Compute performance metrics for the given Y and Y_score without sklearn

In [248]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
# 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 [249]:
```
# let's import the data
data = pd.read_csv('5_a.csv')
```

In [250]:
```
# let's see the header of the data
data.head()
```

Out[250]:

	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

calculate confusion_matrix

In [251]:
```
def custom_confusion_matrix(data):
    y_actual = list(data.iloc[:,0])
    y_predicted = list(data.iloc[:,1])


    # lets binarize y_predicted with threshold 0.5.
    # means >=0.5 is 1 otherwise 0
    y_actual = list(map(int ,y_actual))
    y_predicted = [0 if i<0.5 else 1 for i in y_predicted]

    confusion_matrix = [
                        [0,0],
                        [0,0]
                    ]
    #let's calculate every part of confusion matrix
    # TrueNegative(TN), FalseNegative(FN), TruePositive(TP),FalsePositive(FP)
    tn,fn,tp,fp = 0,0,0,0
    for i in range(len(y_actual)):


        if y_actual[i]==0 and y_predicted[i] ==0:
            tn +=1
        elif y_actual[i]==0 and y_predicted[i] ==1:
            fp +=1
        elif y_actual[i]==1 and y_predicted[i] ==1:
            tp +=1
        elif y_actual[i]==1 and y_predicted[i]==0:
            fn +=1

    confusion_matrix[0][0] = tn
    confusion_matrix[0][1] = fp
    confusion_matrix[1][0] = fn
    confusion_matrix[1][1] = tp

    return np.array(confusion_matrix)
```

In [252]:
```
custom_confusion_matrix(data)
```

Out[252]:
```
array([[    0,   100],
       [    0, 10000]])
```

calculate f1-score

In [253]:
```
def f1_score(data):
    y_actual = list(data.iloc[:,0])
    y_predicted = list(data.iloc[:,1])


    # lets binarize y_predicted with threshold 0.5.
    # means >=0.5 is 1 otherwise 0
    y_actual = list(map(int ,y_actual))
    y_predicted = [0 if i<0.5 else 1 for i in y_predicted]


    #let's calculate every part of confusion matrix
    # TrueNegative(TN), FalseNegative(FN), TruePositive(TP),FalsePositive(FP)
    tn,fn,tp,fp = 0,0,0,0
    for i in range(len(y_actual)):


        if y_actual[i]==0 and y_predicted[i] ==0:
            tn +=1
        elif y_actual[i]==0 and y_predicted[i] ==1:
            fp +=1
        elif y_actual[i]==1 and y_predicted[i] ==1:
            tp +=1
        elif y_actual[i]==1 and y_predicted[i]==0:
            fn +=1

    precision = tp/(tp+fp)
    recall    = tp/(tp+fn)

    f1_score = 2*((precision * recall)/(precision+recall))
    return f1_score
```

In [254]:
```
f1_score(data)
```

Out[254]: 0.9950248756218906

calculate accuracy_score

In [255]:

```
def custom_accuracy_score(data):
    y_actual = list(data.iloc[:,0])
    y_predicted = list(data.iloc[:,1])


    # lets binarize y_predicted with threshold 0.5.
    # means >=0.5 is 1 otherwise 0
    y_actual = list(map(int ,y_actual))
    y_predicted = [0 if i<0.5 else 1 for i in y_predicted]

    #let's calculate every part of confusion matrix
    # TrueNegative(TN), FalseNegative(FN), TruePositive(TP),FalsePositive(FP)
    tn,fn,tp,fp = 0,0,0,0
    for i in range(len(y_actual)):


        if y_actual[i]==0 and y_predicted[i] ==0:
            tn +=1
        elif y_actual[i]==0 and y_predicted[i] ==1:
            fp +=1
        elif y_actual[i]==1 and y_predicted[i] ==1:
            tp +=1
        elif y_actual[i]==1 and y_predicted[i]==0:
            fn +=1

    accuracy = (tp+tn)/(tp+tn+fp+fn)
    return accuracy
```

In [256]:

```
custom_accuracy_score(data)
```

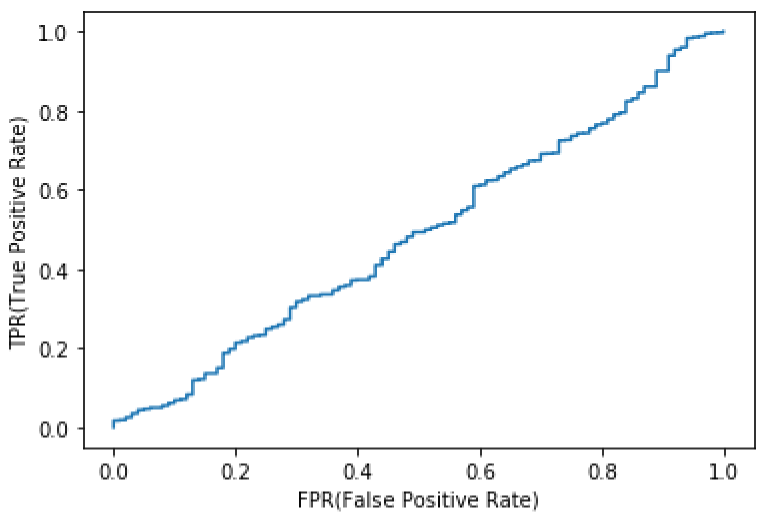
Out[256]: 0.9900990099009901

In [261]:
```
def custom_auc_score(data):
    ##### It might take few minutes to compute AUC Score ########

    y_actual = list(data.iloc[:,0])
    y_predict = list(data.iloc[:,1])


    # lets binarize y_predicted with threshold 0.5.
    # means >=0.5 is 1 otherwise 0
    y_actual = list(map(int ,y_actual))

    #let's initialize every part of confusion matrix
    # TrueNegative(TN), FalseNegative(FN), TruePositive(TP),FalsePositive(FP)
    tn,fn,tp,fp = 0,0,0,0


    # let's find n unique probabilities
    y_predict = np.array(data.iloc[:,1]) # changing to numpy.array
    threshold   = np.unique(y_predict)#finding unique values
    threshold.sort()# sort the probabilities in ascending order

    #for every probabilities in threshold
    fpr_values = []
    tpr_values = []
    for thresh in threshold:# make every probability as threshold
        tn,fn,tp,fp = 0,0,0,0
        # for every threshold value change the y_predicted
        y_predicted = [0 if i<thresh else 1 for i in y_predict]

        #let's calculate every part of confusion matrix
        # TrueNegative(TN), FalseNegative(FN), TruePositive(TP),FalsePositive(FP)
        for i in range(len(y_actual)):
            if y_actual[i]==0 and y_predicted[i] ==0:
                tn +=1
            elif y_actual[i]==0 and y_predicted[i] ==1:
                fp +=1
            elif y_actual[i]==1 and y_predicted[i] ==1:
                tp +=1
            elif y_actual[i]==1 and y_predicted[i]==0:
                fn +=1

        # find tpr and fpr for every threshold
```

```
        tpr = tp/(tp+fn)
        fpr = fp/(fp+tn)

        tpr_values.append(tpr)
        fpr_values.append(fpr)

    # change tpr_values and fpr_values to numpy array
    tpr_array = np.array(tpr_values)
    fpr_array = np.array(fpr_values)

    # finding auc score
    auc_score = abs(np.trapz(tpr_array, fpr_array))

    # plotting
    plt.plot(fpr_array,tpr_array)
    plt.xlabel('FPR(False Positive Rate)')
    plt.ylabel('TPR(True Positive Rate)')
    plt.show()

    return auc_score# returning AUC Score, (tpr and fpr) for testing purpose
```

In [262]:

```
custom_auc_score(data) # It might take few minutes
```



Out[262]: 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 [263]:
```
# importing the dataset 5_b.csv
data_b = pd.read_csv('5_b.csv')
```

In [264]:
```
# see the header of data_b
data_b.head()
```

Out[264]:

	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

1.Compute Confusion matrix

In [265]:
```
confusion_matrix = custom_confusion_matrix(data_b)
confusion_matrix
```

Out[265]:
```
array([[9761,  239],
       [  45,   55]])
```

2.f1-score

In [266]:
```
f1_score(data_b)
```

Out[266]:
```
0.2791878172588833
```

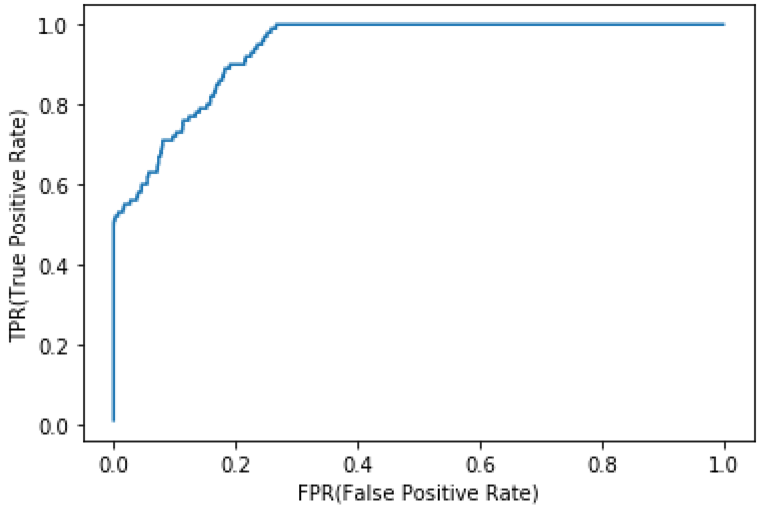
3.accuracy_score

In [267]:
```
custom_accuracy_score(data_b)
```

Out[267]:
```
0.9718811881188119
```

4. auc score

In [268]:
```
custom_auc_score(data_b)
```



Out[268]: 0.937757

In [ ]:
```

```

In [230]:
```
# write your code
```

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 [231]:
```
# import the dataset 5_c.csv
data_c = pd.read_csv('5_c.csv')
```

In [232]:
```
# header of the dataset
data_c.head()
```

Out[232]:

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

In [273]:
```
# creating optimal_threshold method to find best threshold value for given equation.
def optimal_threshold(data):
    y_actual = list(data.iloc[:,0])
    y_predict = list(data.iloc[:,1])


    y_actual = list(map(int ,y_actual))

    #let's initialize
    #, FalseNegative(FN),FalsePositive(FP)
    fn,fp = 0,0


    # let's find n unique probabilities
    y_predict = np.array(data.iloc[:,1]) # changing to numpy.array
    threshold   = np.unique(y_predict)#finding unique values
    threshold.sort()# sort the probabilities(threshold values) in ascending order

    # initializing A to store the result of given equation
    A = []

    for thresh in threshold:# make every probability as threshold
        fn,fp = 0,0
        # for every threshold value change the y_predicted
        y_predicted = [0 if i<thresh else 1 for i in y_predict]

        #let's calculate
        # FalseNegative(FN),FalsePositive(FP)
        for i in range(len(y_actual)):
            if y_actual[i]==0 and y_predicted[i] ==1:
                fp +=1
            elif y_actual[i]==1 and y_predicted[i]==0:
                fn +=1

        # let's compute A= (500*no.of false negative) + (100*no.of false positive)
        A.append((500*fn+100*fp,thresh)) # appending the value of A every threshold


#     result = list(zip(list(A),list(threshold)))
    A.sort()
    return A[0][1] # returning best threshold value
```

In [274]:
```
best_value = optimal_threshold(data_c)
best_value
```

Out[274]:
```
0.23003902789708733
```

I am not getting the threshold that you said in the comments. Please point out where I am doing mistake

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 [237]:
```
# Loading the dataset
data_d = pd.read_csv('5_d.csv')
```

In [238]:
```
# header of the dataset
data_d.head()
```

Out[238]:

	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

1. Mean Squared Error

In [239]:
```
def mean_squared_error(data):

    y_actual = data.iloc[:,0]
    y_predicted = data.iloc[:,1]

    error = 0

    for i in range(len(y_actual)):
        error += (y_actual[i]-y_predicted[i])**2

    result= error/len(y_actual)
    return result
```

In [240]:
```
mean_squared_error(data_d)
```

Out[240]: 177.16569974554707

2. Mean Absolute Percentage Error

In [241]:
```
import numpy as np
np.seterr(divide='ignore', invalid='ignore')
def mean_absolute_percentage_error(data):
    y_actual = np.array(data_d.iloc[:,0])
    y_predicted = np.array(data_d.iloc[:,1])
    error_u = 0
    error_l = 0
    for i in range(len(y_actual)):
        error_u += np.abs((y_actual[i]-y_predicted[i]))# absolute sum of all error
        error_l += y_actual[i] # sum of all actual y

    result= error_u/error_l
    return result*100
```

In [242]:
```
mean_absolute_percentage_error(data_d)
```

Out[242]:
```
12.91202994009687
```

3. R^2 Error

In [243]:
```
def mean_squared_error(data):
    y_actual = np.array(data_d.iloc[:,0])
    y_predicted = np.array(data_d.iloc[:,1])

    y_mean = np.mean(y_actual)

    ss_total = 0
    ss_residual = 0

    for i in range(len(y_actual)):
        ss_total+= (y_actual[i]-y_mean)**2
        ss_residual+= (y_actual[i]-y_predicted[i])**2

    r2 = 1-(ss_residual/ss_total)
    return r2
```

In [244]:
```
mean_squared_error(data_d)
```

Out[244]:
```
0.9563582786990964
```

Let's compare the result with sklearn.metrics's r2_score

In [245]:
```
y_actual = np.array(data_d.iloc[:,0])
y_predicted = np.array(data_d.iloc[:,1])
```

In [246]:
```
from sklearn.metrics import r2_score
```

In [247]:
```
r2_score(y_actual,y_predicted)
```

Out[247]:
```
0.9563582786990937
```