CS498AML_HW4_panz2

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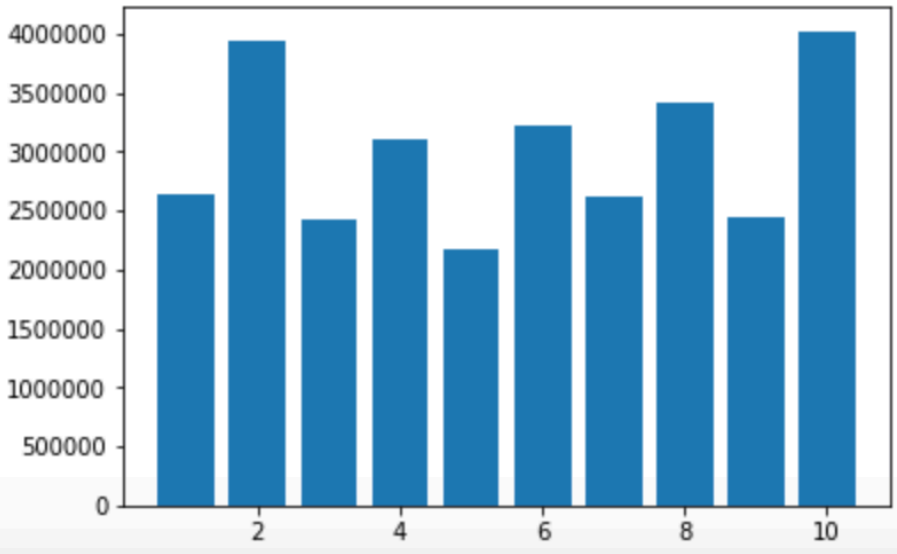
A single plot of error (use mean squared error) vs category (1-10):
Error is calculated based on training data (data_batch_1~5)

```
In [17]: li_MSE
```

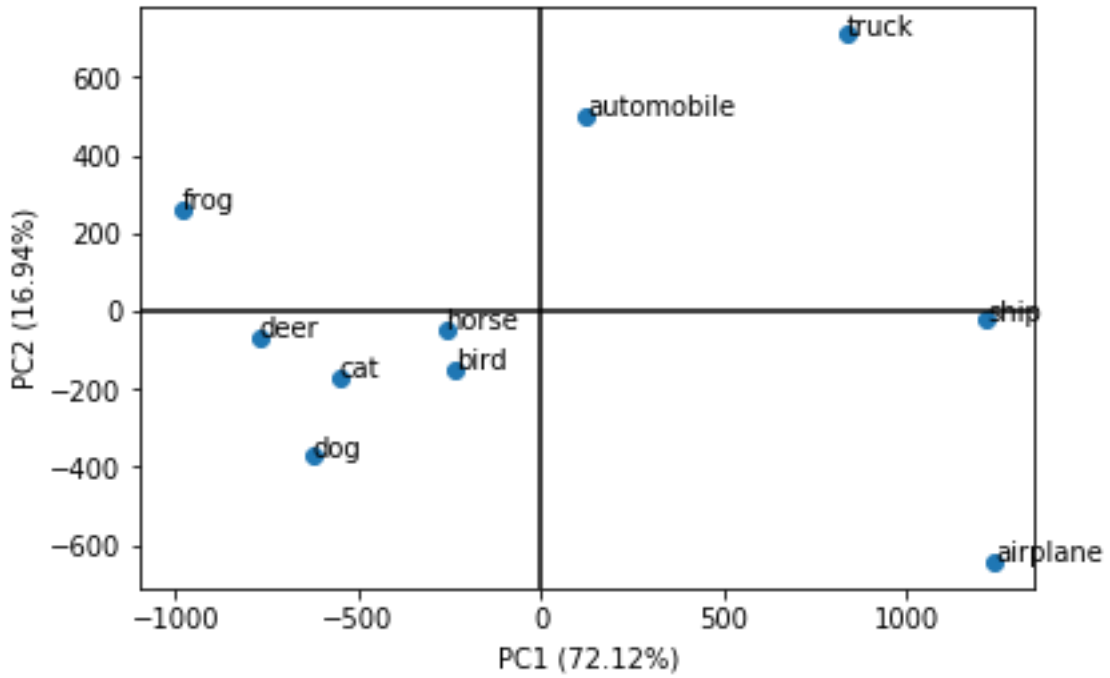
```
Out[17]: [2629467.1550547639,
          3946267.9085392822,
          2432107.4911725386,
          3106124.7729624542,
          2181905.7666432783,
          3230245.0703085512,
          2623410.9962643329,
          3424435.2463813997,
          2438641.3675135057,
          4024349.8710604957]
```

```
In [18]: plt.bar(range(1,11,1), li_MSE)
```

```
Out[18]: <Container object of 10 artists>
```



A single 2D plot with the results of principal coordinate analysis applied to pairs of means:



In [1]:
```
import pickle
import os
import numpy as np
import pandas as pd
from sklearn.decomposition import PCA
from scipy.spatial.distance import euclidean
from skbio.stats.ordination import pcoa
import matplotlib.pyplot as plt
```

In [2]:
```
def unpickle(file):
    with open(file, 'rb') as fo:
        dict = pickle.load(fo, encoding='bytes')
    return dict
```

In [3]:
```
batchName = [i for i in os.listdir() if 'data_batch' in i]
for i in batchName:
    globals()[i] = unpickle(i)
```

In [4]:
```
classLevels = set()
df_class = {}
for eachBatch in batchName:
    # get all class levels
    classLevels = classLevels.union(set(globals()[eachBatch][b'labels']))
    # initialize - create null dataframes
    for classValue in classLevels:
        df_class[classValue] = pd.DataFrame(columns = list(range(0, 3072, 1)))
```

In [5]:
```
def sepPickleClass(batch, classValueRange):
    for classValue in classValueRange:
        ind = [i for i, val in enumerate(batch[b'labels']) if val == classValue]
        df_class[classValue] = df_class[classValue].append(pd.DataFrame(batch[b'data'][ind]))
```

In [6]:
```
for eachBatch in batchName:
    sepPickleClass(globals()[eachBatch], classLevels)
```

In [7]:
```
def getMeanImage(classValue):
    return df_class[classValue].mean(axis = 0)
```

In [8]:
```
mean_class = {}
for classValue in classLevels:
    mean_class[classValue] = getMeanImage(classValue)
```

In [9]:
```
def getPcaRepr(classValue, n_components):
    pca_model = PCA(n_components = n_components, svd_solver = 'full')
    pca_model.fit(df_class[classValue])
    pcaRepr = pca_model.inverse_transform(pca_model.transform(df_class[classValue]))
    return pcaRepr
```

In [10]:
```
pca_repr_class = {}
for classValue in classLevels:
    pca_repr_class[classValue] = getPcaRepr(classValue, 20)
```

In [11]:
```
def getMSE(y_true, y_pred):
    assert y_true.shape[0] == y_pred.shape[0]
    return np.sum(np.sum(np.square(np.subtract(y_pred, y_true)))) / y_true.shape[0]
```

In [12]:
```
li_MSE = []
for classValue in classLevels:
    li_MSE.append(getMSE(df_class[classValue], pca_repr_class[classValue]))
```

In [18]:
```
plt.bar(list(classLevels), li_MSE)
plt.xticks(list(classLevels))
```

In [19]:
```
dTab = []
for classValue1 in classLevels:
    dRow = []
    for classValue2 in classLevels:
        d = euclidean(mean_class[classValue1], mean_class[classValue2])
        dRow.append(d)
    dTab.append(dRow)
dMat = np.matrix(dTab)
```

In [20]:
```
def create2DMap(distanceMat, axes, axis_labels = None):
    ordResult = pcoa(distanceMat)
    coord_matrix = ordResult.samples.values.T
    prop_expl = ordResult.proportion_explained
    fig = plt.figure()
    xs = coord_matrix[axes[0]]
    ys = coord_matrix[axes[1]]
    plt.scatter(xs, ys)
    names = ['airplane', 'automobile', 'bird', 'cat', 'deer', 'dog', 'frog', 'horse', 'ship', 'truck']
    for i in range(len(xs)):
        plt.annotate(names[i], (xs[i], ys[i]))
    if axis_labels is None:
        axis_labels = ['PC{} ({:.2%})'.format((axis+1), prop_expl[axis]) for axis in axes]
    plt.xlabel(axis_labels[0])
    plt.ylabel(axis_labels[1])
    plt.axvline(x=0, color = 'k')
    plt.axhline(y=0, color = 'k')
    return fig
```

In [21]:
```
pcoa_2dMap = create2DMap(dMat, [0,1])
```