuracy on evaluation data: 8479 / 10000

Epoch 25 training complete
Cost on training data: 3.50409850312
Accuracy on training data: 42068 / 50000
Cost on evaluation data: 11.7255074675
Accuracy on evaluation data: 8500 / 10000

Epoch 26 training complete
Cost on training data: 3.51734548355
Accuracy on training data: 42201 / 50000
Cost on evaluation data: 11.7310873338
Accuracy on evaluation data: 8526 / 10000

Epoch 27 training complete
Cost on training data: 3.51608264904
Accuracy on training data: 41718 / 50000
Cost on evaluation data: 11.7221344684
Accuracy on evaluation data: 8446 / 10000

Epoch 28 training complete
Cost on training data: 3.50280611707
Accuracy on training data: 42278 / 50000
Cost on evaluation data: 11.6973531023
Accuracy on evaluation data: 8548 / 10000

Epoch 29 training complete
Cost on training data: 3.51190832818
Accuracy on training data: 42124 / 50000
Cost on evaluation data: 11.7004131128
Accuracy on evaluation data: 8492 / 10000

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

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, 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

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

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

week_1_solution_19_4

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 [10]: import network2
```

```
network2 = reload(network2)
```

```
net2_all_train = network2.Network([784,30, 30, 30, 30, 10], cost=network2.CrossEntropy)
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=0.0001,
    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: 2.17971532554

Accuracy on training data: 4814 / 50000

Cost on evaluation data: 7.41736507717

Accuracy on evaluation data: 944 / 10000

Epoch 1 training complete

Cost on training data: 2.52284313722

Accuracy on training data: 5266 / 50000

Cost on evaluation data: 7.73436578679
Accuracy on evaluation data: 1044 / 10000

Epoch 2 training complete
Cost on training data: 2.93264188598
Accuracy on training data: 5453 / 50000
Cost on evaluation data: 8.10973923812
Accuracy on evaluation data: 1052 / 10000

Epoch 3 training complete
Cost on training data: 3.44048667269
Accuracy on training data: 5469 / 50000
Cost on evaluation data: 8.63507449196
Accuracy on evaluation data: 1075 / 10000

Epoch 4 training complete
Cost on training data: 4.09595712395
Accuracy on training data: 5340 / 50000
Cost on evaluation data: 9.28977521597
Accuracy on evaluation data: 1066 / 10000

Epoch 5 training complete
Cost on training data: 4.72141380623
Accuracy on training data: 5396 / 50000
Cost on evaluation data: 9.91649000849
Accuracy on evaluation data: 1089 / 10000

Epoch 6 training complete
Cost on training data: 4.93081909031
Accuracy on training data: 5724 / 50000
Cost on evaluation data: 10.1150933693
Accuracy on evaluation data: 1135 / 10000

Epoch 7 training complete
Cost on training data: 4.83292904002
Accuracy on training data: 5872 / 50000
Cost on evaluation data: 10.0133304704
Accuracy on evaluation data: 1214 / 10000

Epoch 8 training complete
Cost on training data: 4.70336328164
Accuracy on training data: 6194 / 50000
Cost on evaluation data: 9.88046604005
Accuracy on evaluation data: 1264 / 10000

Epoch 9 training complete
Cost on training data: 4.60231133219
Accuracy on training data: 6464 / 50000

Cost on evaluation data: 9.78358083297
Accuracy on evaluation data: 1353 / 10000

Epoch 10 training complete
Cost on training data: 4.4904320701
Accuracy on training data: 6859 / 50000
Cost on evaluation data: 9.67512386394
Accuracy on evaluation data: 1430 / 10000

Epoch 11 training complete
Cost on training data: 4.41928280993
Accuracy on training data: 7727 / 50000
Cost on evaluation data: 9.61802856425
Accuracy on evaluation data: 1624 / 10000

Epoch 12 training complete
Cost on training data: 4.35562572494
Accuracy on training data: 8564 / 50000
Cost on evaluation data: 9.56046508351
Accuracy on evaluation data: 1799 / 10000

Epoch 13 training complete
Cost on training data: 4.33875126426
Accuracy on training data: 8962 / 50000
Cost on evaluation data: 9.53415201847
Accuracy on evaluation data: 1884 / 10000

Epoch 14 training complete
Cost on training data: 4.33668843766
Accuracy on training data: 9391 / 50000
Cost on evaluation data: 9.53346610201
Accuracy on evaluation data: 1962 / 10000

Epoch 15 training complete
Cost on training data: 4.31041866607
Accuracy on training data: 9775 / 50000
Cost on evaluation data: 9.51205968697
Accuracy on evaluation data: 2057 / 10000

Epoch 16 training complete
Cost on training data: 4.3052143865
Accuracy on training data: 10027 / 50000
Cost on evaluation data: 9.48041392611
Accuracy on evaluation data: 2130 / 10000

Epoch 17 training complete
Cost on training data: 4.31148230237
Accuracy on training data: 10420 / 50000

Cost on evaluation data: 9.49608127236
Accuracy on evaluation data: 2214 / 10000

Epoch 18 training complete
Cost on training data: 4.30239025651
Accuracy on training data: 10577 / 50000
Cost on evaluation data: 9.48619734971
Accuracy on evaluation data: 2250 / 10000

Epoch 19 training complete
Cost on training data: 4.30984197081
Accuracy on training data: 10782 / 50000
Cost on evaluation data: 9.48606569389
Accuracy on evaluation data: 2265 / 10000

Epoch 20 training complete
Cost on training data: 4.31400568097
Accuracy on training data: 10889 / 50000
Cost on evaluation data: 9.4949570211
Accuracy on evaluation data: 2261 / 10000

Epoch 21 training complete
Cost on training data: 4.31021233651
Accuracy on training data: 11059 / 50000
Cost on evaluation data: 9.49226165951
Accuracy on evaluation data: 2310 / 10000

Epoch 22 training complete
Cost on training data: 4.30673448448
Accuracy on training data: 11292 / 50000
Cost on evaluation data: 9.48299209405
Accuracy on evaluation data: 2380 / 10000

Epoch 23 training complete
Cost on training data: 4.30928823938
Accuracy on training data: 11451 / 50000
Cost on evaluation data: 9.49010882687
Accuracy on evaluation data: 2384 / 10000

Epoch 24 training complete
Cost on training data: 4.30193215842
Accuracy on training data: 11473 / 50000
Cost on evaluation data: 9.48448183761
Accuracy on evaluation data: 2380 / 10000

Epoch 25 training complete
Cost on training data: 4.30333429687
Accuracy on training data: 11586 / 50000

Cost on evaluation data: 9.47494811464
Accuracy on evaluation data: 2399 / 10000

Epoch 26 training complete
Cost on training data: 4.30264583179
Accuracy on training data: 11674 / 50000
Cost on evaluation data: 9.47620391555
Accuracy on evaluation data: 2403 / 10000

Epoch 27 training complete
Cost on training data: 4.2997244948
Accuracy on training data: 11726 / 50000
Cost on evaluation data: 9.46838922215
Accuracy on evaluation data: 2415 / 10000

Epoch 28 training complete
Cost on training data: 4.30069344476
Accuracy on training data: 11835 / 50000
Cost on evaluation data: 9.46775108168
Accuracy on evaluation data: 2427 / 10000

Epoch 29 training complete
Cost on training data: 4.30392637041
Accuracy on training data: 11864 / 50000
Cost on evaluation data: 9.46621416428
Accuracy on evaluation data: 2419 / 10000

```
In [11]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tr
        training_data=training_data,
        epochs=100,
        mini_batch_size=10,
        eta=0.0001,
        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: 4.29696942669
Accuracy on training data: 11978 / 50000
Cost on evaluation data: 9.46505333155
Accuracy on evaluation data: 2450 / 10000

Epoch 1 training complete
Cost on training data: 4.29085607386
Accuracy on training data: 12023 / 50000
Cost on evaluation data: 9.45395772865
Accuracy on evaluation data: 2447 / 10000

Epoch 2 training complete
Cost on training data: 4.29755137829
Accuracy on training data: 11959 / 50000
Cost on evaluation data: 9.46226510161
Accuracy on evaluation data: 2437 / 10000

Epoch 3 training complete
Cost on training data: 4.28588793287
Accuracy on training data: 12137 / 50000
Cost on evaluation data: 9.4602965779
Accuracy on evaluation data: 2462 / 10000

Epoch 4 training complete
Cost on training data: 4.28650235854
Accuracy on training data: 12167 / 50000
Cost on evaluation data: 9.46424338734
Accuracy on evaluation data: 2502 / 10000

Epoch 5 training complete
Cost on training data: 4.28655878774
Accuracy on training data: 12248 / 50000
Cost on evaluation data: 9.45677281476
Accuracy on evaluation data: 2506 / 10000

Epoch 6 training complete
Cost on training data: 4.28260631775
Accuracy on training data: 12350 / 50000
Cost on evaluation data: 9.4575776542
Accuracy on evaluation data: 2519 / 10000

Epoch 7 training complete
Cost on training data: 4.28158724257
Accuracy on training data: 12258 / 50000
Cost on evaluation data: 9.44866823356
Accuracy on evaluation data: 2505 / 10000

Epoch 8 training complete
Cost on training data: 4.27970677312
Accuracy on training data: 12364 / 50000
Cost on evaluation data: 9.44733180894
Accuracy on evaluation data: 2542 / 10000

Epoch 9 training complete
Cost on training data: 4.27573327893
Accuracy on training data: 12538 / 50000
Cost on evaluation data: 9.44194569419
Accuracy on evaluation data: 2581 / 10000

Epoch 10 training complete
Cost on training data: 4.27760080985
Accuracy on training data: 12481 / 50000
Cost on evaluation data: 9.43973370686
Accuracy on evaluation data: 2533 / 10000

Epoch 11 training complete
Cost on training data: 4.27404409588
Accuracy on training data: 12527 / 50000
Cost on evaluation data: 9.43997137645
Accuracy on evaluation data: 2538 / 10000

Epoch 12 training complete
Cost on training data: 4.26747756307
Accuracy on training data: 12553 / 50000
Cost on evaluation data: 9.4287428546
Accuracy on evaluation data: 2581 / 10000

Epoch 13 training complete
Cost on training data: 4.27398926938
Accuracy on training data: 12458 / 50000
Cost on evaluation data: 9.43544615437
Accuracy on evaluation data: 2564 / 10000

Epoch 14 training complete
Cost on training data: 4.2703292679
Accuracy on training data: 12645 / 50000
Cost on evaluation data: 9.43243273059
Accuracy on evaluation data: 2581 / 10000

Epoch 15 training complete
Cost on training data: 4.27125354698
Accuracy on training data: 12580 / 50000
Cost on evaluation data: 9.42715298087
Accuracy on evaluation data: 2600 / 10000

Epoch 16 training complete
Cost on training data: 4.27023730564
Accuracy on training data: 12680 / 50000
Cost on evaluation data: 9.42708615404
Accuracy on evaluation data: 2543 / 10000

Epoch 17 training complete
Cost on training data: 4.2665917798
Accuracy on training data: 12756 / 50000
Cost on evaluation data: 9.42141638109
Accuracy on evaluation data: 2601 / 10000

Epoch 18 training complete
Cost on training data: 4.2680779051
Accuracy on training data: 12690 / 50000
Cost on evaluation data: 9.42344148628
Accuracy on evaluation data: 2585 / 10000

Epoch 19 training complete
Cost on training data: 4.27010832103
Accuracy on training data: 12752 / 50000
Cost on evaluation data: 9.42468355338
Accuracy on evaluation data: 2590 / 10000

Epoch 20 training complete
Cost on training data: 4.26860054924
Accuracy on training data: 12676 / 50000
Cost on evaluation data: 9.42645335405
Accuracy on evaluation data: 2587 / 10000

Epoch 21 training complete
Cost on training data: 4.2656870279
Accuracy on training data: 12867 / 50000
Cost on evaluation data: 9.42882020241
Accuracy on evaluation data: 2633 / 10000

Epoch 22 training complete
Cost on training data: 4.26868469731
Accuracy on training data: 12764 / 50000
Cost on evaluation data: 9.43075269712
Accuracy on evaluation data: 2589 / 10000

Epoch 23 training complete
Cost on training data: 4.27493257901
Accuracy on training data: 12677 / 50000
Cost on evaluation data: 9.43353008217
Accuracy on evaluation data: 2577 / 10000

Epoch 24 training complete
Cost on training data: 4.26520358781
Accuracy on training data: 12734 / 50000
Cost on evaluation data: 9.42455784966
Accuracy on evaluation data: 2628 / 10000

Epoch 25 training complete
Cost on training data: 4.261925152
Accuracy on training data: 12873 / 50000
Cost on evaluation data: 9.4211178519
Accuracy on evaluation data: 2614 / 10000

Epoch 26 training complete
Cost on training data: 4.25911383339
Accuracy on training data: 13047 / 50000
Cost on evaluation data: 9.42097600105
Accuracy on evaluation data: 2664 / 10000

Epoch 27 training complete
Cost on training data: 4.26043283779
Accuracy on training data: 12900 / 50000
Cost on evaluation data: 9.4147989307
Accuracy on evaluation data: 2651 / 10000

Epoch 28 training complete
Cost on training data: 4.25514251513
Accuracy on training data: 12930 / 50000
Cost on evaluation data: 9.41067105008
Accuracy on evaluation data: 2681 / 10000

Epoch 29 training complete
Cost on training data: 4.25313034476
Accuracy on training data: 12991 / 50000
Cost on evaluation data: 9.41116436558
Accuracy on evaluation data: 2691 / 10000

Epoch 30 training complete
Cost on training data: 4.25658915789
Accuracy on training data: 12954 / 50000
Cost on evaluation data: 9.40840037281
Accuracy on evaluation data: 2664 / 10000

Epoch 31 training complete
Cost on training data: 4.26227057345
Accuracy on training data: 12924 / 50000
Cost on evaluation data: 9.41448588375
Accuracy on evaluation data: 2668 / 10000

Epoch 32 training complete
Cost on training data: 4.25423525987
Accuracy on training data: 12907 / 50000
Cost on evaluation data: 9.40646027508
Accuracy on evaluation data: 2674 / 10000

Epoch 33 training complete
Cost on training data: 4.25145035239
Accuracy on training data: 13117 / 50000
Cost on evaluation data: 9.40506438796
Accuracy on evaluation data: 2694 / 10000

Epoch 34 training complete
Cost on training data: 4.25011400708
Accuracy on training data: 13130 / 50000
Cost on evaluation data: 9.40122640766
Accuracy on evaluation data: 2690 / 10000

Epoch 35 training complete
Cost on training data: 4.25442433913
Accuracy on training data: 13035 / 50000
Cost on evaluation data: 9.40606113668
Accuracy on evaluation data: 2647 / 10000

Epoch 36 training complete
Cost on training data: 4.2509678864
Accuracy on training data: 13053 / 50000
Cost on evaluation data: 9.4038054889
Accuracy on evaluation data: 2678 / 10000

Epoch 37 training complete
Cost on training data: 4.25103803248
Accuracy on training data: 13106 / 50000
Cost on evaluation data: 9.3992016486
Accuracy on evaluation data: 2667 / 10000

Epoch 38 training complete
Cost on training data: 4.24594113915
Accuracy on training data: 13054 / 50000
Cost on evaluation data: 9.40402050914
Accuracy on evaluation data: 2687 / 10000

Epoch 39 training complete
Cost on training data: 4.25179060135
Accuracy on training data: 13082 / 50000
Cost on evaluation data: 9.40236373239
Accuracy on evaluation data: 2671 / 10000

Epoch 40 training complete
Cost on training data: 4.24938016477
Accuracy on training data: 13123 / 50000
Cost on evaluation data: 9.39900448144
Accuracy on evaluation data: 2664 / 10000

Epoch 41 training complete
Cost on training data: 4.2498696779
Accuracy on training data: 13056 / 50000
Cost on evaluation data: 9.39875279338
Accuracy on evaluation data: 2641 / 10000

Epoch 42 training complete
Cost on training data: 4.24750845775
Accuracy on training data: 13204 / 50000
Cost on evaluation data: 9.39796434878
Accuracy on evaluation data: 2694 / 10000

Epoch 43 training complete
Cost on training data: 4.2423551647
Accuracy on training data: 13184 / 50000
Cost on evaluation data: 9.39267102437
Accuracy on evaluation data: 2729 / 10000

Epoch 44 training complete
Cost on training data: 4.24629351228
Accuracy on training data: 13228 / 50000
Cost on evaluation data: 9.39647055556
Accuracy on evaluation data: 2701 / 10000

Epoch 45 training complete
Cost on training data: 4.24463944729
Accuracy on training data: 13129 / 50000
Cost on evaluation data: 9.39367394069
Accuracy on evaluation data: 2706 / 10000

Epoch 46 training complete
Cost on training data: 4.24926997938
Accuracy on training data: 13246 / 50000
Cost on evaluation data: 9.39880586521
Accuracy on evaluation data: 2692 / 10000

Epoch 47 training complete
Cost on training data: 4.24478953248
Accuracy on training data: 13150 / 50000
Cost on evaluation data: 9.3927802486
Accuracy on evaluation data: 2718 / 10000

Epoch 48 training complete
Cost on training data: 4.2410002575
Accuracy on training data: 13305 / 50000
Cost on evaluation data: 9.39047448152
Accuracy on evaluation data: 2717 / 10000

Epoch 49 training complete
Cost on training data: 4.24450428666
Accuracy on training data: 13241 / 50000
Cost on evaluation data: 9.39146599669
Accuracy on evaluation data: 2675 / 10000

Epoch 50 training complete
Cost on training data: 4.24137844191
Accuracy on training data: 13218 / 50000
Cost on evaluation data: 9.38882330475
Accuracy on evaluation data: 2687 / 10000

Epoch 51 training complete
Cost on training data: 4.24368721112
Accuracy on training data: 13197 / 50000
Cost on evaluation data: 9.38646867452
Accuracy on evaluation data: 2699 / 10000

Epoch 52 training complete
Cost on training data: 4.24559545765
Accuracy on training data: 13247 / 50000
Cost on evaluation data: 9.39066414647
Accuracy on evaluation data: 2686 / 10000

Epoch 53 training complete
Cost on training data: 4.23535379878
Accuracy on training data: 13275 / 50000
Cost on evaluation data: 9.38273309128
Accuracy on evaluation data: 2715 / 10000

Epoch 54 training complete
Cost on training data: 4.23729351518
Accuracy on training data: 13315 / 50000
Cost on evaluation data: 9.38177839265
Accuracy on evaluation data: 2710 / 10000

Epoch 55 training complete
Cost on training data: 4.23649362721
Accuracy on training data: 13434 / 50000
Cost on evaluation data: 9.37853437252
Accuracy on evaluation data: 2738 / 10000

Epoch 56 training complete
Cost on training data: 4.23091671159
Accuracy on training data: 13276 / 50000
Cost on evaluation data: 9.37286952562
Accuracy on evaluation data: 2726 / 10000

Epoch 57 training complete
Cost on training data: 4.24089173749
Accuracy on training data: 13234 / 50000
Cost on evaluation data: 9.38214689552
Accuracy on evaluation data: 2725 / 10000

Epoch 58 training complete
Cost on training data: 4.23279054289
Accuracy on training data: 13388 / 50000
Cost on evaluation data: 9.37698130745
Accuracy on evaluation data: 2709 / 10000

Epoch 59 training complete
Cost on training data: 4.24079051782
Accuracy on training data: 13261 / 50000
Cost on evaluation data: 9.37778770759
Accuracy on evaluation data: 2722 / 10000

Epoch 60 training complete
Cost on training data: 4.23514801406
Accuracy on training data: 13292 / 50000
Cost on evaluation data: 9.37247845067
Accuracy on evaluation data: 2686 / 10000

Epoch 61 training complete
Cost on training data: 4.22621861467
Accuracy on training data: 13460 / 50000
Cost on evaluation data: 9.37192215093
Accuracy on evaluation data: 2752 / 10000

Epoch 62 training complete
Cost on training data: 4.23037934986
Accuracy on training data: 13382 / 50000
Cost on evaluation data: 9.36962000086
Accuracy on evaluation data: 2738 / 10000

Epoch 63 training complete
Cost on training data: 4.23471075675
Accuracy on training data: 13335 / 50000
Cost on evaluation data: 9.3708789704
Accuracy on evaluation data: 2694 / 10000

Epoch 64 training complete
Cost on training data: 4.23909774078
Accuracy on training data: 13260 / 50000
Cost on evaluation data: 9.36929518182
Accuracy on evaluation data: 2724 / 10000

Epoch 65 training complete
Cost on training data: 4.23137542466
Accuracy on training data: 13228 / 50000
Cost on evaluation data: 9.36678694925
Accuracy on evaluation data: 2723 / 10000

Epoch 66 training complete
Cost on training data: 4.22823059594
Accuracy on training data: 13485 / 50000
Cost on evaluation data: 9.36660384942
Accuracy on evaluation data: 2739 / 10000

Epoch 67 training complete
Cost on training data: 4.22689785985
Accuracy on training data: 13433 / 50000
Cost on evaluation data: 9.36050250862
Accuracy on evaluation data: 2764 / 10000

Epoch 68 training complete
Cost on training data: 4.23832456804
Accuracy on training data: 13360 / 50000
Cost on evaluation data: 9.36610683993
Accuracy on evaluation data: 2732 / 10000

Epoch 69 training complete
Cost on training data: 4.22726682744
Accuracy on training data: 13451 / 50000
Cost on evaluation data: 9.36290290563
Accuracy on evaluation data: 2745 / 10000

Epoch 70 training complete
Cost on training data: 4.22452786973
Accuracy on training data: 13610 / 50000
Cost on evaluation data: 9.36228394391
Accuracy on evaluation data: 2748 / 10000

Epoch 71 training complete
Cost on training data: 4.22171691444
Accuracy on training data: 13437 / 50000
Cost on evaluation data: 9.35669645381
Accuracy on evaluation data: 2739 / 10000

Epoch 72 training complete
Cost on training data: 4.22554809107
Accuracy on training data: 13381 / 50000
Cost on evaluation data: 9.35550052517
Accuracy on evaluation data: 2738 / 10000

Epoch 73 training complete
Cost on training data: 4.22839509378
Accuracy on training data: 13372 / 50000
Cost on evaluation data: 9.3593850318
Accuracy on evaluation data: 2733 / 10000

Epoch 74 training complete
Cost on training data: 4.2203226043
Accuracy on training data: 13375 / 50000
Cost on evaluation data: 9.34766318478
Accuracy on evaluation data: 2757 / 10000

Epoch 75 training complete
Cost on training data: 4.22706723913
Accuracy on training data: 13407 / 50000
Cost on evaluation data: 9.36095618963
Accuracy on evaluation data: 2716 / 10000

Epoch 76 training complete
Cost on training data: 4.23528052499
Accuracy on training data: 13407 / 50000
Cost on evaluation data: 9.36647197694
Accuracy on evaluation data: 2743 / 10000

Epoch 77 training complete
Cost on training data: 4.22152750773
Accuracy on training data: 13571 / 50000
Cost on evaluation data: 9.35189632429
Accuracy on evaluation data: 2756 / 10000

Epoch 78 training complete
Cost on training data: 4.22207087959
Accuracy on training data: 13555 / 50000
Cost on evaluation data: 9.3485735312
Accuracy on evaluation data: 2763 / 10000

Epoch 79 training complete
Cost on training data: 4.22280733065
Accuracy on training data: 13447 / 50000
Cost on evaluation data: 9.35181485709
Accuracy on evaluation data: 2728 / 10000

Epoch 80 training complete
Cost on training data: 4.21563226879
Accuracy on training data: 13505 / 50000
Cost on evaluation data: 9.34777916729
Accuracy on evaluation data: 2745 / 10000

Epoch 81 training complete
Cost on training data: 4.23410646212
Accuracy on training data: 13448 / 50000
Cost on evaluation data: 9.35528652921
Accuracy on evaluation data: 2733 / 10000

Epoch 82 training complete
Cost on training data: 4.21511099923
Accuracy on training data: 13578 / 50000
Cost on evaluation data: 9.34188700342
Accuracy on evaluation data: 2778 / 10000

Epoch 83 training complete
Cost on training data: 4.22182703426
Accuracy on training data: 13456 / 50000
Cost on evaluation data: 9.34966264242
Accuracy on evaluation data: 2727 / 10000

Epoch 84 training complete
Cost on training data: 4.21391755957
Accuracy on training data: 13538 / 50000
Cost on evaluation data: 9.34252594043
Accuracy on evaluation data: 2780 / 10000

Epoch 85 training complete
Cost on training data: 4.20909456802
Accuracy on training data: 13501 / 50000
Cost on evaluation data: 9.33765878339
Accuracy on evaluation data: 2769 / 10000

Epoch 86 training complete
Cost on training data: 4.21443649069
Accuracy on training data: 13644 / 50000
Cost on evaluation data: 9.3402519453
Accuracy on evaluation data: 2777 / 10000

Epoch 87 training complete
Cost on training data: 4.22075317602
Accuracy on training data: 13582 / 50000
Cost on evaluation data: 9.34773298881
Accuracy on evaluation data: 2764 / 10000

Epoch 88 training complete
Cost on training data: 4.2131392178
Accuracy on training data: 13569 / 50000
Cost on evaluation data: 9.33887340761
Accuracy on evaluation data: 2776 / 10000

Epoch 89 training complete
Cost on training data: 4.21010498654
Accuracy on training data: 13648 / 50000
Cost on evaluation data: 9.33876252716
Accuracy on evaluation data: 2803 / 10000

Epoch 90 training complete
Cost on training data: 4.20867119382
Accuracy on training data: 13493 / 50000
Cost on evaluation data: 9.3381210174
Accuracy on evaluation data: 2759 / 10000

Epoch 91 training complete
Cost on training data: 4.21576297009
Accuracy on training data: 13536 / 50000
Cost on evaluation data: 9.339869523
Accuracy on evaluation data: 2763 / 10000

Epoch 92 training complete
Cost on training data: 4.21437604974
Accuracy on training data: 13553 / 50000
Cost on evaluation data: 9.33789387592
Accuracy on evaluation data: 2769 / 10000

Epoch 93 training complete
Cost on training data: 4.21631717038
Accuracy on training data: 13524 / 50000
Cost on evaluation data: 9.34172289968
Accuracy on evaluation data: 2789 / 10000

Epoch 94 training complete
Cost on training data: 4.2069284472
Accuracy on training data: 13641 / 50000
Cost on evaluation data: 9.33495685339
Accuracy on evaluation data: 2807 / 10000

Epoch 95 training complete
Cost on training data: 4.20888000229
Accuracy on training data: 13659 / 50000
Cost on evaluation data: 9.33216043044
Accuracy on evaluation data: 2798 / 10000

Epoch 96 training complete
Cost on training data: 4.21368826044
Accuracy on training data: 13437 / 50000
Cost on evaluation data: 9.33480006675
Accuracy on evaluation data: 2756 / 10000

Epoch 97 training complete
Cost on training data: 4.22319592234
Accuracy on training data: 13480 / 50000
Cost on evaluation data: 9.34122885665
Accuracy on evaluation data: 2728 / 10000

Epoch 98 training complete
Cost on training data: 4.21104988904
Accuracy on training data: 13558 / 50000
Cost on evaluation data: 9.33478357333
Accuracy on evaluation data: 2802 / 10000

Epoch 99 training complete
Cost on training data: 4.21963729058
Accuracy on training data: 13614 / 50000
Cost on evaluation data: 9.33822950689
Accuracy on evaluation data: 2783 / 10000

```
In [12]: evaluation_cost_all_train, evaluation_accuracy_all_train, training_cost_all_train, tr
        training_data=training_data,
        epochs=30,
        mini_batch_size=10,
        eta=0.01,
        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: 4.19232739948
Accuracy on training data: 11645 / 50000
Cost on evaluation data: 9.27719005168
Accuracy on evaluation data: 2297 / 10000

Epoch 1 training complete
Cost on training data: 4.12177046783
Accuracy on training data: 11990 / 50000
Cost on evaluation data: 9.14920334416
Accuracy on evaluation data: 2487 / 10000

Epoch 2 training complete
Cost on training data: 4.1438668788
Accuracy on training data: 12081 / 50000

Cost on evaluation data: 9.12647013474
Accuracy on evaluation data: 2456 / 10000

Epoch 3 training complete
Cost on training data: 4.02917453998
Accuracy on training data: 13783 / 50000
Cost on evaluation data: 8.96430966948
Accuracy on evaluation data: 2815 / 10000

Epoch 4 training complete
Cost on training data: 4.02168715083
Accuracy on training data: 13177 / 50000
Cost on evaluation data: 8.88735639182
Accuracy on evaluation data: 2659 / 10000

Epoch 5 training complete
Cost on training data: 3.88894557502
Accuracy on training data: 16062 / 50000
Cost on evaluation data: 8.70415102939
Accuracy on evaluation data: 3291 / 10000

Epoch 6 training complete
Cost on training data: 3.89620290466
Accuracy on training data: 15399 / 50000
Cost on evaluation data: 8.67383572388
Accuracy on evaluation data: 3126 / 10000

Epoch 7 training complete
Cost on training data: 3.87522020268
Accuracy on training data: 16815 / 50000
Cost on evaluation data: 8.6105210978
Accuracy on evaluation data: 3386 / 10000

Epoch 8 training complete
Cost on training data: 3.90614197558
Accuracy on training data: 14629 / 50000
Cost on evaluation data: 8.58923719052
Accuracy on evaluation data: 2950 / 10000

Epoch 9 training complete
Cost on training data: 3.81773480118
Accuracy on training data: 16620 / 50000
Cost on evaluation data: 8.43681879883
Accuracy on evaluation data: 3344 / 10000

Epoch 10 training complete
Cost on training data: 3.72933735426
Accuracy on training data: 17615 / 50000

Cost on evaluation data: 8.31148644219
Accuracy on evaluation data: 3524 / 10000

Epoch 11 training complete
Cost on training data: 3.80707417902
Accuracy on training data: 16910 / 50000
Cost on evaluation data: 8.35413736388
Accuracy on evaluation data: 3364 / 10000

Epoch 12 training complete
Cost on training data: 3.72202764828
Accuracy on training data: 14326 / 50000
Cost on evaluation data: 8.2108819072
Accuracy on evaluation data: 2904 / 10000

Epoch 13 training complete
Cost on training data: 3.64450676986
Accuracy on training data: 19146 / 50000
Cost on evaluation data: 8.09608579465
Accuracy on evaluation data: 3844 / 10000

Epoch 14 training complete
Cost on training data: 3.64236768975
Accuracy on training data: 19409 / 50000
Cost on evaluation data: 8.05719895255
Accuracy on evaluation data: 3912 / 10000

Epoch 15 training complete
Cost on training data: 3.63418209026
Accuracy on training data: 15134 / 50000
Cost on evaluation data: 7.98786763818
Accuracy on evaluation data: 3050 / 10000

Epoch 16 training complete
Cost on training data: 3.57665369305
Accuracy on training data: 19651 / 50000
Cost on evaluation data: 7.90190609054
Accuracy on evaluation data: 3943 / 10000

Epoch 17 training complete
Cost on training data: 3.52662443656
Accuracy on training data: 20993 / 50000
Cost on evaluation data: 7.80101499062
Accuracy on evaluation data: 4226 / 10000

Epoch 18 training complete
Cost on training data: 3.47242486007
Accuracy on training data: 21116 / 50000

Cost on evaluation data: 7.71292749068
Accuracy on evaluation data: 4231 / 10000

Epoch 19 training complete
Cost on training data: 3.4362473712
Accuracy on training data: 21661 / 50000
Cost on evaluation data: 7.62234922031
Accuracy on evaluation data: 4359 / 10000

Epoch 20 training complete
Cost on training data: 3.39802678248
Accuracy on training data: 22482 / 50000
Cost on evaluation data: 7.53499251138
Accuracy on evaluation data: 4535 / 10000

Epoch 21 training complete
Cost on training data: 3.47903293584
Accuracy on training data: 20905 / 50000
Cost on evaluation data: 7.58540977805
Accuracy on evaluation data: 4161 / 10000

Epoch 22 training complete
Cost on training data: 3.36484065347
Accuracy on training data: 22389 / 50000
Cost on evaluation data: 7.44667066352
Accuracy on evaluation data: 4454 / 10000

Epoch 23 training complete
Cost on training data: 3.33162213268
Accuracy on training data: 22937 / 50000
Cost on evaluation data: 7.36409323199
Accuracy on evaluation data: 4625 / 10000

Epoch 24 training complete
Cost on training data: 3.31317414218
Accuracy on training data: 22719 / 50000
Cost on evaluation data: 7.29216933693
Accuracy on evaluation data: 4527 / 10000

Epoch 25 training complete
Cost on training data: 3.21177431671
Accuracy on training data: 22251 / 50000
Cost on evaluation data: 7.17042477016
Accuracy on evaluation data: 4463 / 10000

Epoch 26 training complete
Cost on training data: 3.22296335244
Accuracy on training data: 23879 / 50000

Cost on evaluation data: 7.15331787422
Accuracy on evaluation data: 4760 / 10000

Epoch 27 training complete
Cost on training data: 3.20270499705
Accuracy on training data: 22744 / 50000
Cost on evaluation data: 7.08244978086
Accuracy on evaluation data: 4580 / 10000

Epoch 28 training complete
Cost on training data: 3.17371006131
Accuracy on training data: 23196 / 50000
Cost on evaluation data: 7.00259664787
Accuracy on evaluation data: 4609 / 10000

Epoch 29 training complete
Cost on training data: 3.16664407834
Accuracy on training data: 23888 / 50000
Cost on evaluation data: 6.96811279899
Accuracy on evaluation data: 4810 / 10000

```
In [13]: 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
Cost on training data: 3.65149303125
Accuracy on training data: 15303 / 50000
Cost on evaluation data: 7.11039278219
Accuracy on evaluation data: 3072 / 10000

Epoch 1 training complete
Cost on training data: 3.38856180748
Accuracy on training data: 18013 / 50000
Cost on evaluation data: 6.4846352304
Accuracy on evaluation data: 3588 / 10000

Epoch 2 training complete
Cost on training data: 3.07758487402
Accuracy on training data: 23284 / 50000
Cost on evaluation data: 5.89033311694
Accuracy on evaluation data: 4656 / 10000

Epoch 3 training complete
Cost on training data: 2.50481478925
Accuracy on training data: 30103 / 50000
Cost on evaluation data: 5.04137363078
Accuracy on evaluation data: 6033 / 10000

Epoch 4 training complete
Cost on training data: 2.21751396759
Accuracy on training data: 33559 / 50000
Cost on evaluation data: 4.50116846546
Accuracy on evaluation data: 6819 / 10000

Epoch 5 training complete
Cost on training data: 1.8631822104
Accuracy on training data: 36864 / 50000
Cost on evaluation data: 3.95369037517
Accuracy on evaluation data: 7395 / 10000

Epoch 6 training complete
Cost on training data: 1.87417389294
Accuracy on training data: 34182 / 50000
Cost on evaluation data: 3.73895357733
Accuracy on evaluation data: 6871 / 10000

Epoch 7 training complete
Cost on training data: 1.6375864732
Accuracy on training data: 39610 / 50000
Cost on evaluation data: 3.33065520923
Accuracy on evaluation data: 7943 / 10000

Epoch 8 training complete
Cost on training data: 1.45968257476
Accuracy on training data: 40723 / 50000
Cost on evaluation data: 3.00665487983
Accuracy on evaluation data: 8117 / 10000

Epoch 9 training complete
Cost on training data: 1.25339353086
Accuracy on training data: 41773 / 50000
Cost on evaluation data: 2.64748046749
Accuracy on evaluation data: 8383 / 10000

Epoch 10 training complete
Cost on training data: 1.22987378023
Accuracy on training data: 42469 / 50000
Cost on evaluation data: 2.48914223358
Accuracy on evaluation data: 8517 / 10000

Epoch 11 training complete
Cost on training data: 1.22127016603
Accuracy on training data: 43015 / 50000
Cost on evaluation data: 2.36032919788
Accuracy on evaluation data: 8603 / 10000

Epoch 12 training complete
Cost on training data: 0.997059517608
Accuracy on training data: 43555 / 50000
Cost on evaluation data: 2.03106852877
Accuracy on evaluation data: 8713 / 10000

Epoch 13 training complete
Cost on training data: 1.03180891142
Accuracy on training data: 44015 / 50000
Cost on evaluation data: 1.95907044751
Accuracy on evaluation data: 8782 / 10000

Epoch 14 training complete
Cost on training data: 0.937523272893
Accuracy on training data: 44420 / 50000
Cost on evaluation data: 1.78126022115
Accuracy on evaluation data: 8861 / 10000

Epoch 15 training complete
Cost on training data: 0.876346819366
Accuracy on training data: 44683 / 50000
Cost on evaluation data: 1.64809530295
Accuracy on evaluation data: 8917 / 10000

Epoch 16 training complete
Cost on training data: 0.924274340071
Accuracy on training data: 44919 / 50000
Cost on evaluation data: 1.61586679339
Accuracy on evaluation data: 8935 / 10000

Epoch 17 training complete
Cost on training data: 0.768316702065
Accuracy on training data: 45238 / 50000
Cost on evaluation data: 1.4065806939
Accuracy on evaluation data: 9008 / 10000

Epoch 18 training complete
Cost on training data: 0.758379981298
Accuracy on training data: 45552 / 50000
Cost on evaluation data: 1.33343806047
Accuracy on evaluation data: 9050 / 10000

Epoch 19 training complete
Cost on training data: 0.707865420725
Accuracy on training data: 45848 / 50000
Cost on evaluation data: 1.23024619567
Accuracy on evaluation data: 9112 / 10000

Epoch 20 training complete
Cost on training data: 0.707590517077
Accuracy on training data: 46031 / 50000
Cost on evaluation data: 1.18622871368
Accuracy on evaluation data: 9139 / 10000

Epoch 21 training complete
Cost on training data: 0.724551208891
Accuracy on training data: 46127 / 50000
Cost on evaluation data: 1.16326428536
Accuracy on evaluation data: 9154 / 10000

Epoch 22 training complete
Cost on training data: 0.616778270432
Accuracy on training data: 46318 / 50000
Cost on evaluation data: 1.01222529436
Accuracy on evaluation data: 9203 / 10000

Epoch 23 training complete
Cost on training data: 0.591224943354
Accuracy on training data: 46459 / 50000
Cost on evaluation data: 0.967196483217
Accuracy on evaluation data: 9197 / 10000

Epoch 24 training complete
Cost on training data: 0.579290091045
Accuracy on training data: 46578 / 50000
Cost on evaluation data: 0.920097250051
Accuracy on evaluation data: 9244 / 10000

Epoch 25 training complete
Cost on training data: 0.539146934199
Accuracy on training data: 46755 / 50000
Cost on evaluation data: 0.848639439209
Accuracy on evaluation data: 9277 / 10000

Epoch 26 training complete
Cost on training data: 0.523217774332
Accuracy on training data: 46984 / 50000
Cost on evaluation data: 0.812172773051
Accuracy on evaluation data: 9329 / 10000

Epoch 27 training complete
Cost on training data: 0.610264951041
Accuracy on training data: 47005 / 50000
Cost on evaluation data: 0.867424663119
Accuracy on evaluation data: 9331 / 10000

Epoch 28 training complete
Cost on training data: 0.503864455239
Accuracy on training data: 47097 / 50000
Cost on evaluation data: 0.74684627131
Accuracy on evaluation data: 9348 / 10000

Epoch 29 training complete
Cost on training data: 0.433928954526
Accuracy on training data: 47331 / 50000
Cost on evaluation data: 0.659623254631
Accuracy on evaluation data: 9382 / 10000