Compute performance metrics for the given Y and Y_score without sklearn

In [87]:
```
import numpy as np
import pandas as pd
# other than these two you should not import any other packages
```

A. Compute performance metrics for the given data '5_a.csv'

Note 1: in this data you can see number of positive points >> number of negatives points

Note 2: use pandas or numpy to read the data from **5_a.csv**

Note 3: you need to derive the class labels from given score

$y^{pred} = [0 \text{ if y\_score} < 0.5 \text{ else } 1]$

1. Compute Confusion Matrix
2. Compute F1 Score
3. Compute AUC Score, you need to compute different thresholds and for each threshold compute tpr,fpr and then use numpy.trapz(tpr_array, fpr_array) https://stackoverflow.com/q/53603376/4084039 (https://stackoverflow.com/q/53603376/4084039), https://stackoverflow.com/a/39678975/4084039 (https://stackoverflow.com/a/39678975/4084039) Note: it should be numpy.trapz(tpr_array, fpr_array) not numpy.trapz(fpr_array, tpr_array)
   Note- Make sure that you arrange your probability scores in descending order while calculating AUC
4. Compute Accuracy Score

In [88]:
```
import os
os.chdir("C:\\Users\\amakh\\Downloads")
```

In [89]:
```
#Loading Dataset
df_a=pd.read_csv('5_a.csv')
df_a.head()
```

Out[89]:

	y	proba
0	1.0	0.637387
1	1.0	0.635165
2	1.0	0.766586
3	1.0	0.724564
4	1.0	0.889199

In [90]:
```
df_a.shape
```

Out[90]:
```
(10100, 2)
```

In [91]:
```
#Checking the composition of data

df_a.y.value_counts()
```

Out[91]:
```
1.0    10000
0.0      100
Name: y, dtype: int64
```

In [92]:
```
#labeling y based on proba values
def y_predicted(proba):
    if proba < 0.5:
        return 0
    else:
        return 1
#using lambda function to add y_predicted column to dataframe
#https://thispointer.com/python-pandas-how-to-add-new-columns-in-a-dataframe-usin

df_a["y_predicted"] = df_a.apply(lambda row :y_predicted(row.proba),axis=1)
```

In [93]:
```
df_a.head()
```

Out[93]:

	y	proba	y_predicted
0	1.0	0.637387	1
1	1.0	0.635165	1
2	1.0	0.766586	1
3	1.0	0.724564	1
4	1.0	0.889199	1

Confusion Matrix

In [94]:
```
#Getting TN,FN,FP,TP values

TN = 0
FN = 0
FP = 0
TP = 0

TN = ((df_a['y']==0.0) & (df_a['y_predicted']==0.0)).sum()
FN = ((df_a['y']==1.0) & (df_a['y_predicted']==0.0)).sum()
FP = ((df_a['y']==0.0) & (df_a['y_predicted']==1.0)).sum()
TP = ((df_a['y']==1.0) & (df_a['y_predicted']==1.0)).sum()
```

In [95]:
```
print('TN:',TN)
print('FN:',FN)
print('FP:',FP)
print('TP:',TP)
```

```
TN: 0
FN: 0
FP: 100
TP: 10000
```

In [96]:
```
#The confusion matrix
print("Confusion Matrix:")
np.array([[TN , FP],[FN,TP]])
```

```
Confusion Matrix:
```

Out[96]:
```
array([[    0,   100],
       [    0, 10000]], dtype=int64)
```

F1 Score

In [97]:
```
#calculating precision

Precesion = TP / (TP + FP)
print("Precesion :",Precesion)

#calculating recall

Recall = TP / (TP + FN)
print("Recall:",Recall)

#calculating F1 score
#Harmonic mean of Precision and Recall

F1 = (2 * Precesion * Recall) / (Precesion + Recall)
print("F1 Score:",F1)
```

```
Precesion : 0.9900990099009901
Recall: 1.0
F1 Score: 0.9950248756218906
```

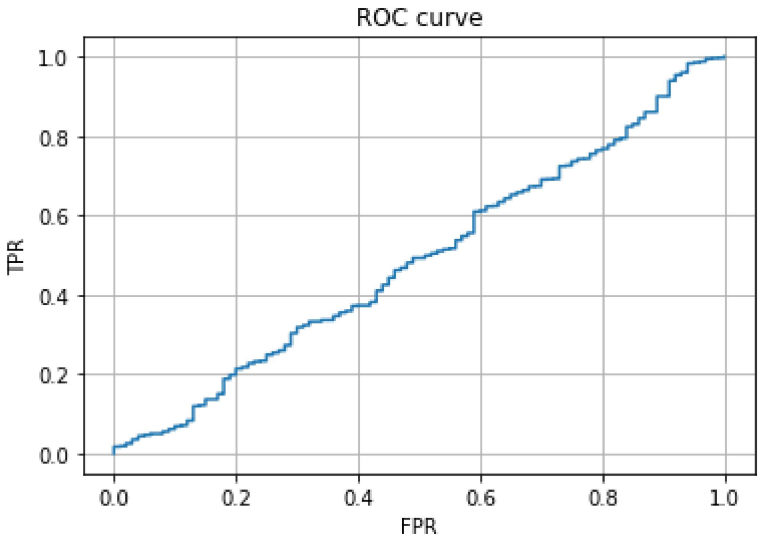
AUC Score

In [98]:
```
#Sorting in ascending order

df_a = pd.read_csv('5_a.csv')
df_a.sort_values("proba", ascending=False, inplace=True)

proba = np.array(df_a['proba'])
y = np.array(df_a['y'])

FPR = []
TPR = []
thresholds = proba

#finding positive and negative points

P_points = df_a.loc[df_a.y == 1]
N_points = df_a.loc[df_a.y == 0]

P = P_points["y"].count()
N = N_points["y"].count()

for t in thresholds:
    FP=0
    TP=0
    for i in range(len(y)):
        if (proba[i] >= t):
            if y[i] == 1:
                TP +=1
            if y[i] == 0:
                FP +=1
    FPR.append(FP/N)
    TPR.append(TP/P)

#https://stackoverflow.com/a/39678975/4084039
#calculating the area under curve using trapezoidal method

FPR_array = np.array(FPR)
TPR_array = np.array(TPR)

AUC_score = np.trapz(TPR_array, FPR_array)
print('AUC Score :',AUC_score)
```

```
AUC Score : 0.48829900000000004
```

In [99]:
```
import matplotlib.pyplot as plt

plt.plot(FPR,TPR)
plt.grid()
plt.title("ROC curve")
plt.xlabel('FPR')
plt.ylabel('TPR')
```

Out[99]:
```
Text(0,0.5,'TPR')
```



Accuracy Score

In [100]:
```
Accuracy = (TP+TN)/(TP+TN+FP+FN)

print('Accuracy :',Accuracy)
```

```
Accuracy : 0.9900990099009901
```

B. Compute performance metrics for the given data '5_b.csv'

Note 1: in this data you can see number of positive points << number of negatives points

Note 2: use pandas or numpy to read the data from **5_b.csv**

Note 3: you need to derive the class labels from given score

$$y^{pred} = [0 \text{ if y\_score} < 0.5 \text{ else } 1]$$

1. Compute Confusion Matrix
2. Compute F1 Score
3. Compute AUC Score, you need to compute different thresholds and for each threshold compute tpr,fpr and then use numpy.trapz(tpr_array, fpr_array) https://stackoverflow.com/q/53603376/4084039 (https://stackoverflow.com/q/53603376/4084039), https://stackoverflow.com/a/39678975/4084039 (https://stackoverflow.com/a/39678975/4084039)
   Note- Make sure that you arrange your probability scores in descending order while calculating AUC
4. Compute Accuracy Score

In [101]:
```
df_b=pd.read_csv('5_b.csv')
df_b.head()
```

Out[101]:

	y	proba
0	0.0	0.281035
1	0.0	0.465152
2	0.0	0.352793
3	0.0	0.157818
4	0.0	0.276648

In [102]:
```
df_b.shape
```

Out[102]: (10100, 2)

In [103]:
```
#Checking the composition of data

df_b.y.value_counts()
```

Out[103]:
```
0.0    10000
1.0      100
Name: y, dtype: int64
```

In [104]:
```
#labeling y based on proba values
def y_predicted(proba):
    if proba < 0.5:
        return 0
    else:
        return 1
#using lambda function to add y_predicted column to dataframe
#https://thispointer.com/python-pandas-how-to-add-new-columns-in-a-dataframe-usin

df_b["y_predicted"] = df_b.apply(lambda row :y_predicted(row.proba),axis=1)
```

In [105]:
```
df_b.head()
```

Out[105]:

	y	proba	y_predicted
0	0.0	0.281035	0
1	0.0	0.465152	0
2	0.0	0.352793	0
3	0.0	0.157818	0
4	0.0	0.276648	0

Confusion Matrix

In [106]:
```
#Getting TN,FN,FP,TP values

TN = 0
FN = 0
FP = 0
TP = 0

TN = ((df_b['y']==0.0) & (df_b['y_predicted']==0.0)).sum()
FN = ((df_b['y']==1.0) & (df_b['y_predicted']==0.0)).sum()
FP = ((df_b['y']==0.0) & (df_b['y_predicted']==1.0)).sum()
TP = ((df_b['y']==1.0) & (df_b['y_predicted']==1.0)).sum()
```

In [107]:
```
print('TN:',TN)
print('FN:',FN)
print('FP:',FP)
print('TP:',TP)
```

```
TN: 9761
FN: 45
FP: 239
TP: 55
```

In [108]:
```
#The confusion matrix
print("Confusion Matrix:")
np.array([[TN , FP],[FN,TP]])
```

```
Confusion Matrix:
```

Out[108]:
```
array([[9761,  239],
       [  45,   55]], dtype=int64)
```

F1 Score

In [109]:
```
#calculating precision

Precesion = TP / (TP + FP)
print("Precesion :",Precesion)

#calculating recall

Recall = TP / (TP + FN)
print("Recall:",Recall)

#calculating F1 score
#Harmonic mean of Precision and Recall

F1 = (2 * Precesion * Recall) / (Precesion + Recall)
print("F1 Score:",F1)
```

```
Precesion : 0.1870748299319728
Recall: 0.55
F1 Score: 0.2791878172588833
```

Accuracy Score

In [110]:
```
Accuracy = (TP+TN)/(TP+TN+FP+FN)

print('Accuracy :',Accuracy)
```

```
Accuracy : 0.9718811881188119
```

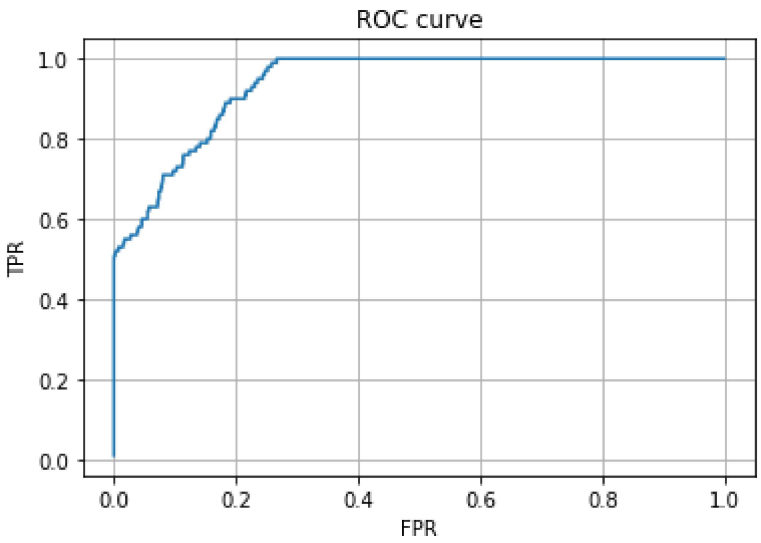
AUC Score

In [111]:
```
#Sorting in ascending order

df_b = pd.read_csv('5_b.csv')
df_b.sort_values("proba", ascending=False, inplace=True)

proba = np.array(df_b['proba'])
y = np.array(df_b['y'])

FPR = []
TPR = []
thresholds = proba

#finding positive and negative points

P_points = df_b.loc[df_b.y == 1]
N_points = df_b.loc[df_b.y == 0]

P = P_points["y"].count()
N = N_points["y"].count()

for t in thresholds:
    FP=0
    TP=0
    for i in range(len(y)):
        if (proba[i] >= t):
            if y[i] == 1:
                TP +=1
            if y[i] == 0:
                FP +=1
    FPR.append(FP/N)
    TPR.append(TP/P)

#https://stackoverflow.com/a/39678975/4084039
#calculating the area under curve using trapezoidal method

FPR_array = np.array(FPR)
TPR_array = np.array(TPR)

AUC_score = np.trapz(TPR_array, FPR_array)
print('AUC Score :',AUC_score)
```

```
AUC Score : 0.9377570000000001
```

In [112]:
```
import matplotlib.pyplot as plt

plt.plot(FPR,TPR)
plt.grid()
plt.title("ROC curve")
plt.xlabel('FPR')
plt.ylabel('TPR')
```

Out[112]:
```
Text(0,0.5,'TPR')
```



C. Compute the best threshold (similarly to ROC curve computation) of probability which gives lowest values of metric A for the given data

you will be predicting label of a data points like this: $y^{pred} = [0 \text{ if y\_score} < \text{threshold else } 1]$

$A = 500 \times \text{number of false negative} + 100 \times \text{numebr of false positive}$

Note 1: in this data you can see number of negative points > number of positive points

Note 2: use pandas or numpy to read the data from **5_c.csv**

In [113]:
```
df_c=pd.read_csv('5_c.csv')
df_c.head()
```

Out[113]:

	y	prob
0	0	0.458521
1	0	0.505037
2	0	0.418652
3	0	0.412057
4	0	0.375579

In [114]:
```
#Taking tresholds as unique proba values
#Sorting them in ascending oirder

tresholds = sorted(np.unique(df_c.prob),reverse = True)
```

In [115]:
```
#Labeling y_predicted bases on treshold values

A = []
FN = 0
FP = 0

for i in tresholds :
    y_predicted = []
    for j in df_c["prob"]:
        if j <= i:
            y_predicted.append(0)
        else:
            y_predicted.append(1)

    df_c['y_predicted'] = y_predicted

    #Getting FN,FP values
    FN = ((df_c['y']==1.0) & (df_c['y_predicted']==0.0)).sum()
    FP = ((df_c['y']==0.0) & (df_c['y_predicted']==1.0)).sum()

    # Getting value for metric A for each treshold value
    A.append((500 * FN) + (100 *FP))
```

In [116]:
```
#Finding the min value of A
min(A)
```

Out[116]:
```
141000
```

In [117]:
```
#Finding the treshold value corresponding to the min A

print("Treshold value",tresholds[A.index(min(A))])
```

```
Treshold value 0.22987164436159915
```

D. Compute performance metrics(for regression) for the given data 5_d.csv

Note 2: use pandas or numpy to read the data from **5_d.csv**

Note 1: **5_d.csv** will having two columns Y and predicted_Y both are real valued features

1. Compute Mean Square Error
2. Compute MAPE: https://www.youtube.com/watch?v=ly6ztgIkUxk
3. Compute R^2 error: https://en.wikipedia.org/wiki/Coefficient_of_determination#Definitions

In [118]:
```
df_d=pd.read_csv('5_d.csv')
df_d.head()
```

Out[118]:

	y	pred
0	101.0	100.0
1	120.0	100.0
2	131.0	113.0
3	164.0	125.0
4	154.0	152.0

In [119]:
```
y_pred = np.array(df_d['pred'])
y_actual = np.array(df_d['y'])
```

Mean Square Error

In [120]:
```
MSE = np.square(np.subtract(y_actual,y_pred )).mean()
print("MSE:",MSE)
```

```
MSE: 177.16569974554707
```

Mean absolute percentage error

In [121]:
```
MAPE = (np.mean(abs(y_actual-y_pred))/np.mean(y_actual))*100
print("MAPE:",MAPE)
```

```
MAPE: 12.91202994009687
```

R^2 error

In [122]:
```
#https://en.wikipedia.org/wiki/Coefficient_of_determination#Definitions

ss_residual = np.square(np.subtract(y_actual,y_pred )).sum()
ss_total = np.square(np.subtract(y_actual,np.mean(y_actual))).sum()

R2_error = 1 - (ss_residual/ss_total)

print("R^2 error:",R2_error)
```

```
R^2 error: 0.9563582786990937
```