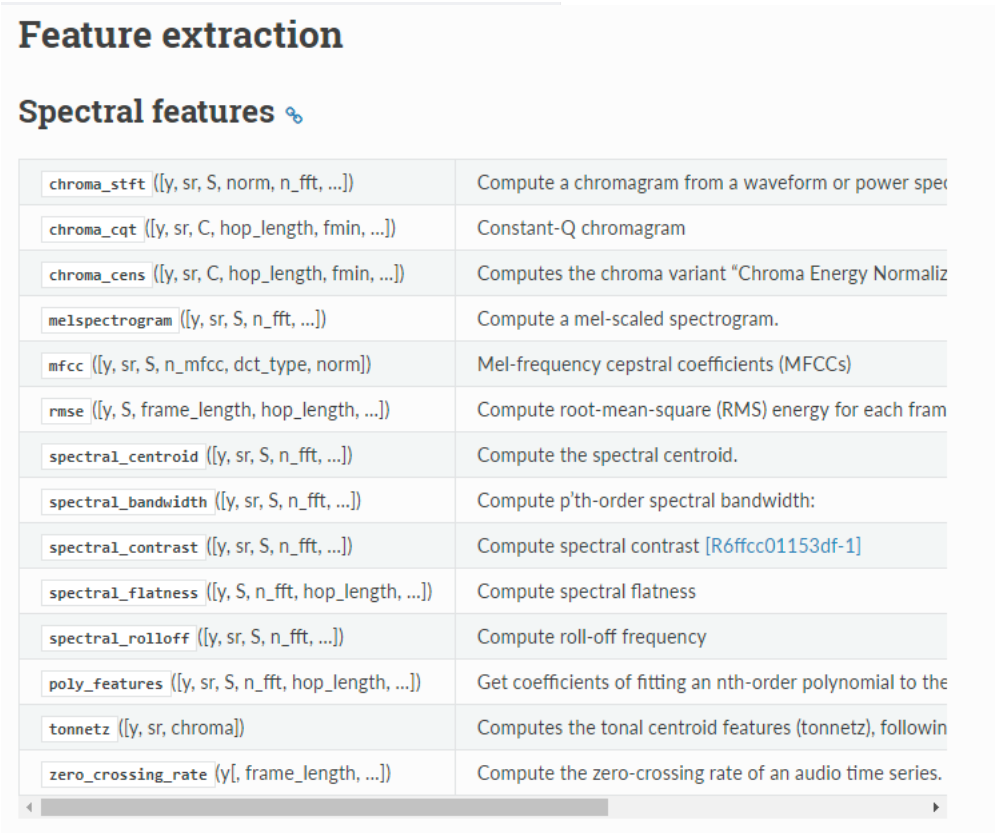
Music Genre Classification with LSTMs



Feature extraction

Spectral features

`chroma_stft` ([y, sr, S, norm, n_fft, ...])	Compute a chromagram from a waveform or power spec
`chroma_cqt` ([y, sr, C, hop_length, fmin, ...])	Constant-Q chromagram
`chroma_cens` ([y, sr, C, hop_length, fmin, ...])	Computes the chroma variant "Chroma Energy Normaliz
`melspectrogram` ([y, sr, S, n_fft, ...])	Compute a mel-scaled spectrogram.
`mfcc` ([y, sr, S, n_mfcc, dct_type, norm])	Mel-frequency cepstral coefficients (MFCCs)
`rmse` ([y, S, frame_length, hop_length, ...])	Compute root-mean-square (RMS) energy for each fram
`spectral_centroid` ([y, sr, S, n_fft, ...])	Compute the spectral centroid.
`spectral_bandwidth` ([y, sr, S, n_fft, ...])	Compute p'th-order spectral bandwidth:
`spectral_contrast` ([y, sr, S, n_fft, ...])	Compute spectral contrast [R6ffcc01153df-1]
`spectral_flatness` ([y, S, n_fft, hop_length, ...])	Compute spectral flatness
`spectral_rolloff` ([y, sr, S, n_fft, ...])	Compute roll-off frequency
`poly_features` ([y, sr, S, n_fft, hop_length, ...])	Get coefficients of fitting an nth-order polynomial to the
`tonnetz` ([y, sr, chroma])	Computes the tonal centroid features (tonnetz), followin
`zero_crossing_rate` (y[, frame_length, ...])	Compute the zero-crossing rate of an audio time series.

经大量研究表明, MFCCs(Mel Frequency Cepstral Coefficents)是一种在自动语音和说话人识别中广泛使用的特征。在语音识别领域，MFCCs 在人工特征方面被证明十分有效，所以在此保留 `mfcc` 这一特征。

此外， `chroma_stft`， `chroma_cqt`， `chroma_cens` 相似性很高，可视为一种特征。

同理， `spectral_centroid`， `spectral_bandwidth`， `spectral_contrast`， `spectral_flatness`， `spectral_rolloff` 也可视为一种特征。

因此可得如下特征组合实验结果。

1.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 4s - loss: 0.3981 - acc: 0.8286
 70/420 [====>.........................] - ETA: 4s - loss: 0.3539 - acc: 0.8714
105/420 [======>.......................] - ETA: 3s - loss: 0.3192 - acc: 0.8857
140/420 [=========>....................] - ETA: 3s - loss: 0.3459 - acc: 0.8643
175/420 [===========>..................] - ETA: 2s - loss: 0.3430 - acc: 0.8571
210/420 [==============>...............] - ETA: 2s - loss: 0.3372 - acc: 0.8571
245/420 [================>.............] - ETA: 2s - loss: 0.3379 - acc: 0.8612
280/420 [===================>..........] - ETA: 1s - loss: 0.3226 - acc: 0.8679
315/420 [=====================>........] - ETA: 1s - loss: 0.3272 - acc: 0.8635
350/420 [========================>.....] - ETA: 0s - loss: 0.3336 - acc: 0.8686
385/420 [==========================>...] - ETA: 0s - loss: 0.3415 - acc: 0.8675
420/420 [==============================] - 5s 12ms/step - loss: 0.3838 - acc: 0.8595

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:    1.373569389184316
Dev accuracy:    0.5833333544433117

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 5ms/step
Test loss:    1.2082031120856602
Test accuracy:    0.6166666721304258
```

2.

```
    for i, file in enumerate(list_of_audiofiles):
        y, sr = librosa.load(file)

        mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
        spectral_center = librosa.feature.spectral_bandwidth(y=y, sr=sr, hop_length=self.hop_length)
        chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length)
        rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)



        splits = re.split('[ .]', file)
        genre = re.split('[ /]', splits[1])[3]
        target.append(genre)

        data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
        data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
        data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
        data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 3s - loss: 0.3491 - acc: 0.8857
 70/420 [====>.........................] - ETA: 3s - loss: 0.3915 - acc: 0.8286
105/420 [======>.......................] - ETA: 3s - loss: 0.4367 - acc: 0.8190
140/420 [=========>....................] - ETA: 2s - loss: 0.4475 - acc: 0.8214
175/420 [===========>..................] - ETA: 2s - loss: 0.4243 - acc: 0.8343
210/420 [==============>...............] - ETA: 2s - loss: 0.4109 - acc: 0.8429
245/420 [================>.............] - ETA: 1s - loss: 0.4001 - acc: 0.8449
280/420 [==================>...........] - ETA: 1s - loss: 0.4070 - acc: 0.8393
315/420 [====================>.........] - ETA: 1s - loss: 0.4365 - acc: 0.8349
350/420 [======================>.....] - ETA: 0s - loss: 0.4444 - acc: 0.8286
385/420 [========================>...] - ETA: 0s - loss: 0.4347 - acc: 0.8338
420/420 [==============================] - 4s 10ms/step - loss: 0.4330 - acc: 0.8333

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:   0.9716353416442871
Dev accuracy:   0.7083333507180214

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 2ms/step
Test loss:   1.0784357984860737
Test accuracy:   0.6666666865348816
```

3.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_flatness(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 4s - loss: 0.0208 - acc: 1.0000
 70/420 [====>.........................] - ETA: 4s - loss: 0.0180 - acc: 1.0000
105/420 [======>.......................] - ETA: 3s - loss: 0.0215 - acc: 1.0000
140/420 [=========>....................] - ETA: 3s - loss: 0.0181 - acc: 1.0000
175/420 [===========>..................] - ETA: 3s - loss: 0.0173 - acc: 1.0000
210/420 [==============>...............] - ETA: 2s - loss: 0.0177 - acc: 1.0000
245/420 [================>.............] - ETA: 2s - loss: 0.0222 - acc: 0.9959
280/420 [===================>..........] - ETA: 1s - loss: 0.0394 - acc: 0.9929
315/420 [=====================>........] - ETA: 1s - loss: 0.0366 - acc: 0.9937
350/420 [========================>.....] - ETA: 0s - loss: 0.0336 - acc: 0.9943
385/420 [==========================>...] - ETA: 0s - loss: 0.0354 - acc: 0.9922
420/420 [==============================] - 5s 12ms/step - loss: 0.0331 - acc: 0.9929

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:   2.27315000196298
Dev accuracy:   0.6166666829958558

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 5ms/step
Test loss:   2.655836800734202
Test accuracy:   0.5333333512147268
```

4.

```python
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)

    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_rolloff(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)



    splits = re.split('[ ]', file)
    genre = re.split('[/]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 3s - loss: 0.5658 - acc: 0.8000
 70/420 [====>.........................] - ETA: 3s - loss: 0.4420 - acc: 0.8286
105/420 [======>.......................] - ETA: 3s - loss: 0.4326 - acc: 0.8381
140/420 [=========>....................] - ETA: 2s - loss: 0.4936 - acc: 0.7929
175/420 [===========>..................] - ETA: 2s - loss: 0.5304 - acc: 0.7771
210/420 [==============>...............] - ETA: 2s - loss: 0.5188 - acc: 0.7810
245/420 [================>.............] - ETA: 2s - loss: 0.5043 - acc: 0.7878
280/420 [==================>...........] - ETA: 1s - loss: 0.5303 - acc: 0.7714
315/420 [====================>.........] - ETA: 1s - loss: 0.5046 - acc: 0.7841
350/420 [======================>.....] - ETA: 0s - loss: 0.5066 - acc: 0.7914
385/420 [========================>...] - ETA: 0s - loss: 0.5076 - acc: 0.7948
420/420 [==============================] - 5s 12ms/step - loss: 0.5159 - acc: 0.7952

Validating ...

 35/120 [=======>......................] - ETA: 2s
 70/120 [================>.............] - ETA: 0s
105/120 [========================>....] - ETA: 0s
120/120 [==============================] - 1s 11ms/step
Dev loss:   0.9538268509010474
Dev accuracy:   0.6583333450059096

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 2ms/step
Test loss:   0.9062086641788483
Test accuracy:   0.6333333402872086
```

5.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length)
    zero_crossing_rate = librosa.feature.zero_crossing_rate(y=y)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = zero_crossing_rate.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 4s - loss: 0.5204 - acc: 0.7714
 70/420 [====>.........................] - ETA: 4s - loss: 0.4260 - acc: 0.8143
105/420 [======>.......................] - ETA: 3s - loss: 0.4514 - acc: 0.8095
140/420 [=========>....................] - ETA: 3s - loss: 0.4494 - acc: 0.8214
175/420 [===========>..................] - ETA: 2s - loss: 0.4155 - acc: 0.8457
210/420 [==============>...............] - ETA: 2s - loss: 0.3908 - acc: 0.8524
245/420 [================>.............] - ETA: 2s - loss: 0.3719 - acc: 0.8571
280/420 [===================>..........] - ETA: 1s - loss: 0.3807 - acc: 0.8571
315/420 [=====================>........] - ETA: 1s - loss: 0.3891 - acc: 0.8476
350/420 [========================>.....] - ETA: 0s - loss: 0.4125 - acc: 0.8429
385/420 [==========================>...] - ETA: 0s - loss: 0.4103 - acc: 0.8468
420/420 [==============================] - 5s 12ms/step - loss: 0.4061 - acc: 0.8476

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 8ms/step
Dev loss:    1.0691008294622104
Dev accuracy:    0.6416666842997074

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 5ms/step
Test loss:    1.193656325340271
Test accuracy:    0.5500000094374021
```

6.

```
    for i, file in enumerate(list_of_audiofiles):
        y, sr = librosa.load(file)

        mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=
        spectral_center = librosa.feature.spectral_bandwidth(y=y, sr=sr, hop_length
        chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length
        zero_crossing_rate = librosa.feature.zero_crossing_rate(y=y)



        splits = re.split('[ .]', file)
        genre = re.split('[ /]', splits[1])[3]
        target.append(genre)

        data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
        data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
        data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
        data[i, :, 26:33] = zero_crossing_rate.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 8s - loss: 0.4538 - acc: 0.8571
 70/420 [====>.........................] - ETA: 7s - loss: 0.4509 - acc: 0.8143
105/420 [======>.......................] - ETA: 6s - loss: 0.4328 - acc: 0.8286
140/420 [=========>....................] - ETA: 5s - loss: 0.4207 - acc: 0.8357
175/420 [===========>..................] - ETA: 5s - loss: 0.4036 - acc: 0.8400
210/420 [==============>...............] - ETA: 4s - loss: 0.4281 - acc: 0.8381
245/420 [================>.............] - ETA: 3s - loss: 0.4271 - acc: 0.8367
280/420 [==================>...........] - ETA: 2s - loss: 0.4169 - acc: 0.8464
315/420 [====================>.........] - ETA: 2s - loss: 0.4123 - acc: 0.8508
350/420 [======================>.....] - ETA: 1s - loss: 0.4108 - acc: 0.8486
385/420 [========================>...] - ETA: 0s - loss: 0.4165 - acc: 0.8442
420/420 [==============================] - 8s 20ms/step - loss: 0.4412 - acc: 0.8381

Validating ...

 35/120 [=======>......................] - ETA: 5s
 70/120 [================>.............] - ETA: 1s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 3s 23ms/step
Dev loss:   1.2569773321350415
Dev accuracy:   0.6166666808227698

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 4ms/step
Test loss:   1.3598987857500713
Test accuracy:   0.5500000268220901
```

7.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)

    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_flatness(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length)
    zero_crossing_rate = librosa.feature.zero_crossing_rate(y=y, hop_length=self.hop_length)


    splits = re.split('[ ]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = zero_crossing_rate.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 3s - loss: 0.1554 - acc: 0.9429
 70/420 [====>.........................] - ETA: 3s - loss: 0.0852 - acc: 0.9714
105/420 [======>.......................] - ETA: 2s - loss: 0.0930 - acc: 0.9619
140/420 [=========>....................] - ETA: 2s - loss: 0.0707 - acc: 0.9714
175/420 [===========>..................] - ETA: 2s - loss: 0.0603 - acc: 0.9771
210/420 [==============>...............] - ETA: 1s - loss: 0.0510 - acc: 0.9810
245/420 [================>.............] - ETA: 1s - loss: 0.0473 - acc: 0.9837
280/420 [==================>...........] - ETA: 1s - loss: 0.0613 - acc: 0.9821
315/420 [=====================>........] - ETA: 0s - loss: 0.0728 - acc: 0.9778
350/420 [========================>.....] - ETA: 0s - loss: 0.0688 - acc: 0.9800
385/420 [==========================>...] - ETA: 0s - loss: 0.0727 - acc: 0.9792
420/420 [==============================] - 4s 9ms/step - loss: 0.0675 - acc: 0.9810

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:   2.0576821342110634
Dev accuracy:   0.6333333551883698

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 2ms/step
Test loss:   2.2607963581879935
Test accuracy:   0.533333328862985
```

8.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_rolloff(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_stft(y=y, sr=sr, hop_length=self.hop_length)
    zero_crossing_rate = librosa.feature.zero_crossing_rate(y=y)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = zero_crossing_rate.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 4s - loss: 0.4505 - acc: 0.8000
 70/420 [====>.........................] - ETA: 4s - loss: 0.4440 - acc: 0.8143
105/420 [======>.......................] - ETA: 3s - loss: 0.4322 - acc: 0.8286
140/420 [=========>....................] - ETA: 3s - loss: 0.4767 - acc: 0.8143
175/420 [===========>..................] - ETA: 2s - loss: 0.4647 - acc: 0.8171
210/420 [==============>...............] - ETA: 2s - loss: 0.4810 - acc: 0.8048
245/420 [================>.............] - ETA: 2s - loss: 0.4850 - acc: 0.8122
280/420 [===================>..........] - ETA: 1s - loss: 0.5203 - acc: 0.8071
315/420 [=====================>........] - ETA: 1s - loss: 0.5180 - acc: 0.8032
350/420 [========================>.....] - ETA: 0s - loss: 0.5303 - acc: 0.7971
385/420 [==========================>...] - ETA: 0s - loss: 0.5399 - acc: 0.7870
420/420 [==============================] - 5s 12ms/step - loss: 0.5269 - acc: 0.7976

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:   0.9134505813320478
Dev accuracy:   0.6583333536982536

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 5ms/step
Test loss:   1.199605683485667
Test accuracy:   0.5500000044703484
```

9.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cqt(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 4s - loss: 0.1938 - acc: 0.9143
 70/420 [====>.........................] - ETA: 4s - loss: 0.2412 - acc: 0.9000
105/420 [======>.......................] - ETA: 3s - loss: 0.2878 - acc: 0.8952
140/420 [=========>....................] - ETA: 3s - loss: 0.2778 - acc: 0.9071
175/420 [===========>..................] - ETA: 3s - loss: 0.2677 - acc: 0.9086
210/420 [==============>...............] - ETA: 2s - loss: 0.2925 - acc: 0.9048
245/420 [================>.............] - ETA: 2s - loss: 0.2869 - acc: 0.8980
280/420 [===================>..........] - ETA: 1s - loss: 0.2831 - acc: 0.9000
315/420 [=====================>........] - ETA: 1s - loss: 0.2996 - acc: 0.8921
350/420 [========================>.....] - ETA: 0s - loss: 0.3010 - acc: 0.8886
385/420 [==========================>...] - ETA: 0s - loss: 0.3332 - acc: 0.8753
420/420 [==============================] - 5s 12ms/step - loss: 0.3233 - acc: 0.8810

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [===============>..............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:   1.1678892870744069
Dev accuracy:   0.6583333536982536

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 5ms/step
Test loss:   1.2402155896027882
Test accuracy:   0.6500000109275182
```

10.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_bandwidth(y=y,sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cqt(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 4s - loss: 0.5335 - acc: 0.7143
 70/420 [====>.........................] - ETA: 4s - loss: 0.5802 - acc: 0.7286
105/420 [======>.......................] - ETA: 3s - loss: 0.4968 - acc: 0.8000
140/420 [=========>....................] - ETA: 3s - loss: 0.5133 - acc: 0.7929
175/420 [===========>..................] - ETA: 3s - loss: 0.4896 - acc: 0.8000
210/420 [==============>...............] - ETA: 2s - loss: 0.5001 - acc: 0.7952
245/420 [================>.............] - ETA: 2s - loss: 0.4949 - acc: 0.7918
280/420 [===================>..........] - ETA: 1s - loss: 0.5077 - acc: 0.7893
315/420 [=====================>........] - ETA: 1s - loss: 0.5133 - acc: 0.7841
350/420 [========================>.....] - ETA: 0s - loss: 0.5151 - acc: 0.7829
385/420 [==========================>...] - ETA: 0s - loss: 0.5163 - acc: 0.7870
420/420 [==============================] - 5s 12ms/step - loss: 0.4985 - acc: 0.7976

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:    1.0489776755372684
Dev accuracy:    0.6083333510905504

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 5ms/step
Test loss:    1.5920234620571136
Test accuracy:    0.5333333512147268
```

11.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)

    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_flatness(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cqt(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)



    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 2s - loss: 0.0080 - acc: 1.0000
 70/420 [====>.........................] - ETA: 2s - loss: 0.0571 - acc: 0.9714
105/420 [======>.......................] - ETA: 2s - loss: 0.0568 - acc: 0.9714
140/420 [=========>....................] - ETA: 2s - loss: 0.0504 - acc: 0.9786
175/420 [===========>..................] - ETA: 2s - loss: 0.0418 - acc: 0.9829
210/420 [==============>...............] - ETA: 1s - loss: 0.0633 - acc: 0.9762
245/420 [================>.............] - ETA: 1s - loss: 0.0570 - acc: 0.9796
280/420 [===================>..........] - ETA: 1s - loss: 0.0505 - acc: 0.9821
315/420 [=====================>........] - ETA: 0s - loss: 0.0474 - acc: 0.9841
350/420 [========================>.....] - ETA: 0s - loss: 0.0601 - acc: 0.9800
385/420 [==========================>...] - ETA: 0s - loss: 0.0552 - acc: 0.9818
420/420 [==============================] - 3s 8ms/step - loss: 0.0519 - acc: 0.9833

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 4ms/step
Dev loss:   1.5269340202212334
Dev accuracy:   0.6833333522081375

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 2ms/step
Test loss:   2.4769909381866455
Test accuracy:   0.5000000124176344
```

12.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_rolloff(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cqt(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 4s - loss: 0.3650 - acc: 0.8571
 70/420 [====>.........................] - ETA: 3s - loss: 0.3188 - acc: 0.8714
105/420 [======>.......................] - ETA: 3s - loss: 0.4842 - acc: 0.8286
140/420 [=========>....................] - ETA: 3s - loss: 0.4743 - acc: 0.8143
175/420 [===========>..................] - ETA: 2s - loss: 0.4710 - acc: 0.8229
210/420 [==============>...............] - ETA: 2s - loss: 0.4542 - acc: 0.8333
245/420 [================>.............] - ETA: 2s - loss: 0.4430 - acc: 0.8367
280/420 [===================>..........] - ETA: 1s - loss: 0.4404 - acc: 0.8393
315/420 [=====================>........] - ETA: 1s - loss: 0.4376 - acc: 0.8349
350/420 [========================>.....] - ETA: 0s - loss: 0.4282 - acc: 0.8429
385/420 [==========================>...] - ETA: 0s - loss: 0.4110 - acc: 0.8494
420/420 [==============================] - 5s 12ms/step - loss: 0.4000 - acc: 0.8571

Validating ...

 35/120 [=======>......................] - ETA: 1s
 70/120 [================>.............] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 7ms/step
Dev loss:    1.1132373834649723
Dev accuracy:    0.6166666857898235

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 5ms/step
Test loss:    0.9893808513879776
Test accuracy:    0.6500000208616257
```

13.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cens(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 1s - loss: 0.2383 - acc: 0.9714
 70/420 [====>.........................] - ETA: 1s - loss: 0.3148 - acc: 0.9000
105/420 [======>.......................] - ETA: 1s - loss: 0.4082 - acc: 0.8571
140/420 [=========>....................] - ETA: 1s - loss: 0.3624 - acc: 0.8786
175/420 [===========>..................] - ETA: 0s - loss: 0.3770 - acc: 0.8743
210/420 [==============>...............] - ETA: 0s - loss: 0.3632 - acc: 0.8810
245/420 [================>.............] - ETA: 0s - loss: 0.3586 - acc: 0.8816
280/420 [===================>..........] - ETA: 0s - loss: 0.3301 - acc: 0.8929
315/420 [=====================>........] - ETA: 0s - loss: 0.3383 - acc: 0.8889
350/420 [========================>.....] - ETA: 0s - loss: 0.3478 - acc: 0.8800
385/420 [==========================>...] - ETA: 0s - loss: 0.3613 - acc: 0.8701
420/420 [==============================] - 2s 4ms/step - loss: 0.3626 - acc: 0.8643

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 3ms/step
Dev loss:    1.1321315790216129
Dev accuracy:    0.6666666828095913

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 909us/step
Test loss:    1.2191942036151886
Test accuracy:    0.6833333422740301
```

14.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cens(y=y, sr=sr, hop_length=self.hop_length)
    spectral_contrast = librosa.feature.spectral_contrast(y=y, sr=sr, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = spectral_contrast.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 1s - loss: 0.3663 - acc: 0.8857
 70/420 [====>.........................] - ETA: 1s - loss: 0.2992 - acc: 0.9000
105/420 [======>.......................] - ETA: 1s - loss: 0.3019 - acc: 0.9048
140/420 [=========>....................] - ETA: 1s - loss: 0.2965 - acc: 0.8929
175/420 [===========>..................] - ETA: 1s - loss: 0.3143 - acc: 0.8800
210/420 [==============>...............] - ETA: 0s - loss: 0.3222 - acc: 0.8810
245/420 [================>.............] - ETA: 0s - loss: 0.3409 - acc: 0.8735
280/420 [===================>..........] - ETA: 0s - loss: 0.3224 - acc: 0.8857
315/420 [=====================>........] - ETA: 0s - loss: 0.3129 - acc: 0.8889
350/420 [========================>.....] - ETA: 0s - loss: 0.3051 - acc: 0.8914
385/420 [==========================>...] - ETA: 0s - loss: 0.3115 - acc: 0.8857
420/420 [==============================] - 2s 4ms/step - loss: 0.3237 - acc: 0.8810

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 3ms/step
Dev loss:    1.0959213078022003
Dev accuracy:    0.6416666842997074

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 884us/step
Test loss:    1.1959176063537598
Test accuracy:    0.6500000208616257
```

15.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cens(y=y, sr=sr, hop_length=self.hop_length)
    spectral_bandwidth = librosa.feature.spectral_bandwidth(y=y, sr=sr, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = spectral_bandwidth.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 1s - loss: 1.1163 - acc: 0.5143
 70/420 [====>.........................] - ETA: 1s - loss: 0.9843 - acc: 0.6286
105/420 [======>.......................] - ETA: 1s - loss: 1.0822 - acc: 0.6000
140/420 [=========>....................] - ETA: 1s - loss: 1.0109 - acc: 0.6357
175/420 [===========>..................] - ETA: 0s - loss: 0.9601 - acc: 0.6514
210/420 [==============>...............] - ETA: 0s - loss: 0.9193 - acc: 0.6667
245/420 [================>.............] - ETA: 0s - loss: 0.9080 - acc: 0.6694
280/420 [===================>..........] - ETA: 0s - loss: 0.8786 - acc: 0.6750
315/420 [=====================>........] - ETA: 0s - loss: 0.8894 - acc: 0.6667
350/420 [========================>.....] - ETA: 0s - loss: 0.8771 - acc: 0.6714
385/420 [==========================>...] - ETA: 0s - loss: 0.8778 - acc: 0.6649
420/420 [==============================] - 2s 4ms/step - loss: 0.8833 - acc: 0.6667

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 3ms/step
Dev loss:    1.020694226026535
Dev accuracy:    0.6166666895151138

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 901us/step
Test loss:    0.9509770373503367
Test accuracy:    0.5833333432674408
```

16.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cens(y=y, sr=sr, hop_length=self.hop_length)
    spectral_flatness = librosa.feature.spectral_flatness(y=y, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = spectral_flatness.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 1s - loss: 0.2677 - acc: 0.8857
 70/420 [====>.........................] - ETA: 1s - loss: 0.3010 - acc: 0.8714
105/420 [======>.......................] - ETA: 1s - loss: 0.2863 - acc: 0.8952
140/420 [=========>....................] - ETA: 1s - loss: 0.2556 - acc: 0.9071
175/420 [===========>..................] - ETA: 0s - loss: 0.2629 - acc: 0.9029
210/420 [==============>...............] - ETA: 0s - loss: 0.2766 - acc: 0.8952
245/420 [================>.............] - ETA: 0s - loss: 0.2941 - acc: 0.8980
280/420 [===================>..........] - ETA: 0s - loss: 0.2730 - acc: 0.9071
315/420 [=====================>........] - ETA: 0s - loss: 0.2676 - acc: 0.9079
350/420 [========================>.....] - ETA: 0s - loss: 0.2711 - acc: 0.9114
385/420 [==========================>...] - ETA: 0s - loss: 0.2693 - acc: 0.9117
420/420 [==============================] - 2s 4ms/step - loss: 0.2690 - acc: 0.9119

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 3ms/step
Dev loss:   0.8947887097795805
Dev accuracy:   0.7583333477377892

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 907us/step
Test loss:   1.029723157485326
Test accuracy:   0.6333333551883698
```

17.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cens(y=y, sr=sr, hop_length=self.hop_length)
    spectral_rolloff = librosa.feature.spectral_rolloff(y=y, sr=sr, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = spectral_rolloff.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 2s - loss: 0.8835 - acc: 0.6857
 70/420 [====>.........................] - ETA: 1s - loss: 1.0689 - acc: 0.5571
105/420 [======>.......................] - ETA: 1s - loss: 1.0933 - acc: 0.5810
140/420 [=========>....................] - ETA: 1s - loss: 1.0484 - acc: 0.5929
175/420 [===========>..................] - ETA: 1s - loss: 1.0241 - acc: 0.6229
210/420 [==============>...............] - ETA: 1s - loss: 1.0300 - acc: 0.6190
245/420 [================>.............] - ETA: 0s - loss: 1.0319 - acc: 0.6245
280/420 [===================>..........] - ETA: 0s - loss: 1.0403 - acc: 0.6214
315/420 [=====================>........] - ETA: 0s - loss: 1.0488 - acc: 0.6222
350/420 [========================>.....] - ETA: 0s - loss: 1.0733 - acc: 0.6086
385/420 [==========================>...] - ETA: 0s - loss: 1.0566 - acc: 0.6104
420/420 [==============================] - 2s 5ms/step - loss: 1.0416 - acc: 0.6143

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 3ms/step
Dev loss:   1.000188333292802
Dev accuracy:   0.6000000151495138

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 1ms/step
Test loss:   1.244888613621394
Test accuracy:   0.4666666661699613
```

18.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cqt(y=y, sr=sr, hop_length=self.hop_length)
    spectral_bandwidth = librosa.feature.spectral_bandwidth(y=y, sr=sr, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = spectral_bandwidth.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 1s - loss: 1.0677 - acc: 0.4857
 70/420 [====>.........................] - ETA: 1s - loss: 1.1393 - acc: 0.5286
105/420 [======>.......................] - ETA: 1s - loss: 1.0420 - acc: 0.5429
140/420 [=========>....................] - ETA: 1s - loss: 0.9928 - acc: 0.5643
175/420 [===========>..................] - ETA: 0s - loss: 0.9586 - acc: 0.5886
210/420 [==============>...............] - ETA: 0s - loss: 0.9879 - acc: 0.5810
245/420 [================>.............] - ETA: 0s - loss: 0.9900 - acc: 0.5878
280/420 [===================>..........] - ETA: 0s - loss: 0.9577 - acc: 0.6107
315/420 [=====================>........] - ETA: 0s - loss: 0.9553 - acc: 0.6063
350/420 [========================>.....] - ETA: 0s - loss: 0.9623 - acc: 0.6000
385/420 [==========================>...] - ETA: 0s - loss: 0.9617 - acc: 0.5974
420/420 [==============================] - 2s 4ms/step - loss: 0.9507 - acc: 0.6024

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 3ms/step
Dev loss:    0.9821401908993721
Dev accuracy:    0.6250000136593977

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 904us/step
Test loss:    0.9612920631965002
Test accuracy:    0.6833333472410837
```

19.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)
    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_centroid(y=y, sr=sr, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cqt(y=y, sr=sr, hop_length=self.hop_length)
    spectral_contrast = librosa.feature.spectral_contrast(y=y, sr=sr, hop_length=self.hop_length)

    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = spectral_contrast.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 1s - loss: 0.3826 - acc: 0.8286
 70/420 [====>.........................] - ETA: 1s - loss: 0.3748 - acc: 0.8429
105/420 [======>.......................] - ETA: 1s - loss: 0.4167 - acc: 0.8571
140/420 [=========>....................] - ETA: 1s - loss: 0.4069 - acc: 0.8714
175/420 [===========>..................] - ETA: 0s - loss: 0.4087 - acc: 0.8743
210/420 [==============>...............] - ETA: 0s - loss: 0.4276 - acc: 0.8619
245/420 [================>.............] - ETA: 0s - loss: 0.4582 - acc: 0.8490
280/420 [===================>..........] - ETA: 0s - loss: 0.4495 - acc: 0.8500
315/420 [=====================>........] - ETA: 0s - loss: 0.4462 - acc: 0.8444
350/420 [========================>.....] - ETA: 0s - loss: 0.4395 - acc: 0.8400
385/420 [==========================>...] - ETA: 0s - loss: 0.4242 - acc: 0.8494
420/420 [==============================] - 2s 4ms/step - loss: 0.4264 - acc: 0.8476

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 3ms/step
Dev loss:   0.9936995257933935
Dev accuracy:   0.6750000156462193

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 1ms/step
Test loss:   1.0625159045060475
Test accuracy:   0.6666666865348816
```

20.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)

    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_bandwidth(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cens(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)



    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 3s - loss: 0.5413 - acc: 0.8571
 70/420 [====>.........................] - ETA: 2s - loss: 0.5927 - acc: 0.8000
105/420 [======>.......................] - ETA: 2s - loss: 0.5818 - acc: 0.7714
140/420 [=========>....................] - ETA: 2s - loss: 0.5376 - acc: 0.7857
175/420 [===========>..................] - ETA: 2s - loss: 0.5079 - acc: 0.8057
210/420 [==============>...............] - ETA: 1s - loss: 0.4997 - acc: 0.8238
245/420 [================>.............] - ETA: 1s - loss: 0.4711 - acc: 0.8327
280/420 [==================>...........] - ETA: 1s - loss: 0.4670 - acc: 0.8357
315/420 [====================>.........] - ETA: 0s - loss: 0.4763 - acc: 0.8317
350/420 [========================>.....] - ETA: 0s - loss: 0.4891 - acc: 0.8257
385/420 [==========================>...] - ETA: 0s - loss: 0.4933 - acc: 0.8234
420/420 [==============================] - 3s 8ms/step - loss: 0.5021 - acc: 0.8143

Validating ...

 35/120 [=======>......................] - ETA: 1s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 1s 5ms/step
Dev loss:   1.2569006780783336
Dev accuracy:   0.6333333464960257

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 2ms/step
Test loss:   1.367306540409724
Test accuracy:   0.5166666780908903
```

21.

```
for i, file in enumerate(list_of_audiofiles):
    y, sr = librosa.load(file)

    mfcc = librosa.feature.mfcc(y=y, sr=sr, hop_length=self.hop_length, n_mfcc=13)
    spectral_center = librosa.feature.spectral_flatness(y=y, hop_length=self.hop_length)
    chroma = librosa.feature.chroma_cens(y=y, sr=sr, hop_length=self.hop_length)
    rmse = librosa.feature.rmse(y=y, hop_length=self.hop_length)



    splits = re.split('[ .]', file)
    genre = re.split('[ /]', splits[1])[3]
    target.append(genre)

    data[i, :, 0:13] = mfcc.T[0:timeseries_length, :]
    data[i, :, 13:14] = spectral_center.T[0:timeseries_length, :]
    data[i, :, 14:26] = chroma.T[0:timeseries_length, :]
    data[i, :, 26:33] = rmse.T[0:timeseries_length, :]
```

```
Epoch 400/400

 35/420 [=>............................] - ETA: 3s - loss: 0.0185 - acc: 1.0000
 70/420 [====>.........................] - ETA: 2s - loss: 0.0108 - acc: 1.0000
105/420 [======>.......................] - ETA: 2s - loss: 0.0238 - acc: 0.9905
140/420 [=========>....................] - ETA: 2s - loss: 0.0211 - acc: 0.9929
175/420 [===========>..................] - ETA: 2s - loss: 0.0179 - acc: 0.9943
210/420 [==============>...............] - ETA: 1s - loss: 0.0206 - acc: 0.9952
245/420 [================>.............] - ETA: 1s - loss: 0.0248 - acc: 0.9959
280/420 [===================>..........] - ETA: 1s - loss: 0.0229 - acc: 0.9964
315/420 [=====================>........] - ETA: 0s - loss: 0.0217 - acc: 0.9968
350/420 [========================>.....] - ETA: 0s - loss: 0.0215 - acc: 0.9971
385/420 [==========================>...] - ETA: 0s - loss: 0.0206 - acc: 0.9974
420/420 [==============================] - 3s 8ms/step - loss: 0.0214 - acc: 0.9976

Validating ...

 35/120 [=======>......................] - ETA: 0s
105/120 [=========================>....] - ETA: 0s
120/120 [==============================] - 0s 4ms/step
Dev loss:   2.0063950767119727
Dev accuracy:   0.6250000223517418

Testing ...

35/60 [================>.............] - ETA: 0s
60/60 [==============================] - 0s 1ms/step
Test loss:   2.245579570531845
Test accuracy:   0.48333333681027096
```