Compute performance metrics for the given Y and Y_score without sklearn

```
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 point
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 t
4. Compute Accuracy Score

```
# write your code here
data=pd.read_csv("5_a.csv")
df = data.copy()
df.head()
```

	y	proba
0	1.0	0.637387
1	1.0	0.635165

```
def getAnalysis(proba):
    if proba < 0.5:
        return 0
    else:
        return 1


df['y_pre'] = df['proba'].apply(getAnalysis)
df.head()
```

	y	proba	y_pre
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

```
y= df['y']
proba = df['y_pre']

def confusion(y,proba):

  TP = 0
  FP = 0
  FN = 0
  TN = 0

  for i, j in zip(y, proba):
    if i == 1 and j == 1:
      TP = TP + 1


    elif i == 0 and j == 1:
      FP = FP + 1


    elif i == 0 and j == 0:
      TN = TN + 1


    elif i == 1 and j == 0:
      FN = FN + 1
```

```
  return TP, FP, FN, TN

TP, FP, FN, TN = confusion(y,proba)


A = [TN,FN]
B = [FP,TP]

print(A,B)

     [0, 0] [100, 10000]


Confusion_matrix = np.matrix([A, B])

print(Confusion_matrix )

     [[    0     0]
      [  100 10000]]


def recall(TP,FP,FN):
  recal  = TP/(TP+FN)

  return recal

def precsion(TP,FP,FN):
  precsions = TP/(TP+FP)

  return precsions

recal = recall(TP,FP,FN)
precsions = precsion(TP,FP,FN)


def TPR1(TP,FN):
  try:
    tpr = TP/(TP+FN)
  except ZeroDivisionError:
    tpr = 0

  return tpr

def FPR1(FP,TN):
  try:
    fpr = FP/(FP+TN)

  except ZeroDivisionError:
    fpr = 0

  return fpr
```

```
TPR = TPR1(TP,FN)
FPR = FPR1(FP,FN)


print(recal)
print(precsions)
print(TPR)
print(FPR)
```

```
1.0
0.9900990099009901
1.0
1.0
```

```
f1_score = 2*((recal*precsions)/(recal+precsions))
print(f1_score)
```

```
0.9950248756218906
```

```
accuracy = (TP+TN)/(TP+FP+FN+TN)
print(accuracy)
```

```
0.9900990099009901
```

```
sorted_y_pre = df.sort_values(by=['proba'])
print(sorted_y_pre)
```

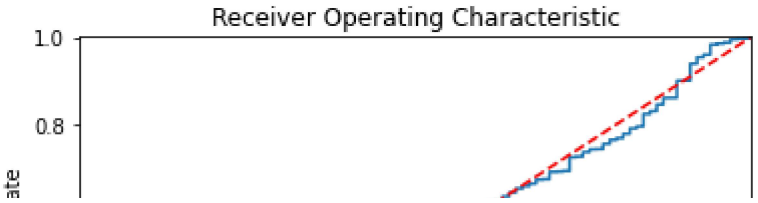
```
          y     proba  y_pre
5012  1.0  0.500019      1
805   1.0  0.500047      1
7421  1.0  0.500058      1
1630  1.0  0.500058      1
8294  1.0  0.500081      1
...   ...       ...    ...
8324  1.0  0.899768      1
9592  1.0  0.899812      1
1028  1.0  0.899825      1
2099  1.0  0.899828      1
1664  1.0  0.899965      1

[10100 rows x 3 columns]
```

```
threshold = sorted_y_pre['proba'].values.tolist()
sort_y = sorted_y_pre['y'].values.tolist()


def compare(value,y,df):
  result = []
  final_result = []
  tpr_list = []
  fpr_list = []
```

```
    s = df['y'].value_counts()
    P = s[1]
    N = s[0]
    for i in range(0,10100):
      temp = value[i]
      result = []
      for j in range(0,10100):
        if temp < value[j]:
          result.append(1)
        else:
          result.append(0)
      final_result.append(result)
      TP, FP, FN, TN = confusion(y,final_result[i])
      tpr_list.append(TP/P)
      fpr_list.append(FP/N)

    return tpr_list,fpr_list

tpr_list, fpr_list = compare(threshold,sort_y,sorted_y_pre)


tpr_list.reverse()
fpr_list.reverse()


roc_auc = np.trapz(tpr_list, fpr_list)
print(roc_auc)
```

```
0.48829900000000004
```

```
import matplotlib.pyplot as plt

plt.title('Receiver Operating Characteristic')
plt.plot(fpr_list, tpr_list, label='AUC = %0.4f'% (roc_auc))
plt.legend(loc='lower right')
plt.plot([0,1],[0,1],'r--')
plt.xlim([-0.001, 1])
plt.ylim([0, 1.001])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show();
```



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 t
4. Compute Accuracy Score

```
# write your code
data=pd.read_csv("5_b.csv")
df = data.copy()
df.head()
```

	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

```
def getAnalysis(proba):
```

```
def getAnalysis(proba):
    if proba < 0.5:
        return 0
    else:
        return 1


df['y_pre'] = df['proba'].apply(getAnalysis)
df.head()
```

	y	proba	y_pre
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

```
y= df['y']
proba = df['y_pre']

def confusion(y,proba):

  TP = 0
  FP = 0
  FN = 0
  TN = 0

  for i, j in zip(y, proba):
    if i == 1 and j == 1:
      TP = TP + 1


    elif i == 0 and j == 1:
      FP = FP + 1


    elif i == 0 and j == 0:
      TN = TN + 1


    elif i == 1 and j == 0:
      FN = FN + 1


  return TP, FP, FN, TN

TP, FP, FN, TN = confusion(y,proba)
```

```
A = [TN,FN]
B = [FP,TP]

print(A,B)

     [9761, 45] [239, 55]


Confusion_matrix = np.matrix([A, B])

print(Confusion_matrix )

     [[9761   45]
      [ 239   55]]


def recall(TP,FP,FN):
  recal  = TP/(TP+FN)

  return recal

def precsion(TP,FP,FN):
  precsions = TP/(TP+FP)

  return precsions

recal = recall(TP,FP,FN)
precsions = precsion(TP,FP,FN)


def TPR1(TP,FN):
  try:
    tpr = TP/(TP+FN)
  except ZeroDivisionError:
    tpr = 0

  return tpr

def FPR1(FP,TN):
  try:
    fpr = FP/(FP+TN)

  except ZeroDivisionError:
    fpr = 0

  return fpr

TPR = TPR1(TP,FN)
FPR = FPR1(FP,FN)


print(recal)
print(precsions)
```

```
print(TPR)
print(FPR)
```

```
0.55
0.1870748299319728
0.55
0.8415492957746479
```

```
f1_score = 2*((recal*precsions)/(recal+precsions))
print(f1_score)
```

```
0.2791878172588833
```

```
accuracy = (TP+TN)/(TP+FP+FN+TN)
print(accuracy)
```

```
0.9718811881188119
```

```
sorted_y_pre = df.sort_values(by=['proba'])
print(sorted_y_pre)
```

```
          y     proba  y_pre
313   0.0  0.100001      0
1938  0.0  0.100161      0
1360  0.0  0.100165      0
2532  0.0  0.100189      0
8290  0.0  0.100230      0
...   ...       ...    ...
8578  1.0  0.588718      1
110   1.0  0.590171      1
1657  1.0  0.592198      1
1978  1.0  0.594808      1
8446  1.0  0.595294      1

[10100 rows x 3 columns]
```

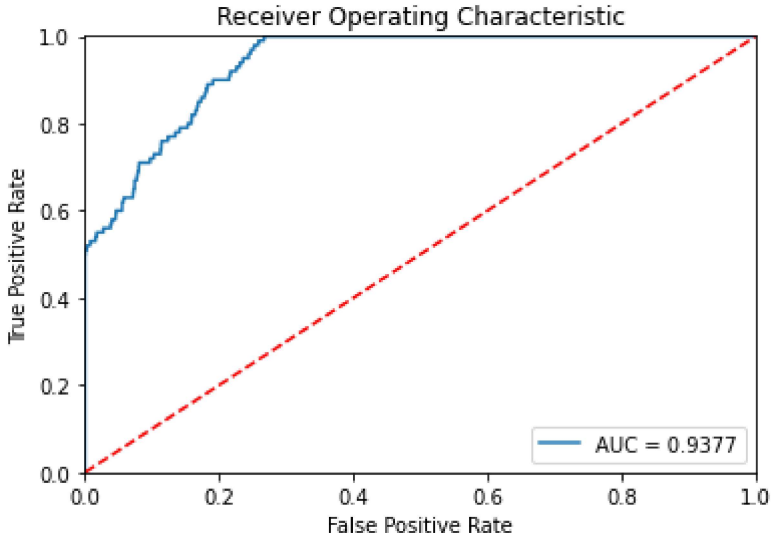
```
threshold = sorted_y_pre['proba'].values.tolist()
sort_y = sorted_y_pre['y'].values.tolist()
```

```
def compare(value,y,df):
  result = []
  final_result = []
  tpr_list = []
  fpr_list = []
  s = df['y'].value_counts()
  P = s[1]
  N = s[0]
  for i in range(0,10100):
    temp = value[i]
    result = []
```

```
    for j in range(0,10100):
      if temp < value[j]:
        result.append(1)
      else:
        result.append(0)
    final_result.append(result)
    TP, FP, FN, TN = confusion(y,final_result[i])
    tpr_list.append(TP/P)
    fpr_list.append(FP/N)

  return tpr_list,fpr_list

tpr_list, fpr_list = compare(threshold,sort_y,sorted_y_pre)


tpr_list.reverse()
fpr_list.reverse()


roc_auc = np.trapz(tpr_list, fpr_list)
print(roc_auc)
```

```
0.9376570000000001
```

```
import matplotlib.pyplot as plt

plt.title('Receiver Operating Characteristic')
plt.plot(fpr_list, tpr_list, label='AUC = %0.4f'% (roc_auc))
plt.legend(loc='lower right')
plt.plot([0,1],[0,1],'r--')
plt.xlim([-0.001, 1])
plt.ylim([0, 1.001])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show();
```



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**

```
 # write your code

data=pd.read_csv("5_c.csv")
df = data.copy()
df.head()
```

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

```
def getAnalysis(prob):
    if prob < 0.5:
        return 0
    else:
        return 1


df['y_pre'] = df['prob'].apply(getAnalysis)
df.head()
```

	y	prob	y_pre
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

```
y= df['y']
```

```
proba = df['y_pre']

def confusion(y,proba):

  TP = 0
  FP = 0
  FN = 0
  TN = 0

  for i, j in zip(y, proba):
    if i == 1 and j == 1:
      TP = TP + 1


    elif i == 0 and j == 1:
      FP = FP + 1


    elif i == 0 and j == 0:
      TN = TN + 1


    elif i == 1 and j == 0:
      FN = FN + 1


  return TP, FP, FN, TN

TP, FP, FN, TN = confusion(y,proba)


A = [TN,FN]
B = [FP,TP]

print(A,B)

     [1637, 462] [168, 585]


Confusion_matrix = np.matrix([A, B])

print(Confusion_matrix )

     [[1637  462]
      [ 168  585]]


def recall(TP,FP,FN):
  recal  = TP/(TP+FN)

  return recal

def precsion(TP,FP,FN):
```

```
    precsions = TP/(TP+FP)

    return precsions

recal = recall(TP,FP,FN)
precsions = precsion(TP,FP,FN)


def TPR1(TP,FN):
  try:
    tpr = TP/(TP+FN)
  except ZeroDivisionError:
    tpr = 0

  return tpr

def FPR1(FP,TN):
  try:
    fpr = FP/(FP+TN)

  except ZeroDivisionError:
    fpr = 0

  return fpr

TPR = TPR1(TP,FN)
FPR = FPR1(FP,FN)


print(recal)
print(precsions)
print(TPR)
print(FPR)
```

```
0.5587392550143266
0.7768924302788844
0.5587392550143266
0.26666666666666666
```

```
f1_score = 2*((recal*precsions)/(recal+precsions))
print(f1_score)
```

```
0.65
```

```
accuracy = (TP+TN)/(TP+FP+FN+TN)
print(accuracy)
```

```
0.7791023842917251
```

```
sorted_y_pre = df.sort_values(by=['prob'])
print(sorted_y_pre)
```

```
      y      prob  y_pre
473   0  0.028038      0
412   0  0.028396      0
454   0  0.028964      0
435   0  0.030269      0
468   0  0.031114      0
...  ..       ...    ...
2456  1  0.941113      1
2788  1  0.944094      1
2447  1  0.948638      1
2548  1  0.951437      1
2634  1  0.957747      1

[2852 rows x 3 columns]
```

```
threshold = sorted_y_pre['prob'].values.tolist()
sort_y = sorted_y_pre['y'].values.tolist()


def min_metric(value,y,df):
  result = []
  final_result = []
  tpr_list = []
  fpr_list = []
  s = df['y'].value_counts()
  P = s[1]
  N = s[0]
  metric = {}
  for i in range(0,len(value)):
    temp = value[i]
    result = []
    for j in range(0,len(value)):
      if temp < value[j]:
        result.append(1)
      else:
        result.append(0)
    final_result.append(result)
    TP, FP, FN, TN = confusion(y,final_result[i])
    metric_val=(500*FN)+(100*FP)
    metric[temp]=metric_val

  return (metric)

result = min_metric(threshold,sort_y,sorted_y_pre)
temp = min(result.values())
res = [key for key in result if result[key] == temp]
print('the key:value pair for min value of the specified metric is-',res,temp)
```

```
the key:value pair for min value of the specified metric is- [0.22987164436159915] 1410
```

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_determinat

```
data_d=pd.read_csv("5_d.csv")
data_d.shape
data_d.head()
```

	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

```
def error(df,col1,col2):
    val=[]
    for index, (value1, value2) in enumerate(zip(df[col1], df[col2])):
        val.append(value1-value2)
    return val

def absolute_error(df,col):
    val=[]
    for index,value in enumerate(df[col]):
        val.append(abs(value))
    return val

def mean_sq_error(df,col):
    return ss_res(df,col)/len(df[col])

def mape(df,col1,col2):
```

```
        val=sum(df[col1])/sum(df[col2])
        return val

    def ss_res(df,col):
        val=0
        for index,value in enumerate(df[col]):
            val=val+(value*value)
        return val

    def ss_tot(df,col):
        val=0
        mean_val=data_d['y'].mean()
        for index,value in enumerate(df[col]):
            val=val+ (value-mean_val)*(value-mean_val)
        return val


    data_d['error']=error(data_d,'y','pred')
    data_d['abs_error']=absolute_error(data_d,'error')


    MSE=mean_sq_error(data_d,'error')
    print("the Mean squared error is : ", MSE)

         the Mean squared error is :  177.16569974554707


    MAPE=mape(data_d,'abs_error','y')
    print('the MAPE value is :', MAPE)

         the MAPE value is : 0.1291202994009687


    SS_RES=ss_res(data_d,'error')
    SS_TOT=ss_tot(data_d,'y')
    R_square= 1- (SS_RES/SS_TOT)
    print('the Co-efficient of determination value is: ',R_square)

         the Co-efficient of determination value is:  0.9563582786990964
```