CS156 (Introduction to AI), Spring 2022

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.

Solution

Load libraries and set random number generator seed

In [1]:

```
# Name : Anh Nguyen
# Assignment : ass2
# Due Date : 03/04/2022

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import operator
from sklearn.model_selection import train_test_split
```

In [2]:

```
np.random.seed(42)
```

Code the solution

In [3]:

```
X, y = np.arange(10).reshape((5, 2)), range(5)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.1, random_state=42
)

np.random.seed(42) #Code B

n = 100
X1 = np.random.normal(loc=-2.0, scale=2.0, size=int(n/2))
X2 = np.random.normal(loc=0.0, scale=1.0, size=int(n/2))

Y1 = 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, Y1), axis=0)
Y = np.concatenate((X2, Y2), axis=0)

l1 = [0]*int(n/2)
l2 = [1]*int(n/2)
labels = l1+l2


dt2D = pd.DataFrame({'X':X, 'Y':Y, 'Class':labels}, columns=['X','Y','Class'])
dt2D.head()


X_train2D, X_test2D, Y_train2D, Y_test2D = train_test_split(dt2D, labels, test_size=0.2,
random_state=0)


# X_train2D_x_coordinate_arr = []
# X_train2D_y_coordinate_arr = []

# for i in range(len(X_train2D)):
#     X_train2D_x_coordinate_arr.append(X_train2D.iloc[i][0])
#     X_train2D_y_coordinate_arr.append(X_train2D.iloc[i][1])


n = 1000
X1 = np.random.normal(loc=0.0 ,scale=3.0, size=int(n/4))
X2 = np.random.normal(loc=-3.0 ,scale=1.0, size=int(n/4))
X3 = np.random.normal(loc=-1.0 ,scale=1.0, size=int(n/4))

Y1 = np.random.normal(loc=0.0, scale=3.0, size=int(n/4))
Y2 = np.random.normal(loc=1.0, scale=2.0, size=int(n/4))
Y3 = np.random.normal(loc=1.0, scale=1.0, size=int(n/4))

Z1 = np.random.normal(loc=0.0, scale=3.0, size=int(n/4))
Z2 = np.random.normal(loc=3.0, scale=1.0, size=int(n/4))
Z3 = np.random.normal(loc=4.0, scale=1.0, size=int(n/4))

W1 = np.random.normal(loc=0.0, scale=3.0, size=int(n/4))
W2 = np.random.normal(loc=5.0, scale=4.0, size=int(n/4))
W3 = np.random.normal(loc=-3.0, scale=1.0, size=int(n/4))

X = np.concatenate((X1, Y1, Z1,W1), axis=0)
Y = np.concatenate((X2, Y2, Z2, W2), axis=0)
Z = np.concatenate((X3, Y3, Z3, W3), axis=0)

l1 = [0]*int(n/4)
l2 = [1]*int(n/4)
l3 = [2]*int(n/4)
l4 = [3]*int(n/4)
labels = l1+l2+l3+l4

dt3D = pd.DataFrame({'X':X, 'Y':Y, 'Z':Z, 'Class':labels}, columns=['X','Y', 'Z','Class'
])
dt3D.head()

X_train3D, X_test3D, Y_train3D, Y_test3D = train_test_split(dt3D, labels, test_size=0.2,
random_state=0)
```

In [4]:

```
# calculate the distance between two points
def distance(p1, p2):
    temp = np.sum(np.square(p1-p2))
    return (np.sqrt(temp))

# KNN method
def knn(newObservation, referenceData, k):
    distances = []
    for i in range(len(referenceData)):
```

```
        dist = distance(newObservation[:-1], referenceData.iloc[i, :-1])
        distances.append((referenceData.iloc[i], dist))
    distances.sort(key = operator.itemgetter(1))
    neighbors = []
    for i in range(k):
        neighbors.append(distances[i][0])
    return neighbors

# prediction
def prediction(neighbors):
    votes = {}
    for neighbor in neighbors:
        response = neighbor[-1]
        if response in votes:
            votes[response] += 1
        else:
            votes[response] = 1
    sortedVotes = sorted(votes.items(), key = operator.itemgetter(1), reverse = True)
    return sortedVotes[0][0]

# calculate the accuracy in percentage
def accuracy(actual, prediction):
    correct = 0
    for i in range(len(actual)):
        if actual[i] == prediction[i]:
            correct+=1
    return correct/float(len(actual))*100.0

# display the graph
def display(X_test, X_train, Y_test, Y_train, predictions):
    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.title("Predicted labels")
    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=predictions, marker="v")

    plt.tight_layout()
    plt.show()
```

In [5]:

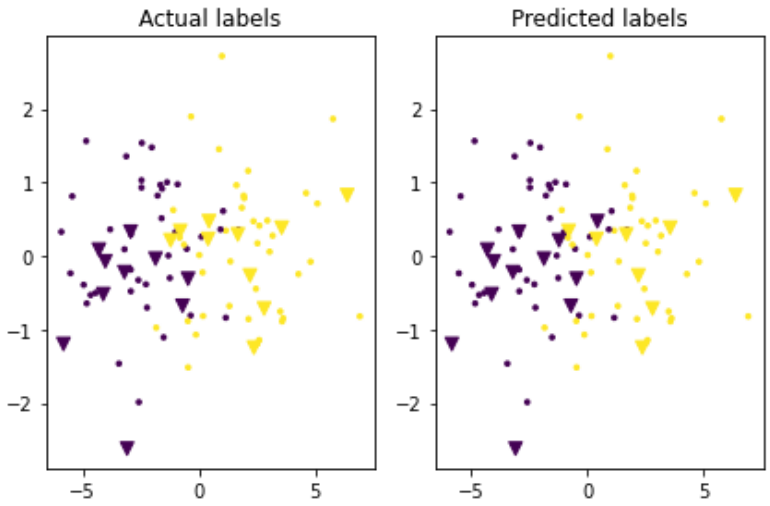
```
def main(X_test, X_train, Y_test, Y_train):
    predictions = []
    for i in range(len(X_test)):
        neighbors = knn(X_test.iloc[i], X_train, 3)
        result = prediction(neighbors)
        predictions.append(result)
        print("Prediction: " + repr(int(result)) + "  |  Actual: " + repr(Y_test[i]))
    accuracyValue = accuracy(Y_test, predictions)
    print("Acuracy in percentage : " + str(accuracyValue) + "%")

    display(X_test, X_train, Y_test, Y_train, predictions)

main(X_test2D, X_train2D, Y_test2D, Y_train2D)
```

```
Prediction: 0  |  Actual: 0
Prediction: 0  |  Actual: 1
Prediction: 0  |  Actual: 0
Prediction: 1  |  Actual: 1
Prediction: 1  |  Actual: 1
Prediction: 1  |  Actual: 1
Prediction: 0  |  Actual: 0
Prediction: 1  |  Actual: 1
Prediction: 1  |  Actual: 1
Prediction: 1  |  Actual: 1
Prediction: 1  |  Actual: 1
Prediction: 0  |  Actual: 1
Prediction: 1  |  Actual: 1
```

```
Prediction: 0  |  Actual: 0
Prediction: 0  |  Actual: 0
Prediction: 0  |  Actual: 0
Prediction: 0  |  Actual: 0
Prediction: 0  |  Actual: 0
Prediction: 0  |  Actual: 0
Prediction: 0  |  Actual: 0
Acuracy in percentage : 90.0%
```



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