# Compute performance metrics for the given Y and Y_score without sklearn

In [1]:

```
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 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

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

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 [2]:

```
# write your code here
data = pd.read_csv("D:/Personal/AppliedAI/5_Performance_metrics/5_a.csv")
data.head()
```

Out[2]:

|  | 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 [3]:

```
data.head()
```

Out[3]:

|  | y | proba |
|---|---|---|
| **0** | 1.0 | 0.637387 |
| **1** | 1.0 | 0.635165 |

|   | y | proba |
|---|---|---|
| **2** | 1.0 | 0.766586 |
| **3** | 1.0 | 0.724564 |
| **4** | 1.0 | 0.889199 |

In [3]:

```
#data.describe()
# replacing the values 0 and 1
data.loc[(data.proba < 0.5),'proba'] = 0
data.loc[(data.proba >= 0.5),'proba'] = 1
```

In [39]:

```
data.head()
```

Out[39]:

|   | y | proba |
|---|---|---|
| **0** | 1.0 | 1.0 |
| **1** | 1.0 | 1.0 |
| **2** | 1.0 | 1.0 |
| **3** | 1.0 | 1.0 |
| **4** | 1.0 | 1.0 |

In [4]:

```
#confusion matrix TP, TN, FP, FN
def perf_measure(y_actual, y_pred):
    TP = 0
    FP = 0
    TN = 0
    FN = 0

    for i in range(len(y_pred)):
        if y_actual[i]==y_pred[i]==1:
           TP += 1
        if y_pred[i]==1 and y_actual[i] != y_pred[i]:
           FP += 1
        if y_pred[i]==0 and y_actual[i] != y_pred[i]:
           FN += 1
        if y_actual[i]==y_pred[i]==0:
           TN += 1

    return(TP, FP, FN, TN)
```

In [5]:

```
count = data['y'].count()
print(count)
print(len(data.proba))
TP, FP, TN, FN = perf_measure(data.y, data.proba)
print(TP, FP, TN, FN)
print(" TP:{}\n FP:{}\n FN:{}\n TN:{}".format(TP/count, FP/count, FN/count, TN/count))
```

```
10100
10100
10000 100 0 0
 TP:0.9900990099009901
 FP:0.009900990099009901
 FN:0.0
 TN:0.0
```

In [6]:

```
#Precision
TruecountP = 0
for i in range(count):
    if data.proba[i] == 1:
        TruecountP += 1
prec = TP / TruecountP
print(TruecountP)
print(prec)
```

```
10100
0.9900990099009901
```

In [7]:

```
#Recall
Truecount = 0
for i in range(count):
    if data.y[i] == 1:
        Truecount += 1
recall = TP / Truecount
print(recall)
```

```
1.0
```

In [8]:

```
#Harmonic mean
Hm = (2*prec*recall) / (prec + recall)
print(Hm)
```

```
0.9950248756218906
```

In [9]:

```
#Accuracy Score

accScore = (TP + TN)/ (TP + TN + FP + FN)
print('Accuracy Score :'+str(accScore))
```

```
Accuracy Score :0.9900990099009901
```

In [10]:

```
#Loading the Data and changing to Descending order by prob values
dataA = pd.read_csv("D:/Personal/AppliedAI/5_Performance_metrics/5_a.csv")
sorted_data=dataA.sort_values(by='proba')
sorted_data.head()
```

Out[10]:

|  | y | proba |
|---|---|---|
| **5012** | 1.0 | 0.500019 |
| **805** | 1.0 | 0.500047 |
| **7421** | 1.0 | 0.500058 |
| **1630** | 1.0 | 0.500058 |
| **8294** | 1.0 | 0.500081 |

In [17]:

```
from tqdm import tqdm

def list_tpr_fpr_values(sorted_data):
    list_tpr_fpr =[]
    for threshold in tqdm(sorted_data['proba']):
        y_pred=[]
        for k in sorted_data['proba']:
            if (k < threshold):
                y_pred.append(0.0)
            else:
                y_pred.append(1.0)
        sorted_data['y_pred'] = y_pred
        TP, FP, FN, TN =  perf_measure(sorted_data.y, sorted_data.y_pred)
        TPR = (TP)/(TP+FN)
        FPR = (FP)/(FP+TN)
        list_tpr_fpr.append([TPR,FPR])
    return list_tpr_fpr
```

In [18]:

```
def AUCScore(list_tpr_fpr):
    sorted_list_tpr_fpr= sorted(list_tpr_fpr)
    tpr, fpr=[], []

    for i in sorted_list_tpr_fpr:
        tpr.append(i[0])
        fpr.append(i[1])

    AUCScore = np.trapz(tpr, fpr)
    return tpr, fpr, AUCScore
```

In [19]:

```
list_tpr_fpr=list_tpr_fpr_values(sorted_data)
tpr, fpr, AUCScore=AUCScore(list_tpr_fpr)

print("AUC Score for A: "+str(AUCScore))
print("Threshold Value: {}{}".format(tpr[0],fpr[0]))
```

```
100%|███████████████████████████████████████████████████████████████████████████| 10100/10100
[2:47:03<00:00,  1.01it/s]
```

```
AUC Score for A: 0.48829900000000004
Threshold Value: 0.00010.0
```

In [25]:

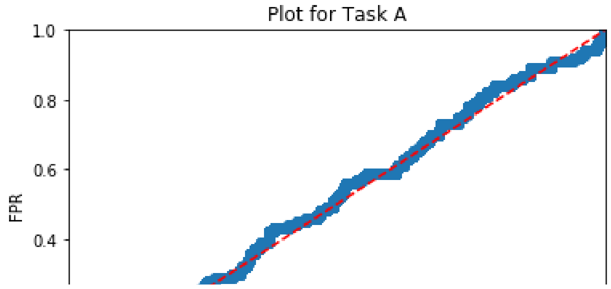
```
print("Threshold Value: {} {}".format(tpr[0],fpr[0]))
print("Threshold Value: {} {}".format(tpr[1],fpr[1]))
```

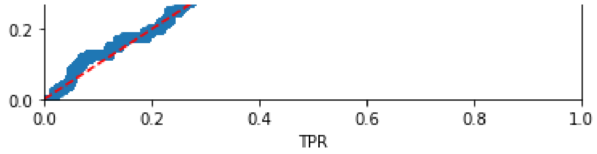
```
Threshold Value: 0.0001 0.0
Threshold Value: 0.0002 0.0
```

In [27]:

```
import matplotlib.pyplot as plt

plt.scatter(tpr, fpr)
plt.plot([0,1],[0,1],'r--')
plt.title('Plot for Task A')
plt.xlabel('TPR')
plt.ylabel('FPR')
plt.xlim([0.0,1.0])
plt.ylim([0.0,1.0])
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

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

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 [28]:

```
# write your code
dataB = pd.read_csv("D:/Personal/AppliedAI/5_Performance_metrics/5_b.csv")
dataB.head()
```

Out[28]:

| | 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 [29]:

```
# replacing the values 0 and 1
dataB.loc[(dataB.proba < 0.5),'proba'] = 0
dataB.loc[(dataB.proba >= 0.5),'proba'] = 1
dataB.head()
```

Out[29]:

| | y | proba |
|---|---|---|
| **0** | 0.0 | 0.0 |
| **1** | 0.0 | 0.0 |
| **2** | 0.0 | 0.0 |
| **3** | 0.0 | 0.0 |
| **4** | 0.0 | 0.0 |

In [30]:

```
count = dataB['y'].count()
print(count)
TPB, FPB, TNB, FNB = perf_measure(dataB.y, dataB.proba)
print("TP_B:{}\n FP_B:{}\n FN_B:{}\n TN_B:{}".format(TPB/count, FPB/count, FNB/count, TNB/count))
```

```
10100
TP_B:0.005445544554455445
 FP_B:0.023663366336633664
 FN_B:0.9664356435643564
 TN_B:0.004455445544554455
```

In [32]:

```
#Precision
TruecountPB = 0
for i in range(count):
    if dataB.proba[i] == 1:
        TruecountPB += 1
precB = TPB / TruecountPB
print(TruecountPB)
print("Precision for B: "+str(precB))
```

```
294
Precision for B: 0.1870748299319728
```

In [33]:

```
#Recall
TruecountB = 0
for i in range(count):
    if dataB.y[i] == 1:
        TruecountB += 1
recallB = TPB / TruecountB
print("Recall or B: "+str(recallB))
```

```
Recall or B: 0.55
```

In [34]:

```
#Harmonic mean
HmB = (2*precB*recallB) / (precB + recallB)
print("armonic mean: "+str(HmB))
```

```
armonic mean: 0.2791878172588833
```

In [35]:

```
#Accuracy Score
aucScoreB = (TPB + FNB)/ (TPB + TNB + FPB + FNB)
print("Accurecy Score for B:"+str(aucScoreB))
```

```
Accurecy Score for B:0.9718811881188119
```

In [36]:

```
#Loading the Data and changing to Descending order by prob values
dataB = pd.read_csv("D:/Personal/AppliedAI/5_Performance_metrics/5_b.csv")
sorted_dataB=dataB.sort_values(by='proba')
sorted_dataB.head()
```

Out[36]:

| | y | proba |
|---|---|---|
| **313** | 0.0 | 0.100001 |
| [illegible] | [illegible] | [illegible] |

|  | y | proba |
|---|---|---|
| 1938 | 0.0 | 0.100161 |
| 1360 | 0.0 | 0.100165 |
| 2532 | 0.0 | 0.100189 |
| 8290 | 0.0 | 0.100230 |

In [46]:

```
list_tpr_fprB = list_tpr_fpr_values(sorted_dataB)
#tprB, fprB, AUCScoreB = AUCScore(list_tpr_fprB)


#print("Threshold Value: {}  {}".format(tprB[0],fprB[0]))
```

```
100%|████████████████████████████████████████████████████████████████████████████████| 10100/10100
[2:12:02<00:00,  1.27it/s]
```

In [47]:

```
sorted_list_tpr_fprB= sorted(list_tpr_fprB)
tprB, fprB=[], []

for i in sorted_list_tpr_fprB:
    tprB.append(i[0])
    fprB.append(i[1])

AUCScoreB = np.trapz(tprB, fprB)
print("AUC Score for B: "+str(AUCScoreB))
```

```
AUC Score for B: 0.9377570000000001
```

In [48]:

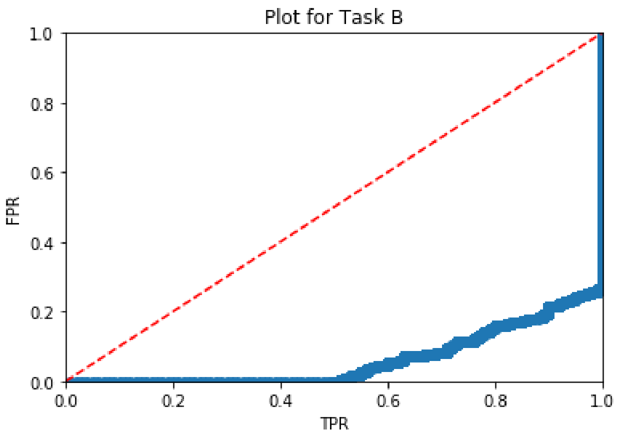
```
print("Threshold Value: {} {}".format(tprB[0],fprB[0]))
print("Threshold Value: {} {}".format(tprB[1],fprB[1]))
```

```
Threshold Value: 0.01 0.0
Threshold Value: 0.02 0.0
```

In [49]:

```
import matplotlib.pyplot as plt

plt.scatter(tprB, fprB)
plt.plot([0,1],[0,1],'r--')
plt.title('Plot for Task B')
plt.xlabel('TPR')
plt.ylabel('FPR')
plt.xlim([0.0,1.0])
plt.ylim([0.0,1.0])
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: $y^{pred}= \text{[0 if y_score < threshold else 1]}$

$ 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 [50]:

```
 # write your code
dataC = pd.read_csv("D:/Personal/AppliedAI/5_Performance_metrics/5_c.csv");
dataC.head()
```

Out[50]:

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

In [51]:

```
# replacing the values 0 and 1
dataC.loc[(dataC.prob < 0.5),'prob'] = 0
dataC.loc[(dataC.prob >= 0.5),'prob'] = 1
dataC.head()
```

Out[51]:

| | y | prob |
|---|---|---|
| **0** | 0 | 0.0 |
| **1** | 0 | 1.0 |
| **2** | 0 | 0.0 |
| **3** | 0 | 0.0 |
| **4** | 0 | 0.0 |

In [52]:

```
def perf_measure_FP_FN(y_actual, y_pred):
    FP = 0
    FN = 0
    for i in range(len(y_pred)):
        if y_pred[i]==1 and y_actual[i]!=y_pred[i]:
           FP += 1
        if y_pred[i]==0 and y_actual[i]!=y_pred[i]:
           FN += 1
    return(FP, FN)
countC = dataC['y'].count()
print(countC)
FP_C, FN_C = perf_measure_FP_FN(dataC.y, dataC.prob)
print("FP_C: {}\nFN_C: {}".format(FP_C, FN_C))
```

```
2852
FP_C: 168
FN_C: 462
```

In [53]:

```
A = 500 * FN_C + 100 * FP_C
print("A:" +str(A))
```

```
A:247800
```

**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 [54]:

```
dataD = pd.read_csv("D:/Personal/AppliedAI/5_Performance_metrics/5_d.csv");
dataD.head()
```

Out[54]:

| | 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 [55]:

```
#Mean Squared Error
n = dataD['pred'].count()
#print(n)
Y_true= dataD['y']
Y_pred=dataD['pred']
MSE2 = np.square(np.subtract(Y_true,Y_pred)).mean()
#summ/n
print("Mean Squared Error:"+str(MSE2))
```

```
Mean Squared Error:177.16569974554707
```

In [57]:

```
#Mean Absolute Percentage Error
print("Mean Absolute Percentage Error:")
MAPE = np.mean(np.abs(np.subtract(Y_true,Y_pred))/np.mean(Y_true))#*100
print(MAPE)
MMAPE = np.sum(np.abs(np.subtract(Y_true,Y_pred)))/np.sum(Y_true)
print(MMAPE)#*100)
```

```
Mean Absolute Percentage Error:
0.12912029940096315
0.1291202994009687
```

In [58]:

```
import math
def get_r2_python(x_list, y_list):
    #n = len(x)
    x_bar = sum(x_list)/n
    y_bar = sum(y_list)/n
    x_std = math.sqrt(sum([(xi-x_bar)**2 for xi in x_list])/(n-1))
    y_std = math.sqrt(sum([(yi-y_bar)**2 for yi in y_list])/(n-1))
    zx = [(xi-x_bar)/x_std for xi in x_list]
    zy = [(yi-y_bar)/y_std for yi in y_list]
    r = sum(zxi*zyi for zxi, zyi in zip(zx, zy))/(n-1)
    return r**2
```

In [59]:

```
print("R^2 error:")
get_r2_python(Y_true,Y_pred)
```

```
R^2 error:
```

Out[59]:

```
0.9563600409879071
```