Exercise 3

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1 EECS 491: Probabilistic Graphical Models Assignment 4

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2 Exercise 3

In this notebook we will utilize PCA to compute the principle components of the MNIST dataset.

First let us load in the MNIST dataset:

```
In [16]: import gzip, pickle
         import numpy as np
         import matplotlib.pyplot as plt
         from sklearn.decomposition import PCA
         %matplotlib inline
```

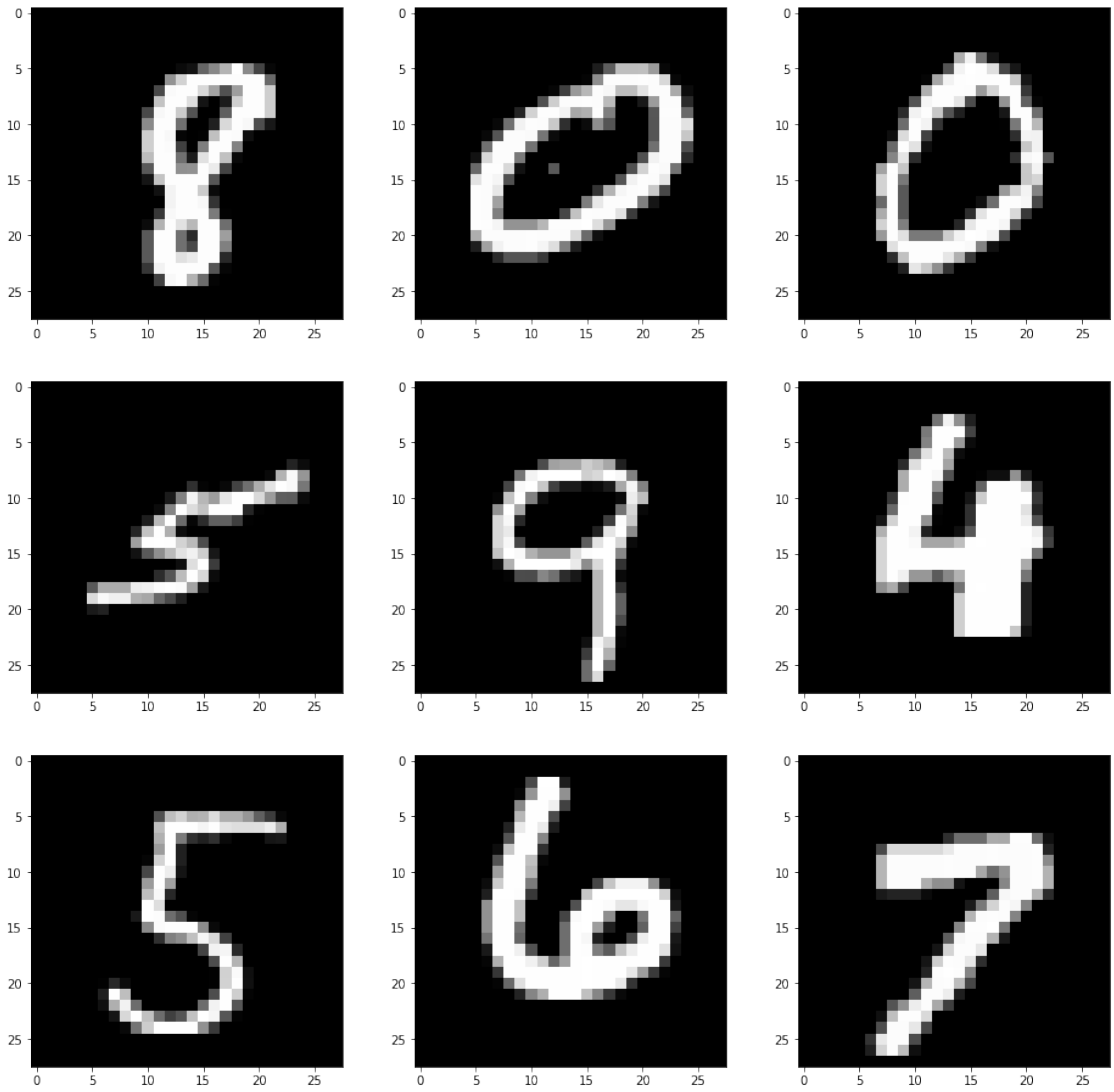
```
In [17]: with gzip.open('data/mnist.pkl.gz', 'rb') as f:
             f = pickle._Unpickler(f)
             f.encoding = 'latin1'
             trainSet, validSet, testSet = f.load()
             mnistData = np.concatenate((trainSet[0], validSet[0], testSet[0]), axis=0)
```

The following is a function taken from the demo that displays a number of image samples from a given dataset:

```
In [18]: def showImageSamples(imageset, n, shape=[28,28], col=3, width=16, dispopt='gray', ran
             row    = np.ceil(n / col)
             height = np.around(row * (width / col))
             plt.figure(figsize=(width, height))
             subplotIndex = 100 * row + 10 * col + 1
             for i in range(n):
                 if random:
                     img = imageset[np.random.randint(len(imageset), size=1)]
                 else:
                     img = imageset[i]
                 plt.subplot(subplotIndex + i)
                 plt.imshow(img.reshape(shape), cmap=dispopt)
```

We will use it to display 9 images from the MNIST dataset:

```
In [19]: showImageSamples(mnistData, 9)
```



Now let us implement a function that will reduce the dimensionality of a given dataset using PCA, and return the eigenvectors and eigenvalues of the covariance matrix of the dataset:

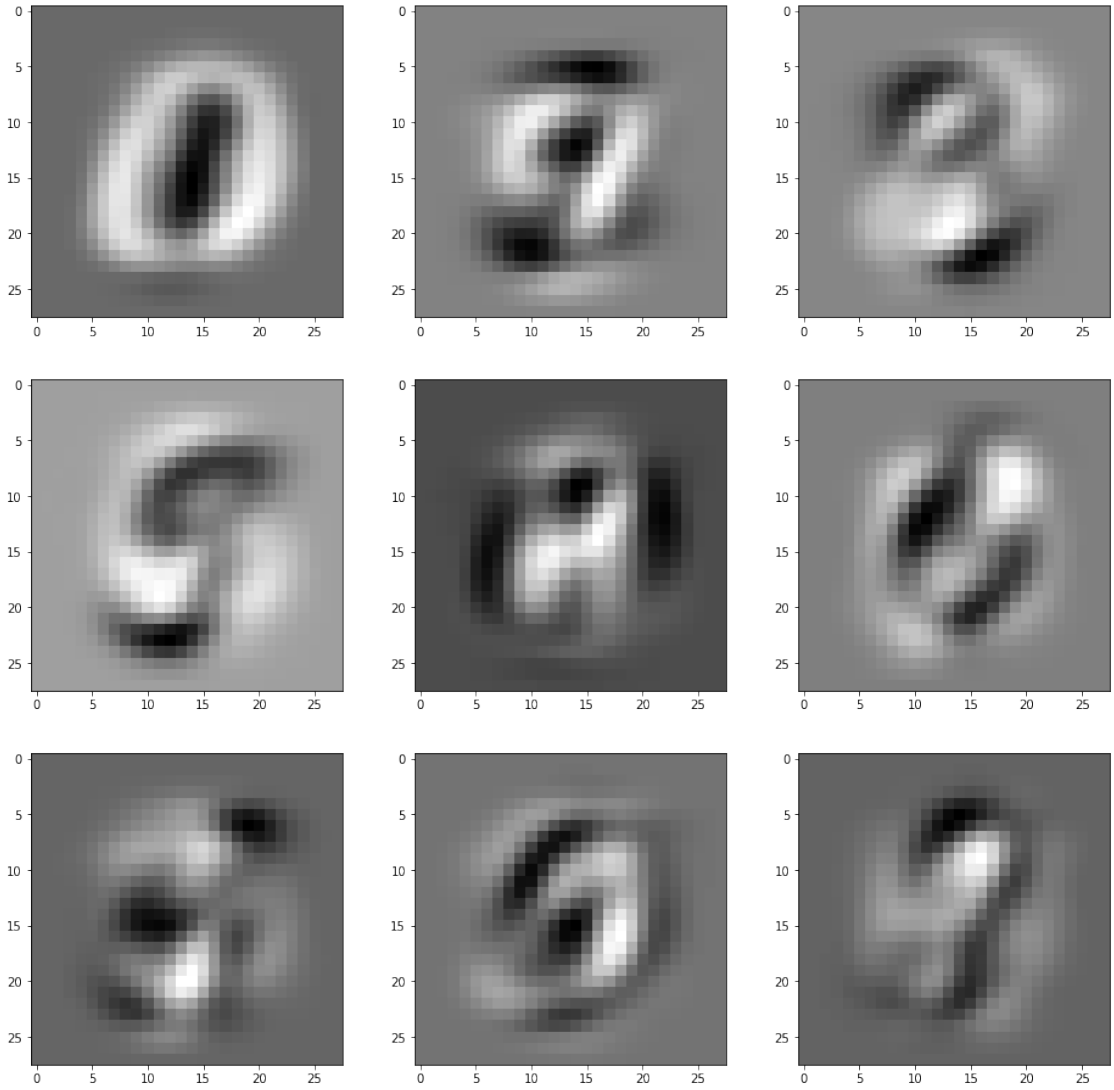
```
In [20]: def dimReducePCA(data, dims):
             pca = PCA(n_components=dims)
             reduced_data = pca.fit_transform(data)
             pca = PCA()
             pca.fit(data)
             eigen_vectors = pca.components_.T
             eigen_values = pca.explained_variance_
             return reduced_data, eigen_vectors, eigen_values
```

Let's call that function on the MNIST dataset:

```
In [23]: mnistData2D, eigenVectors, eigenValues = dimReducePCA(mnistData, 2)
```

Now, using the eigenvectors returned, let's show the first few primary components of MNIST:

```
In [22]: showImageSamples(eigenVectors.T, 9, random=False)
```



In the next exercise, we will use this dimension reduced MNIST dataset to train a Gaussian Mixture Model.