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
import matplotlib.pyplot as plt
# 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

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

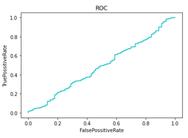
1. Compute Confusion Matrix
2. Compute F1 Score
3. Compute AUC Score, you need to compute different thresholds and for each threshold compute tpr,fpr and then use numpy.trapz(tpr_array, fpr_array) https://stackoverflow.com/q/53603376/4084039, https://stackoverflow.com/a/39678975/4084039 Note: it should be numpy.trapz(fpr_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 [2]:
```
df1=pd.read_csv('5_a.csv')
df1.shape
def confusion_matrix(df,threshold=0.5):
    '''Given Dataframe,this function computes values for confusion matric'''

    df['y^']=np.where(df['proba']<threshold,0,1)  #np.where(condition,iftrue:Value,else:Value)
    #Taken y^ as a binary class ,same as y to compare values
    #...(confusion matrix cant process probability scores)

    TP=df1['y'][(df['y']==1)&(df['y^']==1)].count()
    FP=df1['y'][(df['y']==0)&(df['y^']==1)].count()
    FN=df1['y'][(df['y']==1)&(df['y^']==0)].count()
    TN=df1['y'][(df['y']==0)&(df['y^']==0)].count()

    return TP,FP,FN,TN


def terms(TP,FP,FN,TN):
    '''Given Values for Confusion Matrix this function computes terms to be used in calculation for AUC,ROC'''

    FPR=FP/(FP+TN)
    CorrectlyClassified=TP+TN
    NumberOfPoints=TP+TN+FP+FN #len(df1)

    precision=TP/(TP+FP)
    recall=TP/(TP+FN)

    TPR=recall
    FPR=FP/(FP+TN)

    F1=(2*(precision*recall))/(precision+recall)
    Accuracy=CorrectlyClassified/NumberOfPoints

    return precision,recall,F1,Accuracy,TPR,FPR
```

In [3]:
```
df1=df1.sort_values(by='proba',ascending=False)
def AUC(df):
    '''This function calculates AUC score given DataFrame'''
    global TPR,FPR

    TPR,FPR=[],[]
    for threshold in tqdm(df['proba']):
        TP,FP,FN,TN=confusion_matrix(df,threshold)
        precision,recall,F1,Accuracy,TPRate,FPRate=terms(TP,FP,FN,TN)

        TPR.append(TPRate)
        FPR.append(FPRate)

        df.drop(columns='y^')
    AUC=np.trapz(TPR,FPR)

    return AUC
```

In [4]:
```
print(f"AUC={AUC(df1)}\n")

plt.plot(FPR,TPR,color='c')
plt.title('ROC')
plt.xlabel("FalsePossitiveRate")
plt.ylabel("TruePossitiveRate")
plt.show()
```

```
100%|██████████| 10100/10100 [00:22<00:00, 439.82it/s]
AUC=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/a/39678975/4084039
   Note- Make sure that you arrange your probability scores in descending order while calculating AUC
4. Compute Accuracy Score

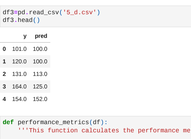
In [5]:
```
df2=pd.read_csv('5_b.csv')
df2.head()
```

Out[5]:

	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 [6]:
```
df2=df2.sort_values(by='proba',ascending=False)
print("AUC:",AUC(df2))

plt.plot(FPR,TPR,color='c')
plt.title('ROC')
plt.xlabel("FalsePossitiveRate")
plt.ylabel("TruePossitiveRate")
plt.show()
```

```
100%|██████████| 10100/10100 [00:42<00:00, 238.70it/s]
AUC: 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

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 [7]:
```
df3=pd.read_csv('5_c.csv')
df3.rename(columns={'prob':'proba'},inplace=True)
df3=df3.sort_values(by='proba',ascending=False)
df3.head()
```

Out[7]:

	y	proba
2634	1	0.957747
2548	1	0.951437
2447	1	0.948638
2788	1	0.944094
2456	1	0.941113

In [8]:
```
def confusion_matrix(df,threshold):
    '''Given Dataframe,this function computes values for confusion matric'''

    df['y^']=np.where(df['proba']<threshold,0,1) #np.where(condition,iftrue:Value,else:Value)
    #confusion matrix cant process probability scores
    TP=df['y'][(df['y']==1)&(df['y^']==1)].count()
    FP=df['y'][(df['y']==0)&(df['y^']==1)].count()
    FN=df['y'][(df['y']==1)&(df['y^']==0)].count()
    TN=df['y'][(df['y']==0)&(df['y^']==0)].count()
    return TP,FP,FN,TN


def terms(TP,FP,FN,TN):
    '''Given Values for Confusion Matrix this function computes terms to be used in calculation for AUC,ROC'''

    FPR=FP/(FP+TN)
    CorrectlyClassified=TP+TN
    NumberOfPoints=TP+TN+FP+FN #len(df)

    precision=TP/(TP+FP)
    recall=TP/(TP+FN)

    TPRate=recall
    FPRate=FP/(FP+TN)

    F1=(2*(precision*recall))/(precision+recall)
    Accuracy=CorrectlyClassified/NumberOfPoints

    return precision,recall,F1,Accuracy,TPRate,FPRate
```

In [9]:
```
def threshold(df):
    '''This function finds the best threshold with its value'''

    th={}
    for prob in tqdm(df['proba']):
        TP,FP,FN,TN=confusion_matrix(df,prob) #block1:calculating thresholds
        A=(500*FN)+(100*FP)
        th[prob]=A

    for k,v in th.items():
        if th[k]==min(th.values()): #block2:getting the best threshold with its value
            threshold,value=k,v
            break

    return threshold,value
```

In [10]:
```
threshold,value=threshold(df3)
print(f"The best threshold is {threshold} with value of {value}")
```

```
100%|██████████| 2852/2852 [00:05<00:00, 544.30it/s]
The best threshold is 0.2300390278970873 with value of 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 [11]:
```
df3=pd.read_csv('5_d.csv')
df3.head()
```

Out[11]:

	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 [12]:
```
def performance_metrics(df):
    '''This function calculates the performance metrics given dataframe (with actual and predicted values)'''

    actual=np.array(df['y'])
    predicted=np.array(df['pred'])

    error=np.subtract(actual,predicted)
    sq_error=np.square(error)
    sum_of_square_of_residual=sq_error.sum()
    total_sum_of_squares_of_errors=np.sum(np.square(np.subtract(actual,actual.mean())))
    R2_error=1-(sum_of_square_of_residual/total_sum_of_squares_of_errors)

    MSE=sq_error.mean()
    MAPE=np.mean(np.abs(error))/np.mean(actual)

    return MSE,MAPE,R2_error
```

In [13]:
```
MSE,MAPE,R2_error=performance_metrics(df3)
print(f"MSE:{MSE}\nMAPE:{MAPE}\nR2_error:{R2_error}")
```

```
MSE:177.16569974554707
MAPE:0.12912029940809687
R2_error:0.9563582786990937
```