Music Genre Classification - A case of Predictive Analytics

August 2, 2019

Md Shamsuzzaman
MSc. of Engineering in Big Data Analytics

1 MULTICLASS CLASSIFICATION FOR MUSIC GENRES

```
In [1]: %matplotlib inline
        import itertools
        import numpy, scipy, matplotlib.pyplot as plt, pandas, librosa,sklearn
        import config

        from sklearn.neighbors import KNeighborsClassifier
        from sklearn.ensemble import RandomForestClassifier
        from sklearn.neural_network import MLPClassifier
        from sklearn.svm import SVC
```

```
In [2]: data_set=pandas.read_csv('data_set.csv',index_col=False)
        GENRES=['Adhunik', 'band', 'Deshhottobodhok', 'Nazrul', 'Polligiti', 'Rabindro','Rock']
        data_set[:5]
```

```
Out[2]:    meanZCR    stdZCR  meanSpecCentroid  stdSpecCentroid  meanSpecContrast  \
        0  0.962721 -0.601874          0.983954        -0.612836         -0.742546
        1  0.489787  0.331832          0.360995        -0.490174         -0.545470
        2  0.419249  0.220103          0.293166        -0.337192         -0.531619
        3  0.707558 -0.150335          0.794879        -0.107344         -0.664695
        4  0.055773 -0.285244          0.285656        -0.014140         -0.659572

           stdSpecContrast  meanSpecBandwidth  stdSpecBandwidth  meanSpecRollof  \
        0        -0.755910           0.812723         -0.695148        0.966339
        1        -0.576120           0.761158         -0.669701        0.599201
        2        -0.541354           0.692485         -0.615743        0.503967
        3        -0.577673           0.674896         -0.231656        0.789003
        4        -0.459264           0.739968         -0.454382        0.548645

           stdSpecRollof  ...  stdMFCC_9  meanMFCC_10  stdMFCC_10  meanMFCC_11  \
        0      -0.617198  ...  -0.757113     0.259305   -0.702903     0.161542
        1      -0.543727  ...  -0.611994     0.076543   -0.053326    -0.124967
        2      -0.338720  ...  -0.738532     0.195369   -0.694261    -0.100478
        3      -0.054182  ...  -0.894098     0.266507   -0.880440    -0.095706
        4      -0.181314  ...  -0.775438     0.120252   -0.473478    -0.073089

           stdMFCC_11  meanMFCC_12  stdMFCC_12  meanMFCC_13  stdMFCC_13    genre
        0   -0.675466     0.158719   -0.751043     0.002768   -0.684250  Adhunik
        1   -0.717158     0.013013   -0.719873    -0.348223   -0.443437  Adhunik
        2   -0.559201    -0.002678   -0.656888    -0.303428   -0.745899  Adhunik
        3   -0.854582     0.066147   -0.832387    -0.291351   -0.692726  Adhunik
        4   -0.528988     0.053426   -0.763586    -0.276285   -0.808457  Adhunik

        [5 rows x 37 columns]
```

```
In [3]: from sklearn.model_selection import train_test_split
        number_of_rows,number_of_cols = data_set.shape
        data_set_values=numpy.array(data_set)
        train, test = train_test_split(data_set_values, test_size = 0.3,random_state=42,
                                       stratify=data_set_values[:,number_of_cols-1])
        train_x=train[:,:number_of_cols-1]
        train_y=train[:,number_of_cols-1]
        test_x=test[:,:number_of_cols-1]
        test_y=test[:,number_of_cols-1]

        print("Training data size: {}".format(train.shape))
        print("Test data size: {}".format(test.shape))
```

```
Training data size: (336, 37)
Test data size: (144, 37)
```

```
In [ ]:
```

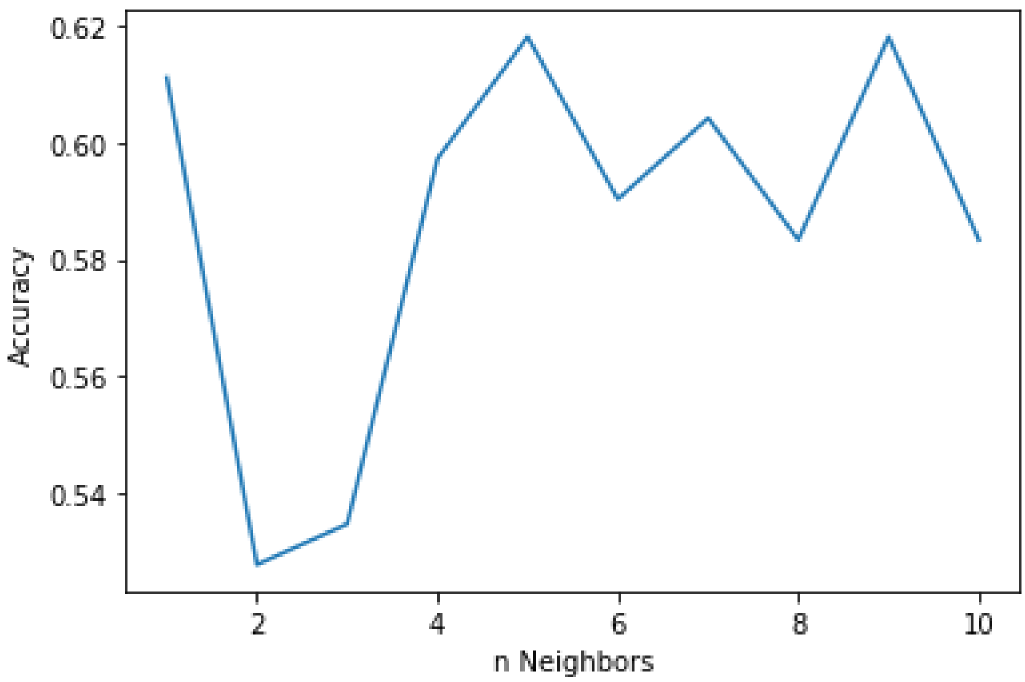
```
In [4]: def confusion_matrix(cm, classes,
                                  title='Confusion matrix',
                                  cmap=plt.cm.Blues):

            plt.imshow(cm, interpolation='nearest', cmap=cmap)
            plt.title(title)
            plt.colorbar()
            tick_marks = numpy.arange(len(classes))
            plt.xticks(tick_marks, classes, rotation=45)
            plt.yticks(tick_marks, classes)

            thresh = cm.max() / 2.
            for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
                plt.text(j, i, cm[i, j],
                         horizontalalignment="center",
                         color="white" if cm[i, j] > thresh else "black")

            plt.tight_layout()
```

```
    plt.ylabel('True label')
    plt.xlabel('Predicted label')

def plot_cnf(model,dataset_x,dataset_y,GENRES):
    true_y=dataset_y
    true_x=dataset_x
    pred=model.predict(true_x)

    print("---------------PERFORMANCE ANALYSIS FOR THE MODEL----------------\n")

    print("Real Test dataset labels: \n{}\n".format(true_y))
    print("Predicted Test dataset labels: \n{}".format(pred))

    cnf_matrix=sklearn.metrics.confusion_matrix(true_y,pred)
    plt.figure()
    a=confusion_matrix(cnf_matrix,classes=GENRES,title='Confusion matrix')
```

1.1 Application of KNN algorithm and its performance analysis

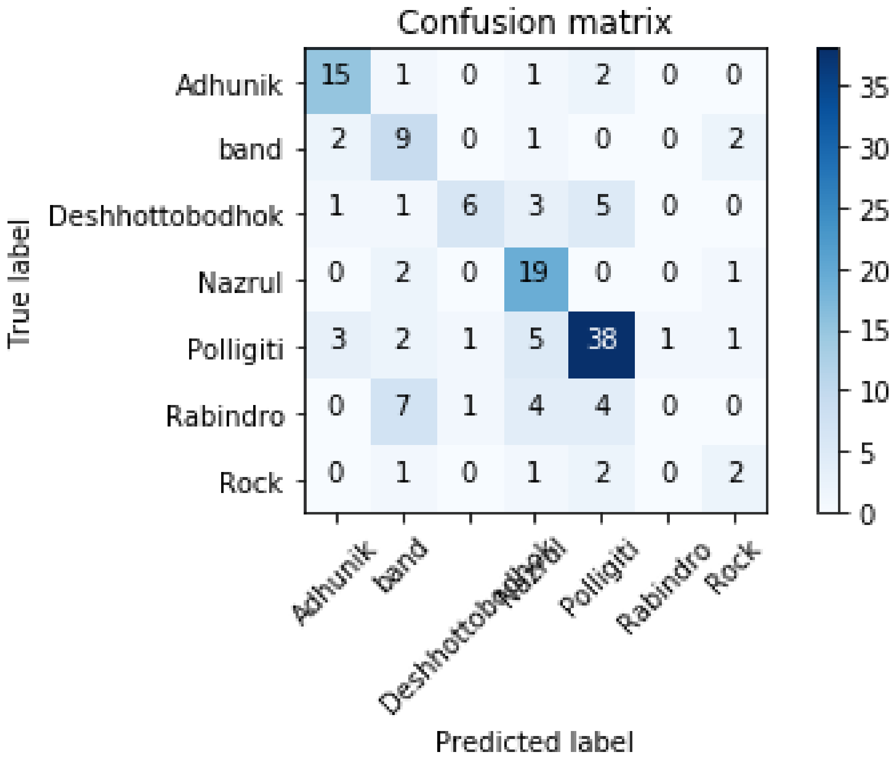
```
In [5]: results_knn=[]
        for i in range(1,11):
            knn=KNeighborsClassifier(n_neighbors=i)
            knn.fit(train_x,train_y)
            results_knn.append(knn.score(test_x,test_y))

        max_accuracy_knn=max(results_knn)
        best_k=1+results_knn.index(max(results_knn))
        print("Max Accuracy is {:.3f} on test dataset with {} neighbors.\n".format(max_accurac

        plt.plot(numpy.arange(1,11),results_knn)
        plt.xlabel("n Neighbors")
        plt.ylabel("Accuracy")


        knn=KNeighborsClassifier(n_neighbors=best_k)
        knn.fit(train_x,train_y)

        print("Test score: {:.3f}".format(knn.score(test_x,test_y)))
```

```
Max Accuracy is 0.618 on test dataset with 5 neighbors.

Test score: 0.618
```



```
In [6]: plot_cnf(knn,test_x,test_y,GENRES)
```

```
---------------PERFORMANCE ANALYSIS FOR THE MODEL----------------

Real Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Band' 'Nazrul' 'Nazrul'
 'Polligiti' 'Band' 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Band'
 'Adhunik' 'Polligiti' 'Polligiti' 'Rock' 'Rabindro' 'Polligiti'
 'Polligiti' 'Rabindro' 'Nazrul' 'Polligiti' 'Nazrul' 'Adhunik'
 'Polligiti' 'Rabindro' 'Polligiti' 'Nazrul' 'Rock' 'Polligiti' 'Nazrul'
 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti' 'Polligiti'
 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Polligiti' 'Adhunik' 'Band' 'Band' 'Nazrul' 'Adhunik' 'Band' 'Adhunik'
 'Polligiti' 'Nazrul' 'Polligiti' 'Rock' 'Rock' 'Nazrul' 'Band'
 'Polligiti' 'Deshhottobodhok' 'Nazrul' 'Rabindro' 'Nazrul' 'Polligiti'
 'Polligiti' 'Polligiti' 'Polligiti' 'Rabindro' 'Adhunik'
 'Deshhottobodhok' 'Deshhottobodhok' 'Deshhottobodhok' 'Polligiti'
 'Rabindro' 'Rock' 'Nazrul' 'Adhunik' 'Nazrul' 'Polligiti' 'Adhunik'
 'Polligiti' 'Band' 'Deshhottobodhok' 'Adhunik' 'Nazrul' 'Deshhottobodhok'
 'Polligiti' 'Polligiti' 'Nazrul' 'Adhunik' 'Deshhottobodhok' 'Adhunik'
 'Band' 'Adhunik' 'Adhunik' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Adhunik' 'Polligiti' 'Rabindro' 'Polligiti' 'Band' 'Rabindro' 'Adhunik'
 'Rabindro' 'Rabindro' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti'
 'Adhunik' 'Rabindro' 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Rock'
 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Polligiti' 'Nazrul' 'Polligiti'
 'Polligiti' 'Rabindro' 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti'
 'Deshhottobodhok' 'Polligiti' 'Deshhottobodhok' 'Deshhottobodhok'
 'Polligiti' 'Adhunik' 'Rabindro' 'Adhunik' 'Nazrul' 'Band' 'Nazrul'
 'Polligiti' 'Adhunik' 'Band']

Predicted Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Adhunik' 'Nazrul'
 'Nazrul' 'Nazrul' 'Band' 'Adhunik' 'Polligiti' 'Polligiti' 'Band'
 'Adhunik' 'Polligiti' 'Polligiti' 'Rock' 'Band' 'Band' 'Band' 'Polligiti'
 'Nazrul' 'Adhunik' 'Nazrul' 'Adhunik' 'Polligiti' 'Nazrul' 'Polligiti'
 'Rock' 'Polligiti' 'Polligiti' 'Nazrul' 'Nazrul' 'Nazrul' 'Band' 'Rock'
 'Polligiti' 'Polligiti' 'Band' 'Polligiti' 'Nazrul' 'Polligiti'
 'Polligiti' 'Nazrul' 'Adhunik' 'Band' 'Band' 'Nazrul' 'Adhunik' 'Band'
 'Polligiti' 'Nazrul' 'Band' 'Polligiti' 'Rock' 'Nazrul' 'Nazrul' 'Band'
 'Polligiti' 'Deshhottobodhok' 'Band' 'Band' 'Nazrul' 'Polligiti'
 'Polligiti' 'Polligiti' 'Polligiti' 'Nazrul' 'Adhunik' 'Deshhottobodhok'
 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Nazrul' 'Band' 'Nazrul' 'Adhunik'
 'Nazrul' 'Polligiti' 'Nazrul' 'Polligiti' 'Nazrul' 'Adhunik' 'Polligiti'
 'Nazrul' 'Band' 'Polligiti' 'Nazrul' 'Nazrul' 'Adhunik' 'Polligiti'
 'Adhunik' 'Band' 'Adhunik' 'Adhunik' 'Polligiti' 'Nazrul' 'Polligiti'
 'Polligiti' 'Adhunik' 'Polligiti' 'Band' 'Polligiti' 'Adhunik' 'Band'
 'Adhunik' 'Deshhottobodhok' 'Nazrul' 'Band' 'Deshhottobodhok' 'Nazrul'
 'Polligiti' 'Adhunik' 'Band' 'Deshhottobodhok' 'Polligiti' 'Polligiti'
 'Polligiti' 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Polligiti' 'Nazrul'
 'Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Rabindro' 'Rock'
 'Polligiti' 'Deshhottobodhok' 'Adhunik' 'Nazrul' 'Polligiti' 'Polligiti'
 'Band' 'Polligiti' 'Adhunik' 'Nazrul' 'Rock' 'Nazrul' 'Polligiti'
 'Adhunik' 'Band']
```

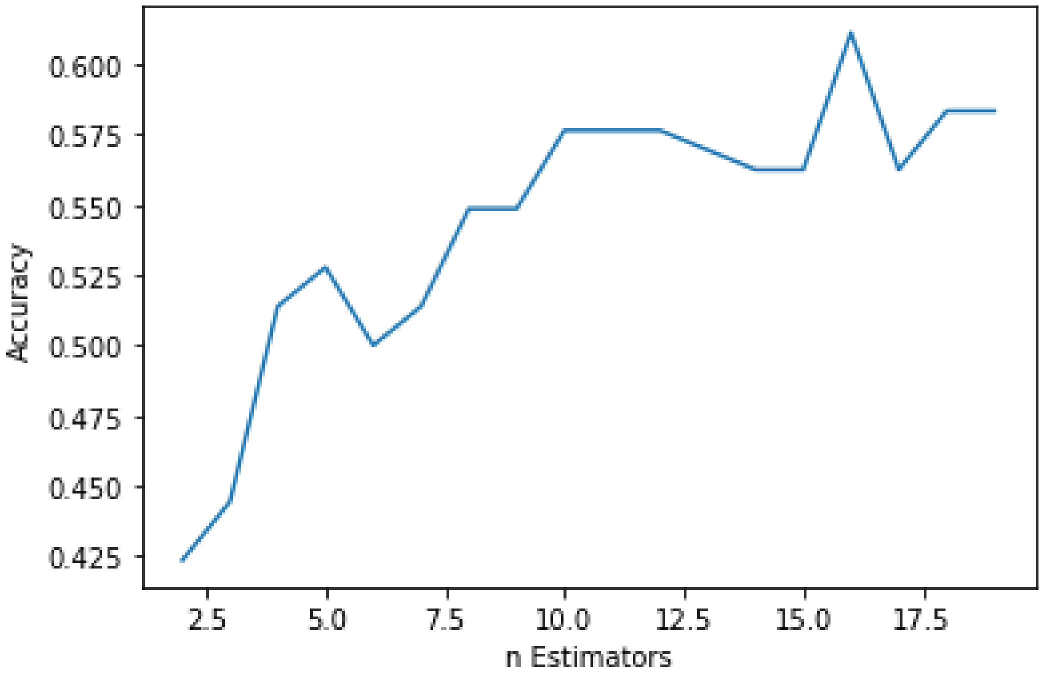


1.2 Application of Random Forest algorithm and its performance analysis

```
In [7]: results_forest=[]
        for i in range(2,20):
            forest=RandomForestClassifier(random_state=42,n_estimators=i)
            forest.fit(train_x,train_y)
            results_forest.append(forest.score(test_x,test_y))

        max_accuracy_forest=max(results_forest)
        best_n_est=2+results_forest.index(max(results_forest))
        print("Max Accuracy is {:.3f} on test dataset with {} estimators.\n".format(max_accura

        plt.plot(numpy.arange(2,20),results_forest)
        plt.xlabel("n Estimators")
        plt.ylabel("Accuracy")


        forest=RandomForestClassifier(random_state=42,n_estimators=best_n_est)
        forest.fit(train_x,train_y)

        print("Test score: {:.3f}".format(forest.score(test_x,test_y)))
```

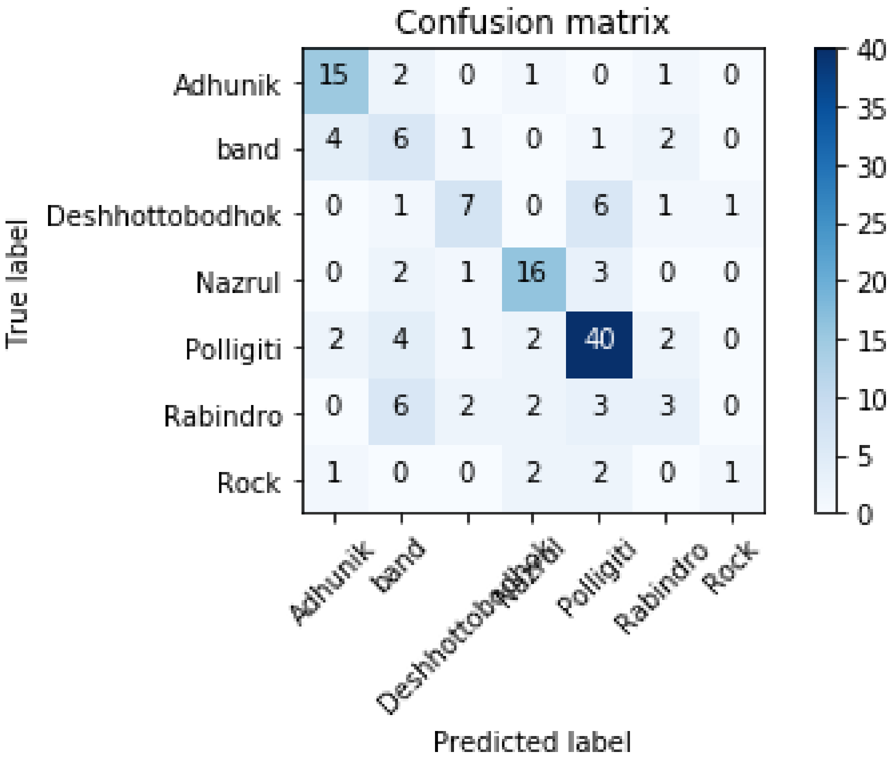
```
Max Accuracy is 0.611 on test dataset with 16 estimators.
```

```
Test score: 0.611
```



```
In [8]: plot_cnf(forest,test_x,test_y,GENRES)
```

```
---------------PERFORMANCE ANALYSIS FOR THE MODEL----------------

Real Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Band' 'Nazrul' 'Nazrul'
 'Polligiti' 'Band' 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Band'
 'Adhunik' 'Polligiti' 'Polligiti' 'Rock' 'Rabindro' 'Polligiti'
 'Polligiti' 'Rabindro' 'Nazrul' 'Polligiti' 'Nazrul' 'Adhunik'
 'Polligiti' 'Rabindro' 'Polligiti' 'Nazrul' 'Rock' 'Polligiti' 'Nazrul'
 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti' 'Polligiti'
 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Polligiti' 'Adhunik' 'Band' 'Band' 'Nazrul' 'Adhunik' 'Band' 'Adhunik'
 'Polligiti' 'Nazrul' 'Polligiti' 'Rock' 'Rock' 'Nazrul' 'Band'
 'Polligiti' 'Deshhottobodhok' 'Nazrul' 'Rabindro' 'Nazrul' 'Polligiti'
 'Polligiti' 'Polligiti' 'Polligiti' 'Rabindro' 'Adhunik'
 'Deshhottobodhok' 'Deshhottobodhok' 'Deshhottobodhok' 'Polligiti'
 'Rabindro' 'Rock' 'Nazrul' 'Adhunik' 'Nazrul' 'Polligiti' 'Adhunik'
 'Polligiti' 'Band' 'Deshhottobodhok' 'Adhunik' 'Nazrul' 'Deshhottobodhok'
 'Polligiti' 'Polligiti' 'Nazrul' 'Adhunik' 'Deshhottobodhok' 'Adhunik'
 'Band' 'Adhunik' 'Adhunik' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Adhunik' 'Polligiti' 'Rabindro' 'Polligiti' 'Band' 'Rabindro' 'Adhunik'
 'Rabindro' 'Rabindro' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti'
 'Adhunik' 'Rabindro' 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Rock'
 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Polligiti' 'Nazrul' 'Polligiti'
 'Polligiti' 'Rabindro' 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti'
 'Deshhottobodhok' 'Polligiti' 'Deshhottobodhok' 'Deshhottobodhok'
 'Polligiti' 'Adhunik' 'Rabindro' 'Adhunik' 'Nazrul' 'Band' 'Nazrul'
 'Polligiti' 'Adhunik' 'Band']

Predicted Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Adhunik' 'Nazrul'
 'Nazrul' 'Polligiti' 'Band' 'Adhunik' 'Polligiti' 'Polligiti' 'Adhunik'
 'Adhunik' 'Band' 'Polligiti' 'Rock' 'Band' 'Polligiti' 'Polligiti'
 'Rabindro' 'Nazrul' 'Deshhottobodhok' 'Nazrul' 'Adhunik' 'Polligiti'
 'Nazrul' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti' 'Nazrul'
 'Deshhottobodhok' 'Polligiti' 'Rabindro' 'Band' 'Polligiti'
 'Deshhottobodhok' 'Polligiti' 'Polligiti' 'Polligiti' 'Polligiti'
 'Polligiti' 'Polligiti' 'Adhunik' 'Band' 'Band' 'Nazrul' 'Adhunik' 'Band'
 'Rabindro' 'Nazrul' 'Band' 'Polligiti' 'Nazrul' 'Nazrul' 'Nazrul'
 'Adhunik' 'Polligiti' 'Rock' 'Band' 'Band' 'Nazrul' 'Band' 'Polligiti'
 'Rabindro' 'Polligiti' 'Rabindro' 'Adhunik' 'Polligiti' 'Polligiti'
 'Deshhottobodhok' 'Polligiti' 'Nazrul' 'Adhunik' 'Nazrul' 'Adhunik'
 'Nazrul' 'Polligiti' 'Nazrul' 'Polligiti' 'Band' 'Rabindro' 'Band'
 'Nazrul' 'Deshhottobodhok' 'Polligiti' 'Nazrul' 'Nazrul' 'Adhunik'
 'Polligiti' 'Adhunik' 'Band' 'Adhunik' 'Adhunik' 'Polligiti' 'Polligiti'
 'Polligiti' 'Polligiti' 'Adhunik' 'Polligiti' 'Band' 'Polligiti'
 'Adhunik' 'Band' 'Adhunik' 'Rabindro' 'Deshhottobodhok' 'Band'
 'Polligiti' 'Nazrul' 'Polligiti' 'Adhunik' 'Band' 'Polligiti' 'Polligiti'
 'Rabindro' 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Polligiti'
 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Polligiti' 'Polligiti'
 'Deshhottobodhok' 'Adhunik' 'Deshhottobodhok' 'Polligiti'
 'Deshhottobodhok' 'Band' 'Band' 'Polligiti' 'Polligiti' 'Band'
 'Deshhottobodhok' 'Adhunik' 'Nazrul' 'Polligiti' 'Nazrul' 'Polligiti'
 'Adhunik' 'Rabindro']
```



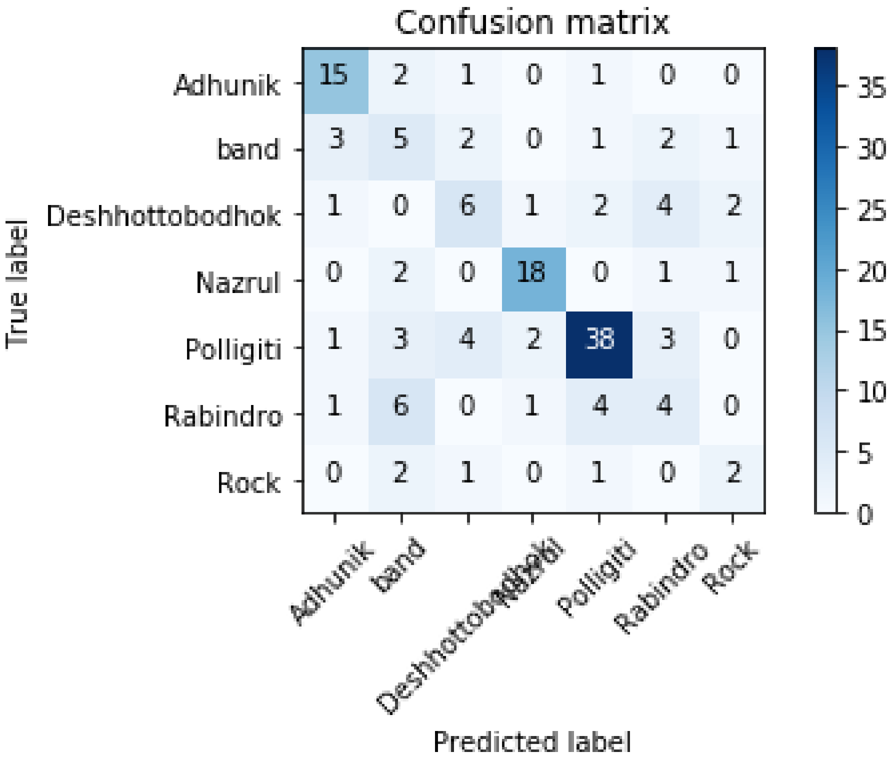
1.3 Application of SVM algorithm and its performance analysis

```
In [9]: svm=SVC(C=100,gamma=0.08)
        svm.fit(train_x,train_y)

        print("Test score: {:.3f}".format(svm.score(test_x,test_y)))
```

```
Test score: 0.611
```

```
In [10]: plot_cnf(svm,test_x,test_y,GENRES)
```

```
---------------PERFORMANCE ANALYSIS FOR THE MODEL----------------

Real Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Band' 'Nazrul' 'Nazrul'
 'Polligiti' 'Band' 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Band'
 'Adhunik' 'Polligiti' 'Polligiti' 'Rock' 'Rabindro' 'Polligiti'
 'Polligiti' 'Rabindro' 'Nazrul' 'Polligiti' 'Nazrul' 'Adhunik'
 'Polligiti' 'Rabindro' 'Polligiti' 'Nazrul' 'Rock' 'Polligiti' 'Nazrul'
 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti' 'Polligiti'
 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Polligiti' 'Adhunik' 'Band' 'Band' 'Nazrul' 'Adhunik' 'Band' 'Adhunik'
 'Polligiti' 'Nazrul' 'Polligiti' 'Rock' 'Rock' 'Nazrul' 'Band'
 'Polligiti' 'Deshhottobodhok' 'Nazrul' 'Rabindro' 'Nazrul' 'Polligiti'
 'Polligiti' 'Polligiti' 'Polligiti' 'Rabindro' 'Adhunik'
 'Deshhottobodhok' 'Deshhottobodhok' 'Deshhottobodhok' 'Polligiti'
 'Rabindro' 'Rock' 'Nazrul' 'Adhunik' 'Nazrul' 'Polligiti' 'Adhunik'
 'Polligiti' 'Band' 'Deshhottobodhok' 'Adhunik' 'Nazrul' 'Deshhottobodhok'
 'Polligiti' 'Polligiti' 'Nazrul' 'Adhunik' 'Deshhottobodhok' 'Adhunik'
 'Band' 'Adhunik' 'Adhunik' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Adhunik' 'Polligiti' 'Rabindro' 'Polligiti' 'Band' 'Rabindro' 'Adhunik'
 'Rabindro' 'Rabindro' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti'
 'Adhunik' 'Rabindro' 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Rock'
 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Polligiti' 'Nazrul' 'Polligiti'
 'Polligiti' 'Rabindro' 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti'
 'Deshhottobodhok' 'Polligiti' 'Deshhottobodhok' 'Deshhottobodhok'
 'Polligiti' 'Adhunik' 'Rabindro' 'Adhunik' 'Nazrul' 'Band' 'Nazrul'
 'Polligiti' 'Adhunik' 'Band']

Predicted Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Adhunik' 'Nazrul'
 'Nazrul' 'Deshhottobodhok' 'Deshhottobodhok' 'Adhunik' 'Deshhottobodhok'
 'Deshhottobodhok' 'Adhunik' 'Adhunik' 'Band' 'Polligiti' 'Band' 'Band'
 'Polligiti' 'Polligiti' 'Rabindro' 'Nazrul' 'Band' 'Nazrul' 'Adhunik'
 'Polligiti' 'Nazrul' 'Polligiti' 'Rock' 'Polligiti' 'Polligiti' 'Nazrul'
 'Nazrul' 'Deshhottobodhok' 'Rabindro' 'Band' 'Polligiti' 'Rock' 'Band'
 'Rabindro' 'Nazrul' 'Polligiti' 'Polligiti' 'Polligiti' 'Adhunik' 'Band'
 'Band' 'Nazrul' 'Adhunik' 'Band' 'Adhunik' 'Nazrul' 'Band' 'Polligiti'
 'Rock' 'Rock' 'Rabindro' 'Band' 'Polligiti' 'Deshhottobodhok' 'Band'
 'Band' 'Nazrul' 'Polligiti' 'Polligiti' 'Polligiti' 'Polligiti'
 'Rabindro' 'Adhunik' 'Deshhottobodhok' 'Rabindro' 'Deshhottobodhok'
 'Polligiti' 'Polligiti' 'Band' 'Nazrul' 'Adhunik' 'Nazrul' 'Polligiti'
 'Deshhottobodhok' 'Polligiti' 'Band' 'Adhunik' 'Polligiti' 'Nazrul'
 'Rock' 'Polligiti' 'Polligiti' 'Nazrul' 'Adhunik' 'Polligiti' 'Adhunik'
 'Deshhottobodhok' 'Adhunik' 'Adhunik' 'Polligiti' 'Nazrul' 'Polligiti'
 'Polligiti' 'Adhunik' 'Polligiti' 'Band' 'Polligiti' 'Adhunik'
 'Polligiti' 'Adhunik' 'Band' 'Polligiti' 'Rabindro' 'Deshhottobodhok'
 'Nazrul' 'Nazrul' 'Band' 'Band' 'Rabindro' 'Polligiti' 'Polligiti'
 'Deshhottobodhok' 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Polligiti'
 'Nazrul' 'Rabindro' 'Polligiti' 'Adhunik' 'Rabindro' 'Rabindro' 'Rock'
 'Polligiti' 'Rabindro' 'Polligiti' 'Deshhottobodhok' 'Polligiti'
 'Polligiti' 'Band' 'Rabindro' 'Adhunik' 'Nazrul' 'Polligiti' 'Nazrul'
 'Polligiti' 'Adhunik' 'Rabindro']
```

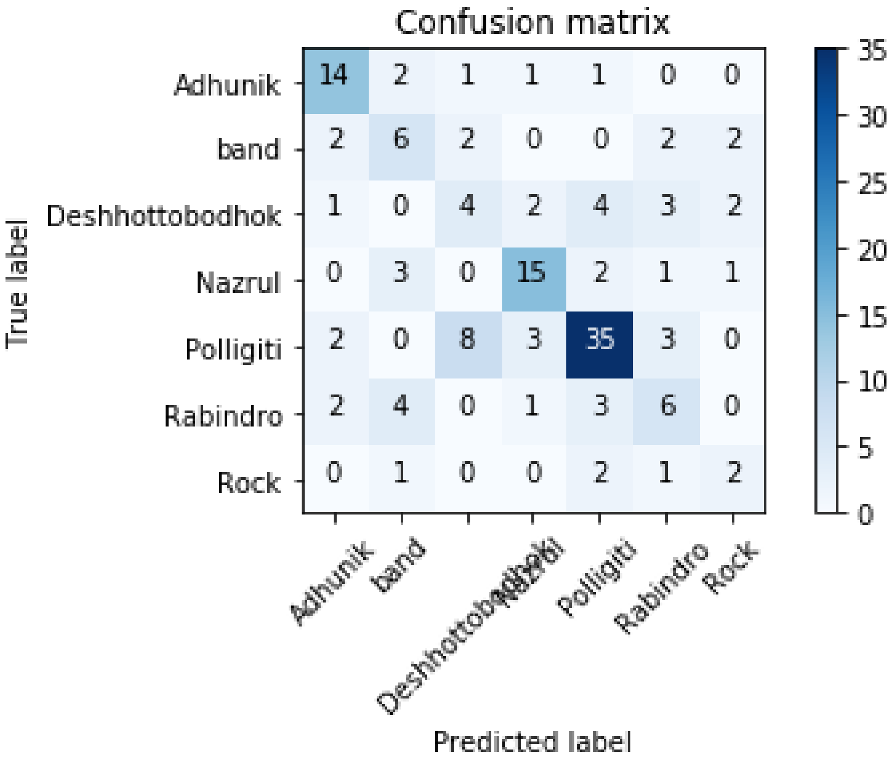


```
In [11]: neural=MLPClassifier(max_iter=400,random_state=2,hidden_layer_sizes=[40,40])
         neural.fit(train_x,train_y)

         print("Test score: {:.3f}".format(neural.score(test_x,test_y)))
```

```
Test score: 0.569


C:\Users\minds\Anaconda3\lib\site-packages\sklearn\neural_network\multilayer_perceptron.py:562
  % self.max_iter, ConvergenceWarning)
```

```
In [12]: plot_cnf(neural,test_x,test_y,GENRES)
```

```
---------------PERFORMANCE ANALYSIS FOR THE MODEL----------------

Real Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Polligiti' 'Band' 'Nazrul' 'Nazrul'
 'Polligiti' 'Band' 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Band'
 'Adhunik' 'Polligiti' 'Polligiti' 'Rock' 'Rabindro' 'Polligiti'
 'Polligiti' 'Rabindro' 'Nazrul' 'Polligiti' 'Nazrul' 'Adhunik'
 'Polligiti' 'Rabindro' 'Polligiti' 'Nazrul' 'Rock' 'Polligiti' 'Nazrul'
 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti' 'Polligiti'
 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Polligiti' 'Adhunik' 'Band' 'Band' 'Nazrul' 'Adhunik' 'Band' 'Adhunik'
 'Polligiti' 'Nazrul' 'Polligiti' 'Rock' 'Rock' 'Nazrul' 'Band'
 'Polligiti' 'Deshhottobodhok' 'Nazrul' 'Rabindro' 'Nazrul' 'Polligiti'
 'Polligiti' 'Polligiti' 'Polligiti' 'Rabindro' 'Adhunik'
 'Deshhottobodhok' 'Deshhottobodhok' 'Deshhottobodhok' 'Polligiti'
 'Rabindro' 'Rock' 'Nazrul' 'Adhunik' 'Nazrul' 'Polligiti' 'Adhunik'
 'Polligiti' 'Band' 'Deshhottobodhok' 'Adhunik' 'Nazrul' 'Deshhottobodhok'
 'Polligiti' 'Polligiti' 'Nazrul' 'Adhunik' 'Deshhottobodhok' 'Adhunik'
 'Band' 'Adhunik' 'Adhunik' 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti'
 'Adhunik' 'Polligiti' 'Rabindro' 'Polligiti' 'Band' 'Rabindro' 'Adhunik'
 'Rabindro' 'Rabindro' 'Rabindro' 'Polligiti' 'Nazrul' 'Polligiti'
 'Adhunik' 'Rabindro' 'Deshhottobodhok' 'Rabindro' 'Polligiti' 'Rock'
 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Polligiti' 'Nazrul' 'Polligiti'
 'Polligiti' 'Rabindro' 'Deshhottobodhok' 'Polligiti' 'Band' 'Polligiti'
 'Deshhottobodhok' 'Polligiti' 'Deshhottobodhok' 'Deshhottobodhok'
 'Polligiti' 'Adhunik' 'Rabindro' 'Adhunik' 'Nazrul' 'Band' 'Nazrul'
 'Polligiti' 'Adhunik' 'Band']

Predicted Test dataset labels:
['Polligiti' 'Polligiti' 'Polligiti' 'Deshhottobodhok' 'Adhunik' 'Nazrul'
 'Nazrul' 'Polligiti' 'Band' 'Adhunik' 'Polligiti' 'Deshhottobodhok'
 'Band' 'Adhunik' 'Polligiti' 'Polligiti' 'Band' 'Band' 'Polligiti'
 'Polligiti' 'Rabindro' 'Rabindro' 'Deshhottobodhok' 'Nazrul' 'Adhunik'
 'Polligiti' 'Nazrul' 'Polligiti' 'Rock' 'Polligiti' 'Polligiti' 'Nazrul'
 'Nazrul' 'Deshhottobodhok' 'Rabindro' 'Deshhottobodhok' 'Polligiti'
 'Rock' 'Rabindro' 'Rabindro' 'Polligiti' 'Polligiti' 'Polligiti'
 'Rabindro' 'Adhunik' 'Band' 'Deshhottobodhok' 'Nazrul' 'Adhunik' 'Band'
 'Polligiti' 'Nazrul' 'Band' 'Polligiti' 'Rock' 'Rock' 'Nazrul' 'Band'
 'Polligiti' 'Deshhottobodhok' 'Band' 'Band' 'Nazrul' 'Deshhottobodhok'
 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Rabindro' 'Adhunik' 'Rabindro'
 'Rabindro' 'Deshhottobodhok' 'Polligiti' 'Polligiti' 'Polligiti' 'Nazrul'
 'Adhunik' 'Nazrul' 'Polligiti' 'Deshhottobodhok' 'Polligiti' 'Band'
 'Adhunik' 'Nazrul' 'Nazrul' 'Rock' 'Polligiti' 'Nazrul' 'Nazrul'
 'Adhunik' 'Polligiti' 'Adhunik' 'Deshhottobodhok' 'Adhunik' 'Adhunik'
 'Polligiti' 'Nazrul' 'Polligiti' 'Polligiti' 'Adhunik' 'Polligiti' 'Band'
 'Adhunik' 'Adhunik' 'Adhunik' 'Adhunik' 'Rabindro' 'Polligiti' 'Rabindro'
 'Deshhottobodhok' 'Nazrul' 'Nazrul' 'Band' 'Band' 'Polligiti' 'Polligiti'
 'Polligiti' 'Rabindro' 'Deshhottobodhok' 'Nazrul' 'Polligiti' 'Polligiti'
 'Band' 'Polligiti' 'Polligiti' 'Adhunik' 'Rabindro' 'Rabindro' 'Rock'
 'Polligiti' 'Nazrul' 'Polligiti' 'Deshhottobodhok' 'Polligiti'
 'Polligiti' 'Band' 'Rabindro' 'Adhunik' 'Nazrul' 'Rock' 'Polligiti'
 'Polligiti' 'Adhunik' 'Rabindro']
```



2 Deep learning

```
In [13]: data=data_set
         # Dropping unneccesary columns
         data = data.drop(['genre'],axis=1)
         data.head()
```

```
Out[13]:    meanZCR    stdZCR  meanSpecCentroid  stdSpecCentroid  meanSpecContrast  \
         0  0.962721 -0.601874          0.983954        -0.612836         -0.742546
         1  0.489787  0.331832          0.360995        -0.490174         -0.545470
         2  0.419249  0.220103          0.293166        -0.337192         -0.531619
         3  0.707558 -0.150335          0.794879        -0.107344         -0.664695
         4  0.055773 -0.285244          0.285656        -0.014140         -0.659572

            stdSpecContrast  meanSpecBandwidth  stdSpecBandwidth  meanSpecRollof  \
         0        -0.755910           0.812723         -0.695148        0.966339
         1        -0.576120           0.761158         -0.669701        0.599201
         2        -0.541354           0.692485         -0.615743        0.503967
         3        -0.577673           0.674896         -0.231656        0.789003
         4        -0.459264           0.739968         -0.454382        0.548645

            stdSpecRollof  ...  meanMFCC_9  stdMFCC_9  meanMFCC_10  stdMFCC_10  \
0      -0.617198  ...    0.072827  -0.757113     0.259305   -0.702903
1      -0.543727  ...   -0.196826  -0.611994     0.076543   -0.053326
2      -0.338720  ...   -0.095695  -0.738532     0.195369   -0.694261
3      -0.054182  ...   -0.085974  -0.894098     0.266507   -0.880440
4      -0.181314  ...   -0.106465  -0.775438     0.120252   -0.473478

   meanMFCC_11  stdMFCC_11  meanMFCC_12  stdMFCC_12  meanMFCC_13  stdMFCC_13
0     0.161542   -0.675466     0.158719   -0.751043     0.002768   -0.684250
1    -0.124967   -0.717158     0.013013   -0.719873    -0.348223   -0.443437
2    -0.100478   -0.559201    -0.002678   -0.656888    -0.303428   -0.745899
3    -0.095706   -0.854582     0.066147   -0.832387    -0.291351   -0.692726
4    -0.073089   -0.528988     0.053426   -0.763586    -0.276285   -0.808457

[5 rows x 36 columns]
```

```
In [14]: from sklearn.model_selection import train_test_split
         from sklearn.preprocessing import LabelEncoder, StandardScaler
         import numpy as np
         genre_list = data_set.iloc[:, -1]
         encoder = LabelEncoder()
         y = encoder.fit_transform(genre_list)
         X = np.array(data.iloc[:, :-1], dtype = float)
```

```
In [15]: X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)
```

```
In [16]: from keras import models
         from keras import layers

         model = models.Sequential()
         model.add(layers.Dense(256, activation='relu', input_shape=(X_train.shape[1],)))

         model.add(layers.Dense(128, activation='relu'))

         model.add(layers.Dense(64, activation='relu'))

         model.add(layers.Dense(10, activation='softmax'))
```

```
Using TensorFlow backend.


WARNING:tensorflow:From C:\Users\minds\Anaconda3\lib\site-packages\tensorflow\python\framework
Instructions for updating:
Colocations handled automatically by placer.
```

```
In [17]: model.compile(optimizer='adam',
                       loss='sparse_categorical_crossentropy',
                       metrics=['accuracy'])
```

```
In [18]: history = model.fit(X_train,
                             y_train,
                             epochs=20,
                             batch_size=128)
```

```
WARNING:tensorflow:From C:\Users\minds\Anaconda3\lib\site-packages\tensorflow\python\ops\math_
Instructions for updating:
Use tf.cast instead.
Epoch 1/20
384/384 [==============================] - 2s 6ms/step - loss: 2.2747 - acc: 0.1172
Epoch 2/20
384/384 [==============================] - 0s 26us/step - loss: 2.1304 - acc: 0.3177
Epoch 3/20
384/384 [==============================] - 0s 26us/step - loss: 1.9929 - acc: 0.4089
Epoch 4/20
384/384 [==============================] - 0s 29us/step - loss: 1.8401 - acc: 0.4271
Epoch 5/20
384/384 [==============================] - 0s 31us/step - loss: 1.7019 - acc: 0.4297
Epoch 6/20
384/384 [==============================] - 0s 36us/step - loss: 1.5955 - acc: 0.4635
Epoch 7/20
384/384 [==============================] - 0s 31us/step - loss: 1.4975 - acc: 0.4948
Epoch 8/20
384/384 [==============================] - 0s 34us/step - loss: 1.4059 - acc: 0.5391
Epoch 9/20
384/384 [==============================] - 0s 34us/step - loss: 1.3239 - acc: 0.5781
Epoch 10/20
384/384 [==============================] - 0s 29us/step - loss: 1.2621 - acc: 0.5938
Epoch 11/20
384/384 [==============================] - 0s 34us/step - loss: 1.2061 - acc: 0.6094
Epoch 12/20
384/384 [==============================] - 0s 34us/step - loss: 1.1571 - acc: 0.6146
Epoch 13/20
384/384 [==============================] - 0s 29us/step - loss: 1.1199 - acc: 0.6172
Epoch 14/20
384/384 [==============================] - 0s 28us/step - loss: 1.0803 - acc: 0.6432
Epoch 15/20
384/384 [==============================] - 0s 31us/step - loss: 1.0413 - acc: 0.6484
Epoch 16/20
384/384 [==============================] - 0s 31us/step - loss: 1.0074 - acc: 0.6667
Epoch 17/20
384/384 [==============================] - 0s 31us/step - loss: 0.9789 - acc: 0.6589
Epoch 18/20
384/384 [==============================] - 0s 31us/step - loss: 0.9513 - acc: 0.6823
Epoch 19/20
384/384 [==============================] - 0s 28us/step - loss: 0.9251 - acc: 0.7161
Epoch 20/20
384/384 [==============================] - 0s 34us/step - loss: 0.8931 - acc: 0.7109
```

```
In [19]: test_loss, test_acc = model.evaluate(X_test,y_test)

96/96 [==============================] - 0s 426us/step
```

```
In [20]: print('test_acc: ',test_acc)

test_acc:  0.59375
```

```
In [ ]:
```

```
In [21]: predictions = model.predict(X_test)
```

```
In [22]: predictions[0].shape

Out[22]: (10,)
```

```
In [23]: np.sum(predictions[0])

Out[23]: 0.99999994
```