CS156 (Introduction to AI), Fall 2021

Homework 2 submission

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Any special notes or anything you would like to communicate to me about this homework submission goes in here.

References and sources

List all your references and sources here. This includes all sites/discussion boards/blogs/posts/etc. where you grabbed some code examples.

1) kmeans.synthetic_data.ipynb (class file)

2) knn.synthetic_data.ipynb (class file)

3) https://medium.com/analytics-vidhya/implementing-k-nearest-neighbours-knn-without-using-scikit-learn-3905b4decc3c (https://medium.com/analytics-vidhya/implementing-k-nearest-neighbours-knn-without-using-scikit-learn-3905b4decc3c)

Solution

Load libraries and set random number generator seed

In [1]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from scipy.spatial import distance
import matplotlib.pyplot as plt
import seaborn as sns
from collections import Counter
from sklearn import metrics
```

In [2]:
```
np.random.seed(42)
```

Code the solution

Generate random 2-D data

In [3]:
```
n = 100 #data points

X1 = np.random.normal(loc=-2.0, scale=2.0, size=int(n/2))   #draw from a Ga
Y1 = np.random.normal(loc=0.0, scale=1.0, size=int(n/2))
X2 = np.random.normal(loc=2.0, scale=2.0, size=int(n/2))
Y2 = np.random.normal(loc=0.0, scale=1.0, size=int(n/2))
X = np.concatenate((X1, X2), axis=0)
Y = np.concatenate((Y1, Y2), axis=0)
```

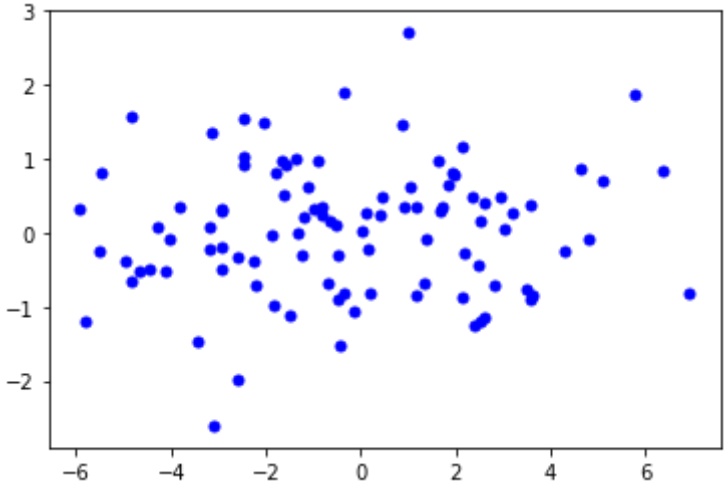
In [4]:
```
l1 = [0]*int(n/2)
l2 = [1]*int(n/2)
labels = l1+l2
print(labels)
# print(len(labels))
```

```
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1]
```

In [5]:
```
dt = pd.DataFrame({'X':X, 'Y':Y}, columns=['X', 'Y'])
dt.head()
dt.shape
```

Out[5]:
```
(100, 2)
```

In [6]:
```
plt.scatter(X, Y, s =25, c = 'b')
plt.show()
```



In [7]:
```
# sns.jointplot(x=X, y=Y, kind="kde")
```

In [8]:
```
X_train, X_test, Y_train, Y_test = train_test_split(dt,labels, test_size=0.
```

In [ ]:
```

```

In [9]:
```
def knn(newObservation, referenceData, k=3):
    final_output= []
    X_test = newObservation
    X_train = referenceData
    for i in range(len(X_test)):
        d = []
        votes = []
        for j in range(len(referenceData)):
            dist = distance.euclidean(X_train.iloc[j] , X_test.iloc[i])
            d.append([dist, j])
        d.sort()
        d = d[0:k]
        for d, j in d:
            votes.append(Y_train[j])
        ans = Counter(votes).most_common(1)[0][0]
        final_output.append(ans)
    return final_output
```

In [10]:
```
prediction = knn(X_test,X_train,3)
for i in prediction:
    print(i, end= ' ')
```

```
0 0 0 1 1 1 0 1 1 1 1 0 1 0 0 0 0 0 0 0
```

In [11]:
```
knn(X_test,X_train,3)
```

Out[11]:
```
[0, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0]
```

```
result = knn(X_test,X_train,3)
```

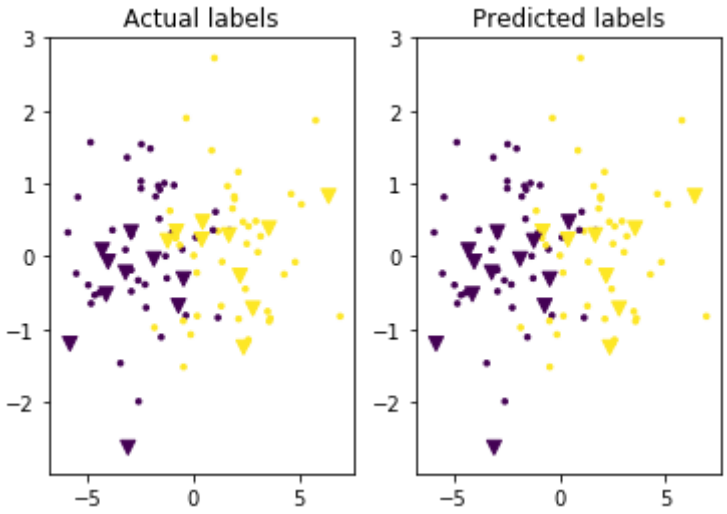
In [ ]:
```

```

In [12]:
```
result = knn(X_test,X_train,3)
print("Accuracy of the predictions on the test dataset is " +
      str( metrics.accuracy_score(Y_test, result)) )
```

```
Accuracy of the predictions on the test dataset is 0.9
```

In [13]:
```
plt.subplot(1, 2, 1)
plt.scatter(X_train.iloc[:,0],X_train.iloc[:,1], s=25, c=Y_train, marker="."
plt.scatter(X_test.iloc[:,0],X_test.iloc[:,1], s=50, c=Y_test, marker="v")
plt.title("Actual labels")

plt.subplot(1, 2, 2)
plt.scatter(X_train.iloc[:,0],X_train.iloc[:,1], s=25, c=Y_train, marker="."
plt.scatter(X_test.iloc[:,0],X_test.iloc[:,1], s=50, c=result, marker="v")
plt.title("Predicted labels")
```

Out[13]:
```
Text(0.5, 1.0, 'Predicted labels')
```



In [ ]:
```
```

Generate random 3-D data (Testing for 3-D data)

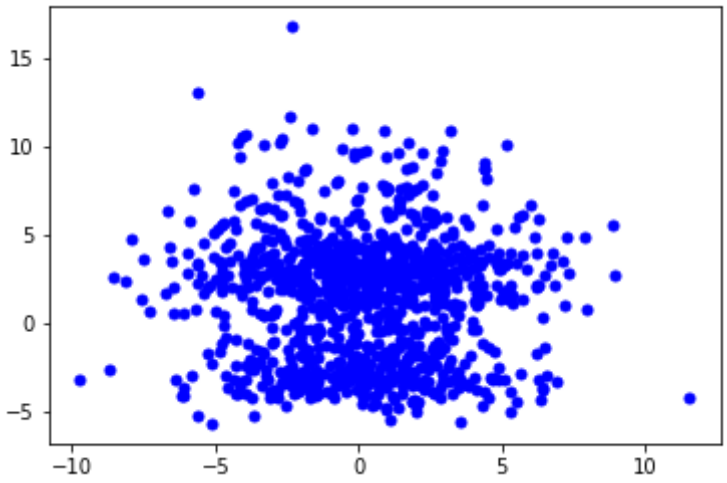
In [14]:
```
num = 1000 #data points

X1 = np.random.normal(loc=0.0, scale=3.0, size=int(num/4))    #draw from a G
Y1 = np.random.normal(loc=-3.0, scale=1.0, size=int(num/4))
Z1 = np.random.normal(loc=-1.0, scale=1.0, size=int(num/4))

X2 = np.random.normal(loc=0.0, scale=3.0, size=int(num/4))
Y2 = np.random.normal(loc=1.0, scale=2.0, size=int(num/4))
Z2 = np.random.normal(loc=1.0, scale=1.0, size=int(num/4))

X3 = np.random.normal(loc=0.0, scale=3.0, size=int(num/4))
Y3 = np.random.normal(loc=3.0, scale=1.0, size=int(num/4))
Z3 = np.random.normal(loc=4.0, scale=1.0, size=int(num/4))

X4 = np.random.normal(loc=0.0, scale=3.0, size=int(num/4))
Y4 = np.random.normal(loc=5.0, scale=3.0, size=int(num/4))
Z4 = np.random.normal(loc=-3.0, scale=1.0, size=int(num/4))

X = np.concatenate((X1, X2, X3, X4), axis=0)
Y = np.concatenate((Y1, Y2, Y3, Y4), axis=0)
Z = np.concatenate((Z1, Z2, Z3, Z4), axis=0)
```

In [15]:
```
dt1 = pd.DataFrame({'X':X, 'Y':Y, 'Z': Z}, columns=['X', 'Y', 'Z'])
dt1.head()
# dt1.shape
```

Out[15]:

	X	Y	Z
0	1.073362	-3.062679	-1.522723
1	1.682354	-2.044858	0.049009
2	3.249154	-3.985726	-1.704344
3	3.161406	-2.495953	-2.408461
4	-4.133008	-3.530258	-2.556629

In [16]:
```
plt.scatter(X, Y, s =25, c = 'b')
plt.show()
```



In [17]:
```
# sns.jointplot(x=X, y=Y, kind="kde")
```

In [18]:
```
l1 = [0]*int(num/2)
l2 = [1]*int(num/2)
labels = l1+l2
print(labels)
```

```
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1]
```

In [19]:
```
X_train, X_test, Y_train, Y_test = train_test_split(dt1,labels, test_size=0
```

In [ ]:
```

```

In [20]:
```
knn(X_test,X_train,3)
```

Out[20]:
```
[1,
 1,
 0,
 0,
 1,
 1,
 1,
 0,
 0,
 1,
 1,
 0,
 0,
 1,
 0,
 1,
 0,
 1,
 0,
 0,
```

In [22]:
```
result = knn(X_test,X_train,3)
print("Accuracy of the predictions on the test dataset is "
      + str( metrics.accuracy_score(Y_test, result)) )
```

```
Accuracy of the predictions on the test dataset is 0.945
```

In [57]:
```

```

In [ ]:
```

```