Chapter 5 - Ex2: Glass.data

Cho dữ liệu glass.data.txt

Sử dụng thuật toán KNN để dự đoán loại kính dựa trên các thông tin được cung cấp

1. Đọc dữ liệu và gán cho biến data. Tiền xử lý dữ liệu (nếu cần)
2. Tạo inputs data với các cột trừ cột *type of class*, và outputs data với 1 cột là type of class
3. Từ inputs data và outputs data => Tạo X_train, X_test, y_train, y_test với tỷ lệ 70-30
4. Thực hiện KNN với X_train, y_train
5. Dự đoán y từ X_test => so sánh với y_test
6. Đánh giá mô hình => Nhận xét
7. Ghi mô hình (nếu mô hình tốt sau khi đánh giá)

Attribute Information:

1. Id number: 1 to 214
2. RI: refractive index
3. Na: Sodium (unit measurement: weight percent in corresponding oxide, as are attributes 4-10)
4. Mg: Magnesium
5. Al: Aluminum
6. Si: Silicon
7. K: Potassium
8. Ca: Calcium
9. Ba: Barium
10. Fe: Iron
11. Type of glass: (class attribute) -- 1 building_windows_float_processed -- 2 building_windows_non_float_processed -- 3 vehicle_windows_float_processed -- 4 vehicle_windows_non_float_processed (none in this database) -- 5 containers -- 6 tableware -- 7 headlamps

In [1]:
```
# from google.colab import drive
# drive.mount("/content/gdrive", force_remount=True)
# %cd '/content/gdrive/My Drive/LDS6_MachineLearning/practice/Chapter5_KNN/'
```

In [2]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
```

In [3]:
```
# import some data to play with
data = pd.read_csv("glass.data.txt", sep=",", header=None)
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 214 entries, 0 to 213
Data columns (total 11 columns):
0     214 non-null int64
1     214 non-null float64
2     214 non-null float64
3     214 non-null float64
4     214 non-null float64
5     214 non-null float64
6     214 non-null float64
7     214 non-null float64
8     214 non-null float64
9     214 non-null float64
10    214 non-null int64
dtypes: float64(9), int64(2)
memory usage: 18.5 KB
```

In [4]:
```
data.shape
```

Out[4]:
```
(214, 11)
```

In [5]:
```
data.head()
```

Out[5]:

	0	1	2	3	4	5	6	7	8	9	10
0	1	1.52101	13.64	4.49	1.10	71.78	0.06	8.75	0.0	0.0	1
1	2	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.0	0.0	1
2	3	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.0	0.0	1
3	4	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.0	0.0	1
4	5	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.0	0.0	1

In [6]:
```
# data.tail()
```

In [7]:
```
# thống kê số lượng các lớp
data.groupby(10).count()[0]
```

Out[7]:
```
10
1    70
2    76
3    17
5    13
6     9
7    29
Name: 0, dtype: int64
```

In [8]:
```
# The columns that we will be making predictions with.
inputs = data.iloc[:,1:-1]
inputs.shape
```

Out[8]: (214, 9)

In [9]:
```
inputs.head()
```

Out[9]:

	1	2	3	4	5	6	7	8	9
0	1.52101	13.64	4.49	1.10	71.78	0.06	8.75	0.0	0.0
1	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.0	0.0
2	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.0	0.0
3	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.0	0.0
4	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.0	0.0

In [10]:
```
# The column that we want to predict.
outputs = data[10]
outputs = np.array(outputs)
outputs.shape
```

Out[10]: (214,)

In [11]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(inputs, outputs,
                                                    test_size=0.30,
                                                    random_state=1)
```

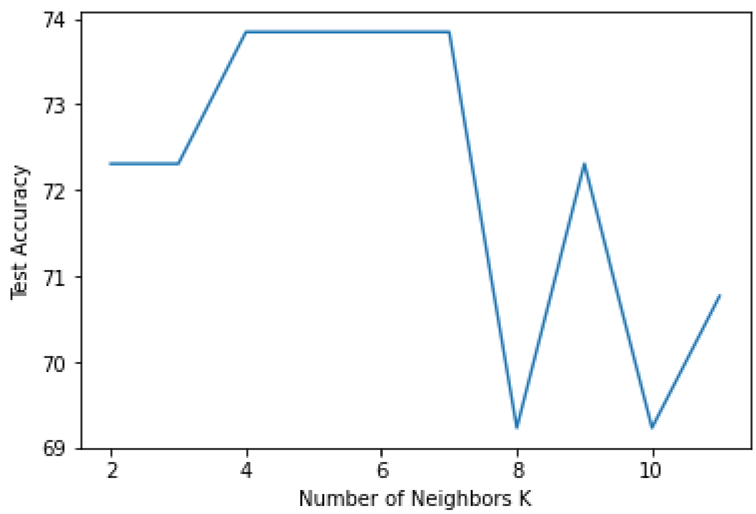
In [12]:
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score
list_k = []
list_acc = []
for K_value in range(2,int(y_train.shape[0]**0.5)):
    list_k.append(K_value)
    neigh = KNeighborsClassifier(n_neighbors = K_value)
    neigh.fit(X_train, y_train)
    y_pred = neigh.predict(X_test)
    acc = accuracy_score(y_test,y_pred)*100
    list_acc.append(acc)
    print("k = ", K_value,": Accuracy is ", accuracy_score(y_test,y_pred))
```

```
k =  2 : Accuracy is  0.7230769230769231
k =  3 : Accuracy is  0.7230769230769231
k =  4 : Accuracy is  0.7384615384615385
k =  5 : Accuracy is  0.7384615384615385
k =  6 : Accuracy is  0.7384615384615385
k =  7 : Accuracy is  0.7384615384615385
k =  8 : Accuracy is  0.6923076923076923
k =  9 : Accuracy is  0.7230769230769231
k =  10 : Accuracy is  0.6923076923076923
k =  11 : Accuracy is  0.7076923076923077
```

In [13]:
```
vi_tri = list_acc.index(max(list_acc))
k = list_k[vi_tri]
print("The optimal number of neighbors is", k,"with", list_acc[vi_tri])
```

```
The optimal number of neighbors is 4 with 73.84615384615385
```

In [14]:
```
plt.plot(list_k, list_acc)
plt.xlabel('Number of Neighbors K')
plt.ylabel('Test Accuracy')
plt.show()
```



In [15]:
```
from sklearn.neighbors import KNeighborsClassifier
```

In [16]:
```
for i in range(4,8):
    knn = KNeighborsClassifier(n_neighbors=i)
    knn.fit(X_train, y_train)
    print("k=", i, ": The Train prediction accuracy is: ",
          knn.score(X_train,y_train)*100,"%")
    print("------ The Test prediction accuracy is: ",
          knn.score(X_test,y_test)*100,"%")
    #.../.../
```

```
k= 4 : The Train prediction accuracy is:  76.51006711409396 %
------ The Test prediction accuracy is:  73.84615384615385 %
k= 5 : The Train prediction accuracy is:  72.48322147651007 %
------ The Test prediction accuracy is:  73.84615384615385 %
k= 6 : The Train prediction accuracy is:  71.14093959731544 %
------ The Test prediction accuracy is:  73.84615384615385 %
k= 7 : The Train prediction accuracy is:  66.44295302013423 %
------ The Test prediction accuracy is:  73.84615384615385 %
```

In [17]:
```
knn = KNeighborsClassifier(n_neighbors=5)
knn.fit(X_train, y_train)
```

Out[17]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
                     metric_params=None, n_jobs=None, n_neighbors=5, p=2,
                     weights='uniform')
```

In [18]:
```
# Kiểm tra độ chính xác
print("The Train prediction accuracy is: ",
      knn.score(X_train,y_train)*100,"%")
print("The Test prediction accuracy is: ",
      knn.score(X_test,y_test)*100,"%")
```

```
The Train prediction accuracy is:  72.48322147651007 %
The Test prediction accuracy is:  73.84615384615385 %
```

In [19]:
```
y_pred = knn.predict(X_test)
# y_pred
```

In [20]:
```
df = pd.DataFrame({'Actual': pd.DataFrame(y_test)[0].values,
                   'Prediction': pd.DataFrame(y_pred)[0].values})
df.head()
```

Out[20]:

	Actual	Prediction
0	2	5
1	7	7
2	2	2
3	2	2
4	1	1

In [21]:
```
# Đánh giá model
from sklearn.metrics import confusion_matrix, classification_report
```

In [22]:
```
confusion_matrix(y_test, y_pred)
```

Out[22]:
```
array([[22,  3,  0,  0,  0,  0],
       [ 3, 15,  0,  2,  1,  0],
       [ 6,  1,  0,  0,  0,  0],
       [ 0,  0,  0,  2,  0,  0],
       [ 0,  0,  0,  0,  1,  0],
       [ 1,  0,  0,  0,  0,  8]], dtype=int64)
```

In [23]:
```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           1       0.69      0.88      0.77        25
           2       0.79      0.71      0.75        21
           3       0.00      0.00      0.00         7
           5       0.50      1.00      0.67         2
           6       0.50      1.00      0.67         1
           7       1.00      0.89      0.94         9

    accuracy                           0.74        65
   macro avg       0.58      0.75      0.63        65
weighted avg       0.68      0.74      0.70        65


c:\program files\python36\lib\site-packages\sklearn\metrics\classification.py:1
437: UndefinedMetricWarning: Precision and F-score are ill-defined and being se
t to 0.0 in labels with no predicted samples.
  'precision', 'predicted', average, warn_for)
```

- Quan sát kết quả và đánh giá: Mô hình có độ chính xác chưa cao, còn có class dự đoán không chính xác do số lượng trong các class còn ít và chưa cân bằng => ??? co cach nao khac tot hon khong???

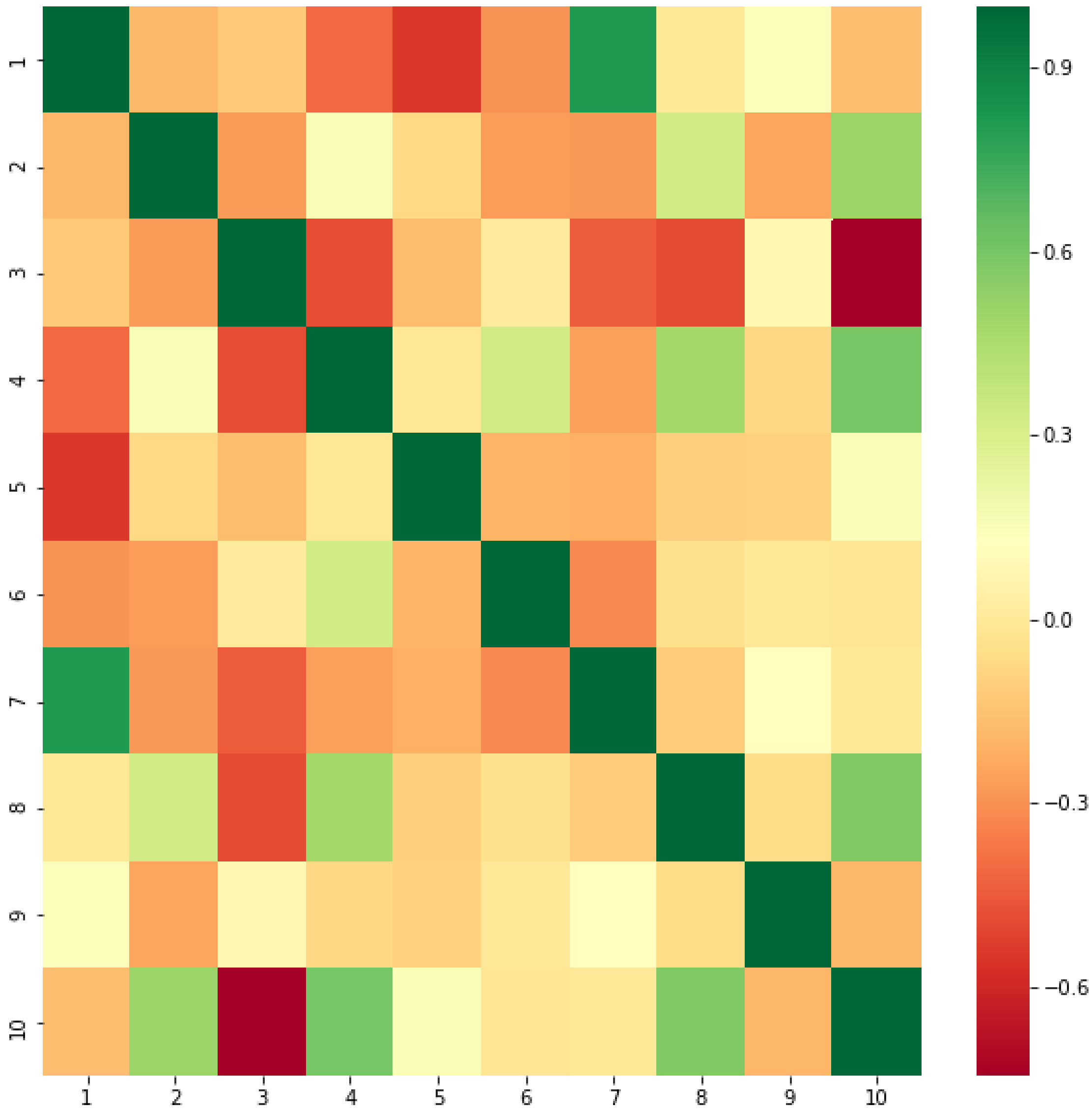
In [24]:
```
# Feature Selection
#get correlations of each features in dataset
data_sub = data.iloc[:,1:]
corrmat = data_sub.corr()
top_corr_features = corrmat.index
```

In [25]:
```
data_sub.corr()
```

Out[25]:

	1	2	3	4	5	6	7	8	9
1	1.000000	-0.191885	-0.122274	-0.407326	-0.542052	-0.289833	0.810403	-0.000386	0.14301(
2	-0.191885	1.000000	-0.273732	0.156794	-0.069809	-0.266087	-0.275442	0.326603	-0.24134(
3	-0.122274	-0.273732	1.000000	-0.481799	-0.165927	0.005396	-0.443750	-0.492262	0.08306(
4	-0.407326	0.156794	-0.481799	1.000000	-0.005524	0.325958	-0.259592	0.479404	-0.07440
5	-0.542052	-0.069809	-0.165927	-0.005524	1.000000	-0.193331	-0.208732	-0.102151	-0.09420
6	-0.289833	-0.266087	0.005396	0.325958	-0.193331	1.000000	-0.317836	-0.042618	-0.00771
7	0.810403	-0.275442	-0.443750	-0.259592	-0.208732	-0.317836	1.000000	-0.112841	0.12496
8	-0.000386	0.326603	-0.492262	0.479404	-0.102151	-0.042618	-0.112841	1.000000	-0.05869
9	0.143010	-0.241346	0.083060	-0.074402	-0.094201	-0.007719	0.124968	-0.058692	1.00000(
10	-0.164237	0.502898	-0.744993	0.598829	0.151565	-0.010054	0.000952	0.575161	-0.18827

In [26]:
```
import seaborn as sns
plt.figure(figsize=(10,10))
#plot heat map
g=sns.heatmap(data[top_corr_features].corr(),cmap="RdYlGn") # annot=True: nếu muc
```



In [27]:
```
# 2, 3, 4, 8 have high corr
```

In [28]:
```
from sklearn.feature_selection import SelectKBest
from sklearn.feature_selection import chi2
```

In [29]:
```
#apply SelectKBest class to extract all best features
bestfeatures = SelectKBest(score_func=chi2, k='all')
fit = bestfeatures.fit(inputs,outputs)
dfscores = pd.DataFrame(fit.scores_)
dfcolumns = pd.DataFrame(inputs.columns)
```

In [30]:
```
#concat two dataframes for better visualization
featureScores = pd.concat([dfcolumns,dfscores],axis=1)
featureScores.columns = ['Specs','Score']  #naming the dataframe columns
print(featureScores.nlargest(9,'Score'))  #print 9 best features
```

```
   Specs       Score
7      8  145.514077
2      3  100.984212
5      6   31.670632
3      4   16.977488
1      2    4.311253
6      7    3.210929
8      9    2.170185
4      5    0.110449
0      1    0.000048
```

In [31]:
```
# 8, 3, 6, 4, 2 have high corr
```

In [32]:
```
# => select features => KNN
# ??? Tot hon ban dau hay khong
```

In [33]:
```
# kiem chung lai voi cac thuat toan da hoc
# xem xet viec scale du lieu?
# xem xet viec resample du lieu: chon cach nao de nang du lieu len?
```