Compute performance metrics for the given Y and Y_score without sklearn

In [1]:
```python
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)

4. Compute Accuracy Score

In [26]:
```python
df=pd.read_csv('5_a.csv')
df.head()
```

Out[26]:
```
     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 [27]:
```python
y_hat=np.zeros(len(df))
for i in range(len(df)):
    if df.loc[i,'proba']>=0.5:
        y_hat[i]=1
    elif df.loc[i,'proba']<0.5:
        y_hat[i]=0
```

In [28]:

```
df['y_hat']=y_hat
df.head()
```

Out[28]:

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

In [29]:

```
TP=0
TN=0
FP=0
FN=0
conf_mat=np.zeros((2,2))
for i in range(len(df)):
    if df.loc[i,'y']==1.0 and df.loc[i,'y_hat']==1.0:
        TP=TP+1
    elif df.loc[i,'y']==1.0 and df.loc[i,'y_hat']==0.0:
        FN=FN+1
    elif df.loc[i,'y']==0.0 and df.loc[i,'y_hat']==1.0:
        FP=FP+1
    elif df.loc[i,'y']==0.0 and df.loc[i,'y_hat']==0.0:
        TN=TN+1
conf_mat[0][0]=TN
conf_mat[0][1]=FN
conf_mat[1][0]=FP
conf_mat[1][1]=TP


print('Confusion Matrix:\n',conf_mat)
```

```
Confusion Matrix:
 [[    0.     0.]
 [  100. 10000.]]
```

In [30]:

```
accuracy=(TP+TN)/(TP+TN+FN+FP)
print('Accuracy:{}'.format(accuracy))
```

```
Accuracy:0.9900990099009901
```

In [31]:

```
precision=TP/(TP+FP)
recall = TP/(TP+FN)
f1_score=(2*precision*recall)/(precision+recall)
print('F1 Score:',f1_score)
```

```
F1 Score: 0.9950248756218906
```

In [37]:

```
sorted_df=df.sort_values('proba',ascending=False)
sorted_df=sorted_df.reset_index(drop=True)
```

In [38]:

```
probability_score=sorted_df['proba'].to_numpy()
y_hat=np.zeros(len(sorted_df))
y=sorted_df['y'].to_numpy()
```

In [39]:

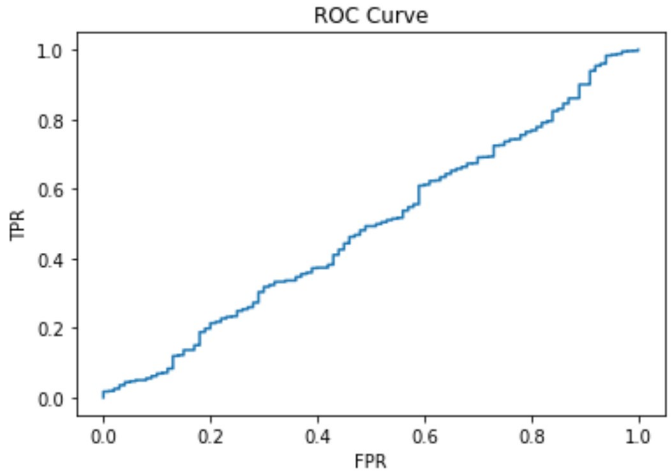
```
tpr=np.zeros(len(sorted_df))
fpr=np.zeros(len(sorted_df))


from tqdm import tqdm
for i in tqdm(range(len(sorted_df))):
    TP=0
    TN=0
    FP=0
    FN=0
    threshold= probability_score[i]
    for j in range(len(sorted_df)):
        if probability_score[j]<threshold:
            y_hat[j]=0
            if y[j]==1.0:
                FN=FN+1
            elif y[j]==0.0:
                TN=TN+1
        elif probability_score[j]>=threshold:
            y_hat[j]=1
            if y[j]==1.0:
                TP=TP+1
            elif y[j]==0.0:
                FP=FP+1
    tpr[i]=TP/(TP+FN)
    fpr[i]=FP/(FP+TN)
```

```
100%|████████████████████████████████████████████████████████████████████████████
█| 10100/10100 [01:31<00:00, 110.36it/s]
```

In [40]:

```
import matplotlib.pyplot as plt
plt.plot(fpr,tpr)
plt.title('ROC Curve')
plt.xlabel('FPR')
plt.ylabel('TPR')
plt.show()
```



In [41]:

```
AUC_score=np.trapz(tpr,fpr)
print('AUC_score:',AUC_score)
```

```
AUC_score: 0.48829900000000004
```

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)

4. Compute Accuracy Score

In [14]:

```python
df=pd.read_csv('5_b.csv')
df.head()
```

Out[14]:

	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 [15]:

```python
y_hat=np.zeros(len(df))
for i in range(len(df)):
    if df.loc[i,'proba']>=0.5:
        y_hat[i]=1
    elif df.loc[i,'proba']<0.5:
        y_hat[i]=0
```

In [16]:

```
df['y_hat']=y_hat
df.head()
```

Out[16]:

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

In [17]:

```
TP=0
TN=0
FP=0
FN=0
conf_mat=np.zeros((2,2))
for i in range(len(df)):
    if df.loc[i,'y']==1.0 and df.loc[i,'y_hat']==1.0:
        TP=TP+1
    elif df.loc[i,'y']==1.0 and df.loc[i,'y_hat']==0.0:
        FN=FN+1
    elif df.loc[i,'y']==0.0 and df.loc[i,'y_hat']==1.0:
        FP=FP+1
    elif df.loc[i,'y']==0.0 and df.loc[i,'y_hat']==0.0:
        TN=TN+1
conf_mat[0][0]=TN
conf_mat[0][1]=FN
conf_mat[1][0]=FP
conf_mat[1][1]=TP


print('Confusion Matrix:\n',conf_mat)
```

```
Confusion Matrix:
 [[9761.   45.]
 [ 239.   55.]]
```

In [18]:

```
accuracy=(TP+TN)/(TP+TN+FN+FP)
print('Accuracy:{}'.format(accuracy))
```

```
Accuracy:0.9718811881188119
```

In [19]:

```
precision=TP/(TP+FP)
recall = TP/(TP+FN)
f1_score=(2*precision*recall)/(precision+recall)
print('F1 Score:',f1_score)
```

```
F1 Score: 0.2791878172588833
```

In [20]:

```
sorted_df=df.sort_values('proba',ascending=False)
sorted_df=sorted_df.reset_index(drop=True)
```

In [21]:
```
sorted_df
```

Out[21]:

	y	proba	y_hat
0	1.0	0.595294	1.0
1	1.0	0.594808	1.0
2	1.0	0.592198	1.0
3	1.0	0.590171	1.0
4	1.0	0.588718	1.0
...	...	...	...
10095	0.0	0.100230	0.0
10096	0.0	0.100189	0.0
10097	0.0	0.100165	0.0
10098	0.0	0.100161	0.0
10099	0.0	0.100001	0.0

10100 rows × 3 columns

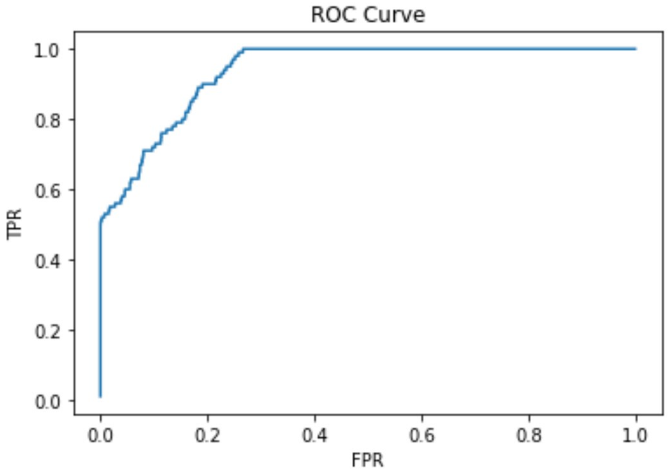
In [22]:
```
probability_score=sorted_df['proba'].to_numpy()
y_hat=np.zeros(len(sorted_df))
y=sorted_df['y'].to_numpy()
```

In [23]:
```
tpr=np.zeros(len(sorted_df))
fpr=np.zeros(len(sorted_df))


for i in tqdm(range(len(sorted_df))):
    TP=0
    TN=0
    FP=0
    FN=0
    threshold= probability_score[i]
    for j in range(len(sorted_df)):
        if probability_score[j]<threshold:
            y_hat[j]=0
            if y[j]==1.0:
                FN=FN+1
            elif y[j]==0.0:
                TN=TN+1
        elif probability_score[j]>=threshold:
            y_hat[j]=1
            if y[j]==1.0:
                TP=TP+1
            elif y[j]==0.0:
                FP=FP+1
    tpr[i]=TP/(TP+FN)
    fpr[i]=FP/(FP+TN)
```

```
100%|███████████████████████████████████████████████████████████
█| 10100/10100 [01:51<00:00, 90.65it/s]
```

In [24]:
```
import matplotlib.pyplot as plt
plt.plot(fpr,tpr)
plt.title('ROC Curve')
plt.xlabel('FPR')
plt.ylabel('TPR')
plt.show()
```



In [25]:
```
AUC_score=np.trapz(tpr,fpr)
print('AUC_score:',AUC_score)
```

```
AUC_score: 0.9377570000000001
```

C. Compute the best threshold (similarly to ROC curve computation) of probability which gives lowest values of metric **A** for the given data **5_c.csv**

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 [49]:
```
df=pd.read_csv('5_c.csv')
df.head()
```

Out[49]:

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

In [76]:

```
sorted_df=df.sort_values('prob',ascending=False)
sorted_df=sorted_df.reset_index(drop=True)
```

Out[76]:

	y	prob
0	1	0.957747
1	1	0.951437
2	1	0.948638
3	1	0.944094
4	1	0.941113
...	...	...
1983	1	0.231369
1984	0	0.231356
1985	1	0.230739
1986	1	0.230332
1987	0	0.230152

1988 rows × 2 columns

In [47]:

```
probability_score=sorted_df['prob'].to_numpy()
y_hat=np.zeros(len(sorted_df))
y=sorted_df['y'].to_numpy()
```

In [56]:

```
A=np.zeros(len(sorted_df))
for i in tqdm(range(len(sorted_df))):
    FP=0
    FN=0
    threshold= probability_score[i]
    for j in range(len(sorted_df)):
        if probability_score[j]<threshold:
            y_hat[j]=0
            if y[j]==1.0:
                FN=FN+1
        elif probability_score[j]>=threshold:
            y_hat[j]=1
            if y[j]==0.0:
                FP=FP+1
    A[i]=(500*FN)+(100*FP)
```

```
100%|████████████████████████████████████████████████████████████████████████████
██| 2852/2852 [00:19<00:00, 150.05it/s]
```

In [74]:

```
best_threshold_index=np.where(A==min(A))
print('Best Threshold value:',probability_score[best_threshold_index[0][0]])
```

```
Best Threshold value: 0.2300390278970873
```

In [ ]:

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 [82]:

```
df=pd.read_csv('5_d.csv')
df
```

Out[82]:

	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
...	...	...
157195	87.0	83.0
157196	97.0	86.0
157197	106.0	93.0
157198	105.0	101.0
157199	81.0	104.0

157200 rows × 2 columns

In [79]:

```
MSE=0
for idx,row in df.iterrows():
    MSE=MSE+((row['y']-row['pred'])**2)
MSE=MSE/len(df)
print('Mean Squared Error:',MSE)
```

```
Mean Squared Error: 177.16569974554707
```

In [84]:

```
MAPE=0
Error=0
Sum_act_values=0
for idx,row in df.iterrows():
    Error=Error+(abs(row['pred']-row['y']))
    Sum_act_values=Sum_act_values+row['y']
MAPE=(Error/Sum_act_values)*100
print('Mean Actual Percentage Error:',MAPE)
```

```
Mean Actual Percentage Error: 12.91202994009687
```

In [87]:

```
R_squared_error=0
SS_residual=0
SS_total=0
mean_y=(Sum_act_values/len(df))
for idx,row in df.iterrows():
    SS_residual=SS_residual+((row['y']-row['pred'])**2)
    SS_total=SS_total+((row['y']-mean_y)**2)
R_squared_error=1-(SS_residual/SS_total)
print('R Squared Error:',R_squared_error)
```

```
R Squared Error: 0.9563582786990964
```