Assignment _2

January 20, 2019

```
In [2]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import scipy.stats
        import sklearn.preprocessing
        from scipy.linalg import eigh
        from sklearn import decomposition
        import seaborn as sns
        from sklearn.manifold import TSNE

In [7]: d = pd.read_csv('mnist_train.csv')

In [10]: d.head(5)
```

Out[10]:

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	\
0	1	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	
2	1	0	0	0	0	0	0	0	0	
3	4	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	

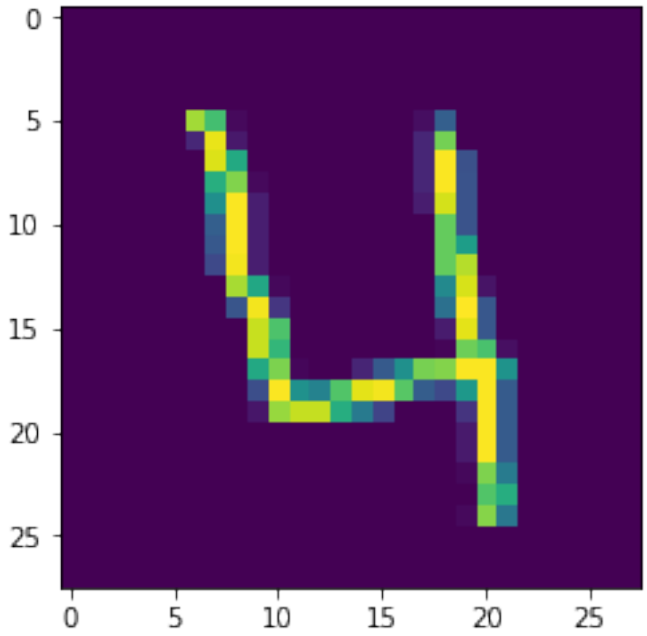
	pixel8	...	pixel774	pixel775	pixel776	pixel777	pixel778	\
0	0	...	0	0	0	0	0	
1	0	...	0	0	0	0	0	
2	0	...	0	0	0	0	0	
3	0	...	0	0	0	0	0	
4	0	...	0	0	0	0	0	

	pixel779	pixel780	pixel781	pixel782	pixel783
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0

[5 rows x 785 columns]

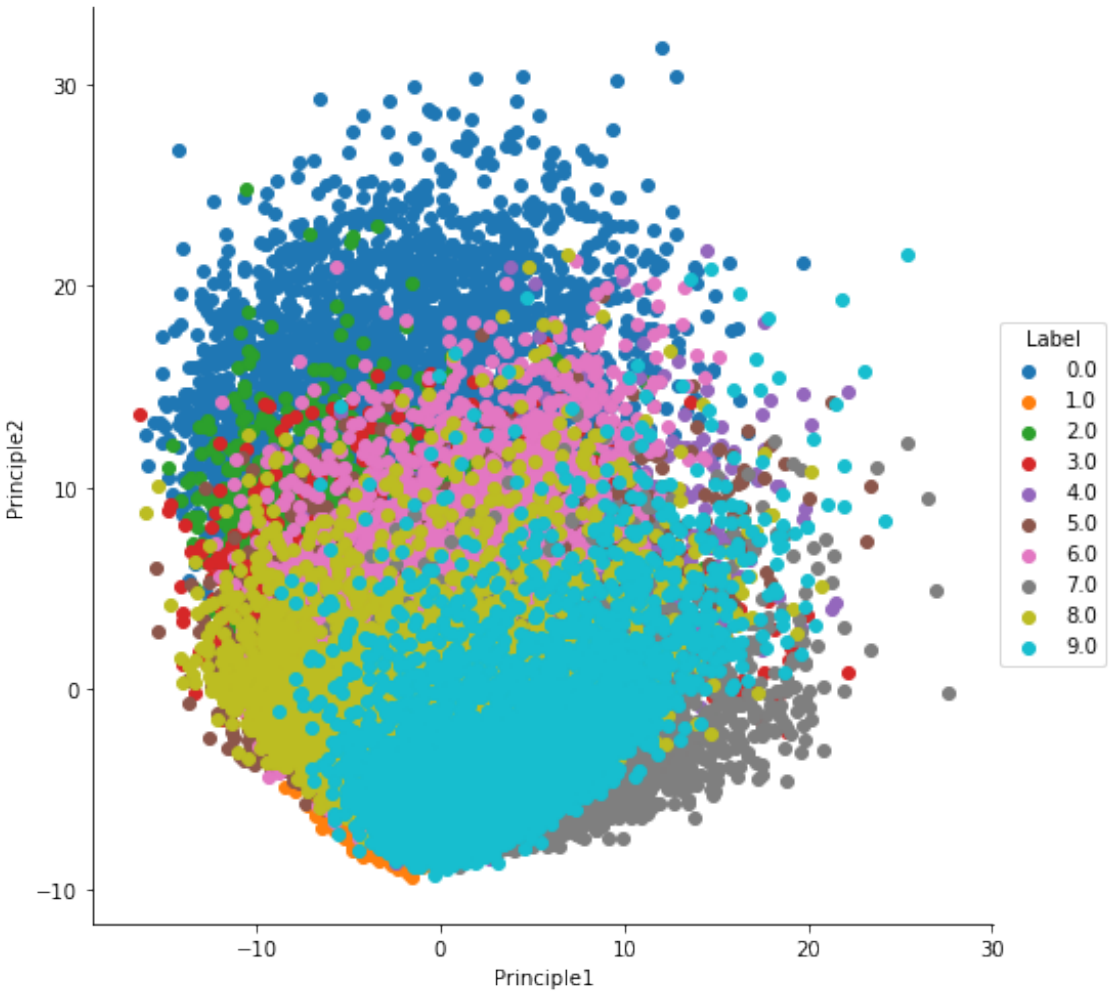
```
In [14]: y = d['label']
```

```
In [20]: data= d.drop(labels = 'label',axis  =1)

In [30]: demo = data.iloc[3].as_matrix().reshape(28,28)

C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: FutureWarning: Method .as_m
  """Entry point for launching an IPython kernel.


In [31]: plt.imshow(demo)

Out[31]: <matplotlib.image.AxesImage at 0x1ac1bb166d8>
```



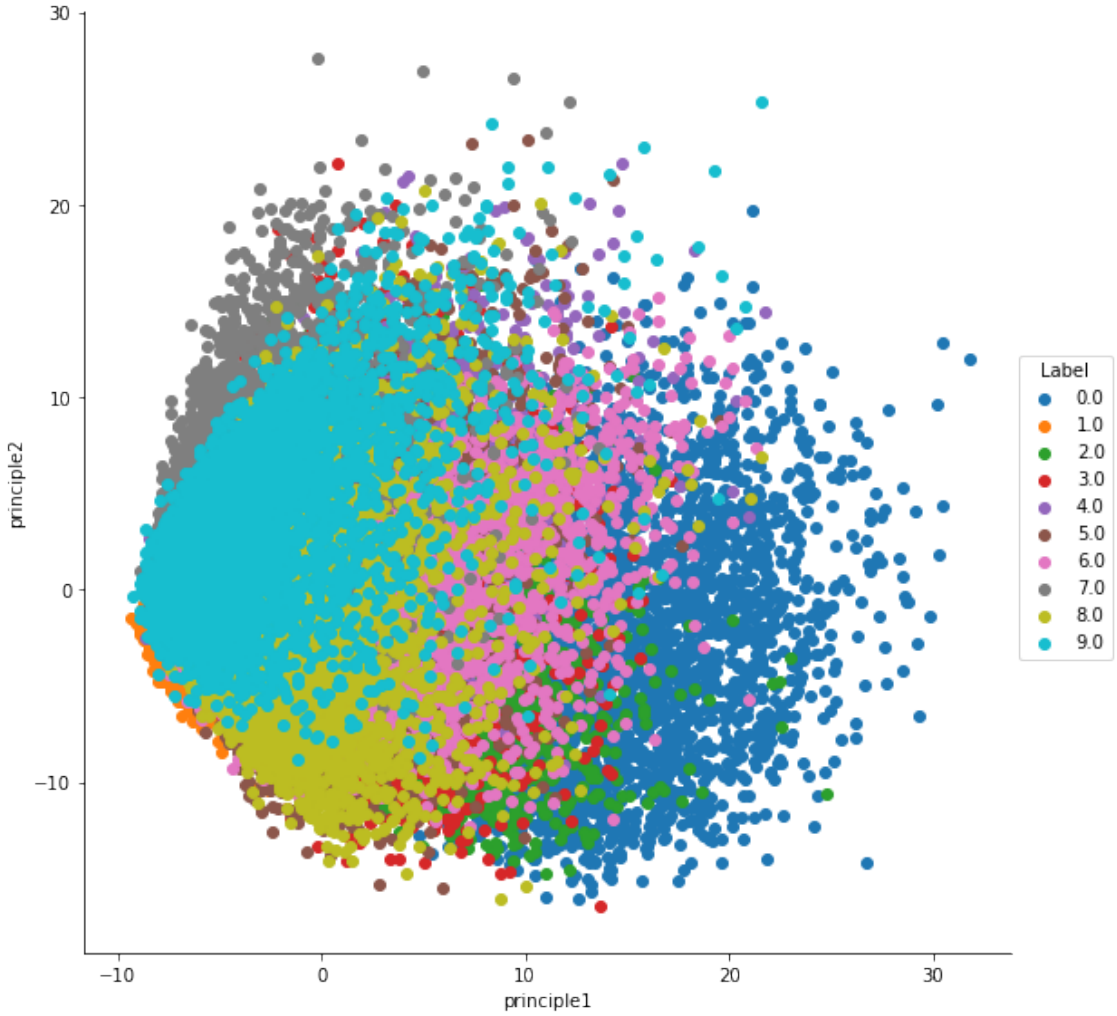

```
In [32]: y[3]

Out[32]: 4

In [33]: std_data = sklearn.preprocessing.StandardScaler().fit_transform(data)

In [35]: covar_matrix = np.matmul(std_data.T,std_data)

In [37]: covar_matrix.shape

Out[37]: (784, 784)

In [40]: val,vec=eigh(covar_matrix,eigvals = (782,783))

In [47]: vec.shape
```

```
Out[47]: (784, 2)

In [60]: a = np.matmul(vec.T,std_data.T) #Projecting all of my datapoints on eigen vectors

In [61]: a.shape

Out[61]: (2, 42000)

In [65]: new_data=np.vstack((a,y)).T

In [67]: new_data.shape

Out[67]: (42000, 3)

In [68]: df = pd.DataFrame(new_data,columns = ['Principle1','Principle2','Label'])
         df.head()

Out[68]:    Principle1  Principle2  Label
         0   -5.226445   -5.140478    1.0
         1    6.032996   19.292332    0.0
         2   -1.705813   -7.644503    1.0
         3    5.836139   -0.474207    4.0
         4    6.024818   26.559574    0.0

In [71]: sns.FacetGrid(df,hue = "Label",size = 7).map(plt.scatter,'Principle1','Principle2').ad

Out[71]: <seaborn.axisgrid.FacetGrid at 0x1ac02f62860>
```



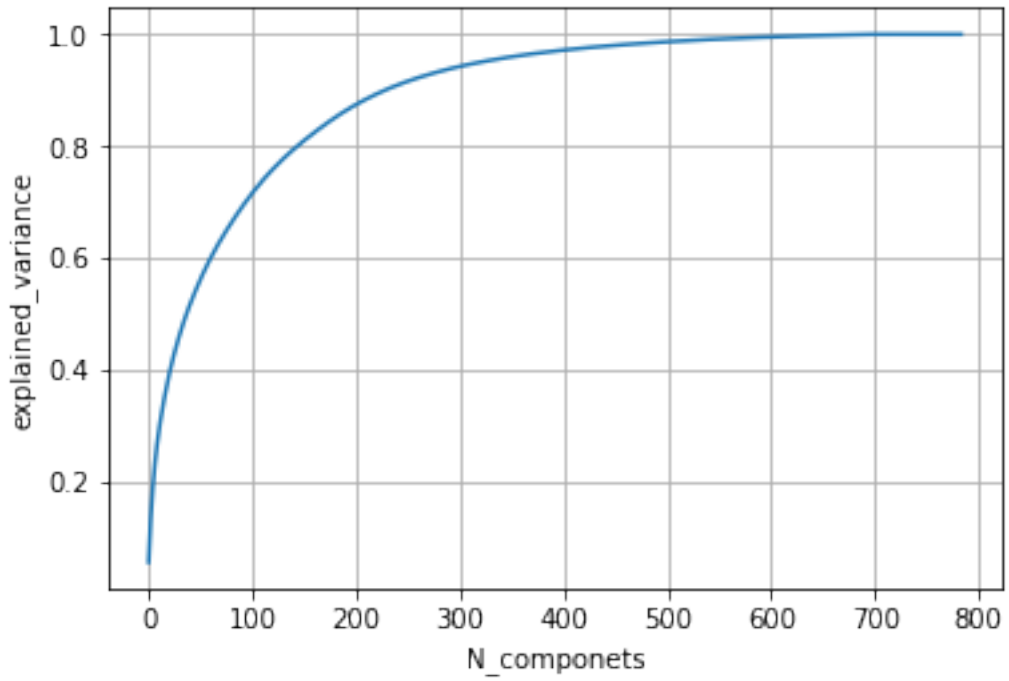

```
In [72]: pca = decomposition.PCA()

In [87]: pca.n_components = 2

In [88]: new = pca.fit_transform(std_data)

In [89]: new1= new.T

In [90]: new1.shape

Out[90]: (2, 42000)

In [92]: Data = np.vstack((new1,y)).T

In [94]: df1 = pd.DataFrame(Data,columns = ["principle1","principle2","Label"])

In [97]: sns.FacetGrid(df1,hue = "Label",size = 8).map(plt.scatter,"principle1","principle2").a
```

Out[97]: <seaborn.axisgrid.FacetGrid at 0x1ac02d4afd0>



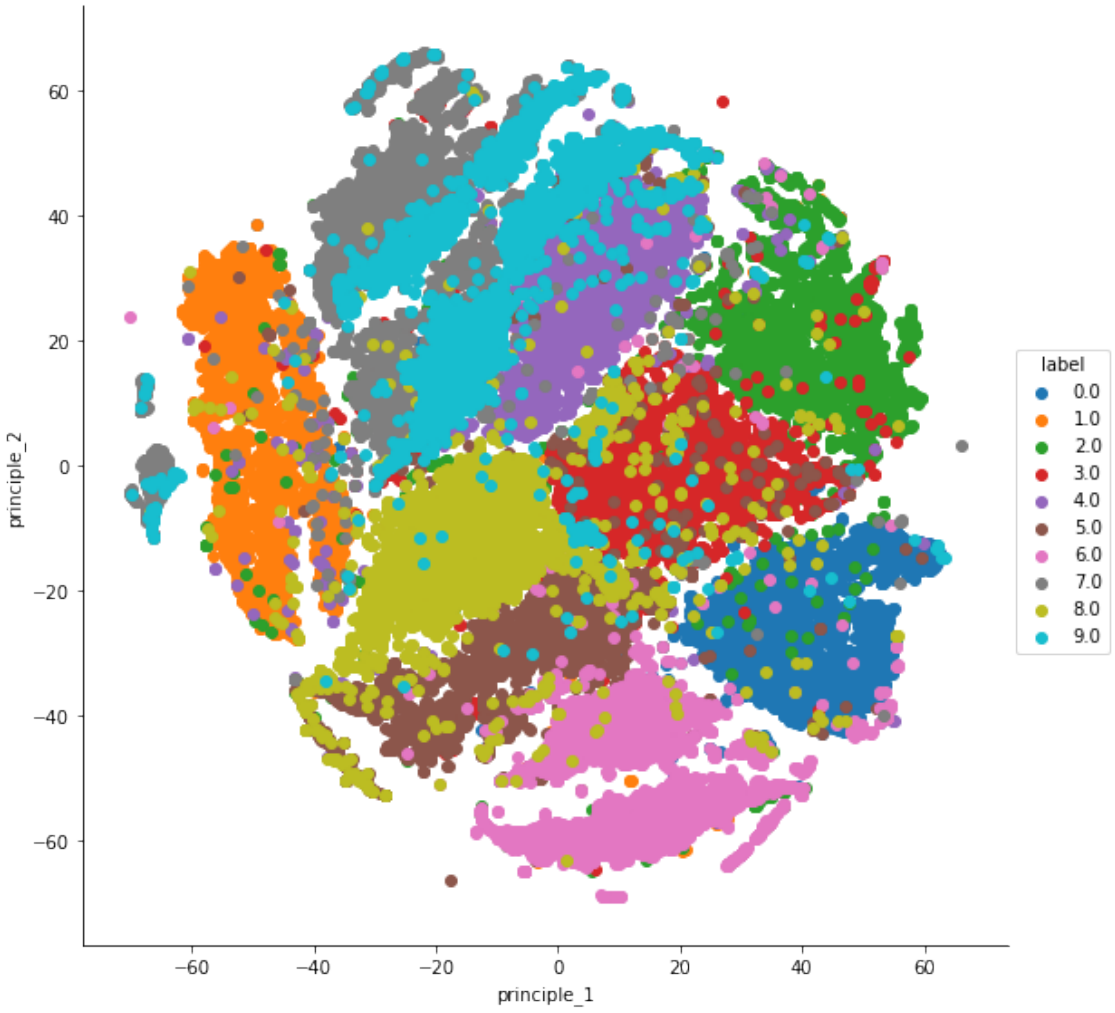
In [109]:
```
pca.n_components =784
pca.fit_transform(std_data)
var = pca.explained_variance_
pdf = var/sum(var)
cdf = np.cumsum(pdf)
plt.grid()
plt.xlabel('N_componets')
plt.ylabel('explained_variance')
plt.plot(cdf)
```

Out[109]: [<matplotlib.lines.Line2D at 0x1ac00b04c50>]



1 T-SNE

```
In [112]: model= TSNE(n_components=2).fit_transform(std_data)

In [116]: model.shape

Out[116]: (42000, 2)

In [117]: tsne_data = np.vstack((model.T,y)).T

In [120]: tsne_data.shape

Out[120]: (42000, 3)

In [121]: df2 = pd.DataFrame(tsne_data,columns = ["principle_1","principle_2","label"])

In [126]: sns.FacetGrid(df2,hue = "label",size = 8).map(plt.scatter,'principle_1','principle_2

Out[126]: <seaborn.axisgrid.FacetGrid at 0x1ac00d25048>
```



Could not do multiple hyperparameter testing due to slow computational speed.