Compute performance metrics for the given Y and Y_score without sklearn

In [10]:

```python
import numpy as np
import pandas as pd
# other than these two you should not import any other packages
```

In [12]:

```python
def comp_precision(tp, fp):
    return ((tp)/ float( tp + fp))*100
```

In [13]:

```python
def comp_recall(tp, fn):
    return (tp  * 100)/ float( tp + fn)
```

In [114]:

```python
def comp_f1_score(y_true, y_pred,tp, tn, fp, fn):
    precision = comp_precision(tp, fp)/100
    recall = comp_recall(tp, fn)/100
    f1_score = (2*precision*recall)/ (precision + recall)
    return f1_score
```

In [25]:

```python
def comp_accuracy(tp, tn, fn, fp):
    return ((tp + tn) / float( tp + tn + fn + fp))
```

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 [107]:

```
df1=pd.read_csv('5_a.csv')
```

In [108]:

```
df1['y_pred'] = (df1.y >= 0.5).astype('int')
df1.head()
```

Out[108]:

	y	proba	y_pred
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 [116]:

```
t=0.5
tp = np.logical_and( df1.proba > t, df1.y==1 ).sum()
tn = np.logical_and( df1.proba <=t, df1.y==0 ).sum()
fp = np.logical_and( df1.proba > t, df1.y==0 ).sum()
fn = np.logical_and( df1.proba <=t, df1.y==1 ).sum()

print('tp',tp)
print('tn',tn)
print('fp',fp)
print('fn',fn)

#tp, tn, fp, fn
```

```
tp 10000
tn 0
fp 100
fn 0
```

```
In [117]: print('F1_score',comp_f1_score(df1.y, df1.y_pred,tp, tn, fp, fn))
```

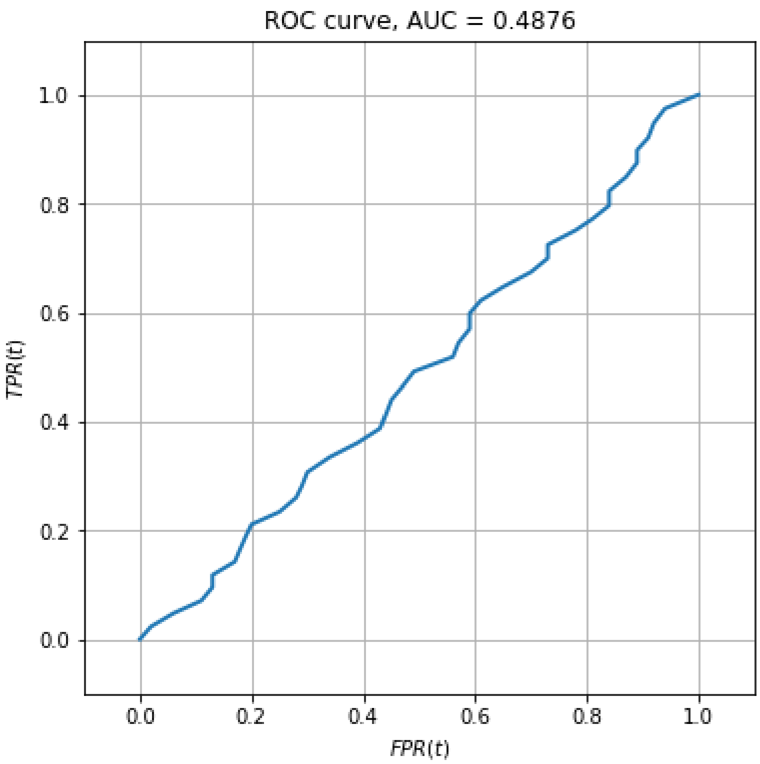
```
F1_score 0.9950248756218906
```

```
In [118]: Accuracy=comp_accuracy(tp, tn, fn, fp)
          print('Accuracy',Accuracy)
```

```
Accuracy 0.9900990099009901
```

In [156]:

```
##Reference :https://notmatthancock.github.io
thresholds = np.arange(0.0, 1.01, .01)
ROC = np.zeros((101,2))

for i in range(101):
    t = thresholds[i]

    # Classifier / label agree and disagreements for current threshold.
    TP_t = np.logical_and( df1.proba > t, df1.y==1 ).sum()
    TN_t = np.logical_and( df1.proba <=t, df1.y==0 ).sum()
    FP_t = np.logical_and( df1.proba > t, df1.y==0 ).sum()
    FN_t = np.logical_and( df1.proba <=t, df1.y==1 ).sum()

    # Compute false positive rate for current threshold.
    FPR_t = FP_t / float(FP_t + TN_t)
    ROC[i,0] = FPR_t
    # Compute true  positive rate for current threshold.
    TPR_t = TP_t / float(TP_t + FN_t)
    ROC[i,1] = TPR_t

fig = plt.figure(figsize=(6,6))
plt.plot(ROC[:,0], ROC[:,1], lw=2)
plt.xlim(-0.1,1.1)
plt.ylim(-0.1,1.1)
plt.xlabel('$FPR(t)$')
plt.ylabel('$TPR(t)$')
plt.grid()

AUC = 0.
for i in range(100):
    AUC += (ROC[i,0]-ROC[i+1,0]) * (ROC[i+1,1]+ROC[i,1])
AUC *= 0.5

plt.title('ROC curve, AUC = %.4f'%AUC)
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 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 [94]:

```
df2=pd.read_csv('5_b.csv')
```

In [124]:

```
df2['y_pred'] = (df2.y >= 0.5).astype('float')
# df2
```

In [125]:

```
t=0.5
tp = np.logical_and( df2.proba > t, df2.y==1 ).sum()
tn = np.logical_and( df2.proba <=t, df2.y==0 ).sum()
fp = np.logical_and( df2.proba > t, df2.y==0 ).sum()
fn = np.logical_and( df2.proba <=t, df2.y==1 ).sum()

print('tp',tp)
print('tn',tn)
print('fp',fp)
print('fn',fn)

# tp, tn, fp, fn
```

```
tp 55
tn 9761
fp 239
fn 45
```

In [121]:

```
print('F1_score',comp_f1_score(df2.y, df2.y_pred,tp, tn, fp, fn))
```

```
F1_score 0.2791878172588833
```

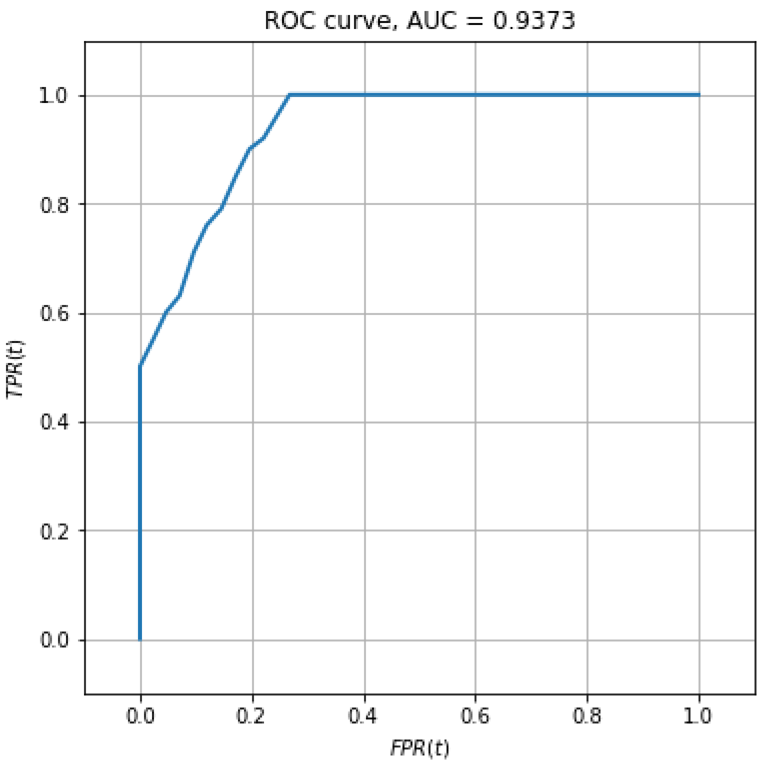
In [122]:

```
Accuracy=comp_accuracy(tp, tn, fn, fp)
print('Accuracy',Accuracy)
```

```
Accuracy 0.9718811881188119
```

In [123]:

```
#Reference :https://notmatthancock.github.io
thresholds = np.arange(0.0, 1.01, .01)
ROC = np.zeros((101,2))

for i in range(101):
    t = thresholds[i]

    # Classifier / label agree and disagreements for current threshold.
    TP_t = np.logical_and( df2.proba > t, df2.y==1 ).sum()
    TN_t = np.logical_and( df2.proba <=t, df2.y==0 ).sum()
    FP_t = np.logical_and( df2.proba > t, df2.y==0 ).sum()
    FN_t = np.logical_and( df2.proba <=t, df2.y==1 ).sum()

    # Compute false positive rate for current threshold.
    FPR_t = FP_t / float(FP_t + TN_t)
    ROC[i,0] = FPR_t
    # Compute true  positive rate for current threshold.
    TPR_t = TP_t / float(TP_t + FN_t)
    ROC[i,1] = TPR_t

fig = plt.figure(figsize=(6,6))
plt.plot(ROC[:,0], ROC[:,1], lw=2)
plt.xlim(-0.1,1.1)
plt.ylim(-0.1,1.1)
plt.xlabel('$FPR(t)$')
plt.ylabel('$TPR(t)$')
plt.grid()

AUC = 0.
for i in range(100):
    AUC += (ROC[i,0]-ROC[i+1,0]) * (ROC[i+1,1]+ROC[i,1])
AUC *= 0.5

plt.title('ROC curve, AUC = %.4f'%AUC)
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**

In [127]:
```
df3=pd.read_csv('5_c.csv')
```

In [136]:
```
# df3
```

In [144]:

```
thresholds = np.linspace(1,0,101)

Dic = {}

for i in range(101):
    t = thresholds[i]

    # Classifier / label agree and disagreements for current threshold.
    TP_t = np.logical_and( df3.prob > t, df3.y==1 ).sum()
    TN_t = np.logical_and( df3.prob <=t, df3.y==0 ).sum()
    FP_t = np.logical_and( df3.prob > t, df3.y==0 ).sum()
    FN_t = np.logical_and( df3.prob <=t, df3.y==1 ).sum()

    A=(500 * FN_t) + (100 * FP_t)
    Dic[thresholds[i]] = A
```

In [146]:

```
Dic
```

In [147]:

```
Dic_sort=sorted(Dic, key=Dic.get)
```

In [149]:

```
print("the threshold value is ",Dic_sort[0])
```

```
the threshold value is  0.22999999999999998
```

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 [36]:

```
df4=pd.read_csv('5_d.csv')
```

In [37]:
```
df4.head(5)
```

Out[37]:

	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 [38]:
```
add = 0
n = df4.shape[0]
for i in range (0,n):
    difference = df4['y'][i] - df4['pred'][i]
    squared_difference = difference**2
    add+= squared_difference
MSE = add/n
print('MSE : ',MSE)
```

```
MSE :  177.16569974554707
```

In [39]:
```
MSE = np.square(np.subtract(df4['y'].to_numpy(),df4['pred'].to_numpy())).mean()
#Geeksforgeeks --> reference
MSE
```

Out[39]:
```
177.16569974554707
```

In [40]:
```
# R - square
mean_y=df4.y.mean()
SSt=((df4.y-mean_y)**2).sum()
SSe=((df4.y-df4.pred)**2).sum()
R_squared=1-(SSe/SSt)
print('R-Square : ',R_squared)
```

```
R-Square :  0.9563582786990937
```

In [41]:
```
div=df4.y.sum()
err=abs(df4.y-df4.pred).sum()

MAPE=err/div
print('MAPE : ',MAPE*100,'%')
```

```
MAPE :  12.91202994009687 %
```