shaikat_303527_exercise_7-

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```
In [1]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        from sklearn.model_selection import train_test_split
        from collections import Counter
        import math as Math
```

0.0.1 Preprocessing Wine Quality Red dataset

```
In [2]: filename=r"E:\Documents\University of Hildesheim\Machine learning lab\lab5\winequality-
        rwine_data = pd.read_csv(filename,delimiter=';')
        rwine_data.head(3)

Out[2]:    fixed acidity  volatile acidity  citric acid  residual sugar  chlorides  \
        0            7.4              0.70         0.00             1.9      0.076
        1            7.8              0.88         0.00             2.6      0.098
        2            7.8              0.76         0.04             2.3      0.092

           free sulfur dioxide  total sulfur dioxide  density    pH  sulphates  \
        0                 11.0                  34.0   0.9978  3.51       0.56
        1                 25.0                  67.0   0.9968  3.20       0.68
        2                 15.0                  54.0   0.9970  3.26       0.65

           alcohol  quality
        0      9.4        5
        1      9.8        5
        2      9.8        5
```

```
In [3]: rwine_data.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
fixed acidity           1599 non-null float64
volatile acidity        1599 non-null float64
citric acid             1599 non-null float64
residual sugar          1599 non-null float64
chlorides               1599 non-null float64
```

```
free sulfur dioxide     1599 non-null float64
total sulfur dioxide    1599 non-null float64
density                 1599 non-null float64
pH                      1599 non-null float64
sulphates               1599 non-null float64
alcohol                 1599 non-null float64
quality                 1599 non-null int64
dtypes: float64(11), int64(1)
memory usage: 150.0 KB
```

0.0.2 Split data into a train and a test split (70% and 30% respectively)

```
In [4]: Xdata_rwine = rwine_data.loc[:,rwine_data.columns!='quality']
        Ydata_rwine = rwine_data[['quality']]
        Xdata_rwine = (Xdata_rwine - Xdata_rwine.mean())/Xdata_rwine.std() #data normalized
        x_train_rwine, x_test_rwine, y_train_rwine, y_test_rwine =train_test_split(Xdata_rwine
                                                                       Ydata_rwine,tra
                                                                       test_size=0.3,
                                                                       random_state=0,
```

```
In [5]: y_train_rwine=pd.DataFrame(y_train_rwine.values.reshape(-1,1))
        y_test_rwine=pd.DataFrame(y_test_rwine.values.reshape(-1,1))
        x_train_rwine=pd.DataFrame(x_train_rwine.values)
        x_test_rwine=pd.DataFrame(x_test_rwine.values)
```

1 Implement K-Nearest Neighbor (KNN)

1.0.1 Calculating Euclidian distance

```
In [6]: def EuclideanDistance(a,b):
            return np.sqrt(np.sum((a-b)**2))
```

1.0.2 predicting the value of y

```
In [17]: def y_prediction(x,y,k):
             y_pred=[]
             for k,v in x:
                 y_pred.append(y[k,0])
             return Counter(y_pred).most_common(1)[0][0]
```

1.0.3 knn prediction

```
In [19]: def predict_knn_reg(x,y,k,z):
             d=dict()
             for i in range(0,len(x)):
                 d[i]=EuclideanDistance(z,x.iloc[i])
             d_new=sorted(d.items(),key=lambda kv:kv[1])
```

```
    c=d_new[:k]
    y_pred=y_prediction(c,y,k)
    return y_pred
```

2 Implementing Kfold cross validation to find the optimal value of k using error minimization

2.0.1 The function data_k_divide is used to divide the dataset according to the number of k fold

2.0.2 The function k_data_train_test is used to get random test and train data in every kfold

```
In [10]: def data_k_divide(data,k):
             k_size=Math.floor(len(data)/k)
             k_data=[]
             c=0
             for i in range (0,k):
                 data_set=pd.DataFrame(data.head(0))
                 for j in range(i*k_size,(i*k_size)+k_size):
                     data_set=data_set.append(data.iloc[j])
                     c=c+1
                 k_data.append(data_set)

             #adding datas which are remaining at the end of k division
             for j in range(c,len(data)):
                 k_data[k-1]=k_data[k-1].append(data.iloc[j])
             return k_data

         def k_data_train_test(x,y,k):
             k_folded_data=[]
             for i in range(0,k):
                 x_test=x[i]
                 y_test=y[i]
                 x_train=pd.DataFrame()
                 y_train=pd.DataFrame()
                 for j in range(0,k):
                     if i!=j:
                         x_train=x_train.append(x[j])
                         y_train=y_train.append(y[j])
                 final_data=dict([('x',x_train),('y',y_train),('xt',x_test),('yt',y_test)])
                 k_folded_data.append(final_data)
             return k_folded_data

         def kfold(x_train,y_train,k):
             x_train_k=data_k_divide(x_train,k)
             y_train_k=data_k_divide(y_train,k)
             data=k_data_train_test(x_train_k,y_train_k,k)
             accuracy=[]
```

```
for i in range(len(data)):
    y_pred=[]
    for j in range(0,len(data[i]['xt'])):
        y_pred.append(predict_knn_reg(data[i]['x'],data[i]['y'].values,k,data[i][
    accuracy.append(classification_accuracy(data[i]['yt'],y_pred))
return accuracy
```

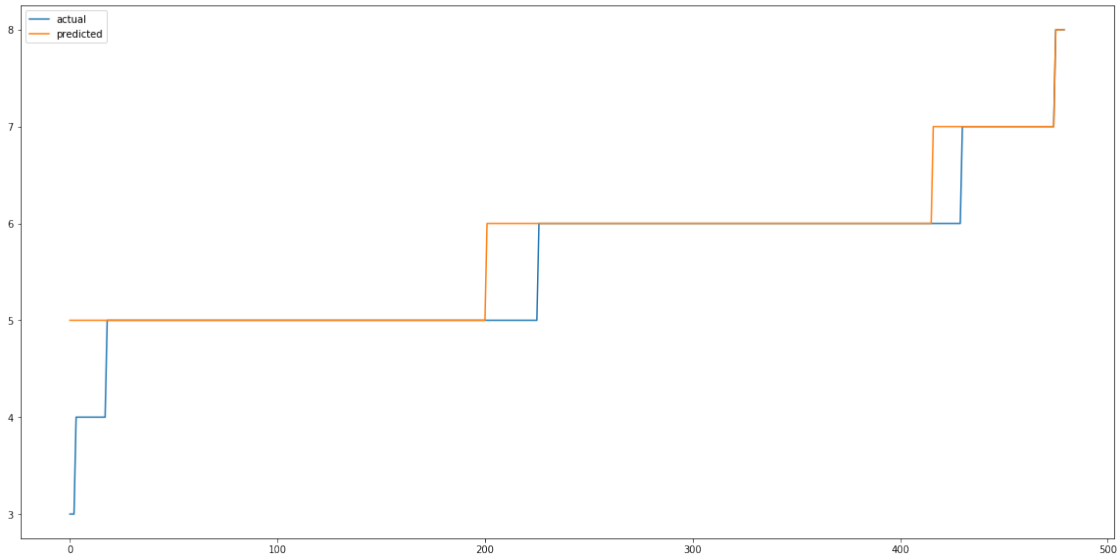
2.0.3 finding out the classification accuracy

```
In [33]: def classification_accuracy(y,y_pred):
             y=pd.DataFrame(y).to_numpy()
             y_pred=np.asarray(y_pred)
             acc=np.mean(y == y_pred)
             return acc
```

```
In [20]: ypred_v=[]
         k=5
         for j in range(0,len(x_test_rwine)):
             ypred_v.append(predict_knn_reg(x_train_rwine,y_train_rwine.values,k,x_test_rwine.i
```

2.0.4 The graph represents the comparison between predicted y and actual y when the value of k is 5

```
In [21]: fig,axs=plt.subplots(1,1,figsize=(20,10))
         axs.plot(sorted(y_test_rwine.values),label='actual')
         axs.plot(sorted(ypred_v),label='predicted')
         axs.legend()
         plt.show()
```



```
In [26]: print('Accuracy rate=',classification_accuracy(y_test_rwine.values,ypred_v))
```

```
Accuracy rate= 0.3834548611111111
```

2.0.5 Calculating the accuracy with different values of k,k > 14 becomes more computionally complex so the limit is 15

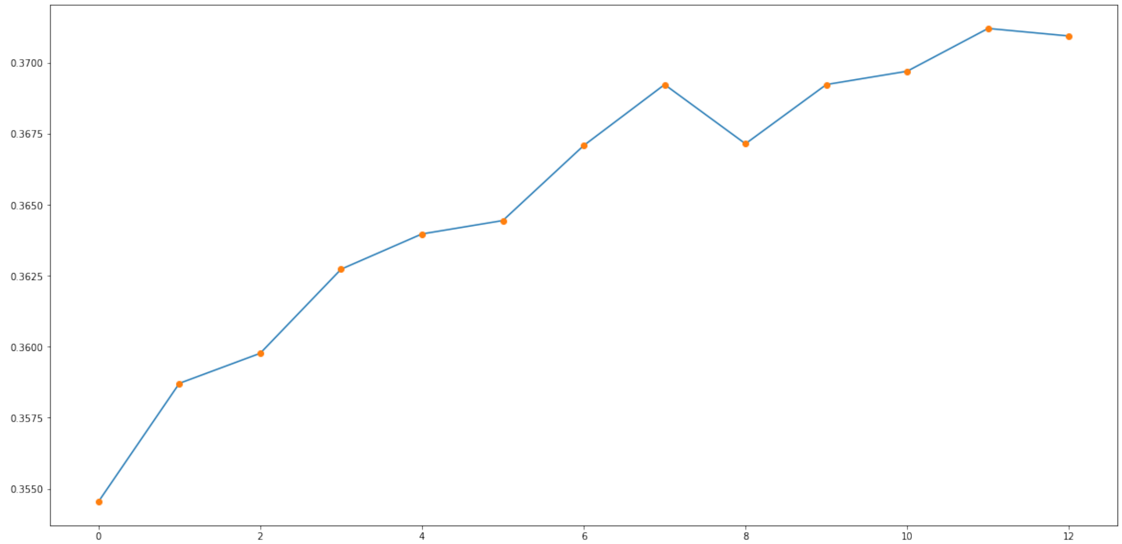
2.0.6 Then we got the best average accuracy of 0.3712 and the best k is 13

```
In [34]: best_accuracy=0
         best_k=0
         accuracyall=[]
         for i in range (2,15): #using k values between 2 to 15
             kr=kfold(x_train_rwine,y_train_rwine,i)
             if(len(accuracyall)==0 or np.average(kr)>best_accuracy):
                 best_k=i
                 best_accuracy=np.average(kr)
             accuracyall.append(np.average(kr))
             print('for value of k=',i,' ','best k=',best_k,'best_accuracy=',best_accuracy)
         print('best average accuracy=',best_accuracy)
         print('best k=',best_k)
```

```
for value of k= 2   best k= 2 best_accuracy= 0.35454560611774993
for value of k= 3   best k= 3 best_accuracy= 0.35871265755761433
for value of k= 4   best k= 4 best_accuracy= 0.3597709960663218
for value of k= 5   best k= 5 best_accuracy= 0.3627328540413858
for value of k= 6   best k= 6 best_accuracy= 0.36397428060493064
for value of k= 7   best k= 7 best_accuracy= 0.36444537472014094
for value of k= 8   best k= 8 best_accuracy= 0.3670880078952534
for value of k= 9   best k= 9 best_accuracy= 0.36923532718033175
for value of k= 10   best k= 9 best_accuracy= 0.36923532718033175
for value of k= 11   best k= 11 best_accuracy= 0.3692360360062136
for value of k= 12   best k= 12 best_accuracy= 0.3697051490327639
for value of k= 13   best k= 13 best_accuracy= 0.37121208186263116
for value of k= 14   best k= 13 best_accuracy= 0.37121208186263116
best average accuracy= 0.37121208186263116
best k= 13
```

2.0.7 After analyzing the graph we can see that with the increase of K accuracy increases because small value of k means that noise will have a higher influence on the result.

```
In [36]: fig,axs=plt.subplots(1,1,figsize=(20,10))
         axs.plot(np.arange(len(accuracyall)),accuracyall)
         axs.plot(np.arange(len(accuracyall)),accuracyall,'o')
         plt.show()
```




```
In [ ]:
```