Dealing with Multiclass Classification Problems

WE need to convert our prb set into Binary problem set.
This is achievable using OneVsRestClassifier

We need to ensure our labels follow the binary nature for ROC and PR.
Rules for OneVsRestClassifier:
1. Labels must be NUMERIC in nature
2. Your model algo must support predict_proba , decision function

When you are working with Multiclass Classification, it recommends to use numerical method to check model is good or not.

If we want to **use ROC and PR Curve**, we need to convert Multiclass Classification to binary classification. ➔ we need to use OneVsRestClassifier.

use ROC and PR Curve ➔ if you are dealing with binary classification
use numerical method ➔ if you are dealing with Multiclass **classification**

Example:

Use-case:
You need to create a model that can predict the species of the flower based on the biological factor of the iris flower.
Dataset link = `'https://gist.githubusercontent.com/curran/a08a1080b88344b0c8a7/raw/639388c2cbc2120a14dcf466e85730eb8be498bb/iris.csv'`

		`data= pd.read_csv(Dataset link)`
		`data.head()` sepal_length | sepal_width | petal_length | petal_width | species 0 | 5.1 | 3.5 | 1.4 | 0.2 | setosa 1 | 4.9 | 3.0 | 1.4 | 0.2 | setosa 2 | 4.7 | 3.2 | 1.3 | 0.2 | setosa 3 | 4.6 | 3.1 | 1.5 | 0.2 | setosa 4 | 5.0 | 3.6 | 1.4 | 0.2 | setosa

	It is a Balanced Dataset	`data.species.value_counts()`
		
		`setosa 50`
		`virginica 50`
		`versicolor 50`
		`Name: species, dtype: int64`

		`features = data.iloc[:,:-1].values` `label = data.iloc[:,-1].values`
		`from sklearn.model_selection import train_test_split`

		`from sklearn.neighbors import KNeighborsClassifier`
		
		`X_train,X_test,y_train,y_test = train_test_split(features,`
		`label,`
		`test_size=0.2,`
		`random_state=23)`
		
		`modelKNN = KNeighborsClassifier(n_neighbors=5)`
		`modelKNN.fit(X_train,y_train)`

		`print(modelKNN.score(X_train,y_train))`
		`print(modelKNN.score(X_test,y_test))`
		
		`0.9583333333333334`
		`1.0`

	Numerical Perspective --- Approved the model!	`modelKNN.score(features,label)`
		
		`0.9666666666666667`

	Viz perspective for this dataset --> ROC AUC For demo I will show Both methods...	
	Dealing with Multiclass Classification Problems	
	WE need to convert our prb set into Binary problem set. This is achievable using OneVsRestClassifier We need to ensure our labels follow the binary nature for ROC and PR Rules for OneVsRestClassifier: 1. Labels must be NUMERIC in nature 2. Your model algo must support predict_proba , decision function	

		`data.species.unique().tolist()`
		
		`['setosa', 'versicolor', 'virginica']`

	Ensure label is written in ascending order	`from sklearn.preprocessing import label_binarize`
		
		`y = label_binarize(label, classes=['setosa', 'versicolor', 'virginica'])`
		`y`
		
		`array([[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`
		`[1, 0, 0],`

```
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
       [1, 0, 0],
...
       [0, 0, 1],
       [0, 0, 1],
       [0, 0, 1],
       [0, 0, 1],

       [0, 0, 1]])
```

Step2: Create Train Test Split

```
X_train,X_test,y_train,y_test = train_test_split(features,
                                                 y,
                                                 test_size=0.2,
                                                  random_state=23)
```

#Step3: Apply algo on OneVsRestClassifier

KNN doesnt support OneVSRestClassifier

```
from sklearn.multiclass import OneVsRestClassifier
from sklearn.linear_model import LogisticRegression


multiClassModel = OneVsRestClassifier(LogisticRegression())


y_score = multiClassModel.fit(X_train,y_train).decision_function(features)
```

y_score

```
array([[ 3.83606109e+00, -1.97392292e+00, -1.27063905e+01],
       [ 3.50578675e+00, -9.40184808e-01, -1.24435397e+01],
       [ 3.98086915e+00, -1.34431683e+00, -1.27340292e+01],
       [ 3.49715100e+00, -1.00315509e+00, -1.21163308e+01],
       [ 3.96269577e+00, -2.14609041e+00, -1.27150572e+01],
       [ 3.19007218e+00, -2.84916735e+00, -1.17027690e+01],
       [ 3.87695946e+00, -1.75008735e+00, -1.22903973e+01],
       [ 3.57415597e+00, -1.69255820e+00, -1.23618484e+01],
       [ 3.63877985e+00, -6.19816773e-01, -1.22467151e+01],
       [ 3.45943183e+00, -9.80722892e-01, -1.24295784e+01],
       [ 3.65116093e+00, -2.38196132e+00, -1.26073659e+01],
       [ 3.43888553e+00, -1.58336099e+00, -1.20259729e+01],
       [ 3.64115278e+00, -8.18952252e-01, -1.26313486e+01],
       [ 4.52294837e+00, -8.74842909e-01, -1.32940189e+01],
       [ 4.39360499e+00, -3.25075554e+00, -1.36723520e+01],
       [ 3.92070128e+00, -4.02719962e+00, -1.25432918e+01],
       [ 4.07732431e+00, -3.08835550e+00, -1.27953937e+01],
       [ 3.74396635e+00, -2.07045538e+00, -1.24872219e+01],
       [ 3.06898963e+00, -2.62986757e+00, -1.19759903e+01],
       [ 3.77224348e+00, -2.60126110e+00, -1.23341447e+01],
       [ 2.95744471e+00, -1.67176449e+00, -1.19409747e+01],
       [ 3.59678536e+00, -2.50092598e+00, -1.20749497e+01],
       [ 5.02303310e+00, -2.28647819e+00, -1.36822432e+01],
       [ 2.72761102e+00, -1.69039404e+00, -1.11493635e+01],
       [ 2.77344644e+00, -1.40396988e+00, -1.12065044e+01],
...
       [-7.63598124e+00, -1.13968087e+00,  1.97446202e+00],
       [-7.06770799e+00,  2.09993212e-01,  8.77045364e-01],
       [-7.27315445e+00, -8.00683291e-01,  1.37967549e+00],
       [-7.52979726e+00, -1.68405669e+00,  2.51746745e+00],

       [-6.60752415e+00, -5.19214855e-01,  8.56340037e-01]])
```

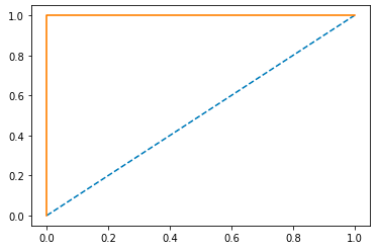
#Plot ROC for each Label

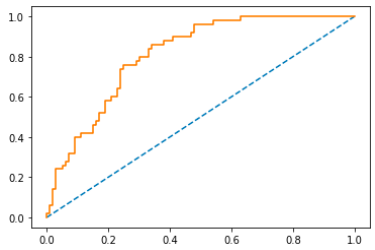
```
from sklearn.metrics import roc_curve
from sklearn.metrics import roc_auc_score
import matplotlib.pyplot as plt
%matplotlib inline


fpr = dict()
```

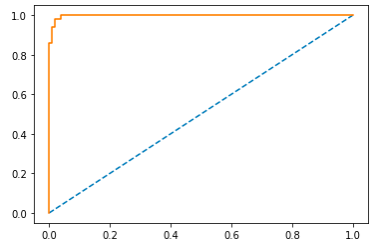
```
Step1: Extract the prob of true value for your label (1)
#probabilityValues = model.predict_proba(X_test)[:,1]
#Step2: Calc AUC
#Step4: Calc fpr tpr
```

```
tpr = dict()
auc = dict()


#Step1: Extract the prob of true value for your label (1)
#probabilityValues = model.predict_proba(X_test)[:,1]


for i in range(0,len(data.species.unique())):
    #Step2: Calc AUC
    auc[i] = roc_auc_score(y[:,i], y_score[:,i])
    #Step4: Calc fpr tpr
    fpr[i],tpr[i],_ = roc_curve(y[:,i],
y_score[:,i])


for i in range(0,len(data.species.unique())):
    plt.figure()
    plt.plot([0,1],[0,1] , linestyle='--')
    plt.plot(fpr[i],tpr[i])
    print(auc[i])
```

```
1.0
0.8112
0.9975999999999999
```





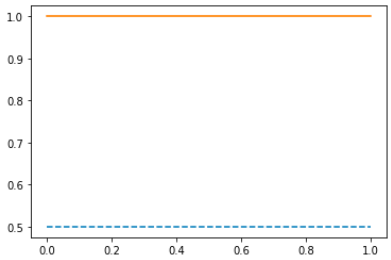
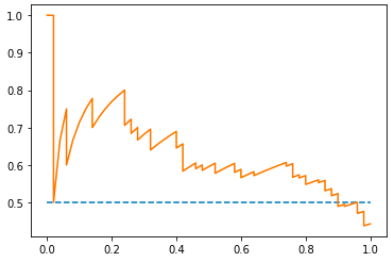
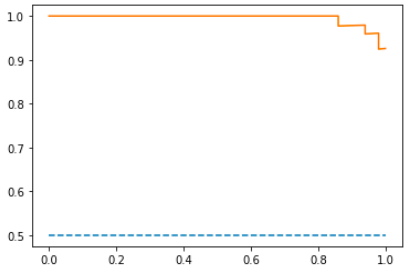


RC

```
#Plot RC for each Label
```

```
from sklearn.metrics import precision_recall_curve
from sklearn.metrics import auc
import matplotlib.pyplot as plt
%matplotlib inline

precision = dict()
recall = dict()
auc1 = dict()


#Step1: Extract the prob of true value for your
label (1)
#probabilityValues =
model.predict_proba(X_test)[:,1]


for i in range(0,len(data.species.unique())):

    #Step4: Calc fpr tpr
    precision[i],recall[i],_ =
precision_recall_curve(y[:,i], y_score[:,i])
    #Step2: Calc AUC
    auc1[i] = auc(recall[i],precision[i])



for i in range(0,len(data.species.unique())):
    plt.figure()
    plt.plot([0,1],[0.5,0.5] , linestyle='--')
    plt.plot(recall[i],precision[i])
    print(auc1[i])
```

```
1.0
0.6251095152832314
0.9951638571214363
```

		  
	Since LogisticRegression is a good candidate for the given sample set, the trained model can be deployed on the basis of ROC Curve Analysis	

Example 2:
Create a model that can identify quality of the wines and that can score the quality of wines based on the attributes defined.

https://archive.ics.uci.edu/dataset/186/wine+quality
SL = 0.1