

```
In [32]: import numpy as np
import pandas as pd
import os
import librosa
from tqdm.notebook import tqdm
# ""
path = "C:/Users/srush/Downloads/Stethaim/archive2/Respiratory_Sound_Database/Respiratory_Sound_
files = []
for f in os.listdir(path):
    if f.split(".")[-1]=="wav":
        files.append(f)
#files
```

```
In [2]: x = np.array(files)
#print(x)
print(x.shape)
```

(920,)

```
In [3]: patient_dia= pd.read_csv("C:/Users/srush/Downloads/Stethaim/archive2/Respiratory_Sound_Database/
patient_dia.set_index('pid',inplace=True)
patient_dia
```

Out[3]: disease

pid	disease
101	URTI
102	Healthy
103	Asthma
104	COPD
105	URTI
...	...
222	COPD
223	COPD
224	Healthy
225	Healthy
226	Pneumonia

126 rows × 1 columns

```
In [4]: diseases = patient_dia['disease']
diseases
```

```
Out[4]: pid
101      URTI
102      Healthy
103      Asthma
104      COPD
105      URTI
...
222      COPD
223      COPD
224      Healthy
225      Healthy
226      Pneumonia
Name: disease, Length: 126, dtype: object
```

```
In [5]: diseases.value_counts()
```

```
Out[5]: COPD          64
Healthy        26
URTI          14
Bronchiectasis    7
Pneumonia       6
Bronchiolitis     6
LRTI            2
Asthma           1
Name: disease, dtype: int64
```

```
In [6]: y_labels=[]
```

```
for file in files:
    pid = int(file.split("_")[0])
    y_labels.append(diseases[pid])
```

```
y_labels
```


'COPD',
'Healthy',
'Healthy',
'Healthy',
'Pneumonia',
'Pneumonia',
'Pneumonia']

```
In [7]: from sklearn import preprocessing
```

```
label_encoder = preprocessing.LabelEncoder()  
y = label_encoder.fit_transform(y_labels)  
y[:20]
```

```
Out[7]: array([7, 7, 4, 0, 3, 3, 3, 3, 3, 3, 3, 7, 3, 3, 3, 3, 3, 3, 3, 3, 3],  
              dtype=int64)
```

```
In [8]: #sr =22050  
file0, fs  
file0.shape
```

Out[8]: (441000,)

```
In [9]: file0
```

```
Out[9]: array([0.06902321, 0.10318135, 0.09086043, ..., 0.08216032, 0.08103456,
   0.08537586], dtype=float32)
```

```
In [10]: mfcc0= librosa.feature.mfcc(y=file0, sr=sr)
mfcc0.shape
```

Out[10]: (20, 862)

In [11]: mfcc0

```
Out[11]: array([[-282.1024, -347.06177, -526.26855, ..., -521.92267,
   -406.40598, -289.31357],
   [ 122.18912, 124.44951, 107.86206, ..., 113.70073,
   123.36837, 109.003105],
   [ 13.666062, 17.754288, 70.18554, ..., 77.03856,
   40.734016, 27.640047],
   ...,
   [ 7.6162567, 7.7836895, 2.3463209, ..., 6.1596327,
   7.554513, 5.9577084],
   [ 2.139107, 4.0958548, 2.901174, ..., 4.7241554,
   5.925596, 4.836587],
   [ 7.1877527, 7.299374, 4.9591923, ..., 4.303367,
   5.7839146, 5.1229453]], dtype=float32)
```

```
In [12]: mfcc0_data=pd.DataFrame(mfcc0)
mfcc0_data
```

```
Out[12]:
```

	0	1	2	3	4	5	6	7	
0	-282.102386	-347.061768	-526.268555	-529.715393	-533.798340	-533.643066	-535.404541	-520.218628	-507.521
1	122.189117	124.449509	107.862061	104.294067	99.344963	98.707108	97.225349	118.714119	134.611
2	13.666062	17.754288	70.185539	68.842949	65.753265	62.971664	63.654453	85.207840	96.631
3	32.476734	34.216236	38.228054	37.404724	35.876495	30.888109	33.087601	54.369011	62.091
4	10.168023	13.816444	24.605679	22.781868	21.581432	15.875908	17.782530	37.301502	43.481
5	20.162477	21.619400	21.221867	19.395054	17.508921	13.399963	13.602999	29.017059	34.621
6	6.682316	9.962695	15.961784	16.049698	13.557902	12.556527	11.207798	21.091934	25.451
7	14.821116	15.882987	8.701469	10.430472	8.279190	9.885613	8.599993	13.875101	16.151
8	4.702484	7.653846	7.402489	8.332818	7.230632	9.440435	9.971238	13.161823	13.381
9	11.797634	12.768690	13.688175	12.390888	11.988113	13.158165	15.776230	18.850849	17.741
10	3.355582	6.269678	19.316011	17.143421	16.461197	16.625931	19.630976	22.875902	21.401
11	9.969526	10.826794	17.034307	16.123299	14.878353	15.144207	16.272371	19.111412	18.361
12	2.727022	5.352603	9.406879	10.072847	9.407190	10.265173	8.881266	11.061150	11.791
13	8.801946	9.349096	4.126810	5.374764	6.933677	7.581333	5.338775	6.945796	8.781
14	2.061586	4.391915	3.932614	5.776532	9.859137	9.308435	8.390165	9.291321	10.701
15	7.711519	8.040598	4.997100	8.482661	13.220037	11.710545	12.615837	12.643829	12.571
16	1.891273	3.985940	3.966965	8.611610	11.272652	10.198511	11.640848	11.172750	10.471
17	7.616257	7.783689	2.346321	5.274732	4.605256	5.155528	5.889407	5.396755	6.141
18	2.139107	4.095855	2.901174	1.921684	-0.748036	1.556329	1.510694	0.275727	3.211
19	7.187753	7.299374	4.959192	1.741133	-0.221002	3.425899	2.889159	-1.036964	2.211

20 rows × 862 columns

```
In [13]: X=[]
```

```
In [14]: for file in tqdm(files):
    f1, sr = librosa.load(path+"/"+file)
    mfccs = librosa.feature.mfcc(y=f1)
    X.append(np.mean(mfccs, axis=1))
```

In [15]: `X=np.array(X)
X.shape`

Out[15]: (920, 20)

In [16]: `X = pd.DataFrame(X)
X`

Out[16]:

	0	1	2	3	4	5	6	7	8	
0	-528.427490	104.520699	69.904068	42.575790	31.209564	27.494476	22.203037	16.555120	15.272655	16.6843
1	-582.506165	95.396805	57.399883	31.437761	28.146194	33.530159	31.566959	22.795122	16.640436	15.6354
2	-596.806458	116.010277	60.591980	25.570784	26.232788	38.502319	36.033993	18.649771	3.547745	0.8061
3	-418.434662	68.258110	48.023357	33.066364	27.972254	26.458151	22.680613	18.160683	15.905028	15.1076
4	-441.498138	100.994850	74.064911	43.247185	19.708635	7.844025	5.499160	8.011956	11.730556	14.8805
...
915	-547.458984	76.001320	54.615574	41.038040	34.075874	29.128040	23.931993	19.739443	16.812328	14.8381
916	-533.142456	99.107254	55.932369	30.749420	24.889029	25.753965	25.999796	22.928568	19.637295	18.2109
917	-520.420898	102.170929	62.050446	36.298801	32.737335	33.513817	25.237780	13.636399	8.804965	9.7687
918	-484.383331	85.328377	64.264946	45.740410	36.413624	32.995514	28.544821	21.263481	14.468318	11.1928
919	-520.003784	85.682472	60.131535	42.650108	38.514229	37.340477	29.413401	17.162458	8.781700	7.3469

920 rows × 20 columns

In [17]: `from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.4, shuffle=True)`

In [18]: `X_train.shape, X_test.shape`

Out[18]: ((552, 20), (368, 20))

In [19]: `from sklearn.ensemble import RandomForestClassifier

model = RandomForestClassifier()

model.fit(X_train, y_train)`

Out[19]: RandomForestClassifier()

In [20]: `y_actu = label_encoder.inverse_transform(y_test)
y_pre = model.predict(X_test)
y_hat = label_encoder.inverse_transform(y_pre)`

In [21]: `comp ={'Predicted values':y_hat, 'Actual values':y_actu}
pd.DataFrame(comp)`

Out[21]:

	Predicted values	Actual values
0	COPD	URTI
1	COPD	COPD
2	COPD	Bronchiectasis
3	Pneumonia	URTI
4	COPD	COPD
...
363	COPD	COPD
364	COPD	COPD
365	COPD	COPD
366	COPD	COPD
367	COPD	COPD

368 rows × 2 columns

In [22]:

```
accu=model.score(X_test, y_test)  
accu
```

Out[22]:

```
0.8967391304347826
```

In [23]:

```
print("The Accuracy is",accu*100 ,"%")
```

The Accuracy is 89.67391304347827 %

In [24]:

```
y_pred_prob= model.predict_proba(X_test)  
y_pred_prob
```

Out[24]:

```
array([[0. , 0.07, 0.07, ..., 0.03, 0.15, 0.08],  
       [0. , 0.03, 0.02, ..., 0. , 0.11, 0.03],  
       [0. , 0.16, 0. , ..., 0. , 0.02, 0.07],  
       ...,  
       [0.01, 0. , 0.02, ..., 0. , 0. , 0. ],  
       [0. , 0. , 0. , ..., 0. , 0. , 0. ],  
       [0. , 0. , 0. , ..., 0. , 0.06, 0. ]])
```

In [26]:

```
pred_wid_prob = []  
  
for pred in y_pred_prob:  
    stri=""  
    for i in pred:  
        if i>0.1:  
            j = np.where(pred==i)[0]  
            dise = label_encoder.inverse_transform(j)  
            stri+=( str(round(i*100,2))+ "% "+dise[0]+", "  
        #stri+="\n"  
    pred_wid_prob.append(stri)  
pred_wid_prob
```

```
Out[26]: ['42.0% COPD, 18.0% Healthy, 15.0% Pneumonia, ',  
 '76.0% COPD, 11.0% Pneumonia, ',  
 '16.0% Bronchiectasis, 70.0% COPD, ',  
 '27.0% COPD, 28.0% Healthy, 31.0% Pneumonia, ',  
 '86.0% COPD, ',  
 '99.0% COPD, ',  
 '91.0% COPD, ',  
 '82.0% COPD, ',  
 '98.0% COPD, ',  
 '97.0% COPD, ',  
 '36.0% COPD, 15.0% Healthy, 45.0% Pneumonia, ',  
 '56.0% COPD, 14.0% Healthy, 20.0% Pneumonia, ',  
 '83.0% COPD, ',  
 '95.0% COPD, ',  
 '99.0% COPD, ',  
 '98.0% COPD, ',  
 '100.0% COPD, ',  
 '15.0% Bronchiolitis, 52.0% COPD, 20.0% URTI, ',  
 '90.0% COPD, ',  
 '99.0% COPD, ',  
 '97.0% COPD, ',  
 '85.0% COPD, 12.0% Pneumonia, ',  
 '100.0% COPD, ',  
 '89.0% COPD, ',  
 '100.0% COPD, ',  
 '96.0% COPD, ',  
 '98.0% COPD, ',  
 '94.0% COPD, ',  
 '93.0% COPD, ',  
 '82.0% COPD, ',  
 '46.0% COPD, 31.0% Pneumonia, ',  
 '100.0% COPD, ',  
 '100.0% COPD, ',  
 '100.0% COPD, ',  
 '42.0% COPD, 15.0% Healthy, 28.0% URTI, ',  
 '98.0% COPD, ',  
 '100.0% COPD, ',  
 '93.0% COPD, ',  
 '34.0% COPD, 28.0% Healthy, 24.0% Pneumonia, ',  
 '90.0% COPD, ',  
 '91.0% COPD, ',  
 '85.0% COPD, ',  
 '99.0% COPD, ',  
 '80.0% COPD, ',  
 '96.0% COPD, ',  
 '100.0% COPD, ',  
 '95.0% COPD, ',  
 '83.0% COPD, 11.0% URTI, ',  
 '98.0% COPD, ',  
 '97.0% COPD, ',  
 '98.0% COPD, ',  
 '99.0% COPD, ',  
 '36.0% COPD, 36.0% COPD, 20.0% Pneumonia, ',  
 '100.0% COPD, ',  
 '88.0% COPD, ',  
 '96.0% COPD, ',  
 '99.0% COPD, ',  
 '70.0% COPD, 14.0% Pneumonia, ',  
 '92.0% COPD, ',  
 '88.0% COPD, ',  
 '98.0% COPD, ',  
 '47.0% COPD, 12.0% Healthy, 13.0% Pneumonia, 19.0% URTI, ',  
 '93.0% COPD, ',  
 '92.0% COPD, ']
```

'51.0% COPD, 20.0% Healthy, ',
'95.0% COPD, ',
'72.0% COPD, 19.0% Pneumonia, ',
'98.0% COPD, ',
'86.0% COPD, ',
'86.0% COPD, ',
'100.0% COPD, ',
'93.0% COPD, ',
'50.0% COPD, 12.0% Healthy, 34.0% Pneumonia, ',
'96.0% COPD, ',
'100.0% COPD, ',
'30.0% Bronchiectasis, 24.0% COPD, 14.0% Healthy, 14.0% Healthy, ',
'90.0% COPD, ',
'100.0% COPD, ',
'90.0% COPD, ',
'100.0% COPD, ',
'50.0% COPD, 13.0% Healthy, 11.0% Pneumonia, 16.0% URTI, ',
'100.0% COPD, ',
'100.0% COPD, ',
'25.0% COPD, 42.0% Healthy, 17.0% Pneumonia, ',
'99.0% COPD, ',
'23.0% COPD, 18.0% Healthy, 52.0% Pneumonia, ',
'96.0% COPD, ',
'95.0% COPD, ',
'88.0% COPD, ',
'78.0% COPD, 11.0% Pneumonia, ',
'99.0% COPD, ',
'94.0% COPD, ',
'100.0% COPD, ',
'99.0% COPD, ',
'11.0% Bronchiectasis, 57.0% COPD, 12.0% Pneumonia, 12.0% Pneumonia, ',
'18.0% COPD, 40.0% Healthy, 23.0% URTI, ',
'91.0% COPD, ',
'92.0% COPD, ',
'94.0% COPD, ',
'99.0% COPD, ',
'86.0% COPD, ',
'65.0% COPD, 14.0% Healthy, ',
'92.0% COPD, ',
'63.0% COPD, 22.0% Pneumonia, ',
'99.0% COPD, ',
'99.0% COPD, ',
'98.0% COPD, ',
'100.0% COPD, ',
'99.0% COPD, ',
'100.0% COPD, ',
'64.0% COPD, 11.0% URTI, ',
'98.0% COPD, ',
'100.0% COPD, ',
'100.0% COPD, ',
'100.0% COPD, ',
'99.0% COPD, ',
'100.0% COPD, ',
'28.0% COPD, 25.0% Healthy, 36.0% Pneumonia, ',
'99.0% COPD, ',
'83.0% COPD, ',
'100.0% COPD, ',
'74.0% COPD, 13.0% URTI, ',
'97.0% COPD, ',
'62.0% Bronchiectasis, 24.0% COPD, ',
'100.0% COPD, ',
'87.0% COPD, ',
'100.0% COPD, ',
'98.0% COPD, ',

'98.0% COPD, ',
'98.0% COPD, ',
'98.0% COPD, ',
'29.0% COPD, 11.0% Healthy, 16.0% Pneumonia, 38.0% URTI, ',
'92.0% COPD, ',
'91.0% COPD, ',
'36.0% COPD, 52.0% Pneumonia, ',
'93.0% COPD, ',
'87.0% COPD, ',
'100.0% COPD, ',
'73.0% COPD, 13.0% URTI, ',
'99.0% COPD, ',
'95.0% COPD, ',
'80.0% COPD, ',
'47.0% COPD, 27.0% Pneumonia, 12.0% URTI, ',
'94.0% COPD, ',
'98.0% COPD, ',
'100.0% COPD, ',
'99.0% COPD, ',
'94.0% COPD, ',
'99.0% COPD, ',
'84.0% COPD, ',
'88.0% COPD, ',
'95.0% COPD, ',
'99.0% COPD, ',
'99.0% COPD, ',
'100.0% COPD, ',
'100.0% COPD, ',
'53.0% COPD, 20.0% Pneumonia, 13.0% URTI, ',
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'100.0% COPD, ',
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'93.0% COPD, ',
'88.0% COPD, ',
'95.0% COPD, ',
'100.0% COPD, ',
'36.0% COPD, 56.0% Pneumonia, ',
'83.0% COPD, ',
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'99.0% COPD, ',
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'100.0% COPD, ',
'99.0% COPD, ',
'100.0% COPD, ',
'100.0% COPD, ',
'100.0% COPD, ',
'21.0% COPD, 28.0% Healthy, 38.0% URTI, ',
'90.0% COPD, ',
'99.0% COPD, ',
'96.0% COPD, ',
'100.0% COPD, ',
'99.0% COPD, ',
'98.0% COPD, ',
'98.0% COPD, ',
'19.0% Bronchiectasis, 16.0% Bronchiolitis, 25.0% COPD, 15.0% Healthy, 23.0% URTI, ',
'91.0% COPD, ',
'98.0% COPD, ',
'88.0% COPD, ',
'39.0% COPD, 23.0% Healthy, 23.0% Healthy, 15.0% URTI, ',
'98.0% COPD, ',
'69.0% COPD, ',
'16.0% Bronchiolitis, 20.0% COPD, 19.0% Healthy, 20.0% COPD, 19.0% Healthy, ',
'15.0% Bronchiectasis, 49.0% COPD, 13.0% Healthy, 11.0% Pneumonia, ',
'96.0% COPD, ',

'91.0% COPD, ',
'100.0% COPD, ',
'16.0% Bronchiectasis, 67.0% COPD, ',
'90.0% COPD, ',
'92.0% COPD, ',
'85.0% COPD, ',
'99.0% COPD, ',
'45.0% COPD, 22.0% Healthy, 11.0% Pneumonia, 11.0% Pneumonia, ',
'99.0% COPD, ',
'79.0% COPD, 16.0% Pneumonia, ',
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'99.0% COPD, ',
'99.0% COPD, ',
'100.0% COPD, ',
'85.0% COPD, ',
'100.0% COPD, ',
'99.0% COPD, ',
'98.0% COPD, ',
'88.0% COPD, ',
'99.0% COPD, ',
'11.0% Bronchiolitis, 37.0% COPD, 20.0% Healthy, 16.0% URTI, ',
'100.0% COPD, ',
'13.0% Bronchiectasis, 32.0% COPD, 14.0% Healthy, 23.0% Pneumonia, 16.0% URTI, ',
'99.0% COPD, ',
'98.0% COPD, ',
'99.0% COPD, ',
'100.0% COPD, ',
'70.0% COPD, 11.0% Healthy, ',
'98.0% COPD, ',
'41.0% COPD, 14.0% Healthy, 35.0% Pneumonia, ',
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'100.0% COPD, ',
'44.0% Healthy, 11.0% Pneumonia, 23.0% URTI, ',
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'75.0% COPD, 11.0% Healthy, ',
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'96.0% COPD, ',
'92.0% COPD, ',
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'57.0% COPD, 15.0% Healthy, 15.0% Healthy, ',
'89.0% COPD, ',
'100.0% COPD, ',
'94.0% COPD, ',
'98.0% COPD, ',
'91.0% COPD, ',
'99.0% COPD, ',
'83.0% COPD, ',
'100.0% COPD, ',
'100.0% COPD, ',
'94.0% COPD, ',
'94.0% COPD, ',
'99.0% COPD, ',
'43.0% COPD, 41.0% Pneumonia, ',
'98.0% COPD, ',
'84.0% COPD, ',
'98.0% COPD, ',
'97.0% COPD, ',

'95.0% COPD, ',
'13.0% Bronchiectasis, 45.0% COPD, 32.0% Pneumonia, ',
'54.0% COPD, 15.0% Healthy, 17.0% Pneumonia, ',
'100.0% COPD, ',
'90.0% COPD, ',
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'100.0% COPD, ',
'98.0% COPD, ',
'91.0% COPD, ',
'99.0% COPD, ',
'99.0% COPD, ',
'89.0% COPD, ',
'100.0% COPD, ',
'80.0% COPD, ',
'55.0% COPD, 16.0% Healthy, ',
'98.0% COPD, ',
'99.0% COPD, ',
'95.0% COPD, ',
'93.0% COPD, ',
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'94.0% COPD, ',
'79.0% COPD, ',
'93.0% COPD, ',
'96.0% COPD, ',
'95.0% COPD, ',
'84.0% COPD, ',
'81.0% COPD, ',
'81.0% COPD, ',
'89.0% COPD, ',
'98.0% COPD, ',
'98.0% COPD, ',
'55.0% COPD, 26.0% Healthy, ',
'100.0% COPD, ',
'14.0% Bronchiectasis, 53.0% COPD, 17.0% URTI, ',
'93.0% COPD, ',
'100.0% COPD, ',
'87.0% COPD, ',
'98.0% COPD, ',
'92.0% COPD, ',
'12.0% Bronchiectasis, 62.0% COPD, 12.0% Bronchiectasis, ',
'100.0% COPD, ',
'100.0% COPD, ',
'96.0% COPD, ',
'97.0% COPD, ',
'100.0% COPD, ',
'93.0% COPD, ',
'97.0% COPD, ',
'79.0% COPD, ',
'96.0% COPD, ',
'100.0% COPD, ',
'99.0% COPD, ',
'43.0% Bronchiectasis, 46.0% COPD, ',
'100.0% COPD, ',
'85.0% COPD, ',
'79.0% COPD, 12.0% Pneumonia, ',
'79.0% COPD, ',
'95.0% COPD, ',
'90.0% COPD, ',
'97.0% COPD, ',
'94.0% COPD, ',
'98.0% COPD, '

```
'100.0% COPD, ',  
'100.0% COPD, ',  
'37.0% COPD, 38.0% Healthy, ',  
'12.0% Bronchiectasis, 15.0% Bronchiolitis, 31.0% COPD, 26.0% Pneumonia, ',  
'27.0% Bronchiectasis, 43.0% COPD, 15.0% Healthy, ',  
'100.0% COPD, ',  
'12.0% Bronchiolitis, 22.0% COPD, 24.0% Healthy, 26.0% Pneumonia, 15.0% URTI, ',  
'94.0% COPD, ',  
'98.0% COPD, ',  
'100.0% COPD, ',  
'98.0% COPD, ',  
'100.0% COPD, ',  
'91.0% COPD, ',  
'93.0% COPD, ',  
'93.0% COPD, ',  
'12.0% Bronchiolitis, 46.0% COPD, 13.0% Healthy, 17.0% URTI, ',  
'56.0% COPD, 19.0% Pneumonia, ',  
'45.0% COPD, 37.0% Healthy, 11.0% Pneumonia, ',  
'93.0% COPD, ',  
'85.0% COPD, ',  
'73.0% COPD, 12.0% Pneumonia, ',  
'90.0% COPD, ',  
'82.0% COPD, ',  
'91.0% COPD, ',  
'94.0% COPD, ',  
'16.0% Bronchiectasis, 77.0% COPD, ',  
'100.0% COPD, ',  
'91.0% COPD, ',  
'45.0% COPD, 18.0% Healthy, 14.0% Pneumonia, 12.0% URTI, ',  
'35.0% COPD, 30.0% Healthy, 21.0% Pneumonia, 11.0% URTI, ',  
'100.0% COPD, ',  
'99.0% COPD, ',  
'100.0% COPD, ',  
'95.0% COPD, ',  
'99.0% COPD, ',  
'80.0% COPD, ',  
'99.0% COPD, ',  
'40.0% COPD, 46.0% Pneumonia, ',  
'100.0% COPD, ',  
'100.0% COPD, ',  
'91.0% COPD, ',  
'92.0% COPD, ',  
'99.0% COPD, ',  
'100.0% COPD, ',  
'12.0% Bronchiectasis, 67.0% COPD, ',  
'96.0% COPD, ',  
'100.0% COPD, ',  
'93.0% COPD, ']
```

```
In [27]: final_res ={ 'Given Disease':y_hat , 'Our prediction':pred_wid_prob }  
results = pd.DataFrame(final_res)  
results
```

Out[27]:

	Given Disease	Our prediction
0	COPD	42.0% COPD, 18.0% Healthy, 15.0% Pneumonia,
1	COPD	76.0% COPD, 11.0% Pneumonia,
2	COPD	16.0% Bronchiectasis, 70.0% COPD,
3	Pneumonia	27.0% COPD, 28.0% Healthy, 31.0% Pneumonia,
4	COPD	86.0% COPD,
...
363	COPD	100.0% COPD,
364	COPD	12.0% Bronchiectasis, 67.0% COPD,
365	COPD	96.0% COPD,
366	COPD	100.0% COPD,
367	COPD	93.0% COPD,

368 rows × 2 columns

In [31]:

```
from sklearn.metrics import confusion_matrix  
confusion_matrix(y_actu, y_hat)
```

Out[31]:

```
array([[ 1,  0,  5,  0,  0,  0,  0],  
       [ 0,  0,  4,  0,  0,  1,  0],  
       [ 0,  0, 322,  0,  0,  1,  0],  
       [ 1,  0,  8,  3,  0,  1,  1],  
       [ 0,  0,  0,  0,  0,  1,  0],  
       [ 0,  0,  9,  0,  0,  3,  0],  
       [ 0,  0,  4,  1,  0,  1,  1]], dtype=int64)
```

In []:

In []: