```
from google.colab import drive
drive.mount('/content/drive')
import numpy as np
import scipy.io
import pandas as pd
from skimage import color
from skimage import io
import math
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, confusion_matrix
from sklearn.decomposition import PCA
```

```
Mounted at /content/drive
```

```
ctScans = scipy.io.loadmat('/content/drive/My Drive/CCE-AIMIA/ctscan_hw1.mat')
ctMasks = scipy.io.loadmat('/content/drive/My Drive/CCE-AIMIA/infmsk_hw1.mat')
ctScansembed = scipy.io.loadmat('/content/drive/My Drive/CCE-AIMIA/ctscan_embeddings_hw2.
```

```
print(ctScansembed['feat'].shape)
X = ctScansembed['feat']
```

```
(3554, 1024)
```

```
(ms,ns,cs)= (ctScans['ctscan']).shape
(mm,nm,cm)= (ctMasks['infmsk']).shape
print((ms,ns,cs))
print((mm,nm,cm))
```

```
(512, 512, 3554)
(512, 512, 3554)
```

```
ctscansarray = []
ctmasksarray = []
for i in range(cm):
    ctscansarray.append((ctScans['ctscan'][:,:,i]))
    ctmasksarray.append((ctMasks['infmsk'][:,:,i]))
```

```
ctmasksHealthy = []
ctmasksInfected = []
Percentage_infection = []
for i in range(len(ctmasksarray)):
  ctmasksHealthy.append(np.sum((ctmasksarray[i])==2))
  ctmasksInfected.append(np.sum((ctmasksarray[i])==1))
  Percentage_infection.append((ctmasksInfected[i]/(ctmasksHealthy[i]+ctmasksInfected[i]))
```

```
CtembedLabels = []
SevereInfCT = []
MildInfCT = []
NormalCT = []
for i in range(len(Percentage_infection)):
  if(Percentage_infection[i] >= 40):
    CtembedLabels.append(0)
  elif((Percentage_infection[i] > 0 ) and (Percentage_infection[i] < 40 )):
    CtembedLabels.append(1)
  else:
    CtembedLabels.append(2)
```

```
CtembedLabels = np.array(CtembedLabels)
print(CtembedLabels.shape)
```

```
(3554,)
```

```
n_components=1024
pca = PCA(n_components)
X_reduced = pca.fit_transform(X)
```

```
X = pd.DataFrame(X_reduced)
y = pd.Series(CtembedLabels)
# Experimented with two kinds of Dataset splits
X_train, X_test, y_train, y_test = train_test_split(X,
                                                    y,
                                                    test_size=.2,
                                                    random_state=123)

# look at the distrubution of labels in the train set
pd.Series(y_train).value_counts()
```

```
1    1576
2    1138
0     129
dtype: int64
```

```
from sklearn.metrics import accuracy_score
from sklearn.svm import SVC
from sklearn.metrics import roc_curve, auc
# define support vector classifier
svm = SVC(kernel='linear', probability=True, random_state=42)

# fit model
svm.fit(X_train, y_train)
```

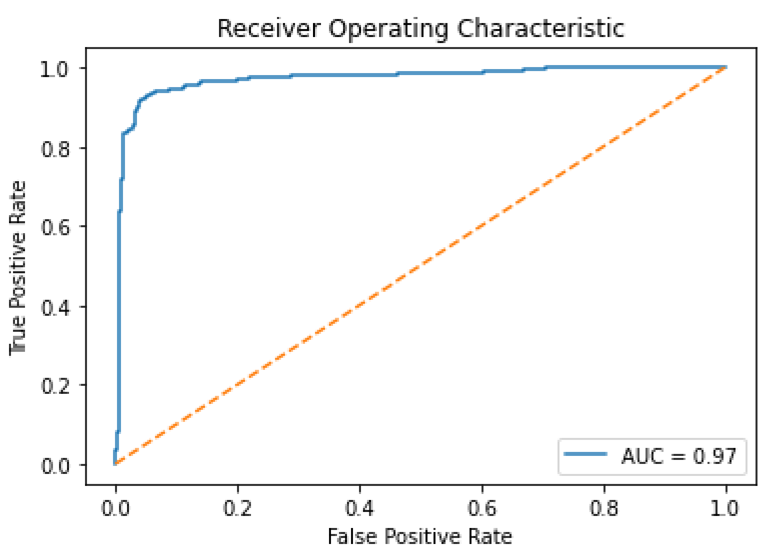
```
SVC(kernel='linear', probability=True, random_state=42)
```

```
# generate predictions
```

```
y_pred = svm.predict(X_test)

# calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print('Model accuracy is: ', accuracy)
```

```
Model accuracy is:  0.9381153305203939
```

```
# predict probabilities for X_test using predict_proba
#Took help from Sklearn website
probabilities = svm.predict_proba(X_test)

# select the probabilities for label 1.0
y_proba = probabilities[:, 1]

# calculate FPR and TPR at different thresholds
false_positive_rate, true_positive_rate, thresholds = roc_curve(y_test, y_proba, pos_labe

# calculate AUC
roc_auc = auc(false_positive_rate, true_positive_rate)

plt.title('Receiver Operating Characteristic')
# plot the FPR on the x axis and the TPR on the y axis
roc_plot = plt.plot(false_positive_rate,
                    true_positive_rate,
                    label='AUC = {:0.2f}'.format(roc_auc))

plt.legend(loc=0)
plt.plot([0,1], [0,1], ls='--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate');
```




```
svm = SVC(kernel='rbf', probability=True, random_state=42)

```

```
# fit model
svm.fit(X_train, y_train)
```

```
SVC(probability=True, random_state=42)
```

```
# generate predictions
y_pred = svm.predict(X_test)

# calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print('Model accuracy is: ', accuracy)
```

```
Model accuracy is:  0.9184247538677919
```

```
# predict probabilities for X_test using predict_proba
probabilities = svm.predict_proba(X_test)

# select the probabilities for label 1.0
y_proba = probabilities[:, 1]

# calculate FPR and TPR at different thresholds
false_positive_rate, true_positive_rate, thresholds = roc_curve(y_test, y_proba, pos_labe

# calculate AUC
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roc_plot = plt.plot(false_positive_rate,
                    true_positive_rate,
                    label='AUC = {:0.2f}'.format(roc_auc))

plt.legend(loc=0)
plt.plot([0,1], [0,1], ls='--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate');
```

```
##NOW THE DATASET SPLIT AS PER THE Q2
#Applied SVM with Linear Kernel and RBF Kerner
```

```
train_ratio = 0.70
validation_ratio = 0.10
test_ratio = 0.20

x_train, x_test, y_train, y_test = train_test_split(X, y, test_size=1 - train_ratio)
x_val, x_test, y_val, y_test = train_test_split(x_test, y_test, test_size=test_ratio/(tes
#print(x_train, x_val, x_test)
```

```
svm = SVC(kernel='linear', probability=True, random_state=42)

# fit model
svm.fit(x_train, y_train)
```

```
SVC(kernel='linear', probability=True, random_state=42)
```

```
# generate predictions
y_pred = svm.predict(x_val)

# calculate accuracy
accuracy = accuracy_score(y_val, y_pred)
print('Validation accuracy is: ', accuracy)
```

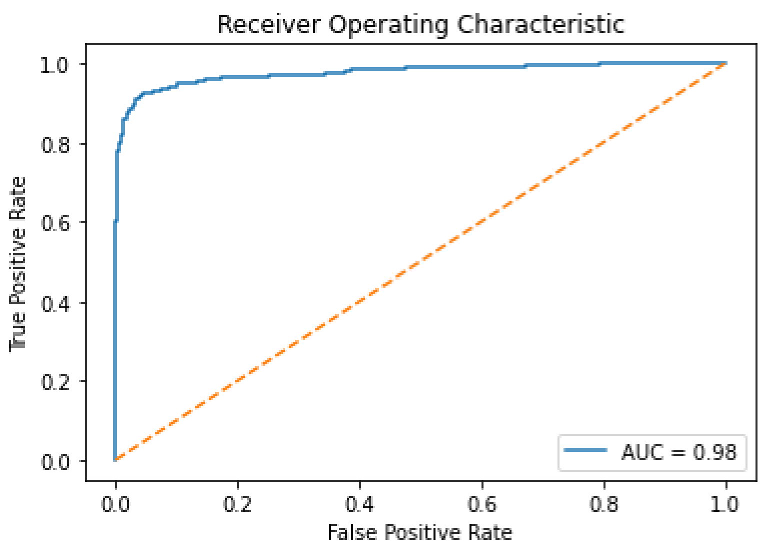
```
Validation accuracy is:  0.9211267605633803
```

```
# generate predictions
y_pred = svm.predict(x_test)

# calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print('Model accuracy is: ', accuracy)
```

```
Model accuracy is:  0.9339887640449438
```

```
# predict probabilities for X_test using predict_proba
probabilities = svm.predict_proba(x_test)

# select the probabilities for label 1.0
y_proba = probabilities[:, 1]

# calculate FPR and TPR at different thresholds
false_positive_rate, true_positive_rate, thresholds = roc_curve(y_test, y_proba, pos_labe

# calculate AUC
```

```
roc_auc = auc(false_positive_rate, true_positive_rate)

plt.title('Receiver Operating Characteristic')
# plot the FPR on the x axis and the TPR on the y axis
roc_plot = plt.plot(false_positive_rate,
                    true_positive_rate,
                    label='AUC = {:0.2f}'.format(roc_auc))

plt.legend(loc=0)
plt.plot([0,1], [0,1], ls='--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate');
```




```
from sklearn.metrics import f1_score
f1_score(y_test, y_pred,average='micro')
```

```
0.9339887640449438
```

```
train_ratio = 0.70
validation_ratio = 0.10
test_ratio = 0.20
x_train, x_test, y_train, y_test = train_test_split(X, y, test_size=1 - train_ratio)
x_val, x_test, y_val, y_test = train_test_split(x_test, y_test, test_size=test_ratio/(tes
```

```
svm = SVC(kernel='rbf', probability=True, random_state=42)

# fit model
svm.fit(x_train, y_train)
```

```
SVC(probability=True, random_state=42)
```

```
# generate predictions
y_pred = svm.predict(x_val)

```

```
# calculate accuracy
accuracy = accuracy_score(y_val, y_pred)
print('Validation accuracy is: ', accuracy)
```

```
Validation accuracy is:  0.895774647887324
```

```
# generate predictions
y_pred = svm.predict(x_test)

# calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print('Model accuracy is: ', accuracy)
```

```
Model accuracy is:  0.922752808988764
```

```
# predict probabilities for X_test using predict_proba
probabilities = svm.predict_proba(x_test)

# select the probabilities for label 1.0
y_proba = probabilities[:, 1]

# calculate FPR and TPR at different thresholds
false_positive_rate, true_positive_rate, thresholds = roc_curve(y_test, y_proba, pos_labe

# calculate AUC
roc_auc = auc(false_positive_rate, true_positive_rate)

plt.title('Receiver Operating Characteristic')
# plot the FPR on the x axis and the TPR on the y axis
roc_plot = plt.plot(false_positive_rate,
                    true_positive_rate,
                    label='AUC = {:0.2f}'.format(roc_auc))

plt.legend(loc=0)
plt.plot([0,1], [0,1], ls='--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate');
```


```
from sklearn.metrics import f1_score
print(f1_score(y_test, y_pred,average='micro'))
```

```
0.922752808988764
```

```
from sklearn.metrics import multilabel_confusion_matrix
```

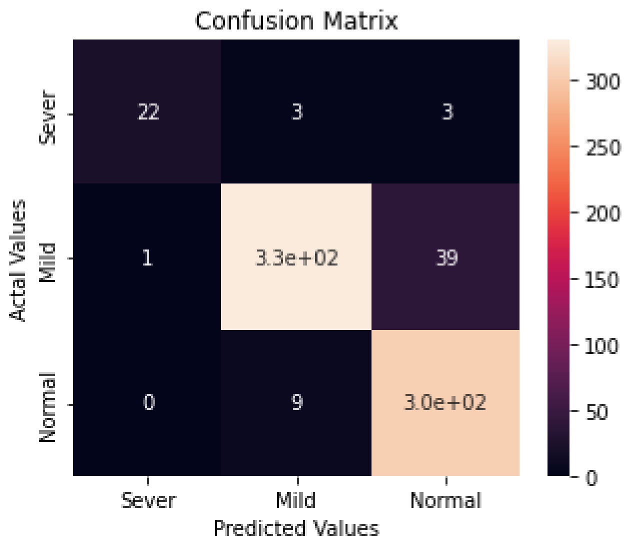
```
multilabel_confusion_matrix(y_test, y_pred)
```

```
array([[[683,   1],
        [  6,  22]],

       [[330,  12],
        [ 40, 330]],

       [[356,  42],
        [  9, 305]]])
```

```
cm = confusion_matrix(y_test, y_pred)
```

```
# Creating a dataframe for a array-formatted Confusion matrix, for easy plotting.
cm_df = pd.DataFrame(cm,
                     index = ['Sever','Mild','Normal'],
                     columns = ['Sever','Mild','Normal'])
```

```
#Plotting the confusion matrix
import seaborn as sns
plt.figure(figsize=(5,4))
sns.heatmap(cm_df, annot=True)
plt.title('Confusion Matrix')
plt.ylabel('Actal Values')
plt.xlabel('Predicted Values')
plt.show()
```


Confusion Matrix
Actal Values
Sever
Mild
Normal
22
3
3
1
3.3e+02
39
0
9
3.0e+02
Sever
Mild
Normal
Predicted Values
300
250
200
150
100
50
0