Compute performance metrics for the given Y and Y_score without sklearn

In [41]:
```python
import numpy as np
import pandas as pd
import seaborn as sns
# 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/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 [42]:
```python
# write your code here
#Reading the csv file
data=pd.read_csv("5_a.csv")
data
```

Out[42]:

	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
...	...	...
10095	1.0	0.665371
10096	1.0	0.607961
10097	1.0	0.777724
10098	1.0	0.846036
10099	1.0	0.679507

10100 rows × 2 columns

In [43]:
```python
# Count of positive and negative points
positive_points=0
negative_points=0

for i in range(0,len(data)):
    if data['y'].loc[i] == 1:
        positive_points+=1
    if data['y'].loc[i] == 0:
        negative_points+=1

print('positive points:',positive_points)
print('negative points:',negative_points)
```

```
positive points: 10000
negative points: 100
```

In [44]:
```python
#Creating y_pred from the given class label
data['Ypred']=data['proba'].map(lambda x:0 if x<0.5 else 1)
data
```

Out[44]:

	y	proba	Ypred
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
...	...	...	...
10095	1.0	0.665371	1
10096	1.0	0.607961	1
10097	1.0	0.777724	1
10098	1.0	0.846036	1
10099	1.0	0.679507	1

10100 rows × 3 columns

In [48]:
```python
# Creating the confusion matrix
confusion_matrix=[]
#Calculating True positive,False positive,True negative,False negative
T_P=((data.y==1)&(data.Ypred==1))
TP=sum(T_P)
F_N=((data.y==1)&(data.Ypred==0))
FN=sum(F_N)
F_P=((data.y==0)&(data.Ypred==1))
FP=sum(F_P)
T_N=((data.y==0)&(data.Ypred==0))
TN=sum(T_N)


confusion_matrix.append(TP)
confusion_matrix.append(FN)
confusion_matrix.append(FP)
confusion_matrix.append(TN)

print('Confusion Matrix:',np.asarray(confusion_matrix))
```

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

In [47]:
```python
#Calculating precision,recall,F1score
precision=TP/(TP+FP)
recall=TP/(FN+TP)
F1_score=(2*precision*recall)/(precision+recall)
print("F1 Score:",F1_score)
```

```
F1 Score: 0.9950248756218906
```

In [49]:
```python
#calculating the accuracy
accuracy=(TP+TN)/(TP+FP+TN+FN)
print('Accuracy:',accuracy)
```

```
Accuracy: 0.9900990099009901
```

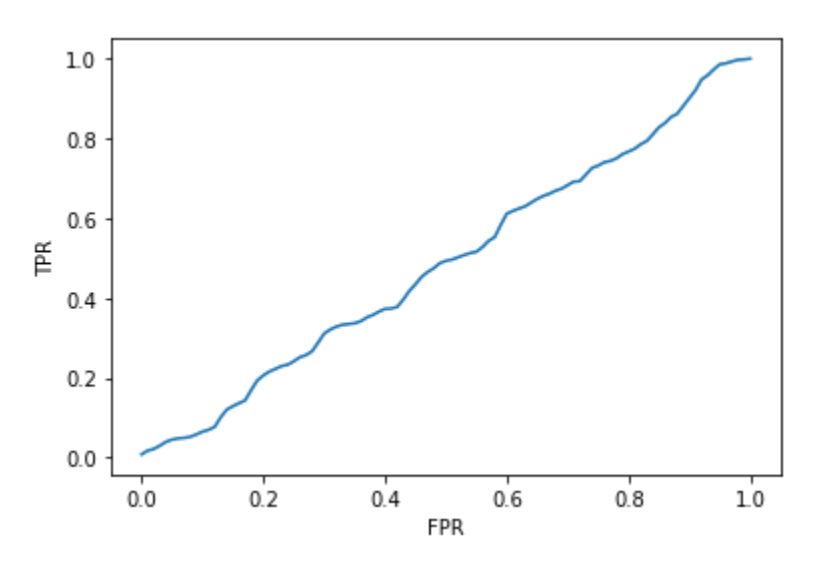
In [51]:
```python
# Computing AUC score
data=data.sort_values(by=['proba'],ascending=False)
proba_score=data.values[:,1]
y=data.values[:,0]
plotting_data=[]
for threshold in proba_score:
    threshold_y_pred=np.where(proba_score>=threshold,1,0)
    TP=((y==1)&(threshold_y_pred==1)).sum()
    FN=((y==1)&(threshold_y_pred==0)).sum()
    FP=((y==0)&(threshold_y_pred==1)).sum()
    TN=((y==0)&(threshold_y_pred==0)).sum()
    TPR=TP/(TP+FN)
    FPR=FP/(FP+TN)
    plotting_data.append([TPR,FPR])

tpr_array=np.array([i for i,_ in plotting_data])
fpr_array=np.array([i for _,i in plotting_data])
AUC=np.trapz(tpr_array,fpr_array)
print('AUC score:',AUC)
```

```
AUC score: 0.48829900000000004
```

In [13]:
```python
#Plot of TPR vs FPR to represent the AUC score
df=pd.DataFrame(data=plotting_data,columns=['TPR','FPR'])
sns.lineplot(data = df,x='FPR',y='TPR')
```

Out[13]: <AxesSubplot:xlabel='FPR', ylabel='TPR'>



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/a/39678975/4084039
4. Compute Accuracy Score

In [52]:
```python
# write your code
#Reading the csv file
data1=pd.read_csv("5_b.csv")
data1
```

Out[52]:

	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
...	...	...
10095	0.0	0.474401
10096	0.0	0.128403
10097	0.0	0.499331
10098	0.0	0.157616
10099	0.0	0.296618

10100 rows × 2 columns

In [53]:
```python
# Count of positive and negative points
positive_points=0
negative_points=0

for i in range(0,len(data1)):
    if data1['y'].loc[i]==1:
        positive_points+=1
    if data1['y'].loc[i]==0:
        negative_points+=1
print('Positive data points:',positive_points)
print('Negative data points:',negative_points)
```

```
Positive data points: 100
Negative data points: 10000
```

In [54]:
```python
#Creating y_pred from the given class label
data1['y_pred']=data1['proba'].map(lambda x:0 if x<0.5 else 1)
data1
```

Out[54]:

	y	proba	y_pred
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
...	...	...	...
10095	0.0	0.474401	0
10096	0.0	0.128403	0
10097	0.0	0.499331	0
10098	0.0	0.157616	0
10099	0.0	0.296618	0

10100 rows × 3 columns

In [55]:
```python
# Creating the confusion matrix
confusion_matrix=[]
#Calculating True positive,False positive,True negative,False negative
T_P=((data1['y']==1)&(data1['y_pred']==1))
TP=sum(T_P)
F_N=((data1['y']==1)&(data1['y_pred']==0))
FN=sum(F_N)
F_P=((data1['y']==0)&(data1['y_pred']==1))
FP=sum(F_P)
T_N=((data1['y']==0)&(data1['y_pred']==0))
TN=sum(T_N)

confusion_matrix.append(TP)
confusion_matrix.append(FN)
confusion_matrix.append(FP)
confusion_matrix.append(TN)

print('Confusion Matrix:',np.asarray(confusion_matrix))
```

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

In [56]:
```python
#Calculating precision,recall,F1score
precision=TP/(TP+FP)
recall=TP/(FN+TP)
F1_score=(2*precision*recall)/(precision+recall)
print("F1 Score:",F1_score)
```

```
F1 Score: 0.2791878172588833
```

In [57]:
```python
#calculating the accuracy
accuracy=(TP+TN)/(TP+FP+TN+FN)
print('Accuracy:',accuracy)
```

```
Accuracy: 0.9718811881188119
```

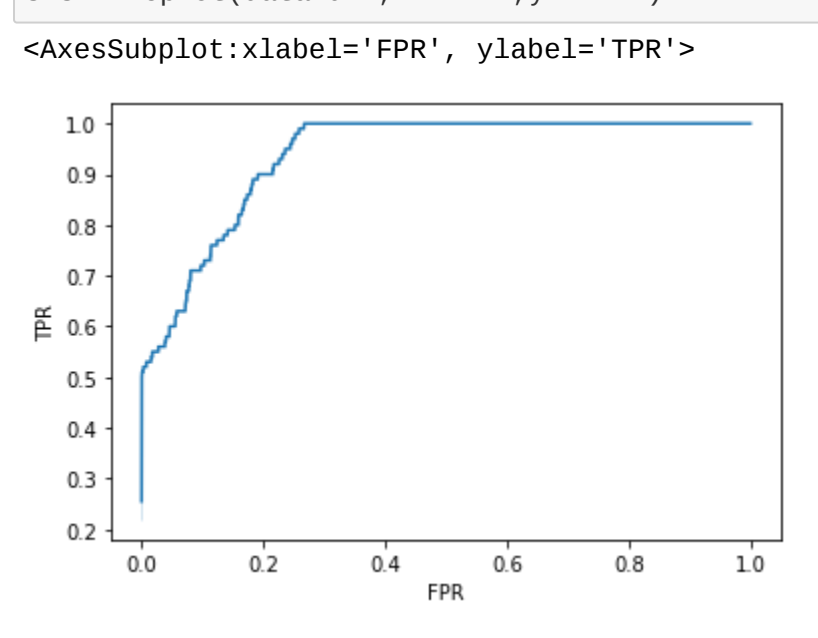
In [58]:
```python
# Computing AUC score
data1=data1.sort_values(by=['proba'],ascending=False)
proba_score=data1.values[:,1]
y=data1.values[:,0]
plotting_data=[]
for threshold in proba_score:
    threshold_y_pred=np.where(proba_score>=threshold,1,0)
    TP=((y==1)&(threshold_y_pred==1)).sum()
    FP=((y==0)&(threshold_y_pred==1)).sum()
    FN=((y==1)&(threshold_y_pred==0)).sum()
    TN=((y==0)&(threshold_y_pred==0)).sum()
    TPR=(TP)/(TP+FN)
    FPR=(FP)/(FP+TN)
    plotting_data.append([TPR,FPR])

tpr_array=np.array([i for i,_ in plotting_data])
fpr_array=np.array([i for _,i in plotting_data])
AUC=np.trapz(tpr_array,fpr_array)
print('AUC score:',AUC)
```

```
AUC score: 0.9377570000000001
```

In [59]:
```python
# Plot of TPR vs FPR to represent the AUC score
df1=pd.DataFrame(data=plotting_data,columns=['TPR','FPR'])
sns.lineplot(data=df1,x='FPR',y='TPR')
```

Out[59]: <AxesSubplot:xlabel='FPR', ylabel='TPR'>



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 [15]:
```python
 # write your code
data2=pd.read_csv('5_c.csv')
data2
```

Out[15]:

	y	prob
0	0	0.458521
1	0	0.505037
2	0	0.418652
3	0	0.412057
4	0	0.375579
...	...	...
2847	1	0.491663
2848	1	0.292109
2849	1	0.659161
2850	1	0.456265
2851	1	0.659161

2852 rows × 2 columns

In [17]:
```python
#Creating y_pred from the given class label
data2['ypred']=data2['prob'].map(lambda x:0 if x<0.5 else 1)
data2
```

Out[17]:

	y	prob	ypred
0	0	0.458521	0
1	0	0.505037	1
2	0	0.418652	0
3	0	0.412057	0
4	0	0.375579	0
...	...	...	...
2847	1	0.491663	0
2848	1	0.292109	0
2849	1	0.659161	1
2850	1	0.456265	0
2851	1	0.659161	1

2852 rows × 3 columns

In [74]:
```python
#Sorting the data in descending order
data2=data2.sort_values(by='prob',ascending=False)
y=data2.values[:,0]
prob_score=data2.values[:,1]
A_metric=[]
for threshold in prob_score:
    threshold_y_pred=np.where(prob_score>threshold,1,0)
    FN=((y==1)&(threshold_y_pred==0)).sum()
    FP=((y==0)&(threshold_y_pred==1)).sum()
    A=(500*FN)+(100*FP)
    A_metric.append(A)

print('Minimum value which gives the best threshold is:',min(A_metric))
```

```
Minimum value which gives the best threshold is: 141000
```

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 [23]:
```python
data3=pd.read_csv("5_d.csv")
data3
```

Out[23]:

	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 [75]:
```python
#Calculating the Mean Squared Error
y=data3.values[:,0]
y_pred=data3.values[:,1]
n=len(data3)

MSE=np.sum((y-y_pred)**2)/n
print("Mean Squared Error :",MSE)
```

```
Mean Squared Error : 177.16569974554707
```

In [76]:
```python
#Calculating Mean Absolute Percentage Error
MAPE=np.sum(np.absolute(y-y_pred))/np.sum(y)
print("Mean Absolute Percentage Error :",MAPE)
```

```
Mean Absolute Percentage Error : 0.1291202994009687
```

In [77]:
```python
#Calculating coefficient of determination
y_mean=np.sum(y)/n

sum_of_squares_residuals=np.sum((y-y_pred)**2)

total_sum_of_squares=np.sum((y-y1)**2)

coeff_of_determination=1-(sum_of_squares_residuals/total_sum_of_squares)
print("coefficient of determination :",coeff_of_determination)
```

```
coefficient of determination : 0.9563582786990937
```