Compute performance metrics for the given Y and Y_score without sklearn

In [1]:
```
import numpy as np
import pandas as pd
from tqdm import tqdm
# 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 [2]:
```
# write your code here
```

In [3]:
```
df = pd.read_csv("5_a.csv") #reading the csv file using the pandas

df.head() # printing the first 10 rows of the csv file using pandas
```

Out[3]:

	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 [4]:
```
 thresh=0.5
    #here i am using the condtion that   ypred=[0 if y_score < 0.5 else 1]

df['y_predict']=(df.proba>=0.5).astype('int') #creating the label
df.head()
```

Out[4]:

	y	proba	y_predict
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

In [5]:
```
#here i am counting the total no of positive class and negative class

P=0
N=0
for i in range(len(df.y_predict)):
    if df.iloc[i][0]==1:
        P=P+1
print(P)
for i in range(len(df.y_predict)):
    if df.iloc[i][0]==0:
        N=N+1
print(N)
```

```
10000
100
```

confusion matrix

In [6]:
```
def compute_TP_TN_FN_FP(y,y_predict):     #definig the function to compute confusion matrix
    TP=sum((y==1) & (y_predict==1))
    TN=sum((y==0) & (y_predict==0))
    FN=sum((y==1) & (y_predict==0))
    FP=sum((y==0) & (y_predict==1))
    return TP, TN, FN, FP
```

In [7]:
```
TP,TN,FP,FN=compute_TP_TN_FN_FP(df.y,df.y_predict)
```

In [8]:
```
#printing the TP TN FP FN values
print('The valve of TP:',TP)
print('the valve of TN:',TN)
print('the valev of FP:',FP)
print('the valve of FN:',FN)
```

```
The valve of TP: 10000
the valve of TN: 0
the valev of FP: 0
the valve of FN: 100
```

In [9]:
```
#printing the confusion matrix
print("Confusion matrix:",'\n',[TP,FP],'\n',[FN,TN])
```

```
Confusion matrix:
 [10000, 0]
 [100, 0]
```

F1 Score

In [10]:
```
#calculating the precision
precision = TP/(FP+TP)
print(precision)
```

```
1.0
```

In [11]:
```
#calculatig the recall
recall= TP/(TP+FN)
print(recall)
```

```
0.9900990099009901
```

In [12]:
```
#calculating the F1 Score
F1=((2*precision*recall)/(precision+recall))
print(F1)
```

```
0.9950248756218906
```

Accuracy score

In [13]:
```
#Calculating the Accuracy score
Accuracy=((TP+TN)/(TP+FN+TN+FP))
print(Accuracy)
```

```
0.9900990099009901
```

In [14]:
```
Y_unique=df['proba'].unique()
Y_sorted=sorted(Y_unique,reverse=True)
len(Y_sorted)
print(Y_sorted[10])
```

```
0.8992941132435506
```

AUC Score & Threshold

In [15]:
```
B=df.sort_values(by='proba',ascending=False)
B.drop(['y','y_predict'],axis=1)
B.reset_index(inplace=True,drop=True)
A=np.zeros((2,2))
```

In [16]:
```python
def tpr(val,df):    #defing the function
    new = pd.DataFrame(columns=['y^'])
    TP=0
    FN=0
    FP=0
    TN=0
    new['y^']=np.where(df['proba']>=val,1,0)
    for k,l in zip(df['y'],new['y^']):
        if(k==1 and l==1):
            TP+=1
        else:
            if(k==1 and l==0):
                FN+=1
            else:
                if(k==0 and l==1):
                    FP+=1
                else:
                    if(k==0 and l==0):
                        TN+=1
    true_positive_rate=TP/(TP+FN)
    false_positive_rate=FP/(FP+TN)
    return true_positive_rate,false_positive_rate

TPR=[]
FPR=[]
for val in tqdm(B['proba']): #Calculating the TPR AND FPR Values
    A,B=tpr(val,df)
    TPR.append(A)
    FPR.append(B)

TPR=np.array(TPR)    #making the values into the array
FPR=np.array(FPR)
```

```
100%|██████████████████████████████████████████████████| 10100/10100 [01:54<00:00,
88.04it/s]
```

In [17]:
```
#printing the TPR AND FPR values as an array
print(TPR)
print(FPR)
```

```
[1.000e-04 2.000e-04 3.000e-04 ... 9.998e-01 9.999e-01 1.000e+00]
[0. 0. 0. ... 1. 1. 1.]
```

In [18]:
```
#printing the AUC score
print('AUC Score is: ',np.trapz(TPR, FPR))
```

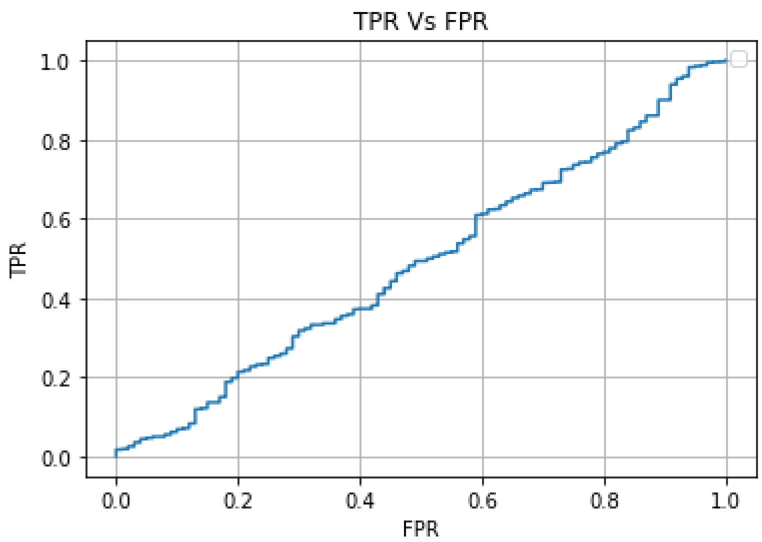
```
AUC Score is:  0.48829900000000004
```

In [19]:
```
import matplotlib.pyplot as plt
```

In [20]:
```
#ploting the graph between the TPR VS FPR
plt.plot(FPR,TPR)
plt.grid()
plt.xlabel('FPR')
plt.ylabel('TPR')
plt.title('TPR Vs FPR')
plt.legend()
```

```
No handles with labels found to put in legend.
```

Out[20]: <matplotlib.legend.Legend at 0x1f58cec73c8>



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 [21]:
```
# write your code
```

In [22]:
```
df=pd.read_csv('5_b.csv')
df.head()
```

Out[22]:

	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 [23]:
```
 thresh=0.5
    #here i am using the condtion that   ypred=[0 if y_score < 0.5 else 1]

df['y_predict']=(df.proba>=0.5).astype('int')
df.head()
```

Out[23]:

	y	proba	y_predict
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

In [24]:
```
##here i am counting the total no of positive class and negative class..

P=0
N=0
for i in range(len(df.y_predict)):
    if df.iloc[i][0]==1:
        P=P+1
print(P)
for i in range(len(df.y_predict)):
    if df.iloc[i][0]==0:
        N=N+1
print(N)
#
```

```
100
10000
```

Confusion matrix

In [25]:
```
def compute_TP_TN_FN_FP(y,y_predict):     #definig the function to compute confusion matrix
    TP=sum((y==1) & (y_predict==1))
    TN=sum((y==0) & (y_predict==0))
    FN=sum((y==1) & (y_predict==0))
    FP=sum((y==0) & (y_predict==1))
    return TP, TN, FN, FP
```

In [26]:
```
TP,TN,FP,FN=compute_TP_TN_FN_FP(df.y,df.y_predict)
```

In [27]:
```
#printing the TP TN FP FN values
print('The valve of TP:',TP)
print('the valve of TN:',TN)
print('the valev of FP:',FP)
print('the valve of FN:',FN)
```

```
The valve of TP: 55
the valve of TN: 9761
the valev of FP: 45
the valve of FN: 239
```

In [28]:
```
#printing the confusion matrix
print("Confusion matrix:",'\n',[TP,FP],'\n',[FN,TN])
```

```
Confusion matrix:
 [55, 45]
 [239, 9761]
```

F1 score

In [29]:
```
#calculating the precision
precision = TP/(FP+TP)
print(precision)
```

```
0.55
```

In [30]:
```
#calculatig the recall
recall= TP/(TP+FN)
print(recall)
```

```
0.1870748299319728
```

In [31]:
```
#calculating the F1 Score
F1=((2*precision*recall)/(precision+recall))
print(F1)
```

```
0.2791878172588833
```

Accuracy score

In [32]:
```
#Calculating the Accuracy score
Accuracy=((TP+TN)/(TP+FN+TN+FP))
print(Accuracy)
```

```
0.9718811881188119
```

AUC Score & Threshold

In [33]:
```
B=df.sort_values(by='proba',ascending=False)
B.drop(['y','y_predict'],axis=1)
B.reset_index(inplace=True,drop=True)
A=np.zeros((2,2))
```

In [34]:
```
def tpr(val,df):                #defing the function
    new = pd.DataFrame(columns=['y^'])
    TP=0
    FN=0
    FP=0
    TN=0
    new['y^']=np.where(df['proba']>=val,1,0)
    for k,l in zip(df['y'],new['y^']):
        if(k==1 and l==1):
            TP+=1
        else:
            if(k==1 and l==0):
                FN+=1
            else:
                if(k==0 and l==1):
                    FP+=1
                else:
                    if(k==0 and l==0):
                        TN+=1
    true_positive_rate=TP/(TP+FN)
    false_positive_rate=FP/(FP+TN)
    return true_positive_rate,false_positive_rate

TPR=[]
FPR=[]
for val in tqdm(B['proba']):    #calacuating the RTPR AND FPR values
    A,B=tpr(val,df)
    TPR.append(A)
    FPR.append(B)

TPR=np.array(TPR)
FPR=np.array(FPR)
```

```
100%|██████████████████████████████████████████████| 10100/10100 [02:01<00:00,
83.10it/s]
```

In [35]:
```
#printing the tpr and fpr values

print(TPR)
print(FPR)
```

```
[0.01 0.02 0.03 ... 1.   1.   1.  ]
[0.     0.     0.     ... 0.9998 0.9999 1.    ]
```

In [36]:
```
#printing the AUC Scores
print('AUC Score is: ',np.trapz(TPR, FPR))
```

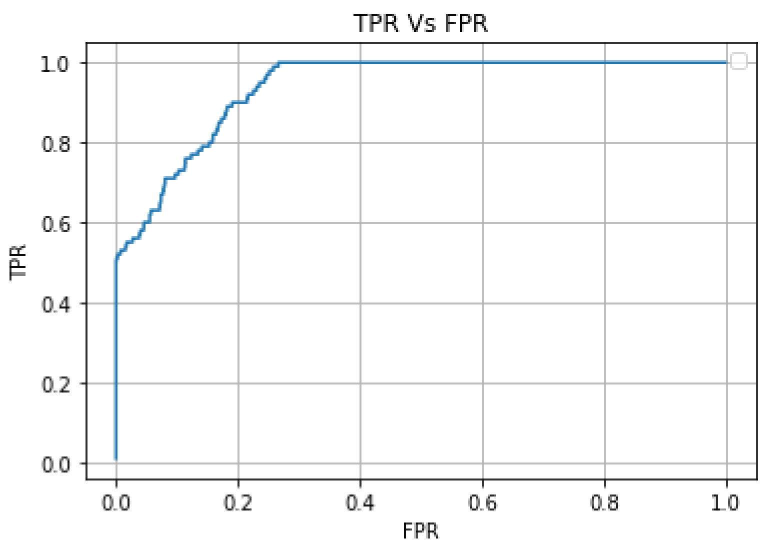
```
AUC Score is:  0.9377570000000001
```

In [37]:
```
import matplotlib.pyplot as plt
```

In [38]:
```
#plotng the graph between the TPR AND FPR
plt.plot(FPR,TPR)
plt.grid()
plt.xlabel('FPR')
plt.ylabel('TPR')
plt.title('TPR Vs FPR')
plt.legend()
```

```
No handles with labels found to put in legend.
```

Out[38]:
```
<matplotlib.legend.Legend at 0x1f58cfe14e0>
```



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 [39]:
```
# write your code
```

In [40]:
```
from tqdm import tqdm_notebook
df_c=pd.read_csv('5_c.csv')
df_c.head()
```

Out[40]:

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

In [41]:
```
df_c.shape
```

Out[41]:
```
(2852, 2)
```

In [42]:
```
S = df_c['y'].value_counts()
                               #Actual Labels
print("Occurence of P, ",S[1])
print("Occurence of N, ",S[0])
```

```
Occurence of P,  1047
Occurence of N,  1805
```

In [43]:
```
B = df_c['prob'].value_counts()
                                  # Predicted Labels
print("Occurence of Prob, ",B)
```

```
Occurence of Prob,  0.839377    4
0.672003    3
0.596618    3
0.704297    2
0.123316    2
0.437359    2
0.908067    2
0.111976    2
0.894187    2
0.745530    2
0.438637    2
0.258501    2
0.472074    2
0.788193    2
0.871710    2
0.836304    2
0.671970    2
0.235492    2
0.290497    2
0.110897    2
0.656920    2
0.847020    2
0.516616    2
0.568532    2
0.324517    2
0.204013    2
0.124856    2
0.416823    2
0.388835    2
0.353034    2
           ..
0.239369    1
0.326009    1
0.633678    1
0.837677    1
0.039081    1
0.350693    1
0.845589    1
0.584372    1
0.181155    1
0.560788    1
0.816020    1
0.213467    1
```

```
0.418596    1
0.418738    1
0.154771    1
0.380040    1
0.421326    1
0.941113    1
0.196891    1
0.406844    1
0.561684    1
0.202624    1
0.771744    1
0.476652    1
0.318557    1
0.315248    1
0.355742    1
0.214257    1
0.190617    1
0.332771    1
Name: prob, Length: 2791, dtype: int64
```

In [44]:
```
def partition(c,x):
    if x < c:
        return 0
    return 1
pre = df_c['prob']
f = lambda lst: partition(0.5,lst)
p = pre.map(f)
df_c['proba'] = p
df_c.head(10)
```

Out[44]:

	y	prob	proba
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
5	0	0.595387	1
6	0	0.370288	0
7	0	0.299273	0
8	0	0.297000	0
9	0	0.266479	0

In [45]:
```
def para(df_c):
    tp=0
    tn=0
    fp=0
    fn=0
    for i in range(df_c.shape[0]):
        if df_c['y'][i]==df_c['prob'][i]:
            if df_c['y'][i]==1:
                tp += 1
            else:
                tn += 1
        else:
            if df_c['y'][i]==1:
                fn += 1
            else:
                fp += 1
    return(tp,tn,fp,fn)
```

In [46]:
```
def metric(df_c,uni):
    s = df_c['y'].value_counts()
    a = []
    for el in tqdm_notebook(uni):
        dx = df_c.copy()
        pre = dx['prob']
        f = lambda lst: partition(el,lst)
        h = pre.map(f)
        dx['prob'] = h
        tp,tn,fp,fn=para(dx)
        a.append(500*fn+100*fp)

    return uni[a.index(min(a))],min(a)
```

In [47]:
```
df_c = df_c.sort_values(by='prob',ascending=False)
print(df_c.head(10))
uni = list(df_c.prob.unique())
uni.sort(reverse=True)
print("-----------------")
for i in range(5):
    print(uni[i],'\n')
print(len(uni))
df_c = pd.read_csv("5_c.csv")
```

```
      y      prob  proba
2634  1  0.957747      1
2548  1  0.951437      1
2447  1  0.948638      1
2788  1  0.944094      1
2456  1  0.941113      1
2469  1  0.921611      1
2599  1  0.918113      1
2515  1  0.916364      1
2294  1  0.913375      1
2702  1  0.913280      1
-----------------
0.9577467989277196

0.9514369163158778

0.9486377939984604

0.9440936134070964

0.9411131844327256

2791
```

In [48]:
```
low,b=metric(df_c,uni)
print("Threshold and the value of the min metric are as follows resp.")
print(low,'\n',b)
```

```
Threshold and the value of the min metric are as follows resp.
0.2300390278970873
 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 [49]:
```
df_d=pd.read_csv('5_d.csv')
```

In [50]:
```
df_d.head()
```

Out[50]:

	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 [51]:
```
df_d['Y_differ'] = df_d.apply(lambda row:(row.y)-(row.pred),axis=1)
```

In [52]:
```
df_d.head()
```

Out[52]:

	y	pred	Y_differ
0	101.0	100.0	1.0
1	120.0	100.0	20.0
2	131.0	113.0	18.0
3	164.0	125.0	39.0
4	154.0	152.0	2.0

Mean square error (mse)

In [53]:
```
mse=0
for i in range(len(df_d.Y_differ)):
    mse=mse+((df_d.Y_differ[i])**2)
MSE=(mse/len(df_d.Y_differ))
print(MSE)
```

```
177.16569974554707
```

R-Square

In [54]:
```
sum=0
for i in range(len(df_d.y)):  #calculating the  sum of "y"
    sum=sum+df_d.y[i]

avg=sum/(len(df_d.y))   #calculating the average of "y"
print(sum,'\n',avg)  #printing the sum and avg values respectively
```

```
10463560.0
 66.56208651399491
```

In [55]:
```
df_d['y_yavg'] = df_d.apply(lambda row:(row.y)-(avg),axis=1)#computing (y-y_Avg)
```

In [56]:
```
df_d.head()
```

Out[56]:

	y	pred	Y_differ	y_yavg
0	101.0	100.0	1.0	34.437913
1	120.0	100.0	20.0	53.437913
2	131.0	113.0	18.0	64.437913
3	164.0	125.0	39.0	97.437913
4	154.0	152.0	2.0	87.437913

In [57]:
```
sum=0
Y=0                #here i am considering the Y as y_yavg
for i in range(len(df_d.y)):                #computing the sun of y_yavg vsle
    Y+= ((df_d.y_yavg[i])**2)
print(Y,'\n')

R2=1-(mse/Y) #calculating the r square value
print(R2)
```

```
638161080.035662

0.9563582786990964
```

MAPE

In [58]:
```
Sum=0
for i in range(len(df_d.y)):  #calculating the  sum of "y"
    Sum=Sum+df_d.y[i]

SOE=0
for i in range(len(df_d.Y_differ)):
    SOE=SOE+abs(df_d.Y_differ[i])#sum of sq (y-y_pred)
MAPE=(SOE/(Sum))#MAPe
print(SOE)
print(MAPE)
```

```
1351058.0
0.1291202994009687
```

In [59]:
```
df_d.head()
```

Out[59]:

	y	pred	Y_differ	y_yavg
0	101.0	100.0	1.0	34.437913
1	120.0	100.0	20.0	53.437913
2	131.0	113.0	18.0	64.437913
3	164.0	125.0	39.0	97.437913
4	154.0	152.0	2.0	87.437913

In [60]:
```
##reference
#https://www.youtube.com/watch?v=9PbrWiLC-4k
#https://www.geeksforgeeks.org/python-mean-squared-error/
#https://stats.stackexchange.com/questions/58391/mean-absolute-percentage-error-mape-in-scikit-learn
#https://stackoverflow.com/questions/893657/how-do-i-calculate-r-squared-using-python-and-numpy
```

In [ ]: