Audio Data Classification

April 17, 2021

0.0.1 import libraries

```python
[53]: import pandas as pd
      import numpy as np
      import matplotlib.pyplot as plt
      %matplotlib inline
      import librosa
      import IPython.display as ipd
      import os
      import librosa.display
      import seaborn as sns

      from sklearn.model_selection import train_test_split
      from sklearn.preprocessing import MinMaxScaler
      from sklearn.preprocessing import LabelEncoder
      from keras.utils import np_utils

      import tensorflow as tf
      from tensorflow.keras.models import Sequential,load_model
      from tensorflow.keras.layers import␣
       ↪Dense,Dropout,Activation,Flatten,BatchNormalization,LSTM
      from tensorflow.keras.optimizers import Adam
      from sklearn.metrics import␣
       ↪classification_report,confusion_matrix,accuracy_score,average_precision_score,roc_auc_score
      from sklearn.metrics import plot_confusion_matrix, ConfusionMatrixDisplay,␣
       ↪roc_curve,auc
      from tensorflow.keras.callbacks import ModelCheckpoint,EarlyStopping
      from datetime import datetime
```

0.0.2 import data

```python
[54]: df = pd.read_csv("urbansound8k/UrbanSound8K.csv")
```

```python
[55]: df.head()
```

```
[55]:      slice_file_name     fsID  start        end  salience  fold  classID  \
      0    100032-3-0-0.wav  100032    0.0  0.317551         1     5        3
```

```
1  100263-2-0-117.wav  100263  58.5  62.500000       1   5      2
2  100263-2-0-121.wav  100263  60.5  64.500000       1   5      2
3  100263-2-0-126.wav  100263  63.0  67.000000       1   5      2
4  100263-2-0-137.wav  100263  68.5  72.500000       1   5      2


                class
0            dog_bark
1    children_playing
2    children_playing
3    children_playing
4    children_playing
```

df is the metadata file of all the recordings in the 10 folds class is the dependant/target variable. Fold tells us which fold the file belongs to.

0.0.3 EDA

Missing Values

```
[56]: print("Missing Values in df: \n{}".format(df.isnull().sum()))
```

```
Missing Values in df:
slice_file_name    0
fsID               0
start              0
end                0
salience           0
fold               0
classID            0
class              0
dtype: int64
```

There are no missing values. So, there is no need to impute missing data or remove missing rows.

```
[57]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8732 entries, 0 to 8731
Data columns (total 8 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   slice_file_name  8732 non-null   object
 1   fsID             8732 non-null   int64
 2   start            8732 non-null   float64
 3   end              8732 non-null   float64
 4   salience         8732 non-null   int64
 5   fold             8732 non-null   int64
 6   classID          8732 non-null   int64
 7   class            8732 non-null   object
```

```
dtypes: float64(2), int64(4), object(2)
memory usage: 545.9+ KB
```

class is category, while rest are numeric variables expect slice_file_name which we will use to extact features from audio file and map to its meta data for classifications.

0.0.4 Checking Class Balance

```
[58]: df['classID'].value_counts()
```

```
[58]: 7    1000
      5    1000
      4    1000
      3    1000
      2    1000
      9    1000
      0    1000
      8     929
      1     429
      6     374
      Name: classID, dtype: int64
```

```
[59]: import seaborn as sns
      plt.figure(figsize=(12,4))
      sns.countplot(x="class",data=df)
      plt.xticks(rotation=30)
      plt.show()
```
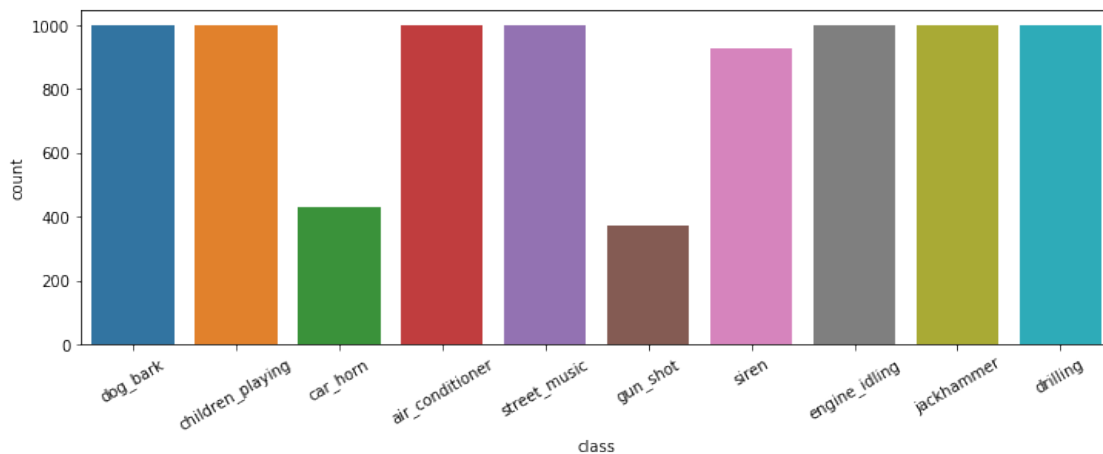

Data is clearly imblanced with Gunshot and Carhorn much less than other classes. But this is practical in countries like the United Kingdom, where gun shots and car horns are rare compared to dog barking and children playing.

0.0.5 Visualize wave plots and play audio files

```
[60]: def display_audio_file(folderpath,filename):
          full_file_path = folderpath+'/'+filename
          data,sample_rate = librosa.load(full_file_path)
          plt.figure(figsize=(12,6))
          plt.subplot(2,2,1)
          spectrogram = librosa.amplitude_to_db(np.abs(librosa.stft(data)),ref=np.max)
          librosa.display.specshow(spectrogram,y_axis='linear')
          signal_plot = plt.subplot(2,2,2)
          librosa.display.waveplot(data,sr=sample_rate)
          ipd.Audio(full_file_path)
          print('Class of {0} is {1}'.
      →format(filename,df[df['slice_file_name']==filename]['class'].values[0]))
```

```
[61]: display_audio_file("urbansound8k/fold5","100032-3-0-0.wav")
```

Class of 100032-3-0-0.wav is dog_bark
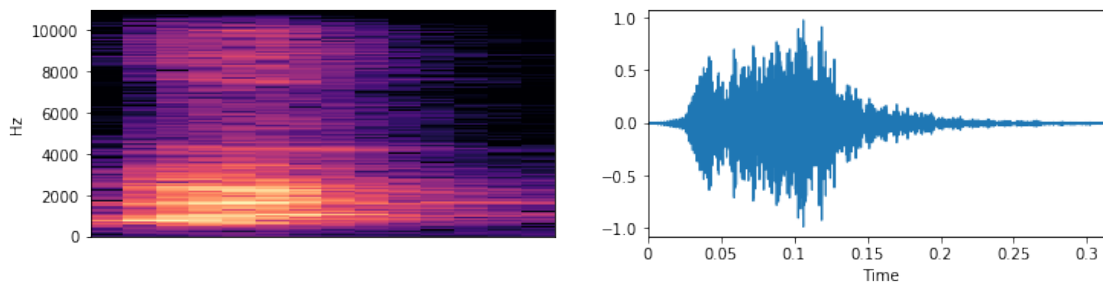

```
[62]: display_audio_file("urbansound8k/fold5","100263-2-0-117.wav")
```

Class of 100263-2-0-117.wav is children_playing
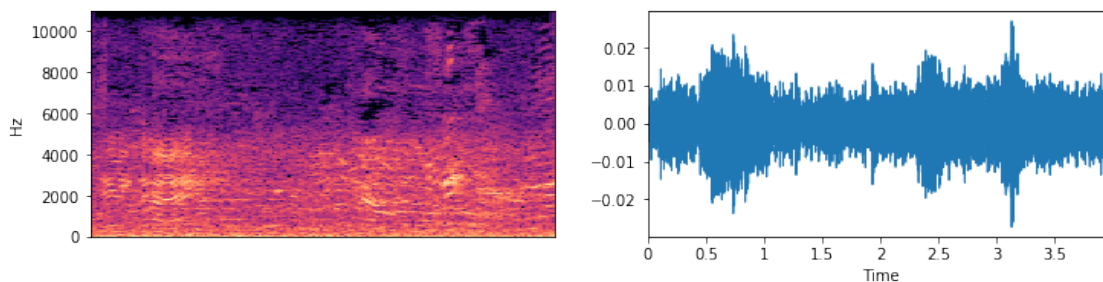
In the first audio file, its a dog bark, and second audio file is children playing. Although, its not possible to identify just looking at the spectrograms and waveplots , they are significantly different.

0.0.6 Extract Features

In this classification, I will be using Mel-Frequency Cepstral Coefficients (MFCC) extracted from the audio files. WIth MFCCs, its possible to analyse both time and frequency charateristics of sound as MFCC summarises frequency distribution across different window sizes.

```python
[63]: def extract_features(file):
          audio,sample_rate = librosa.load(file, res_type = 'kaiser_fast')
          mfcc_features = librosa.feature.mfcc(y=audio, sr=sample_rate, n_mfcc=40,
       ↪n_fft=512)
          mfccs_scaled_features = np.mean(mfcc_features.T,axis=0)
          return mfccs_scaled_features
```

```python
[64]: #### Iterating through files in all the folds and extracting MFCCs features
      extracted_features = []
      for i in range(df.shape[0]):
          file_name = "urbansound8k/fold" + str(df["fold"][i]) + "/" +
       ↪df["slice_file_name"][i]
          final_class_labels = df["class"][i]
          data_extractor = extract_features(file_name)
          extracted_features.append([data_extractor,final_class_labels])
```

```python
[65]: extracted_features_df = pd.
       ↪DataFrame(extracted_features,columns=['feature','class'])
      extracted_features_df.head()
```

```
[65]:                                              feature            class
      0  [-380.24576, 72.70962, -123.79629, -49.95936, …        dog_bark
      1  [-572.2464, 107.203476, -55.02533, 61.04218, -…  children_playing
      2  [-607.13104, 119.261246, -48.85975, 52.394897,…  children_playing
      3  [-562.47943, 103.08413, -36.00558, 54.394485, …  children_playing
      4  [-594.7944, 111.152794, -55.252316, 60.861256,…  children_playing
```

0.0.7 split data set into independant and target variables

```python
[66]: X = np.array(extracted_features_df["feature"].tolist())
      y = np.array(extracted_features_df["class"].tolist())
```

```python
[67]: X.shape
```

```
[67]: (8732, 40)
```

0.0.8 Splitting data into train and test in thr ratio of 80:20

```python
[68]: X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.
       ↪2,random_state=0,stratify=y)
```

Stratify is applied on target variable so that, target classes are equally distributed among test and train dataset. Random_state is set to 0 for reproducibility.

0.0.9 Encoding y

Target variable y is a category, hence encoding so that 'y' can work in nueral network

```
[69]: le = LabelEncoder()
      le_y_train = le.fit_transform(y_train)
      le_y_test = le.transform(y_test)
```

```
[70]: np.unique(le_y_train)
```

```
[70]: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

0.0.10 Scaling Data

```
[71]: scaler = MinMaxScaler()
      X_train_scaled = scaler.fit_transform(X_train)
      X_test_scaled = scaler.transform(X_test)
```

```
[72]: X_train_scaled.shape
```

```
[72]: (6985, 40)
```

```
[73]: X_test_scaled.shape
```

```
[73]: (1747, 40)
```

Data is sclaed since it increases efficiency of nueral network

0.0.11 Creating Model for Nueral Networks #1

```
[74]: model = Sequential()

      # first layer
      model.add(Dense(100,input_shape=(40,)))
      model.add(Activation('relu'))
      BatchNormalization()
      model.add(Dropout(0.15))

      # second layer
      model.add(Dense(100))
      model.add(Activation('relu'))
      BatchNormalization()
      model.add(Dropout(0.15))

      # third layer
```

```python
model.add(Dense(100))
model.add(Activation('relu'))
BatchNormalization()
model.add(Dropout(0.15))

# final layer
model.add(Dense(10))
model.add(Activation('softmax'))
```

[75]:
```python
model.summary()
```

```
Model: "sequential_2"

_____
Layer (type)                 Output Shape              Param #
=================================================================
dense_7 (Dense)              (None, 100)               4100
_____
activation_8 (Activation)    (None, 100)               0
_____
dropout_6 (Dropout)          (None, 100)               0
_____
dense_8 (Dense)              (None, 100)               10100
_____
activation_9 (Activation)    (None, 100)               0
_____
dropout_7 (Dropout)          (None, 100)               0
_____
dense_9 (Dense)              (None, 100)               10100
_____
activation_10 (Activation)   (None, 100)               0
_____
dropout_8 (Dropout)          (None, 100)               0
_____
dense_10 (Dense)             (None, 10)                1010
_____
activation_11 (Activation)   (None, 10)                0
=================================================================
Total params: 25,310
Trainable params: 25,310
Non-trainable params: 0

_____
```

optimizer and compiling

[76]:
```python
#optimizer
adam = Adam(lr=0.0006)
model.
 ↪compile(loss='sparse_categorical_crossentropy',metrics=['accuracy'],optimizer=adam)
```

```
[77]: num_epochs = 350
      num_batch_size = 64

      checkpointer = ModelCheckpoint(filepath='audio_classification_nn.
       ↪h5',verbose=1,save_best_only=True)
      early_stopping = EarlyStopping(monitor='val_loss',patience =30, min_delta=0.
       ↪01,restore_best_weights=True)

      start = datetime.now()

      history = model.fit(X_train_scaled,le_y_train,batch_size=num_batch_size,␣
       ↪epochs=num_epochs,
                          ␣
       ↪validation_data=(X_test_scaled,le_y_test),callbacks=[checkpointer,early_stopping],␣
       ↪verbose=1)
```

```
Train on 6985 samples, validate on 1747 samples
Epoch 1/350
4608/6985 [==================>…] - ETA: 0s - loss: 2.2531 - accuracy:
0.1374
Epoch 00001: val_loss improved from inf to 2.10845, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 1s 73us/sample - loss: 2.2288 -
accuracy: 0.1526 - val_loss: 2.1085 - val_accuracy: 0.2582
Epoch 2/350
4800/6985 [==================>…] - ETA: 0s - loss: 2.0372 - accuracy:
0.2562
Epoch 00002: val_loss improved from 2.10845 to 1.79642, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.9990 -
accuracy: 0.2760 - val_loss: 1.7964 - val_accuracy: 0.3995
Epoch 3/350
4928/6985 [==================>…] - ETA: 0s - loss: 1.8270 - accuracy:
0.3488
Epoch 00003: val_loss improved from 1.79642 to 1.66531, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.7948 -
accuracy: 0.3632 - val_loss: 1.6653 - val_accuracy: 0.4190
Epoch 4/350
4864/6985 [==================>…] - ETA: 0s - loss: 1.6919 - accuracy:
0.3974
Epoch 00004: val_loss improved from 1.66531 to 1.53139, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.6787 -
accuracy: 0.4030 - val_loss: 1.5314 - val_accuracy: 0.4699
Epoch 5/350
4928/6985 [==================>…] - ETA: 0s - loss: 1.6156 - accuracy:
```

0.4272
Epoch 00005: val_loss improved from 1.53139 to 1.45750, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.5991 -
accuracy: 0.4355 - val_loss: 1.4575 - val_accuracy: 0.4837
Epoch 6/350
4672/6985 [===================>…] - ETA: 0s - loss: 1.5471 - accuracy:
0.4456
Epoch 00006: val_loss improved from 1.45750 to 1.41471, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 1.5451 -
accuracy: 0.4501 - val_loss: 1.4147 - val_accuracy: 0.5209
Epoch 7/350
4992/6985 [===================>…] - ETA: 0s - loss: 1.4902 - accuracy:
0.4720
Epoch 00007: val_loss improved from 1.41471 to 1.38470, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.4783 -
accuracy: 0.4812 - val_loss: 1.3847 - val_accuracy: 0.5323
Epoch 8/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.4602 - accuracy:
0.4929
Epoch 00008: val_loss improved from 1.38470 to 1.34528, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.4585 -
accuracy: 0.4885 - val_loss: 1.3453 - val_accuracy: 0.5449
Epoch 9/350
4736/6985 [===================>…] - ETA: 0s - loss: 1.4351 - accuracy:
0.4930
Epoch 00009: val_loss improved from 1.34528 to 1.29722, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.4260 -
accuracy: 0.4963 - val_loss: 1.2972 - val_accuracy: 0.5610
Epoch 10/350
6720/6985 [===========================>..] - ETA: 0s - loss: 1.3918 - accuracy:
0.5190
Epoch 00010: val_loss improved from 1.29722 to 1.27351, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 31us/sample - loss: 1.3910 -
accuracy: 0.5190 - val_loss: 1.2735 - val_accuracy: 0.5713
Epoch 11/350
4736/6985 [===================>…] - ETA: 0s - loss: 1.3509 - accuracy:
0.5353
Epoch 00011: val_loss improved from 1.27351 to 1.23270, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.3490 -
accuracy: 0.5337 - val_loss: 1.2327 - val_accuracy: 0.5913
Epoch 12/350

```
6592/6985 [============================>..] - ETA: 0s - loss: 1.3558 - accuracy:
0.5267
Epoch 00012: val_loss did not improve from 1.23270
6985/6985 [==============================] - 0s 29us/sample - loss: 1.3547 -
accuracy: 0.5264 - val_loss: 1.2570 - val_accuracy: 0.5707
Epoch 13/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.3090 - accuracy:
0.5512
Epoch 00013: val_loss improved from 1.23270 to 1.20190, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.3106 -
accuracy: 0.5505 - val_loss: 1.2019 - val_accuracy: 0.5919
Epoch 14/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.2856 - accuracy:
0.5535
Epoch 00014: val_loss improved from 1.20190 to 1.19425, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.2859 -
accuracy: 0.5571 - val_loss: 1.1942 - val_accuracy: 0.5913
Epoch 15/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.2592 - accuracy:
0.5704
Epoch 00015: val_loss improved from 1.19425 to 1.19084, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.2721 -
accuracy: 0.5652 - val_loss: 1.1908 - val_accuracy: 0.6022
Epoch 16/350
4672/6985 [===================>…] - ETA: 0s - loss: 1.2568 - accuracy:
0.5659
Epoch 00016: val_loss improved from 1.19084 to 1.14244, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.2545 -
accuracy: 0.5681 - val_loss: 1.1424 - val_accuracy: 0.6199
Epoch 17/350
4672/6985 [===================>…] - ETA: 0s - loss: 1.2440 - accuracy:
0.5773
Epoch 00017: val_loss improved from 1.14244 to 1.12364, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.2498 -
accuracy: 0.5696 - val_loss: 1.1236 - val_accuracy: 0.6308
Epoch 18/350
4864/6985 [===================>…] - ETA: 0s - loss: 1.2335 - accuracy:
0.5798
Epoch 00018: val_loss did not improve from 1.12364
6985/6985 [==============================] - 0s 27us/sample - loss: 1.2114 -
accuracy: 0.5875 - val_loss: 1.1265 - val_accuracy: 0.6268
Epoch 19/350
4992/6985 [===================>…] - ETA: 0s - loss: 1.2060 - accuracy:
```

0.5819
Epoch 00019: val_loss improved from 1.12364 to 1.09853, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.1953 -
accuracy: 0.5901 - val_loss: 1.0985 - val_accuracy: 0.6422
Epoch 20/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.1921 - accuracy:
0.5896
Epoch 00020: val_loss improved from 1.09853 to 1.09173, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.1882 -
accuracy: 0.5917 - val_loss: 1.0917 - val_accuracy: 0.6337
Epoch 21/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.1770 - accuracy:
0.6021
Epoch 00021: val_loss improved from 1.09173 to 1.06263, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 1.1730 -
accuracy: 0.6019 - val_loss: 1.0626 - val_accuracy: 0.6485
Epoch 22/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.1388 - accuracy:
0.6110
Epoch 00022: val_loss did not improve from 1.06263
6985/6985 [==============================] - 0s 27us/sample - loss: 1.1567 -
accuracy: 0.6020 - val_loss: 1.0797 - val_accuracy: 0.6422
Epoch 23/350
6848/6985 [=============================>.] - ETA: 0s - loss: 1.1511 - accuracy:
0.6095
Epoch 00023: val_loss did not improve from 1.06263
6985/6985 [==============================] - 0s 28us/sample - loss: 1.1507 -
accuracy: 0.6097 - val_loss: 1.0728 - val_accuracy: 0.6445
Epoch 24/350
4736/6985 [===================>…] - ETA: 0s - loss: 1.1287 - accuracy:
0.6147
Epoch 00024: val_loss improved from 1.06263 to 1.03811, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.1209 -
accuracy: 0.6208 - val_loss: 1.0381 - val_accuracy: 0.6525
Epoch 25/350
6976/6985 [============================>.] - ETA: 0s - loss: 1.1174 - accuracy:
0.6216
Epoch 00025: val_loss did not improve from 1.03811
6985/6985 [==============================] - 0s 27us/sample - loss: 1.1173 -
accuracy: 0.6218 - val_loss: 1.0609 - val_accuracy: 0.6508
Epoch 26/350
4736/6985 [===================>…] - ETA: 0s - loss: 1.0955 - accuracy:
0.6223
Epoch 00026: val_loss improved from 1.03811 to 1.00108, saving model to

```
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.0974 -
accuracy: 0.6242 - val_loss: 1.0011 - val_accuracy: 0.6680
Epoch 27/350
6976/6985 [============================>.] - ETA: 0s - loss: 1.0951 - accuracy:
0.6349
Epoch 00027: val_loss improved from 1.00108 to 0.98709, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.0951 -
accuracy: 0.6348 - val_loss: 0.9871 - val_accuracy: 0.6703
Epoch 28/350
4736/6985 [===================>…] - ETA: 0s - loss: 1.0797 - accuracy:
0.6356
Epoch 00028: val_loss did not improve from 0.98709
6985/6985 [==============================] - 0s 27us/sample - loss: 1.0707 -
accuracy: 0.6381 - val_loss: 1.0096 - val_accuracy: 0.6657
Epoch 29/350
4736/6985 [===================>…] - ETA: 0s - loss: 1.0999 - accuracy:
0.6206
Epoch 00029: val_loss improved from 0.98709 to 0.96690, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.0693 -
accuracy: 0.6346 - val_loss: 0.9669 - val_accuracy: 0.6766
Epoch 30/350
4800/6985 [===================>…] - ETA: 0s - loss: 1.0560 - accuracy:
0.6423
Epoch 00030: val_loss did not improve from 0.96690
6985/6985 [==============================] - 0s 26us/sample - loss: 1.0516 -
accuracy: 0.6407 - val_loss: 0.9868 - val_accuracy: 0.6726
Epoch 31/350
4736/6985 [===================>…] - ETA: 0s - loss: 1.0426 - accuracy:
0.6510
Epoch 00031: val_loss did not improve from 0.96690
6985/6985 [==============================] - 0s 27us/sample - loss: 1.0444 -
accuracy: 0.6458 - val_loss: 0.9679 - val_accuracy: 0.6772
Epoch 32/350
4608/6985 [==================>…] - ETA: 0s - loss: 1.0239 - accuracy:
0.6510
Epoch 00032: val_loss improved from 0.96690 to 0.94524, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.0335 -
accuracy: 0.6471 - val_loss: 0.9452 - val_accuracy: 0.6863
Epoch 33/350
5056/6985 [===================>…] - ETA: 0s - loss: 1.0236 - accuracy:
0.6547
Epoch 00033: val_loss did not improve from 0.94524
6985/6985 [==============================] - 0s 26us/sample - loss: 1.0188 -
accuracy: 0.6525 - val_loss: 0.9651 - val_accuracy: 0.6852
```

```
Epoch 34/350
4864/6985 [==================>…] - ETA: 0s - loss: 1.0144 - accuracy:
0.6567
Epoch 00034: val_loss improved from 0.94524 to 0.94300, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 1.0128 -
accuracy: 0.6565 - val_loss: 0.9430 - val_accuracy: 0.6840
Epoch 35/350
4544/6985 [==================>…] - ETA: 0s - loss: 1.0149 - accuracy:
0.6609
Epoch 00035: val_loss improved from 0.94300 to 0.91595, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 1.0171 -
accuracy: 0.6617 - val_loss: 0.9160 - val_accuracy: 0.7023
Epoch 36/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.9860 - accuracy:
0.6594
Epoch 00036: val_loss improved from 0.91595 to 0.90208, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.9926 -
accuracy: 0.6616 - val_loss: 0.9021 - val_accuracy: 0.7092
Epoch 37/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.9844 - accuracy:
0.6715
Epoch 00037: val_loss did not improve from 0.90208
6985/6985 [==============================] - 0s 27us/sample - loss: 0.9855 -
accuracy: 0.6704 - val_loss: 0.9378 - val_accuracy: 0.6915
Epoch 38/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.9745 - accuracy:
0.6739
Epoch 00038: val_loss did not improve from 0.90208
6985/6985 [==============================] - 0s 26us/sample - loss: 0.9843 -
accuracy: 0.6691 - val_loss: 0.9052 - val_accuracy: 0.7161
Epoch 39/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.9558 - accuracy:
0.6801
Epoch 00039: val_loss improved from 0.90208 to 0.88633, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.9476 -
accuracy: 0.6833 - val_loss: 0.8863 - val_accuracy: 0.7064
Epoch 40/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.9492 - accuracy:
0.6875
Epoch 00040: val_loss improved from 0.88633 to 0.86575, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.9539 -
accuracy: 0.6849 - val_loss: 0.8657 - val_accuracy: 0.7104
Epoch 41/350
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4800/6985 [==================>…] - ETA: 0s - loss: 0.9541 - accuracy:
0.6879
Epoch 00041: val_loss improved from 0.86575 to 0.84860, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.9424 -
accuracy: 0.6859 - val_loss: 0.8486 - val_accuracy: 0.7310
Epoch 42/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.9431 - accuracy:
0.6862
Epoch 00042: val_loss did not improve from 0.84860
6985/6985 [==============================] - 0s 26us/sample - loss: 0.9410 -
accuracy: 0.6862 - val_loss: 0.8525 - val_accuracy: 0.7218
Epoch 43/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.9430 - accuracy:
0.6894
Epoch 00043: val_loss improved from 0.84860 to 0.83946, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.9281 -
accuracy: 0.6928 - val_loss: 0.8395 - val_accuracy: 0.7241
Epoch 44/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.9285 - accuracy:
0.6873
Epoch 00044: val_loss did not improve from 0.83946
6985/6985 [==============================] - 0s 26us/sample - loss: 0.9254 -
accuracy: 0.6873 - val_loss: 0.8482 - val_accuracy: 0.7247
Epoch 45/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.9093 - accuracy:
0.6975
Epoch 00045: val_loss improved from 0.83946 to 0.81564, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.9094 -
accuracy: 0.6975 - val_loss: 0.8156 - val_accuracy: 0.7355
Epoch 46/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.9041 - accuracy:
0.7027
Epoch 00046: val_loss did not improve from 0.81564
6985/6985 [==============================] - 0s 27us/sample - loss: 0.9083 -
accuracy: 0.6988 - val_loss: 0.8208 - val_accuracy: 0.7355
Epoch 47/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.9029 - accuracy:
0.6965
Epoch 00047: val_loss improved from 0.81564 to 0.80965, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.8970 -
accuracy: 0.6945 - val_loss: 0.8097 - val_accuracy: 0.7350
Epoch 48/350
6912/6985 [===========================>.] - ETA: 0s - loss: 0.8912 - accuracy:
0.7008
```

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Epoch 00048: val_loss improved from 0.80965 to 0.80635, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.8905 -
accuracy: 0.7014 - val_loss: 0.8063 - val_accuracy: 0.7459
Epoch 49/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.8854 - accuracy:
0.6988
Epoch 00049: val_loss improved from 0.80635 to 0.78529, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.8879 -
accuracy: 0.7002 - val_loss: 0.7853 - val_accuracy: 0.7527
Epoch 50/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.8683 - accuracy:
0.6991
Epoch 00050: val_loss did not improve from 0.78529
6985/6985 [==============================] - 0s 27us/sample - loss: 0.8605 -
accuracy: 0.7049 - val_loss: 0.7970 - val_accuracy: 0.7355
Epoch 51/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.8531 - accuracy:
0.7091
Epoch 00051: val_loss improved from 0.78529 to 0.78436, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.8529 -
accuracy: 0.7092 - val_loss: 0.7844 - val_accuracy: 0.7436
Epoch 52/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.8603 - accuracy:
0.7117
Epoch 00052: val_loss did not improve from 0.78436
6985/6985 [==============================] - 0s 27us/sample - loss: 0.8610 -
accuracy: 0.7114 - val_loss: 0.7861 - val_accuracy: 0.7436
Epoch 53/350
5056/6985 [===================>…] - ETA: 0s - loss: 0.8378 - accuracy:
0.7180
Epoch 00053: val_loss improved from 0.78436 to 0.77528, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.8478 -
accuracy: 0.7131 - val_loss: 0.7753 - val_accuracy: 0.7453
Epoch 54/350
6912/6985 [===========================>.] - ETA: 0s - loss: 0.8383 - accuracy:
0.7218
Epoch 00054: val_loss improved from 0.77528 to 0.76328, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.8405 -
accuracy: 0.7214 - val_loss: 0.7633 - val_accuracy: 0.7476
Epoch 55/350
4544/6985 [==================>…] - ETA: 0s - loss: 0.8427 - accuracy:
0.7229
Epoch 00055: val_loss did not improve from 0.76328
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6985/6985 [==============================] - 0s 27us/sample - loss: 0.8333 -
accuracy: 0.7266 - val_loss: 0.7691 - val_accuracy: 0.7424
Epoch 56/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.8347 - accuracy:
0.7232
Epoch 00056: val_loss did not improve from 0.76328
6985/6985 [==============================] - 0s 28us/sample - loss: 0.8360 -
accuracy: 0.7230 - val_loss: 0.7744 - val_accuracy: 0.7464
Epoch 57/350
4672/6985 [===================>…] - ETA: 0s - loss: 0.8314 - accuracy:
0.7252
Epoch 00057: val_loss improved from 0.76328 to 0.76037, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.8216 -
accuracy: 0.7280 - val_loss: 0.7604 - val_accuracy: 0.7521
Epoch 58/350
6592/6985 [===========================>..] - ETA: 0s - loss: 0.8167 - accuracy:
0.7245
Epoch 00058: val_loss improved from 0.76037 to 0.73111, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 31us/sample - loss: 0.8213 -
accuracy: 0.7237 - val_loss: 0.7311 - val_accuracy: 0.7636
Epoch 59/350
4672/6985 [===================>…] - ETA: 0s - loss: 0.8072 - accuracy:
0.7295
Epoch 00059: val_loss did not improve from 0.73111
6985/6985 [==============================] - 0s 27us/sample - loss: 0.8060 -
accuracy: 0.7301 - val_loss: 0.7329 - val_accuracy: 0.7510
Epoch 60/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.7754 - accuracy:
0.7401
Epoch 00060: val_loss did not improve from 0.73111
6985/6985 [==============================] - 0s 26us/sample - loss: 0.7893 -
accuracy: 0.7349 - val_loss: 0.7486 - val_accuracy: 0.7556
Epoch 61/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.7890 - accuracy:
0.7364
Epoch 00061: val_loss improved from 0.73111 to 0.72183, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.7891 -
accuracy: 0.7363 - val_loss: 0.7218 - val_accuracy: 0.7607
Epoch 62/350
6592/6985 [===========================>..] - ETA: 0s - loss: 0.7984 - accuracy:
0.7360
Epoch 00062: val_loss did not improve from 0.72183
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7990 -
accuracy: 0.7350 - val_loss: 0.7270 - val_accuracy: 0.7624
Epoch 63/350
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4736/6985 [===================>…] - ETA: 0s - loss: 0.8033 - accuracy:
0.7266
Epoch 00063: val_loss improved from 0.72183 to 0.71401, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7942 -
accuracy: 0.7321 - val_loss: 0.7140 - val_accuracy: 0.7693
Epoch 64/350
4672/6985 [===================>…] - ETA: 0s - loss: 0.7719 - accuracy:
0.7419
Epoch 00064: val_loss did not improve from 0.71401
6985/6985 [==============================] - 0s 27us/sample - loss: 0.7735 -
accuracy: 0.7409 - val_loss: 0.7247 - val_accuracy: 0.7516
Epoch 65/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.7708 - accuracy:
0.7423
Epoch 00065: val_loss improved from 0.71401 to 0.69273, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.7690 -
accuracy: 0.7432 - val_loss: 0.6927 - val_accuracy: 0.7670
Epoch 66/350
6848/6985 [============================>.] - ETA: 0s - loss: 0.7636 - accuracy:
0.7408
Epoch 00066: val_loss did not improve from 0.69273
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7625 -
accuracy: 0.7413 - val_loss: 0.7147 - val_accuracy: 0.7659
Epoch 67/350
6848/6985 [============================>.] - ETA: 0s - loss: 0.7624 - accuracy:
0.7420
Epoch 00067: val_loss did not improve from 0.69273
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7604 -
accuracy: 0.7426 - val_loss: 0.7371 - val_accuracy: 0.7573
Epoch 68/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.7625 - accuracy:
0.7461
Epoch 00068: val_loss improved from 0.69273 to 0.69101, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.7569 -
accuracy: 0.7487 - val_loss: 0.6910 - val_accuracy: 0.7722
Epoch 69/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.7364 - accuracy:
0.7500
Epoch 00069: val_loss improved from 0.69101 to 0.68668, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7405 -
accuracy: 0.7506 - val_loss: 0.6867 - val_accuracy: 0.7659
Epoch 70/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.7148 - accuracy:
0.7570
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Epoch 00070: val_loss did not improve from 0.68668
6985/6985 [==============================] - 0s 27us/sample - loss: 0.7295 -
accuracy: 0.7520 - val_loss: 0.7120 - val_accuracy: 0.7665
Epoch 71/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.7395 - accuracy:
0.7562
Epoch 00071: val_loss did not improve from 0.68668
6985/6985 [==============================] - 0s 26us/sample - loss: 0.7454 -
accuracy: 0.7523 - val_loss: 0.7201 - val_accuracy: 0.7624
Epoch 72/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.7510 - accuracy:
0.7484
Epoch 00072: val_loss did not improve from 0.68668
6985/6985 [==============================] - 0s 26us/sample - loss: 0.7577 -
accuracy: 0.7445 - val_loss: 0.7024 - val_accuracy: 0.7613
Epoch 73/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.7381 - accuracy:
0.7556
Epoch 00073: val_loss improved from 0.68668 to 0.66690, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7350 -
accuracy: 0.7560 - val_loss: 0.6669 - val_accuracy: 0.7779
Epoch 74/350
4672/6985 [===================>…] - ETA: 0s - loss: 0.7217 - accuracy:
0.7624
Epoch 00074: val_loss did not improve from 0.66690
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7289 -
accuracy: 0.7616 - val_loss: 0.6670 - val_accuracy: 0.7859
Epoch 75/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.7257 - accuracy:
0.7547
Epoch 00075: val_loss improved from 0.66690 to 0.66191, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.7256 -
accuracy: 0.7548 - val_loss: 0.6619 - val_accuracy: 0.7779
Epoch 76/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.7017 - accuracy:
0.7637
Epoch 00076: val_loss improved from 0.66191 to 0.65183, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 31us/sample - loss: 0.7251 -
accuracy: 0.7560 - val_loss: 0.6518 - val_accuracy: 0.7836
Epoch 77/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.7089 - accuracy:
0.7526
Epoch 00077: val_loss did not improve from 0.65183
6985/6985 [==============================] - 0s 27us/sample - loss: 0.7103 -
accuracy: 0.7585 - val_loss: 0.6686 - val_accuracy: 0.7750
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Epoch 78/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.6962 - accuracy:
0.7605
Epoch 00078: val_loss improved from 0.65183 to 0.64818, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.7002 -
accuracy: 0.7585 - val_loss: 0.6482 - val_accuracy: 0.7853
Epoch 79/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.7126 - accuracy:
0.7592
Epoch 00079: val_loss improved from 0.64818 to 0.64772, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.7018 -
accuracy: 0.7621 - val_loss: 0.6477 - val_accuracy: 0.7922
Epoch 80/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.6999 - accuracy:
0.7600
Epoch 00080: val_loss did not improve from 0.64772
6985/6985 [==============================] - 0s 26us/sample - loss: 0.6978 -
accuracy: 0.7625 - val_loss: 0.6523 - val_accuracy: 0.7773
Epoch 81/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.7064 - accuracy:
0.7573
Epoch 00081: val_loss improved from 0.64772 to 0.64548, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.6907 -
accuracy: 0.7658 - val_loss: 0.6455 - val_accuracy: 0.7916
Epoch 82/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.6831 - accuracy:
0.7704
Epoch 00082: val_loss did not improve from 0.64548
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6828 -
accuracy: 0.7705 - val_loss: 0.6521 - val_accuracy: 0.7899
Epoch 83/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.6741 - accuracy:
0.7763
Epoch 00083: val_loss improved from 0.64548 to 0.62193, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.6654 -
accuracy: 0.7792 - val_loss: 0.6219 - val_accuracy: 0.7956
Epoch 84/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.6856 - accuracy:
0.7669
Epoch 00084: val_loss did not improve from 0.62193
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6787 -
accuracy: 0.7671 - val_loss: 0.6446 - val_accuracy: 0.7934
Epoch 85/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.6742 - accuracy:
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0.7736
Epoch 00085: val_loss did not improve from 0.62193
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6771 -
accuracy: 0.7704 - val_loss: 0.6263 - val_accuracy: 0.7922
Epoch 86/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.6960 - accuracy:
0.7578
Epoch 00086: val_loss improved from 0.62193 to 0.61965, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.6865 -
accuracy: 0.7641 - val_loss: 0.6197 - val_accuracy: 0.7956
Epoch 87/350
6912/6985 [=============================>.] - ETA: 0s - loss: 0.6648 - accuracy:
0.7779
Epoch 00087: val_loss did not improve from 0.61965
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6641 -
accuracy: 0.7780 - val_loss: 0.6207 - val_accuracy: 0.7916
Epoch 88/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.6785 - accuracy:
0.7749
Epoch 00088: val_loss did not improve from 0.61965
6985/6985 [==============================] - 0s 26us/sample - loss: 0.6732 -
accuracy: 0.7735 - val_loss: 0.6407 - val_accuracy: 0.7859
Epoch 89/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.6355 - accuracy:
0.7865
Epoch 00089: val_loss improved from 0.61965 to 0.60149, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.6507 -
accuracy: 0.7802 - val_loss: 0.6015 - val_accuracy: 0.8014
Epoch 90/350
6912/6985 [=============================>.] - ETA: 0s - loss: 0.6766 - accuracy:
0.7690
Epoch 00090: val_loss did not improve from 0.60149
6985/6985 [==============================] - 0s 28us/sample - loss: 0.6751 -
accuracy: 0.7692 - val_loss: 0.6068 - val_accuracy: 0.8008
Epoch 91/350
6912/6985 [=============================>.] - ETA: 0s - loss: 0.6524 - accuracy:
0.7837
Epoch 00091: val_loss did not improve from 0.60149
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6533 -
accuracy: 0.7838 - val_loss: 0.6148 - val_accuracy: 0.7962
Epoch 92/350
6912/6985 [=============================>.] - ETA: 0s - loss: 0.6450 - accuracy:
0.7782
Epoch 00092: val_loss did not improve from 0.60149
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6448 -
accuracy: 0.7785 - val_loss: 0.6076 - val_accuracy: 0.7991

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Epoch 93/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.6322 - accuracy:
0.7872
Epoch 00093: val_loss did not improve from 0.60149
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6374 -
accuracy: 0.7864 - val_loss: 0.6015 - val_accuracy: 0.8019
Epoch 94/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.6552 - accuracy:
0.7770
Epoch 00094: val_loss improved from 0.60149 to 0.60049, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.6494 -
accuracy: 0.7818 - val_loss: 0.6005 - val_accuracy: 0.8014
Epoch 95/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.6657 - accuracy:
0.7703
Epoch 00095: val_loss improved from 0.60049 to 0.59234, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.6514 -
accuracy: 0.7777 - val_loss: 0.5923 - val_accuracy: 0.8071
Epoch 96/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.6256 - accuracy:
0.7904
Epoch 00096: val_loss did not improve from 0.59234
6985/6985 [==============================] - 0s 26us/sample - loss: 0.6340 -
accuracy: 0.7845 - val_loss: 0.6273 - val_accuracy: 0.7911
Epoch 97/350
6848/6985 [===========================>.] - ETA: 0s - loss: 0.6392 - accuracy:
0.7773
Epoch 00097: val_loss improved from 0.59234 to 0.59034, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.6385 -
accuracy: 0.7775 - val_loss: 0.5903 - val_accuracy: 0.8082
Epoch 98/350
6592/6985 [==========================>..] - ETA: 0s - loss: 0.6346 - accuracy:
0.7791
Epoch 00098: val_loss improved from 0.59034 to 0.58465, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 31us/sample - loss: 0.6373 -
accuracy: 0.7782 - val_loss: 0.5847 - val_accuracy: 0.8054
Epoch 99/350
4608/6985 [=================>…] - ETA: 0s - loss: 0.6264 - accuracy:
0.7862
Epoch 00099: val_loss did not improve from 0.58465
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6276 -
accuracy: 0.7867 - val_loss: 0.5874 - val_accuracy: 0.8105
Epoch 100/350
5120/6985 [==================>…] - ETA: 0s - loss: 0.6368 - accuracy:
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0.7852
Epoch 00100: val_loss did not improve from 0.58465
6985/6985 [==============================] - 0s 25us/sample - loss: 0.6241 -
accuracy: 0.7870 - val_loss: 0.6040 - val_accuracy: 0.8002
Epoch 101/350
6912/6985 [==========================>.] - ETA: 0s - loss: 0.6098 - accuracy:
0.7888
Epoch 00101: val_loss improved from 0.58465 to 0.58080, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.6114 -
accuracy: 0.7883 - val_loss: 0.5808 - val_accuracy: 0.8128
Epoch 102/350
6976/6985 [==========================>.] - ETA: 0s - loss: 0.6085 - accuracy:
0.7923
Epoch 00102: val_loss did not improve from 0.58080
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6080 -
accuracy: 0.7924 - val_loss: 0.5825 - val_accuracy: 0.8077
Epoch 103/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.6222 - accuracy:
0.7862
Epoch 00103: val_loss improved from 0.58080 to 0.55808, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.6172 -
accuracy: 0.7877 - val_loss: 0.5581 - val_accuracy: 0.8117
Epoch 104/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.6161 - accuracy:
0.7922
Epoch 00104: val_loss did not improve from 0.55808
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6025 -
accuracy: 0.7973 - val_loss: 0.5645 - val_accuracy: 0.8145
Epoch 105/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.5822 - accuracy:
0.7963
Epoch 00105: val_loss did not improve from 0.55808
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5945 -
accuracy: 0.7926 - val_loss: 0.5783 - val_accuracy: 0.8071
Epoch 106/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.5740 - accuracy:
0.8010
Epoch 00106: val_loss did not improve from 0.55808
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5965 -
accuracy: 0.7933 - val_loss: 0.5725 - val_accuracy: 0.8237
Epoch 107/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.5868 - accuracy:
0.7999
Epoch 00107: val_loss did not improve from 0.55808
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5896 -
accuracy: 0.7976 - val_loss: 0.5739 - val_accuracy: 0.8100

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Epoch 108/350
4608/6985 [==================>…] - ETA: 0s - loss: 0.6195 - accuracy:
0.7854
Epoch 00108: val_loss improved from 0.55808 to 0.55456, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.6032 -
accuracy: 0.7930 - val_loss: 0.5546 - val_accuracy: 0.8145
Epoch 109/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.5848 - accuracy:
0.7986
Epoch 00109: val_loss did not improve from 0.55456
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5854 -
accuracy: 0.7984 - val_loss: 0.5990 - val_accuracy: 0.8048
Epoch 110/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.6130 - accuracy:
0.7926
Epoch 00110: val_loss did not improve from 0.55456
6985/6985 [==============================] - 0s 27us/sample - loss: 0.6096 -
accuracy: 0.7923 - val_loss: 0.5757 - val_accuracy: 0.8065
Epoch 111/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.5994 - accuracy:
0.7923
Epoch 00111: val_loss did not improve from 0.55456
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5923 -
accuracy: 0.7948 - val_loss: 0.5729 - val_accuracy: 0.8054
Epoch 112/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.6030 - accuracy:
0.7920
Epoch 00112: val_loss improved from 0.55456 to 0.54980, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5832 -
accuracy: 0.8004 - val_loss: 0.5498 - val_accuracy: 0.8117
Epoch 113/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.5831 - accuracy:
0.7977
Epoch 00113: val_loss improved from 0.54980 to 0.54415, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5872 -
accuracy: 0.7981 - val_loss: 0.5441 - val_accuracy: 0.8237
Epoch 114/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.5863 - accuracy:
0.7952
Epoch 00114: val_loss did not improve from 0.54415
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5897 -
accuracy: 0.7958 - val_loss: 0.5452 - val_accuracy: 0.8277
Epoch 115/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.5990 - accuracy:
0.8004
```

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Epoch 00115: val_loss improved from 0.54415 to 0.53767, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.5903 -
accuracy: 0.7999 - val_loss: 0.5377 - val_accuracy: 0.8260
Epoch 116/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.5759 - accuracy:
0.8063
Epoch 00116: val_loss did not improve from 0.53767
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5763 -
accuracy: 0.8064 - val_loss: 0.5396 - val_accuracy: 0.8214
Epoch 117/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.5927 - accuracy:
0.7990
Epoch 00117: val_loss improved from 0.53767 to 0.53660, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.5875 -
accuracy: 0.7990 - val_loss: 0.5366 - val_accuracy: 0.8243
Epoch 118/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.5720 - accuracy:
0.8053
Epoch 00118: val_loss improved from 0.53660 to 0.53400, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5599 -
accuracy: 0.8069 - val_loss: 0.5340 - val_accuracy: 0.8214
Epoch 119/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.5866 - accuracy:
0.7954
Epoch 00119: val_loss did not improve from 0.53400
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5680 -
accuracy: 0.8053 - val_loss: 0.5617 - val_accuracy: 0.8100
Epoch 120/350
5056/6985 [====================>…] - ETA: 0s - loss: 0.5617 - accuracy:
0.8066
Epoch 00120: val_loss did not improve from 0.53400
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5652 -
accuracy: 0.8054 - val_loss: 0.5432 - val_accuracy: 0.8168
Epoch 121/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.5784 - accuracy:
0.7973
Epoch 00121: val_loss did not improve from 0.53400
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5767 -
accuracy: 0.7996 - val_loss: 0.5377 - val_accuracy: 0.8271
Epoch 122/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.5587 - accuracy:
0.8144
Epoch 00122: val_loss improved from 0.53400 to 0.52824, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.5566 -
```

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accuracy: 0.8152 - val_loss: 0.5282 - val_accuracy: 0.8306
Epoch 123/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.5506 - accuracy:
0.8164
Epoch 00123: val_loss improved from 0.52824 to 0.52366, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5556 -
accuracy: 0.8126 - val_loss: 0.5237 - val_accuracy: 0.8311
Epoch 124/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.5497 - accuracy:
0.8108
Epoch 00124: val_loss improved from 0.52366 to 0.51241, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.5497 -
accuracy: 0.8109 - val_loss: 0.5124 - val_accuracy: 0.8306
Epoch 125/350
4544/6985 [==================>…] - ETA: 0s - loss: 0.5674 - accuracy:
0.8052
Epoch 00125: val_loss did not improve from 0.51241
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5574 -
accuracy: 0.8070 - val_loss: 0.5354 - val_accuracy: 0.8163
Epoch 126/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.5481 - accuracy:
0.8121
Epoch 00126: val_loss did not improve from 0.51241
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5549 -
accuracy: 0.8094 - val_loss: 0.5390 - val_accuracy: 0.8277
Epoch 127/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.5608 - accuracy:
0.8114
Epoch 00127: val_loss did not improve from 0.51241
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5523 -
accuracy: 0.8139 - val_loss: 0.5203 - val_accuracy: 0.8300
Epoch 128/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.5650 - accuracy:
0.8122
Epoch 00128: val_loss did not improve from 0.51241
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5638 -
accuracy: 0.8126 - val_loss: 0.5197 - val_accuracy: 0.8248
Epoch 129/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.5365 - accuracy:
0.8149
Epoch 00129: val_loss improved from 0.51241 to 0.51104, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.5364 -
accuracy: 0.8160 - val_loss: 0.5110 - val_accuracy: 0.8357
Epoch 130/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.5293 - accuracy:
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0.8183
Epoch 00130: val_loss did not improve from 0.51104
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5262 -
accuracy: 0.8178 - val_loss: 0.5376 - val_accuracy: 0.8203
Epoch 131/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.5415 - accuracy:
0.8142
Epoch 00131: val_loss improved from 0.51104 to 0.50908, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.5418 -
accuracy: 0.8142 - val_loss: 0.5091 - val_accuracy: 0.8346
Epoch 132/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.5127 - accuracy:
0.8281
Epoch 00132: val_loss did not improve from 0.50908
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5182 -
accuracy: 0.8249 - val_loss: 0.5282 - val_accuracy: 0.8277
Epoch 133/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.5565 - accuracy:
0.8083
Epoch 00133: val_loss improved from 0.50908 to 0.50295, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5487 -
accuracy: 0.8116 - val_loss: 0.5030 - val_accuracy: 0.8329
Epoch 134/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.5415 - accuracy:
0.8139
Epoch 00134: val_loss did not improve from 0.50295
6985/6985 [==============================] - 0s 28us/sample - loss: 0.5413 -
accuracy: 0.8142 - val_loss: 0.5340 - val_accuracy: 0.8226
Epoch 135/350
4928/6985 [====================>…] - ETA: 0s - loss: 0.5313 - accuracy:
0.8139
Epoch 00135: val_loss improved from 0.50295 to 0.49933, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.5334 -
accuracy: 0.8137 - val_loss: 0.4993 - val_accuracy: 0.8374
Epoch 136/350
6784/6985 [===========================>.] - ETA: 0s - loss: 0.5264 - accuracy:
0.8126
Epoch 00136: val_loss improved from 0.49933 to 0.49048, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 31us/sample - loss: 0.5298 -
accuracy: 0.8123 - val_loss: 0.4905 - val_accuracy: 0.8369
Epoch 137/350
6720/6985 [===========================>..] - ETA: 0s - loss: 0.5259 - accuracy:
0.8201
Epoch 00137: val_loss did not improve from 0.49048

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6985/6985 [==============================] - 0s 28us/sample - loss: 0.5270 -
accuracy: 0.8190 - val_loss: 0.5171 - val_accuracy: 0.8369
Epoch 138/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.5218 - accuracy:
0.8232
Epoch 00138: val_loss did not improve from 0.49048
6985/6985 [==============================] - 0s 28us/sample - loss: 0.5223 -
accuracy: 0.8228 - val_loss: 0.5061 - val_accuracy: 0.8300
Epoch 139/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.5151 - accuracy:
0.8201
Epoch 00139: val_loss did not improve from 0.49048
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5285 -
accuracy: 0.8186 - val_loss: 0.5134 - val_accuracy: 0.8329
Epoch 140/350
4672/6985 [===================>…] - ETA: 0s - loss: 0.5360 - accuracy:
0.8063
Epoch 00140: val_loss did not improve from 0.49048
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5261 -
accuracy: 0.8142 - val_loss: 0.5103 - val_accuracy: 0.8363
Epoch 141/350
5056/6985 [===================>…] - ETA: 0s - loss: 0.5300 - accuracy:
0.8208
Epoch 00141: val_loss did not improve from 0.49048
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5264 -
accuracy: 0.8233 - val_loss: 0.4998 - val_accuracy: 0.8334
Epoch 142/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.5023 - accuracy:
0.8250
Epoch 00142: val_loss did not improve from 0.49048
6985/6985 [==============================] - 0s 28us/sample - loss: 0.5051 -
accuracy: 0.8265 - val_loss: 0.5028 - val_accuracy: 0.8334
Epoch 143/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.5164 - accuracy:
0.8221
Epoch 00143: val_loss did not improve from 0.49048
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5116 -
accuracy: 0.8233 - val_loss: 0.5044 - val_accuracy: 0.8334
Epoch 144/350
5056/6985 [===================>…] - ETA: 0s - loss: 0.5079 - accuracy:
0.8246
Epoch 00144: val_loss improved from 0.49048 to 0.47476, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5046 -
accuracy: 0.8251 - val_loss: 0.4748 - val_accuracy: 0.8466
Epoch 145/350
6976/6985 [=============================>.] - ETA: 0s - loss: 0.5002 - accuracy:
0.8294
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Epoch 00145: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5007 -
accuracy: 0.8293 - val_loss: 0.5000 - val_accuracy: 0.8369
Epoch 146/350
6976/6985 [=============================>.] - ETA: 0s - loss: 0.5187 - accuracy:
0.8243
Epoch 00146: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5184 -
accuracy: 0.8245 - val_loss: 0.5029 - val_accuracy: 0.8306
Epoch 147/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.5307 - accuracy:
0.8230
Epoch 00147: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5195 -
accuracy: 0.8238 - val_loss: 0.4997 - val_accuracy: 0.8306
Epoch 148/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.5017 - accuracy:
0.8292
Epoch 00148: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 31us/sample - loss: 0.5030 -
accuracy: 0.8272 - val_loss: 0.4901 - val_accuracy: 0.8414
Epoch 149/350
5632/6985 [=======================>…] - ETA: 0s - loss: 0.4983 - accuracy:
0.8290
Epoch 00149: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 33us/sample - loss: 0.5050 -
accuracy: 0.8248 - val_loss: 0.5021 - val_accuracy: 0.8351
Epoch 150/350
4928/6985 [====================>…] - ETA: 0s - loss: 0.5024 - accuracy:
0.8283
Epoch 00150: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 26us/sample - loss: 0.5076 -
accuracy: 0.8291 - val_loss: 0.4913 - val_accuracy: 0.8340
Epoch 151/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.5215 - accuracy:
0.8218
Epoch 00151: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5308 -
accuracy: 0.8203 - val_loss: 0.4847 - val_accuracy: 0.8403
Epoch 152/350
6784/6985 [=============================>.] - ETA: 0s - loss: 0.5066 - accuracy:
0.8277
Epoch 00152: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 29us/sample - loss: 0.5044 -
accuracy: 0.8288 - val_loss: 0.4861 - val_accuracy: 0.8426
Epoch 153/350
4608/6985 [==================>…] - ETA: 0s - loss: 0.5220 - accuracy:
0.8262

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Epoch 00153: val_loss did not improve from 0.47476
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5027 -
accuracy: 0.8288 - val_loss: 0.4963 - val_accuracy: 0.8437
Epoch 154/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.4947 - accuracy:
0.8310
Epoch 00154: val_loss improved from 0.47476 to 0.46929, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.4977 -
accuracy: 0.8314 - val_loss: 0.4693 - val_accuracy: 0.8512
Epoch 155/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.5035 - accuracy:
0.8298
Epoch 00155: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4957 -
accuracy: 0.8332 - val_loss: 0.4782 - val_accuracy: 0.8386
Epoch 156/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.4889 - accuracy:
0.8318
Epoch 00156: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4924 -
accuracy: 0.8285 - val_loss: 0.4757 - val_accuracy: 0.8449
Epoch 157/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.5156 - accuracy:
0.8201
Epoch 00157: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4973 -
accuracy: 0.8253 - val_loss: 0.4775 - val_accuracy: 0.8426
Epoch 158/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.4907 - accuracy:
0.8310
Epoch 00158: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4992 -
accuracy: 0.8268 - val_loss: 0.4750 - val_accuracy: 0.8409
Epoch 159/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4837 - accuracy:
0.8391
Epoch 00159: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 29us/sample - loss: 0.4821 -
accuracy: 0.8389 - val_loss: 0.4765 - val_accuracy: 0.8449
Epoch 160/350
4608/6985 [==================>…] - ETA: 0s - loss: 0.4870 - accuracy:
0.8312
Epoch 00160: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4894 -
accuracy: 0.8296 - val_loss: 0.4932 - val_accuracy: 0.8374
Epoch 161/350
6656/6985 [==========================>..] - ETA: 0s - loss: 0.4975 - accuracy:
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0.8266
Epoch 00161: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 39us/sample - loss: 0.4953 -
accuracy: 0.8261 - val_loss: 0.4771 - val_accuracy: 0.8454
Epoch 162/350
5184/6985 [=====================>…] - ETA: 0s - loss: 0.4931 - accuracy:
0.8233
Epoch 00162: val_loss did not improve from 0.46929
6985/6985 [==============================] - 0s 25us/sample - loss: 0.4801 -
accuracy: 0.8316 - val_loss: 0.4707 - val_accuracy: 0.8460
Epoch 163/350
6720/6985 [===========================>..] - ETA: 0s - loss: 0.4782 - accuracy:
0.8382
Epoch 00163: val_loss improved from 0.46929 to 0.46351, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 32us/sample - loss: 0.4816 -
accuracy: 0.8368 - val_loss: 0.4635 - val_accuracy: 0.8500
Epoch 164/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.4677 - accuracy:
0.8361
Epoch 00164: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4678 -
accuracy: 0.8366 - val_loss: 0.4740 - val_accuracy: 0.8460
Epoch 165/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.4669 - accuracy:
0.8375
Epoch 00165: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4704 -
accuracy: 0.8366 - val_loss: 0.4901 - val_accuracy: 0.8392
Epoch 166/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.5126 - accuracy:
0.8237
Epoch 00166: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 27us/sample - loss: 0.5022 -
accuracy: 0.8283 - val_loss: 0.4817 - val_accuracy: 0.8477
Epoch 167/350
6656/6985 [==========================>..] - ETA: 0s - loss: 0.4778 - accuracy:
0.8392
Epoch 00167: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 29us/sample - loss: 0.4756 -
accuracy: 0.8397 - val_loss: 0.4798 - val_accuracy: 0.8437
Epoch 168/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.4797 - accuracy:
0.8356
Epoch 00168: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4650 -
accuracy: 0.8411 - val_loss: 0.4637 - val_accuracy: 0.8477
Epoch 169/350

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4800/6985 [==================>…] - ETA: 0s - loss: 0.4679 - accuracy:
0.8323
Epoch 00169: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4614 -
accuracy: 0.8351 - val_loss: 0.4710 - val_accuracy: 0.8392
Epoch 170/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.4806 - accuracy:
0.8328
Epoch 00170: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4793 -
accuracy: 0.8329 - val_loss: 0.4831 - val_accuracy: 0.8386
Epoch 171/350
6528/6985 [==========================>..] - ETA: 0s - loss: 0.4845 - accuracy:
0.8333
Epoch 00171: val_loss did not improve from 0.46351
6985/6985 [==============================] - 0s 30us/sample - loss: 0.4827 -
accuracy: 0.8338 - val_loss: 0.4922 - val_accuracy: 0.8466
Epoch 172/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.4730 - accuracy:
0.8366
Epoch 00172: val_loss improved from 0.46351 to 0.46066, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4607 -
accuracy: 0.8395 - val_loss: 0.4607 - val_accuracy: 0.8517
Epoch 173/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.4585 - accuracy:
0.8448
Epoch 00173: val_loss did not improve from 0.46066
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4713 -
accuracy: 0.8365 - val_loss: 0.4876 - val_accuracy: 0.8466
Epoch 174/350
6784/6985 [===========================>.] - ETA: 0s - loss: 0.4593 - accuracy:
0.8368
Epoch 00174: val_loss did not improve from 0.46066
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4615 -
accuracy: 0.8354 - val_loss: 0.4633 - val_accuracy: 0.8540
Epoch 175/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.4832 - accuracy:
0.8329
Epoch 00175: val_loss did not improve from 0.46066
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4747 -
accuracy: 0.8379 - val_loss: 0.4736 - val_accuracy: 0.8460
Epoch 176/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.4527 - accuracy:
0.8460
Epoch 00176: val_loss did not improve from 0.46066
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4569 -
accuracy: 0.8442 - val_loss: 0.4811 - val_accuracy: 0.8420
```

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Epoch 177/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.4589 - accuracy:
0.8452
Epoch 00177: val_loss did not improve from 0.46066
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4575 -
accuracy: 0.8462 - val_loss: 0.4706 - val_accuracy: 0.8500
Epoch 178/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.4599 - accuracy:
0.8399
Epoch 00178: val_loss improved from 0.46066 to 0.45892, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4631 -
accuracy: 0.8412 - val_loss: 0.4589 - val_accuracy: 0.8466
Epoch 179/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4645 - accuracy:
0.8396
Epoch 00179: val_loss improved from 0.45892 to 0.45272, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.4667 -
accuracy: 0.8404 - val_loss: 0.4527 - val_accuracy: 0.8477
Epoch 180/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4548 - accuracy:
0.8442
Epoch 00180: val_loss did not improve from 0.45272
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4592 -
accuracy: 0.8404 - val_loss: 0.4754 - val_accuracy: 0.8489
Epoch 181/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4560 - accuracy:
0.8467
Epoch 00181: val_loss did not improve from 0.45272
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4608 -
accuracy: 0.8427 - val_loss: 0.4731 - val_accuracy: 0.8437
Epoch 182/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.4641 - accuracy:
0.8352
Epoch 00182: val_loss did not improve from 0.45272
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4591 -
accuracy: 0.8371 - val_loss: 0.4625 - val_accuracy: 0.8512
Epoch 183/350
4544/6985 [=================>…] - ETA: 0s - loss: 0.4589 - accuracy:
0.8435
Epoch 00183: val_loss did not improve from 0.45272
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4521 -
accuracy: 0.8465 - val_loss: 0.4771 - val_accuracy: 0.8409
Epoch 184/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.4459 - accuracy:
0.8415
Epoch 00184: val_loss did not improve from 0.45272
```

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6985/6985 [==============================] - 0s 26us/sample - loss: 0.4476 -
accuracy: 0.8437 - val_loss: 0.4723 - val_accuracy: 0.8483
Epoch 185/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4483 - accuracy:
0.8433
Epoch 00185: val_loss improved from 0.45272 to 0.45118, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.4549 -
accuracy: 0.8405 - val_loss: 0.4512 - val_accuracy: 0.8489
Epoch 186/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4831 - accuracy:
0.8336
Epoch 00186: val_loss did not improve from 0.45118
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4771 -
accuracy: 0.8349 - val_loss: 0.4587 - val_accuracy: 0.8477
Epoch 187/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4501 - accuracy:
0.8444
Epoch 00187: val_loss improved from 0.45118 to 0.44279, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.4476 -
accuracy: 0.8437 - val_loss: 0.4428 - val_accuracy: 0.8586
Epoch 188/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4668 - accuracy:
0.8423
Epoch 00188: val_loss did not improve from 0.44279
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4628 -
accuracy: 0.8438 - val_loss: 0.4626 - val_accuracy: 0.8506
Epoch 189/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4512 - accuracy:
0.8421
Epoch 00189: val_loss did not improve from 0.44279
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4461 -
accuracy: 0.8454 - val_loss: 0.4698 - val_accuracy: 0.8449
Epoch 190/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.4338 - accuracy:
0.8504
Epoch 00190: val_loss did not improve from 0.44279
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4337 -
accuracy: 0.8505 - val_loss: 0.4666 - val_accuracy: 0.8506
Epoch 191/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4424 - accuracy:
0.8478
Epoch 00191: val_loss did not improve from 0.44279
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4475 -
accuracy: 0.8450 - val_loss: 0.4465 - val_accuracy: 0.8569
Epoch 192/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4388 - accuracy:
```

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0.8446
Epoch 00192: val_loss did not improve from 0.44279
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4442 -
accuracy: 0.8447 - val_loss: 0.4459 - val_accuracy: 0.8563
Epoch 193/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.4494 - accuracy:
0.8435
Epoch 00193: val_loss did not improve from 0.44279
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4497 -
accuracy: 0.8432 - val_loss: 0.4760 - val_accuracy: 0.8500
Epoch 194/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4360 - accuracy:
0.8563
Epoch 00194: val_loss did not improve from 0.44279
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4353 -
accuracy: 0.8537 - val_loss: 0.4480 - val_accuracy: 0.8609
Epoch 195/350
5120/6985 [====================>…] - ETA: 0s - loss: 0.4426 - accuracy:
0.8520
Epoch 00195: val_loss improved from 0.44279 to 0.44278, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4434 -
accuracy: 0.8508 - val_loss: 0.4428 - val_accuracy: 0.8558
Epoch 196/350
6592/6985 [==========================>..] - ETA: 0s - loss: 0.4583 - accuracy:
0.8421
Epoch 00196: val_loss did not improve from 0.44278
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4562 -
accuracy: 0.8434 - val_loss: 0.4548 - val_accuracy: 0.8517
Epoch 197/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4408 - accuracy:
0.8475
Epoch 00197: val_loss did not improve from 0.44278
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4563 -
accuracy: 0.8412 - val_loss: 0.4592 - val_accuracy: 0.8506
Epoch 198/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4450 - accuracy:
0.8446
Epoch 00198: val_loss did not improve from 0.44278
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4408 -
accuracy: 0.8462 - val_loss: 0.4544 - val_accuracy: 0.8586
Epoch 199/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.4436 - accuracy:
0.8488
Epoch 00199: val_loss improved from 0.44278 to 0.43975, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.4404 -
accuracy: 0.8508 - val_loss: 0.4398 - val_accuracy: 0.8592
```

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Epoch 200/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.4506 - accuracy:
0.8398
Epoch 00200: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 29us/sample - loss: 0.4449 -
accuracy: 0.8427 - val_loss: 0.4413 - val_accuracy: 0.8546
Epoch 201/350
6976/6985 [=============================>.] - ETA: 0s - loss: 0.4290 - accuracy:
0.8513
Epoch 00201: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4288 -
accuracy: 0.8513 - val_loss: 0.4837 - val_accuracy: 0.8437
Epoch 202/350
6976/6985 [=============================>.] - ETA: 0s - loss: 0.4530 - accuracy:
0.8460
Epoch 00202: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4533 -
accuracy: 0.8460 - val_loss: 0.4570 - val_accuracy: 0.8506
Epoch 203/350
5056/6985 [====================>…] - ETA: 0s - loss: 0.4403 - accuracy:
0.8424
Epoch 00203: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4429 -
accuracy: 0.8431 - val_loss: 0.4442 - val_accuracy: 0.8552
Epoch 204/350
4928/6985 [====================>…] - ETA: 0s - loss: 0.4294 - accuracy:
0.8531
Epoch 00204: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4224 -
accuracy: 0.8541 - val_loss: 0.4474 - val_accuracy: 0.8546
Epoch 205/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4164 - accuracy:
0.8563
Epoch 00205: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4275 -
accuracy: 0.8498 - val_loss: 0.4513 - val_accuracy: 0.8569
Epoch 206/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4355 - accuracy:
0.8501
Epoch 00206: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4296 -
accuracy: 0.8531 - val_loss: 0.4434 - val_accuracy: 0.8638
Epoch 207/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4188 - accuracy:
0.8581
Epoch 00207: val_loss did not improve from 0.43975
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4141 -
accuracy: 0.8578 - val_loss: 0.4433 - val_accuracy: 0.8598
```

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Epoch 208/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.4345 - accuracy:
0.8532
Epoch 00208: val_loss improved from 0.43975 to 0.43241, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 32us/sample - loss: 0.4351 -
accuracy: 0.8537 - val_loss: 0.4324 - val_accuracy: 0.8626
Epoch 209/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.4242 - accuracy:
0.8519
Epoch 00209: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4238 -
accuracy: 0.8521 - val_loss: 0.4810 - val_accuracy: 0.8420
Epoch 210/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4099 - accuracy:
0.8646
Epoch 00210: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4193 -
accuracy: 0.8563 - val_loss: 0.4402 - val_accuracy: 0.8558
Epoch 211/350
4928/6985 [====================>…] - ETA: 0s - loss: 0.4262 - accuracy:
0.8504
Epoch 00211: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4305 -
accuracy: 0.8513 - val_loss: 0.4358 - val_accuracy: 0.8558
Epoch 212/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4206 - accuracy:
0.8573
Epoch 00212: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4263 -
accuracy: 0.8554 - val_loss: 0.4366 - val_accuracy: 0.8575
Epoch 213/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4337 - accuracy:
0.8537
Epoch 00213: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4392 -
accuracy: 0.8517 - val_loss: 0.4577 - val_accuracy: 0.8529
Epoch 214/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.4087 - accuracy:
0.8567
Epoch 00214: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 31us/sample - loss: 0.4087 -
accuracy: 0.8560 - val_loss: 0.4338 - val_accuracy: 0.8615
Epoch 215/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.4213 - accuracy:
0.8516
Epoch 00215: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4213 -
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accuracy: 0.8515 - val_loss: 0.4397 - val_accuracy: 0.8506
Epoch 216/350
4992/6985 [====================>…] - ETA: 0s - loss: 0.4037 - accuracy:
0.8608
Epoch 00216: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4125 -
accuracy: 0.8550 - val_loss: 0.4337 - val_accuracy: 0.8552
Epoch 217/350
6016/6985 [=========================>…] - ETA: 0s - loss: 0.4286 - accuracy:
0.8511
Epoch 00217: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 32us/sample - loss: 0.4269 -
accuracy: 0.8494 - val_loss: 0.4378 - val_accuracy: 0.8558
Epoch 218/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.4021 - accuracy:
0.8608
Epoch 00218: val_loss did not improve from 0.43241
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4084 -
accuracy: 0.8580 - val_loss: 0.4337 - val_accuracy: 0.8603
Epoch 219/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4193 - accuracy:
0.8598
Epoch 00219: val_loss improved from 0.43241 to 0.42847, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4207 -
accuracy: 0.8591 - val_loss: 0.4285 - val_accuracy: 0.8649
Epoch 220/350
6720/6985 [===========================>..] - ETA: 0s - loss: 0.4129 - accuracy:
0.8548
Epoch 00220: val_loss did not improve from 0.42847
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4123 -
accuracy: 0.8553 - val_loss: 0.4305 - val_accuracy: 0.8638
Epoch 221/350
4608/6985 [==================>…] - ETA: 0s - loss: 0.4094 - accuracy:
0.8576
Epoch 00221: val_loss did not improve from 0.42847
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4149 -
accuracy: 0.8551 - val_loss: 0.4350 - val_accuracy: 0.8603
Epoch 222/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4062 - accuracy:
0.8583
Epoch 00222: val_loss improved from 0.42847 to 0.42154, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4112 -
accuracy: 0.8573 - val_loss: 0.4215 - val_accuracy: 0.8615
Epoch 223/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.4042 - accuracy:
0.8591
```

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Epoch 00223: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4040 -
accuracy: 0.8593 - val_loss: 0.4229 - val_accuracy: 0.8712
Epoch 224/350
4672/6985 [===================>…] - ETA: 0s - loss: 0.3927 - accuracy:
0.8607
Epoch 00224: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3932 -
accuracy: 0.8616 - val_loss: 0.4355 - val_accuracy: 0.8603
Epoch 225/350
6848/6985 [============================>.] - ETA: 0s - loss: 0.4256 - accuracy:
0.8512
Epoch 00225: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4274 -
accuracy: 0.8504 - val_loss: 0.4237 - val_accuracy: 0.8592
Epoch 226/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.4107 - accuracy:
0.8545
Epoch 00226: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4060 -
accuracy: 0.8568 - val_loss: 0.4346 - val_accuracy: 0.8643
Epoch 227/350
5120/6985 [====================>…] - ETA: 0s - loss: 0.4076 - accuracy:
0.8514
Epoch 00227: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3978 -
accuracy: 0.8570 - val_loss: 0.4282 - val_accuracy: 0.8626
Epoch 228/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.4141 - accuracy:
0.8584
Epoch 00228: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4061 -
accuracy: 0.8581 - val_loss: 0.4436 - val_accuracy: 0.8643
Epoch 229/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.4261 - accuracy:
0.8551
Epoch 00229: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4113 -
accuracy: 0.8613 - val_loss: 0.4265 - val_accuracy: 0.8632
Epoch 230/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4042 - accuracy:
0.8560
Epoch 00230: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4115 -
accuracy: 0.8555 - val_loss: 0.4422 - val_accuracy: 0.8615
Epoch 231/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.4120 - accuracy:
0.8525
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Epoch 00231: val_loss did not improve from 0.42154
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4071 -
accuracy: 0.8565 - val_loss: 0.4281 - val_accuracy: 0.8672
Epoch 232/350
5184/6985 [====================>…] - ETA: 0s - loss: 0.4048 - accuracy:
0.8578
Epoch 00232: val_loss improved from 0.42154 to 0.41737, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4124 -
accuracy: 0.8564 - val_loss: 0.4174 - val_accuracy: 0.8683
Epoch 233/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.4098 - accuracy:
0.8568
Epoch 00233: val_loss did not improve from 0.41737
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4051 -
accuracy: 0.8606 - val_loss: 0.4197 - val_accuracy: 0.8724
Epoch 234/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.3843 - accuracy:
0.8686
Epoch 00234: val_loss did not improve from 0.41737
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3939 -
accuracy: 0.8636 - val_loss: 0.4370 - val_accuracy: 0.8609
Epoch 235/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.4287 - accuracy:
0.8516
Epoch 00235: val_loss did not improve from 0.41737
6985/6985 [==============================] - 0s 27us/sample - loss: 0.4217 -
accuracy: 0.8515 - val_loss: 0.4447 - val_accuracy: 0.8540
Epoch 236/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.3966 - accuracy:
0.8674
Epoch 00236: val_loss did not improve from 0.41737
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3930 -
accuracy: 0.8673 - val_loss: 0.4373 - val_accuracy: 0.8620
Epoch 237/350
5184/6985 [====================>…] - ETA: 0s - loss: 0.4001 - accuracy:
0.8628
Epoch 00237: val_loss did not improve from 0.41737
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4110 -
accuracy: 0.8573 - val_loss: 0.4377 - val_accuracy: 0.8575
Epoch 238/350
4992/6985 [==================>…] - ETA: 0s - loss: 0.4061 - accuracy:
0.8542
Epoch 00238: val_loss did not improve from 0.41737
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4019 -
accuracy: 0.8571 - val_loss: 0.4298 - val_accuracy: 0.8672
Epoch 239/350
5120/6985 [==================>…] - ETA: 0s - loss: 0.4043 - accuracy:
```

0.8572
Epoch 00239: val_loss improved from 0.41737 to 0.41563, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4069 -
accuracy: 0.8573 - val_loss: 0.4156 - val_accuracy: 0.8689
Epoch 240/350
6784/6985 [============================>.] - ETA: 0s - loss: 0.3905 - accuracy:
0.8672
Epoch 00240: val_loss did not improve from 0.41563
6985/6985 [==============================] - 0s 29us/sample - loss: 0.3905 -
accuracy: 0.8673 - val_loss: 0.4428 - val_accuracy: 0.8672
Epoch 241/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.3975 - accuracy:
0.8598
Epoch 00241: val_loss improved from 0.41563 to 0.41322, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.4110 -
accuracy: 0.8590 - val_loss: 0.4132 - val_accuracy: 0.8689
Epoch 242/350
6912/6985 [=============================>.] - ETA: 0s - loss: 0.4009 - accuracy:
0.8587
Epoch 00242: val_loss did not improve from 0.41322
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4035 -
accuracy: 0.8578 - val_loss: 0.4206 - val_accuracy: 0.8706
Epoch 243/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.4175 - accuracy:
0.8557
Epoch 00243: val_loss improved from 0.41322 to 0.41305, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.4098 -
accuracy: 0.8577 - val_loss: 0.4131 - val_accuracy: 0.8706
Epoch 244/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.3840 - accuracy:
0.8647
Epoch 00244: val_loss did not improve from 0.41305
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3870 -
accuracy: 0.8623 - val_loss: 0.4232 - val_accuracy: 0.8689
Epoch 245/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.3891 - accuracy:
0.8684
Epoch 00245: val_loss did not improve from 0.41305
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3867 -
accuracy: 0.8663 - val_loss: 0.4190 - val_accuracy: 0.8638
Epoch 246/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.3905 - accuracy:
0.8655
Epoch 00246: val_loss improved from 0.41305 to 0.41042, saving model to
audio_classification_nn.h5

```
6985/6985 [==============================] - 0s 28us/sample - loss: 0.3895 -
accuracy: 0.8654 - val_loss: 0.4104 - val_accuracy: 0.8632
Epoch 247/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.3970 - accuracy:
0.8627
Epoch 00247: val_loss did not improve from 0.41042
6985/6985 [==============================] - 0s 28us/sample - loss: 0.3971 -
accuracy: 0.8626 - val_loss: 0.4410 - val_accuracy: 0.8586
Epoch 248/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.3792 - accuracy:
0.8704
Epoch 00248: val_loss improved from 0.41042 to 0.40715, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.3836 -
accuracy: 0.8659 - val_loss: 0.4072 - val_accuracy: 0.8706
Epoch 249/350
6592/6985 [===========================>..] - ETA: 0s - loss: 0.3854 - accuracy:
0.8648
Epoch 00249: val_loss did not improve from 0.40715
6985/6985 [==============================] - 0s 29us/sample - loss: 0.3868 -
accuracy: 0.8639 - val_loss: 0.4606 - val_accuracy: 0.8500
Epoch 250/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.4020 - accuracy:
0.8620
Epoch 00250: val_loss did not improve from 0.40715
6985/6985 [==============================] - 0s 26us/sample - loss: 0.4071 -
accuracy: 0.8594 - val_loss: 0.4177 - val_accuracy: 0.8678
Epoch 251/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.4005 - accuracy:
0.8655
Epoch 00251: val_loss did not improve from 0.40715
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3987 -
accuracy: 0.8650 - val_loss: 0.4096 - val_accuracy: 0.8758
Epoch 252/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.3761 - accuracy:
0.8645
Epoch 00252: val_loss did not improve from 0.40715
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3777 -
accuracy: 0.8646 - val_loss: 0.4378 - val_accuracy: 0.8598
Epoch 253/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.3911 - accuracy:
0.8645
Epoch 00253: val_loss did not improve from 0.40715
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3935 -
accuracy: 0.8653 - val_loss: 0.4138 - val_accuracy: 0.8672
Epoch 254/350
4608/6985 [==================>…] - ETA: 0s - loss: 0.3823 - accuracy:
0.8676
```

```
Epoch 00254: val_loss did not improve from 0.40715
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3834 -
accuracy: 0.8653 - val_loss: 0.4377 - val_accuracy: 0.8569
Epoch 255/350
5184/6985 [=====================>…] - ETA: 0s - loss: 0.3777 - accuracy:
0.8665
Epoch 00255: val_loss improved from 0.40715 to 0.40535, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.3763 -
accuracy: 0.8666 - val_loss: 0.4054 - val_accuracy: 0.8752
Epoch 256/350
6592/6985 [===========================>..] - ETA: 0s - loss: 0.3673 - accuracy:
0.8717
Epoch 00256: val_loss did not improve from 0.40535
6985/6985 [==============================] - 0s 28us/sample - loss: 0.3657 -
accuracy: 0.8713 - val_loss: 0.4081 - val_accuracy: 0.8724
Epoch 257/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.3812 - accuracy:
0.8671
Epoch 00257: val_loss did not improve from 0.40535
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3695 -
accuracy: 0.8723 - val_loss: 0.4179 - val_accuracy: 0.8758
Epoch 258/350
5184/6985 [=====================>…] - ETA: 0s - loss: 0.3823 - accuracy:
0.8690
Epoch 00258: val_loss improved from 0.40535 to 0.40378, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3863 -
accuracy: 0.8676 - val_loss: 0.4038 - val_accuracy: 0.8678
Epoch 259/350
6656/6985 [===========================>..] - ETA: 0s - loss: 0.3871 - accuracy:
0.8628
Epoch 00259: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 29us/sample - loss: 0.3845 -
accuracy: 0.8634 - val_loss: 0.4326 - val_accuracy: 0.8603
Epoch 260/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.3760 - accuracy:
0.8683
Epoch 00260: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3773 -
accuracy: 0.8676 - val_loss: 0.4042 - val_accuracy: 0.8741
Epoch 261/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.3922 - accuracy:
0.8602
Epoch 00261: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3855 -
accuracy: 0.8630 - val_loss: 0.4466 - val_accuracy: 0.8586
Epoch 262/350
```

```
4800/6985 [==================>…] - ETA: 0s - loss: 0.3830 - accuracy:
0.8681
Epoch 00262: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3799 -
accuracy: 0.8683 - val_loss: 0.4092 - val_accuracy: 0.8661
Epoch 263/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.4003 - accuracy:
0.8565
Epoch 00263: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3874 -
accuracy: 0.8617 - val_loss: 0.4182 - val_accuracy: 0.8683
Epoch 264/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.3820 - accuracy:
0.8662
Epoch 00264: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3831 -
accuracy: 0.8666 - val_loss: 0.4270 - val_accuracy: 0.8620
Epoch 265/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.3881 - accuracy:
0.8629
Epoch 00265: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3775 -
accuracy: 0.8673 - val_loss: 0.4196 - val_accuracy: 0.8718
Epoch 266/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.4097 - accuracy:
0.8526
Epoch 00266: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 30us/sample - loss: 0.4035 -
accuracy: 0.8568 - val_loss: 0.4488 - val_accuracy: 0.8632
Epoch 267/350
6208/6985 [=======================>…] - ETA: 0s - loss: 0.3622 - accuracy:
0.8776
Epoch 00267: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 31us/sample - loss: 0.3661 -
accuracy: 0.8760 - val_loss: 0.4133 - val_accuracy: 0.8718
Epoch 268/350
6208/6985 [=======================>…] - ETA: 0s - loss: 0.3791 - accuracy:
0.8678
Epoch 00268: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 30us/sample - loss: 0.3801 -
accuracy: 0.8680 - val_loss: 0.4242 - val_accuracy: 0.8661
Epoch 269/350
4992/6985 [==================>…] - ETA: 0s - loss: 0.3852 - accuracy:
0.8596
Epoch 00269: val_loss did not improve from 0.40378
6985/6985 [==============================] - 0s 25us/sample - loss: 0.3868 -
accuracy: 0.8618 - val_loss: 0.4275 - val_accuracy: 0.8643
Epoch 270/350
```

```
4480/6985 [==================>…] - ETA: 0s - loss: 0.4000 - accuracy:
0.8567
Epoch 00270: val_loss improved from 0.40378 to 0.39706, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 29us/sample - loss: 0.3852 -
accuracy: 0.8631 - val_loss: 0.3971 - val_accuracy: 0.8781
Epoch 271/350
4928/6985 [===================>…] - ETA: 0s - loss: 0.3776 - accuracy:
0.8679
Epoch 00271: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3852 -
accuracy: 0.8667 - val_loss: 0.4070 - val_accuracy: 0.8781
Epoch 272/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.3683 - accuracy:
0.8762
Epoch 00272: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3755 -
accuracy: 0.8712 - val_loss: 0.4089 - val_accuracy: 0.8672
Epoch 273/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.3567 - accuracy:
0.8726
Epoch 00273: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3663 -
accuracy: 0.8706 - val_loss: 0.4013 - val_accuracy: 0.8706
Epoch 274/350
6528/6985 [===========================>..] - ETA: 0s - loss: 0.3753 - accuracy:
0.8716
Epoch 00274: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 29us/sample - loss: 0.3725 -
accuracy: 0.8719 - val_loss: 0.4181 - val_accuracy: 0.8672
Epoch 275/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.3737 - accuracy:
0.8711
Epoch 00275: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 28us/sample - loss: 0.3734 -
accuracy: 0.8707 - val_loss: 0.4003 - val_accuracy: 0.8764
Epoch 276/350
4992/6985 [===================>…] - ETA: 0s - loss: 0.3748 - accuracy:
0.8724
Epoch 00276: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 25us/sample - loss: 0.3657 -
accuracy: 0.8752 - val_loss: 0.4090 - val_accuracy: 0.8741
Epoch 277/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.3761 - accuracy:
0.8701
Epoch 00277: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3655 -
accuracy: 0.8754 - val_loss: 0.4039 - val_accuracy: 0.8718
```

```
Epoch 278/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.3743 - accuracy:
0.8671
Epoch 00278: val_loss did not improve from 0.39706
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3732 -
accuracy: 0.8671 - val_loss: 0.4293 - val_accuracy: 0.8695
Epoch 279/350
5056/6985 [===================>…] - ETA: 0s - loss: 0.3919 - accuracy:
0.8627
Epoch 00279: val_loss improved from 0.39706 to 0.39571, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3912 -
accuracy: 0.8653 - val_loss: 0.3957 - val_accuracy: 0.8792
Epoch 280/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.3554 - accuracy:
0.8723
Epoch 00280: val_loss did not improve from 0.39571
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3599 -
accuracy: 0.8717 - val_loss: 0.4067 - val_accuracy: 0.8741
Epoch 281/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.3603 - accuracy:
0.8740
Epoch 00281: val_loss did not improve from 0.39571
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3612 -
accuracy: 0.8733 - val_loss: 0.4095 - val_accuracy: 0.8724
Epoch 282/350
5184/6985 [=====================>…] - ETA: 0s - loss: 0.3793 - accuracy:
0.8646
Epoch 00282: val_loss improved from 0.39571 to 0.39493, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.3810 -
accuracy: 0.8660 - val_loss: 0.3949 - val_accuracy: 0.8815
Epoch 283/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.3625 - accuracy:
0.8739
Epoch 00283: val_loss did not improve from 0.39493
6985/6985 [==============================] - 0s 29us/sample - loss: 0.3668 -
accuracy: 0.8726 - val_loss: 0.4046 - val_accuracy: 0.8706
Epoch 284/350
4672/6985 [===================>…] - ETA: 0s - loss: 0.3981 - accuracy:
0.8656
Epoch 00284: val_loss did not improve from 0.39493
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3780 -
accuracy: 0.8714 - val_loss: 0.4023 - val_accuracy: 0.8786
Epoch 285/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.3639 - accuracy:
0.8729
Epoch 00285: val_loss did not improve from 0.39493
```

```
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3703 -
accuracy: 0.8704 - val_loss: 0.4018 - val_accuracy: 0.8735
Epoch 286/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.3722 - accuracy:
0.8691
Epoch 00286: val_loss did not improve from 0.39493
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3694 -
accuracy: 0.8687 - val_loss: 0.4018 - val_accuracy: 0.8752
Epoch 287/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.3550 - accuracy:
0.8717
Epoch 00287: val_loss improved from 0.39493 to 0.39163, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 28us/sample - loss: 0.3538 -
accuracy: 0.8727 - val_loss: 0.3916 - val_accuracy: 0.8781
Epoch 288/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.3456 - accuracy:
0.8792
Epoch 00288: val_loss did not improve from 0.39163
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3599 -
accuracy: 0.8740 - val_loss: 0.3997 - val_accuracy: 0.8678
Epoch 289/350
4736/6985 [===================>…] - ETA: 0s - loss: 0.3591 - accuracy:
0.8704
Epoch 00289: val_loss did not improve from 0.39163
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3588 -
accuracy: 0.8722 - val_loss: 0.4160 - val_accuracy: 0.8683
Epoch 290/350
4800/6985 [===================>…] - ETA: 0s - loss: 0.3648 - accuracy:
0.8710
Epoch 00290: val_loss did not improve from 0.39163
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3694 -
accuracy: 0.8681 - val_loss: 0.4008 - val_accuracy: 0.8769
Epoch 291/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.3556 - accuracy:
0.8742
Epoch 00291: val_loss did not improve from 0.39163
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3597 -
accuracy: 0.8730 - val_loss: 0.4016 - val_accuracy: 0.8741
Epoch 292/350
4864/6985 [===================>…] - ETA: 0s - loss: 0.3600 - accuracy:
0.8748
Epoch 00292: val_loss did not improve from 0.39163
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3608 -
accuracy: 0.8737 - val_loss: 0.4056 - val_accuracy: 0.8775
Epoch 293/350
6848/6985 [============================>.] - ETA: 0s - loss: 0.3543 - accuracy:
0.8759
```

```
Epoch 00293: val_loss improved from 0.39163 to 0.39091, saving model to
audio_classification_nn.h5
6985/6985 [==============================] - 0s 30us/sample - loss: 0.3538 -
accuracy: 0.8764 - val_loss: 0.3909 - val_accuracy: 0.8769
Epoch 294/350
4736/6985 [==================>…] - ETA: 0s - loss: 0.3939 - accuracy:
0.8647
Epoch 00294: val_loss did not improve from 0.39091
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3865 -
accuracy: 0.8669 - val_loss: 0.3940 - val_accuracy: 0.8775
Epoch 295/350
4864/6985 [==================>…] - ETA: 0s - loss: 0.3531 - accuracy:
0.8742
Epoch 00295: val_loss did not improve from 0.39091
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3536 -
accuracy: 0.8750 - val_loss: 0.4242 - val_accuracy: 0.8643
Epoch 296/350
4672/6985 [==================>…] - ETA: 0s - loss: 0.3338 - accuracy:
0.8868
Epoch 00296: val_loss did not improve from 0.39091
6985/6985 [==============================] - 0s 27us/sample - loss: 0.3441 -
accuracy: 0.8822 - val_loss: 0.4103 - val_accuracy: 0.8689
Epoch 297/350
4800/6985 [==================>…] - ETA: 0s - loss: 0.3581 - accuracy:
0.8767
Epoch 00297: val_loss did not improve from 0.39091
6985/6985 [==============================] - 0s 26us/sample - loss: 0.3526 -
accuracy: 0.8790 - val_loss: 0.4032 - val_accuracy: 0.8735
Epoch 298/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.3694 - accuracy:
0.8723
Epoch 00298: val_loss did not improve from 0.39091
6985/6985 [==============================] - 0s 30us/sample - loss: 0.3673 -
accuracy: 0.8727 - val_loss: 0.4060 - val_accuracy: 0.8769
Epoch 299/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.3657 - accuracy:
0.8695
Epoch 00299: val_loss did not improve from 0.39091
6985/6985 [==============================] - 0s 32us/sample - loss: 0.3647 -
accuracy: 0.8706 - val_loss: 0.4158 - val_accuracy: 0.8769
Epoch 300/350
5376/6985 [=====================>…] - ETA: 0s - loss: 0.3549 - accuracy:
0.8733
Epoch 00300: val_loss did not improve from 0.39091
6985/6985 [==============================] - 0s 34us/sample - loss: 0.3556 -
accuracy: 0.8752 - val_loss: 0.3992 - val_accuracy: 0.8798
```

0.0.12 Plot accuracy vs validation accuracy while training

```python
[78]: plt.plot(history.history['accuracy'])
      plt.plot(history.history['val_accuracy'])
      plt.title('model_accuracy')
      plt.ylabel('accuracy')
      plt.xlabel('epoch')
      plt.legend(['train','val'])
      plt.show()

      plt.plot(history.history['loss'])
      plt.plot(history.history['val_loss'])
      plt.title('model_loss')
      plt.ylabel('loss')
      plt.xlabel('epoch')
      plt.legend(['train','val'])
      plt.show()
```
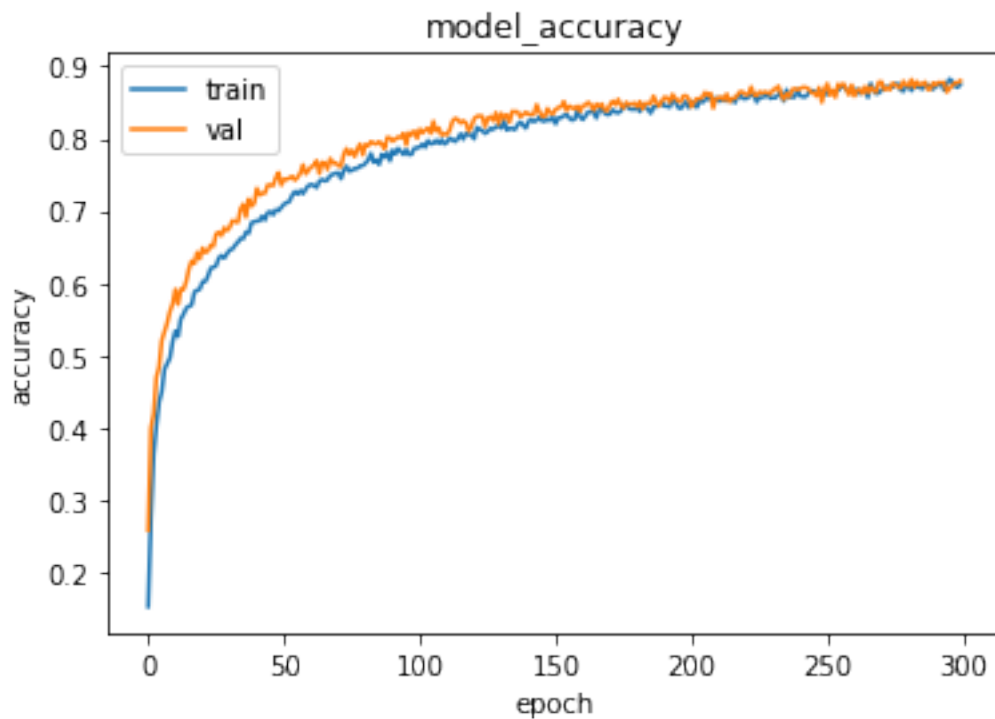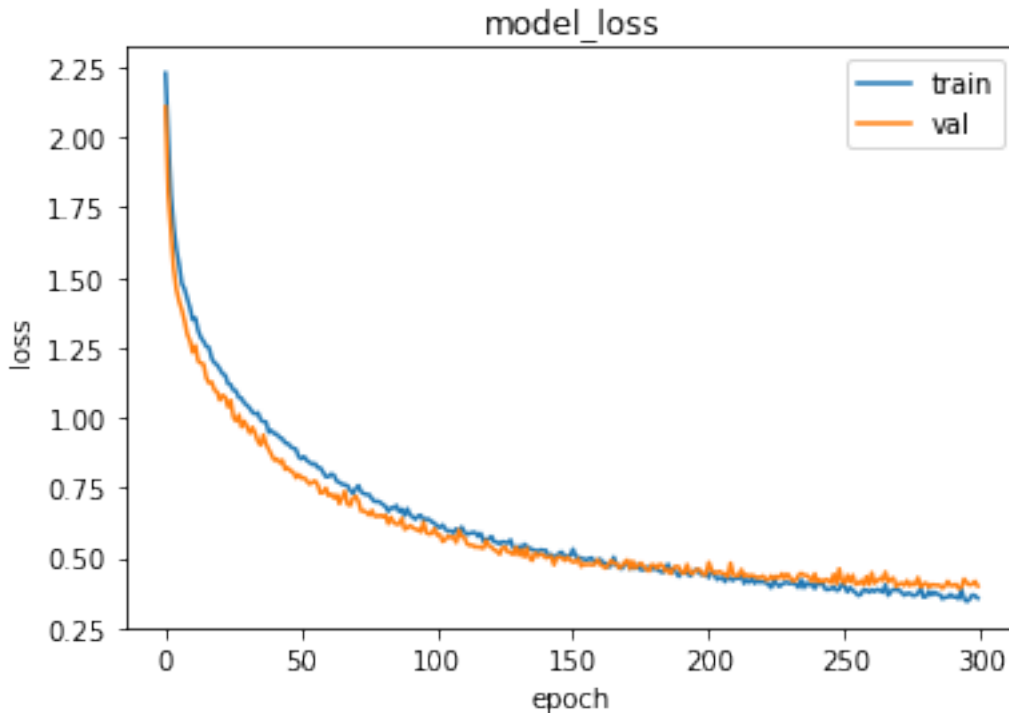
Model Evaluation:

```
[79]: print('Validation loss is {0} , validation accuracy is {1}'.format(history.
      ↪history['val_loss'][-1],history.history['val_accuracy'][-1]))
```

```
Validation loss is 0.39917056157579406 , validation accuracy is
0.8797939419746399
```

0.0.13 Predictions using nueral networks models

```
[80]: y_pred_le_nn = model.predict(X_test_scaled)
      y_pred_le_nn = np.argmax(y_pred_le_nn,axis=1)
      y_pred_nn = le.inverse_transform(y_pred_le_nn)
```

0.0.14 Evaluation of Model

fucntion to get sensitivity,specificity and precision

```
[81]: def get_metrics(cnf_matrix,columns= ['Metric','air_conditioner', 'car_horn',
      ↪'children_playing', 'dog_bark',
          'drilling', 'engine_idling', 'gun_shot', 'jackhammer', 'siren',
          'street_music']):
          FP = cnf_matrix.sum(axis=0) - np.diag(cnf_matrix)
          FN = cnf_matrix.sum(axis=1) - np.diag(cnf_matrix)
          TP = np.diag(cnf_matrix)
```

```python
        TN = cnf_matrix.sum() - (FP + FN + TP)
        FP = FP.astype(float)
        FN = FN.astype(float)
        TP = TP.astype(float)
        TN = TN.astype(float)

        df = pd.DataFrame(columns=columns)
        row_list = []
        # Sensitivity, hit rate, recall, or true positive rate
        TPR = TP/(TP+FN)
        row_list.append(np.append('Sensitivity',np.round(TPR,2)))

        # Specificity or true negative rate
        TNR = TN/(TN+FP)
        row_list.append(np.append('Specificity',np.round(TNR,2)))

        # Precision or positive predictive value
        PPV = TP/(TP+FP)
        row_list.append(np.append('Precision',np.round(PPV,2)))

        return pd.DataFrame(row_list, columns=columns)
```

fucntion to get auc_roc curve

```python
[82]: def plot_multiclass_roc(clf, X_test, y_test, n_classes, figsize=(17,␣
      ↪6),name="Model"):
          y_score = clf.predict_proba(X_test)
          if name=="LSTM":
              y_score = y_score.reshape(y_score.shape[0],y_score.shape[2])
          # structures
          fpr = dict()
          tpr = dict()
          roc_auc = dict()

          # calculate dummies once
          encoder = pd.get_dummies(y_test, drop_first=False)
          y_test_dummies = encoder.values
          for i in range(n_classes):
              fpr[i], tpr[i], _ = roc_curve(y_test_dummies[:, i], y_score[:, i])
              roc_auc[i] = auc(fpr[i], tpr[i])

          # roc for each class
          fig, ax = plt.subplots(figsize=figsize)
          ax.plot([0, 1], [0, 1], 'k--')
          ax.set_xlim([0.0, 1.0])
          ax.set_ylim([0.0, 1.05])
          ax.set_xlabel('False Positive Rate')
```

```
    ax.set_ylabel('True Positive Rate')
    ax.set_title('Receiver operating characteristic curve for {}'.format(name))
    for i in range(n_classes):
        ax.plot(fpr[i], tpr[i], label='ROC curve (area = %0.2f) for type %s' %␣
 ↪(roc_auc[i], encoder.columns.tolist()[i]))
    ax.legend(loc="best")
    ax.grid(alpha=.4)
    sns.despine()
    plt.show()
```

[83]: `print(classification_report(y_test,y_pred_nn))`

```
                    precision    recall  f1-score   support

    air_conditioner      0.91      0.94      0.92       200
           car_horn      0.97      0.90      0.93        86
   children_playing      0.75      0.82      0.78       200
           dog_bark      0.85      0.67      0.75       200
           drilling      0.95      0.91      0.93       200
      engine_idling      0.90      0.95      0.92       200
           gun_shot      0.78      0.84      0.81        75
         jackhammer      0.92      0.99      0.95       200
              siren      0.96      0.96      0.96       186
       street_music      0.80      0.80      0.80       200

           accuracy                          0.88      1747
          macro avg      0.88      0.88      0.88      1747
       weighted avg      0.88      0.88      0.88      1747
```
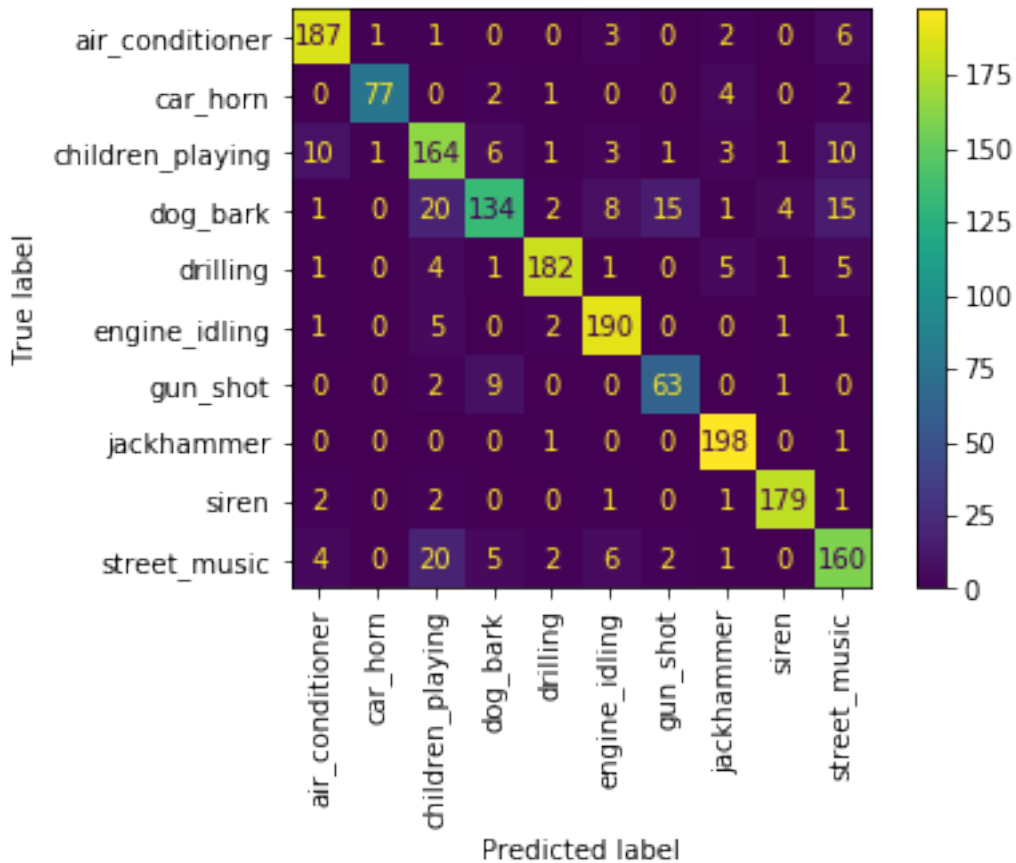
[84]:
```
nn_cnf_matrix = confusion_matrix(y_test,y_pred_nn)
disp_nn = ConfusionMatrixDisplay(nn_cnf_matrix,le.classes_)
disp_nn.plot(values_format='d',xticks_rotation='vertical')
```

[84]: `<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7f918c730890>`

```
[85]: nn_met = get_metrics(nn_cnf_matrix)
      nn_met
```

```
[85]:        Metric air_conditioner car_horn children_playing dog_bark drilling  \
      0  Sensitivity            0.94      0.9             0.82     0.67     0.91
      1  Specificity            0.99      1.0             0.97     0.99     0.99
      2    Precision            0.91     0.97             0.75     0.85     0.95

         engine_idling gun_shot jackhammer siren street_music
      0           0.95     0.84       0.99  0.96          0.8
      1           0.99     0.99       0.99  0.99         0.97
      2            0.9     0.78       0.92  0.96          0.8
```

```
[86]: plot_multiclass_roc(model, X_test_scaled, y_test, n_classes=10, figsize=(15,
      →6),name="Nueral Networks")
```

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Receiver operating characteristic curve for Nueral Networks
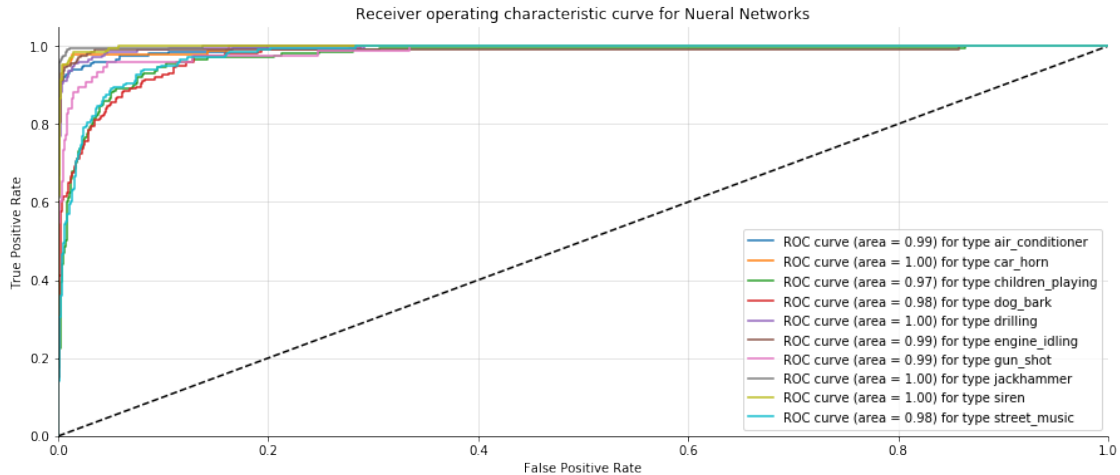
0.0.15 LSTM for audio classification

For LSTM data has to be reshaped to a 3 dimensal

Reshape_data

```
[87]: X_train_lstm = X_train_scaled.reshape((X_train_scaled.shape[0],1,X_train_scaled.
      ↪shape[1]))
      X_test_lstm = X_test_scaled.reshape((X_test_scaled.shape[0],1,X_test_scaled.
      ↪shape[1]))
```

```
[88]: print('Training Data Shape:',X_train_lstm.shape)
      print('Testing Data Shape:',X_test_lstm.shape)
```

```
Training Data Shape: (6985, 1, 40)
Testing Data Shape: (1747, 1, 40)
```

In the above example, use Nueral Networks for audio classification, here we will be using LSTM for audio classification.

```
[89]: model_lstm = Sequential()

      # first layer
      model_lstm.add(LSTM(100,input_shape=(1,40),return_sequences=True))
      model_lstm.add(Activation('relu'))
      BatchNormalization()
      model_lstm.add(Dropout(0.15))

      # second layer
      #model_lstm.add(LSTM(100,input_shape=(1,40)))
      model_lstm.add(Dense(100))
      model_lstm.add(Activation('relu'))
```

```python
BatchNormalization()
model_lstm.add(Dropout(0.15))

# third layer
model_lstm.add(Dense(100))
model_lstm.add(Activation('relu'))
BatchNormalization()
model_lstm.add(Dropout(0.15))

# final layer
model_lstm.add(Dense(10))
model_lstm.add(Activation('softmax'))
```

model optimizer and compiling

```python
[90]: #optimizer
      adam = Adam(lr=0.0006)
      model_lstm.
       ↪compile(loss='sparse_categorical_crossentropy',metrics=['accuracy'],optimizer=adam)
```

```python
[91]: num_epochs = 350
      num_batch_size = 64

      checkpointer = ModelCheckpoint(filepath='audio_classification_lstm.
       ↪h5',verbose=1,save_best_only=True)
      early_stopping = EarlyStopping(monitor='val_loss',patience =30, min_delta=0.01,␣
       ↪restore_best_weights =True)

      history = model_lstm.fit(X_train_lstm,le_y_train,batch_size=num_batch_size,␣
       ↪epochs=num_epochs,
                            ␣
       ↪validation_data=(X_test_lstm,le_y_test),callbacks=[checkpointer,early_stopping],␣
       ↪verbose=1)
```

```
Train on 6985 samples, validate on 1747 samples
Epoch 1/350
6208/6985 [==========================>…] - ETA: 0s - loss: 2.2670 - accuracy:
0.1295
Epoch 00001: val_loss improved from inf to 2.20577, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 2s 253us/sample - loss: 2.2621 -
accuracy: 0.1341 - val_loss: 2.2058 - val_accuracy: 0.2599
Epoch 2/350
6400/6985 [=========================>…] - ETA: 0s - loss: 2.0942 - accuracy:
0.2303
Epoch 00002: val_loss improved from 2.20577 to 1.90812, saving model to
audio_classification_lstm.h5
```

```
6985/6985 [==============================] - 0s 51us/sample - loss: 2.0842 -
accuracy: 0.2336 - val_loss: 1.9081 - val_accuracy: 0.2936
Epoch 3/350
6144/6985 [=========================>…] - ETA: 0s - loss: 1.8697 - accuracy:
0.3231
Epoch 00003: val_loss improved from 1.90812 to 1.72188, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.8659 -
accuracy: 0.3253 - val_loss: 1.7219 - val_accuracy: 0.4093
Epoch 4/350
6016/6985 [=========================>…] - ETA: 0s - loss: 1.7226 - accuracy:
0.3815
Epoch 00004: val_loss improved from 1.72188 to 1.56988, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 1.7017 -
accuracy: 0.3911 - val_loss: 1.5699 - val_accuracy: 0.4442
Epoch 5/350
6208/6985 [=========================>…] - ETA: 0s - loss: 1.6273 - accuracy:
0.4177
Epoch 00005: val_loss improved from 1.56988 to 1.49925, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.6202 -
accuracy: 0.4203 - val_loss: 1.4992 - val_accuracy: 0.4705
Epoch 6/350
6016/6985 [=========================>…] - ETA: 0s - loss: 1.5630 - accuracy:
0.4437
Epoch 00006: val_loss improved from 1.49925 to 1.43208, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.5603 -
accuracy: 0.4421 - val_loss: 1.4321 - val_accuracy: 0.4986
Epoch 7/350
6272/6985 [=========================>…] - ETA: 0s - loss: 1.5139 - accuracy:
0.4530
Epoch 00007: val_loss improved from 1.43208 to 1.40322, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.5098 -
accuracy: 0.4554 - val_loss: 1.4032 - val_accuracy: 0.4991
Epoch 8/350
6208/6985 [=========================>…] - ETA: 0s - loss: 1.4837 - accuracy:
0.4768
Epoch 00008: val_loss improved from 1.40322 to 1.38837, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.4822 -
accuracy: 0.4770 - val_loss: 1.3884 - val_accuracy: 0.5226
Epoch 9/350
5952/6985 [=========================>…] - ETA: 0s - loss: 1.4516 - accuracy:
0.4820
Epoch 00009: val_loss improved from 1.38837 to 1.38128, saving model to
```

```
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 1.4496 -
accuracy: 0.4827 - val_loss: 1.3813 - val_accuracy: 0.5363
Epoch 10/350
5952/6985 [=========================>…] - ETA: 0s - loss: 1.4267 - accuracy:
0.4904
Epoch 00010: val_loss improved from 1.38128 to 1.32756, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 55us/sample - loss: 1.4232 -
accuracy: 0.4902 - val_loss: 1.3276 - val_accuracy: 0.5386
Epoch 11/350
6144/6985 [==========================>…] - ETA: 0s - loss: 1.4046 - accuracy:
0.5059
Epoch 00011: val_loss did not improve from 1.32756
6985/6985 [==============================] - 0s 50us/sample - loss: 1.4016 -
accuracy: 0.5042 - val_loss: 1.3315 - val_accuracy: 0.5266
Epoch 12/350
6336/6985 [===========================>…] - ETA: 0s - loss: 1.3817 - accuracy:
0.5073
Epoch 00012: val_loss improved from 1.32756 to 1.30714, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 1.3813 -
accuracy: 0.5084 - val_loss: 1.3071 - val_accuracy: 0.5507
Epoch 13/350
6272/6985 [==========================>…] - ETA: 0s - loss: 1.3574 - accuracy:
0.5252
Epoch 00013: val_loss improved from 1.30714 to 1.26132, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.3573 -
accuracy: 0.5228 - val_loss: 1.2613 - val_accuracy: 0.5604
Epoch 14/350
6272/6985 [==========================>…] - ETA: 0s - loss: 1.3325 - accuracy:
0.5332
Epoch 00014: val_loss improved from 1.26132 to 1.24994, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.3287 -
accuracy: 0.5341 - val_loss: 1.2499 - val_accuracy: 0.5678
Epoch 15/350
6272/6985 [==========================>…] - ETA: 0s - loss: 1.3138 - accuracy:
0.5394
Epoch 00015: val_loss did not improve from 1.24994
6985/6985 [==============================] - 0s 49us/sample - loss: 1.3156 -
accuracy: 0.5364 - val_loss: 1.2560 - val_accuracy: 0.5547
Epoch 16/350
6016/6985 [========================>…] - ETA: 0s - loss: 1.3049 - accuracy:
0.5447
Epoch 00016: val_loss improved from 1.24994 to 1.23506, saving model to
audio_classification_lstm.h5
```

```
6985/6985 [==============================] - 0s 53us/sample - loss: 1.3064 -
accuracy: 0.5437 - val_loss: 1.2351 - val_accuracy: 0.5747
Epoch 17/350
6272/6985 [=========================>…] - ETA: 0s - loss: 1.2872 - accuracy:
0.5534
Epoch 00017: val_loss improved from 1.23506 to 1.21470, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 1.2802 -
accuracy: 0.5552 - val_loss: 1.2147 - val_accuracy: 0.6010
Epoch 18/350
6208/6985 [=========================>…] - ETA: 0s - loss: 1.2677 - accuracy:
0.5606
Epoch 00018: val_loss improved from 1.21470 to 1.19525, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.2658 -
accuracy: 0.5602 - val_loss: 1.1952 - val_accuracy: 0.5976
Epoch 19/350
6400/6985 [=========================>…] - ETA: 0s - loss: 1.2565 - accuracy:
0.5631
Epoch 00019: val_loss improved from 1.19525 to 1.15357, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 1.2537 -
accuracy: 0.5636 - val_loss: 1.1536 - val_accuracy: 0.6182
Epoch 20/350
6016/6985 [=========================>…] - ETA: 0s - loss: 1.2170 - accuracy:
0.5814
Epoch 00020: val_loss improved from 1.15357 to 1.14814, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.2278 -
accuracy: 0.5741 - val_loss: 1.1481 - val_accuracy: 0.6176
Epoch 21/350
6080/6985 [=========================>…] - ETA: 0s - loss: 1.2142 - accuracy:
0.5849
Epoch 00021: val_loss improved from 1.14814 to 1.13868, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.2124 -
accuracy: 0.5844 - val_loss: 1.1387 - val_accuracy: 0.6125
Epoch 22/350
6080/6985 [=========================>…] - ETA: 0s - loss: 1.1965 - accuracy:
0.5865
Epoch 00022: val_loss improved from 1.13868 to 1.13640, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.1985 -
accuracy: 0.5844 - val_loss: 1.1364 - val_accuracy: 0.6239
Epoch 23/350
6336/6985 [=========================>…] - ETA: 0s - loss: 1.1811 - accuracy:
0.6005
Epoch 00023: val_loss improved from 1.13640 to 1.13157, saving model to
```

```
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.1884 -
accuracy: 0.5966 - val_loss: 1.1316 - val_accuracy: 0.6211
Epoch 24/350
6080/6985 [=========================>…] - ETA: 0s - loss: 1.1634 - accuracy:
0.5965
Epoch 00024: val_loss did not improve from 1.13157
6985/6985 [==============================] - 0s 50us/sample - loss: 1.1624 -
accuracy: 0.5960 - val_loss: 1.1571 - val_accuracy: 0.6096
Epoch 25/350
6208/6985 [=========================>…] - ETA: 0s - loss: 1.1587 - accuracy:
0.6024
Epoch 00025: val_loss improved from 1.13157 to 1.07363, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 1.1564 -
accuracy: 0.6026 - val_loss: 1.0736 - val_accuracy: 0.6422
Epoch 26/350
6272/6985 [=========================>…] - ETA: 0s - loss: 1.1523 - accuracy:
0.6105
Epoch 00026: val_loss did not improve from 1.07363
6985/6985 [==============================] - 0s 50us/sample - loss: 1.1493 -
accuracy: 0.6079 - val_loss: 1.0811 - val_accuracy: 0.6394
Epoch 27/350
6336/6985 [=========================>…] - ETA: 0s - loss: 1.1419 - accuracy:
0.6027
Epoch 00027: val_loss did not improve from 1.07363
6985/6985 [==============================] - 0s 49us/sample - loss: 1.1404 -
accuracy: 0.6040 - val_loss: 1.0925 - val_accuracy: 0.6359
Epoch 28/350
6400/6985 [=========================>…] - ETA: 0s - loss: 1.1278 - accuracy:
0.6017
Epoch 00028: val_loss improved from 1.07363 to 1.04355, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 1.1245 -
accuracy: 0.6047 - val_loss: 1.0436 - val_accuracy: 0.6457
Epoch 29/350
6144/6985 [=========================>…] - ETA: 0s - loss: 1.1094 - accuracy:
0.6227
Epoch 00029: val_loss improved from 1.04355 to 1.04212, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.1087 -
accuracy: 0.6243 - val_loss: 1.0421 - val_accuracy: 0.6617
Epoch 30/350
6144/6985 [=========================>…] - ETA: 0s - loss: 1.0961 - accuracy:
0.6268
Epoch 00030: val_loss improved from 1.04212 to 1.03915, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.0976 -
```

accuracy: 0.6272 - val_loss: 1.0391 - val_accuracy: 0.6543
Epoch 31/350
6080/6985 [==========================>…] - ETA: 0s - loss: 1.0932 - accuracy:
0.6308
Epoch 00031: val_loss improved from 1.03915 to 1.00771, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.0883 -
accuracy: 0.6322 - val_loss: 1.0077 - val_accuracy: 0.6743
Epoch 32/350
6336/6985 [==========================>…] - ETA: 0s - loss: 1.0626 - accuracy:
0.6367
Epoch 00032: val_loss improved from 1.00771 to 0.99252, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 1.0672 -
accuracy: 0.6364 - val_loss: 0.9925 - val_accuracy: 0.6789
Epoch 33/350
6144/6985 [==========================>…] - ETA: 0s - loss: 1.0681 - accuracy:
0.6359
Epoch 00033: val_loss did not improve from 0.99252
6985/6985 [==============================] - 0s 50us/sample - loss: 1.0648 -
accuracy: 0.6354 - val_loss: 1.0174 - val_accuracy: 0.6566
Epoch 34/350
6016/6985 [=========================>…] - ETA: 0s - loss: 1.0485 - accuracy:
0.6438
Epoch 00034: val_loss did not improve from 0.99252
6985/6985 [==============================] - 0s 52us/sample - loss: 1.0531 -
accuracy: 0.6414 - val_loss: 1.0125 - val_accuracy: 0.6646
Epoch 35/350
6400/6985 [==========================>…] - ETA: 0s - loss: 1.0572 - accuracy:
0.6438
Epoch 00035: val_loss improved from 0.99252 to 0.98627, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 57us/sample - loss: 1.0542 -
accuracy: 0.6434 - val_loss: 0.9863 - val_accuracy: 0.6766
Epoch 36/350
5888/6985 [=======================>…] - ETA: 0s - loss: 1.0455 - accuracy:
0.6411
Epoch 00036: val_loss improved from 0.98627 to 0.98362, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 1.0433 -
accuracy: 0.6427 - val_loss: 0.9836 - val_accuracy: 0.6772
Epoch 37/350
6272/6985 [=========================>…] - ETA: 0s - loss: 1.0236 - accuracy:
0.6556
Epoch 00037: val_loss improved from 0.98362 to 0.96991, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.0233 -
accuracy: 0.6564 - val_loss: 0.9699 - val_accuracy: 0.6783

```
Epoch 38/350
6336/6985 [=========================>…] - ETA: 0s - loss: 1.0198 - accuracy:
0.6537
Epoch 00038: val_loss did not improve from 0.96991
6985/6985 [==============================] - 0s 49us/sample - loss: 1.0200 -
accuracy: 0.6540 - val_loss: 0.9911 - val_accuracy: 0.6709
Epoch 39/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.9994 - accuracy:
0.6652
Epoch 00039: val_loss improved from 0.96991 to 0.94411, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 1.0007 -
accuracy: 0.6650 - val_loss: 0.9441 - val_accuracy: 0.6926
Epoch 40/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.9853 - accuracy:
0.6622
Epoch 00040: val_loss did not improve from 0.94411
6985/6985 [==============================] - 0s 49us/sample - loss: 0.9879 -
accuracy: 0.6636 - val_loss: 0.9525 - val_accuracy: 0.6995
Epoch 41/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.9927 - accuracy:
0.6629
Epoch 00041: val_loss improved from 0.94411 to 0.92543, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.9903 -
accuracy: 0.6644 - val_loss: 0.9254 - val_accuracy: 0.6995
Epoch 42/350
6016/6985 [========================>…] - ETA: 0s - loss: 0.9772 - accuracy:
0.6719
Epoch 00042: val_loss did not improve from 0.92543
6985/6985 [==============================] - 0s 50us/sample - loss: 0.9748 -
accuracy: 0.6720 - val_loss: 0.9306 - val_accuracy: 0.7098
Epoch 43/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.9632 - accuracy:
0.6773
Epoch 00043: val_loss did not improve from 0.92543
6985/6985 [==============================] - 0s 48us/sample - loss: 0.9677 -
accuracy: 0.6759 - val_loss: 0.9334 - val_accuracy: 0.6972
Epoch 44/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.9537 - accuracy:
0.6807
Epoch 00044: val_loss did not improve from 0.92543
6985/6985 [==============================] - 0s 49us/sample - loss: 0.9607 -
accuracy: 0.6773 - val_loss: 0.9457 - val_accuracy: 0.6880
Epoch 45/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.9414 - accuracy:
0.6805
Epoch 00045: val_loss improved from 0.92543 to 0.92349, saving model to
```

```
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.9514 -
accuracy: 0.6786 - val_loss: 0.9235 - val_accuracy: 0.7086
Epoch 46/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.9357 - accuracy:
0.6821
Epoch 00046: val_loss improved from 0.92349 to 0.89236, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 0.9350 -
accuracy: 0.6836 - val_loss: 0.8924 - val_accuracy: 0.7144
Epoch 47/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.9225 - accuracy:
0.6878
Epoch 00047: val_loss improved from 0.89236 to 0.86912, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.9202 -
accuracy: 0.6895 - val_loss: 0.8691 - val_accuracy: 0.7184
Epoch 48/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.9328 - accuracy:
0.6910
Epoch 00048: val_loss did not improve from 0.86912
6985/6985 [==============================] - 0s 49us/sample - loss: 0.9293 -
accuracy: 0.6918 - val_loss: 0.8959 - val_accuracy: 0.7178
Epoch 49/350
6272/6985 [=========================>…] - ETA: 0s - loss: 0.9172 - accuracy:
0.6980
Epoch 00049: val_loss did not improve from 0.86912
6985/6985 [==============================] - 0s 50us/sample - loss: 0.9181 -
accuracy: 0.6972 - val_loss: 0.8781 - val_accuracy: 0.7224
Epoch 50/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.9109 - accuracy:
0.6928
Epoch 00050: val_loss did not improve from 0.86912
6985/6985 [==============================] - 0s 49us/sample - loss: 0.9064 -
accuracy: 0.6955 - val_loss: 0.8768 - val_accuracy: 0.7235
Epoch 51/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.9132 - accuracy:
0.6890
Epoch 00051: val_loss improved from 0.86912 to 0.86508, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.9102 -
accuracy: 0.6918 - val_loss: 0.8651 - val_accuracy: 0.7333
Epoch 52/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.9082 - accuracy:
0.6931
Epoch 00052: val_loss did not improve from 0.86508
6985/6985 [==============================] - 0s 49us/sample - loss: 0.9040 -
accuracy: 0.6952 - val_loss: 0.8802 - val_accuracy: 0.7109
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Epoch 53/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.8881 - accuracy:
0.7036
Epoch 00053: val_loss improved from 0.86508 to 0.83258, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.8862 -
accuracy: 0.7026 - val_loss: 0.8326 - val_accuracy: 0.7315
Epoch 54/350
5888/6985 [=======================>…] - ETA: 0s - loss: 0.8959 - accuracy:
0.6999
Epoch 00054: val_loss did not improve from 0.83258
6985/6985 [==============================] - 0s 51us/sample - loss: 0.8898 -
accuracy: 0.7009 - val_loss: 0.8401 - val_accuracy: 0.7344
Epoch 55/350
6272/6985 [=========================>…] - ETA: 0s - loss: 0.8717 - accuracy:
0.7028
Epoch 00055: val_loss improved from 0.83258 to 0.83041, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.8723 -
accuracy: 0.7047 - val_loss: 0.8304 - val_accuracy: 0.7367
Epoch 56/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.8672 - accuracy:
0.7098
Epoch 00056: val_loss improved from 0.83041 to 0.82164, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.8680 -
accuracy: 0.7098 - val_loss: 0.8216 - val_accuracy: 0.7333
Epoch 57/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.8756 - accuracy:
0.7084
Epoch 00057: val_loss did not improve from 0.82164
6985/6985 [==============================] - 0s 50us/sample - loss: 0.8669 -
accuracy: 0.7114 - val_loss: 0.8294 - val_accuracy: 0.7430
Epoch 58/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.8621 - accuracy:
0.7155
Epoch 00058: val_loss improved from 0.82164 to 0.80431, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.8574 -
accuracy: 0.7181 - val_loss: 0.8043 - val_accuracy: 0.7516
Epoch 59/350
6016/6985 [=======================>…] - ETA: 0s - loss: 0.8462 - accuracy:
0.7216
Epoch 00059: val_loss did not improve from 0.80431
6985/6985 [==============================] - 0s 51us/sample - loss: 0.8443 -
accuracy: 0.7183 - val_loss: 0.8396 - val_accuracy: 0.7247
Epoch 60/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.8479 - accuracy:
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0.7167
Epoch 00060: val_loss improved from 0.80431 to 0.78990, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.8561 -
accuracy: 0.7131 - val_loss: 0.7899 - val_accuracy: 0.7539
Epoch 61/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.8300 - accuracy:
0.7211
Epoch 00061: val_loss did not improve from 0.78990
6985/6985 [==============================] - 0s 50us/sample - loss: 0.8313 -
accuracy: 0.7214 - val_loss: 0.8403 - val_accuracy: 0.7241
Epoch 62/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.8526 - accuracy:
0.7110
Epoch 00062: val_loss did not improve from 0.78990
6985/6985 [==============================] - 0s 48us/sample - loss: 0.8458 -
accuracy: 0.7141 - val_loss: 0.7957 - val_accuracy: 0.7476
Epoch 63/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.8331 - accuracy:
0.7223
Epoch 00063: val_loss did not improve from 0.78990
6985/6985 [==============================] - 0s 49us/sample - loss: 0.8287 -
accuracy: 0.7218 - val_loss: 0.7942 - val_accuracy: 0.7504
Epoch 64/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.8251 - accuracy:
0.7207
Epoch 00064: val_loss improved from 0.78990 to 0.77238, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.8267 -
accuracy: 0.7218 - val_loss: 0.7724 - val_accuracy: 0.7584
Epoch 65/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.8266 - accuracy:
0.7227
Epoch 00065: val_loss did not improve from 0.77238
6985/6985 [==============================] - 0s 49us/sample - loss: 0.8243 -
accuracy: 0.7230 - val_loss: 0.8500 - val_accuracy: 0.7315
Epoch 66/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.8224 - accuracy:
0.7233
Epoch 00066: val_loss did not improve from 0.77238
6985/6985 [==============================] - 0s 48us/sample - loss: 0.8220 -
accuracy: 0.7237 - val_loss: 0.7854 - val_accuracy: 0.7544
Epoch 67/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.8291 - accuracy:
0.7214
Epoch 00067: val_loss did not improve from 0.77238
6985/6985 [==============================] - 0s 48us/sample - loss: 0.8225 -
accuracy: 0.7240 - val_loss: 0.8126 - val_accuracy: 0.7315
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Epoch 68/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.8086 - accuracy:
0.7259
Epoch 00068: val_loss did not improve from 0.77238
6985/6985 [==============================] - 0s 48us/sample - loss: 0.8078 -
accuracy: 0.7258 - val_loss: 0.7904 - val_accuracy: 0.7493
Epoch 69/350
6912/6985 [==========================>.] - ETA: 0s - loss: 0.7927 - accuracy:
0.7347
Epoch 00069: val_loss improved from 0.77238 to 0.76821, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 57us/sample - loss: 0.7915 -
accuracy: 0.7353 - val_loss: 0.7682 - val_accuracy: 0.7550
Epoch 70/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.7903 - accuracy:
0.7382
Epoch 00070: val_loss improved from 0.76821 to 0.75726, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.7912 -
accuracy: 0.7379 - val_loss: 0.7573 - val_accuracy: 0.7602
Epoch 71/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.7801 - accuracy:
0.7375
Epoch 00071: val_loss improved from 0.75726 to 0.73773, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.7794 -
accuracy: 0.7407 - val_loss: 0.7377 - val_accuracy: 0.7590
Epoch 72/350
6144/6985 [========================>…] - ETA: 0s - loss: 0.7954 - accuracy:
0.7367
Epoch 00072: val_loss did not improve from 0.73773
6985/6985 [==============================] - 0s 49us/sample - loss: 0.7934 -
accuracy: 0.7374 - val_loss: 0.7780 - val_accuracy: 0.7539
Epoch 73/350
6272/6985 [========================>…] - ETA: 0s - loss: 0.7731 - accuracy:
0.7409
Epoch 00073: val_loss did not improve from 0.73773
6985/6985 [==============================] - 0s 50us/sample - loss: 0.7745 -
accuracy: 0.7394 - val_loss: 0.7660 - val_accuracy: 0.7579
Epoch 74/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.7677 - accuracy:
0.7424
Epoch 00074: val_loss improved from 0.73773 to 0.72218, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.7683 -
accuracy: 0.7422 - val_loss: 0.7222 - val_accuracy: 0.7699
Epoch 75/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.7587 - accuracy:
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0.7492
Epoch 00075: val_loss did not improve from 0.72218
6985/6985 [==============================] - 0s 49us/sample - loss: 0.7557 - accuracy: 0.7513 - val_loss: 0.7736 - val_accuracy: 0.7304
Epoch 76/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.7795 - accuracy: 0.7384
Epoch 00076: val_loss did not improve from 0.72218
6985/6985 [==============================] - 0s 48us/sample - loss: 0.7782 - accuracy: 0.7386 - val_loss: 0.7443 - val_accuracy: 0.7550
Epoch 77/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.7620 - accuracy: 0.7428
Epoch 00077: val_loss did not improve from 0.72218
6985/6985 [==============================] - 0s 50us/sample - loss: 0.7649 - accuracy: 0.7422 - val_loss: 0.7289 - val_accuracy: 0.7602
Epoch 78/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.7666 - accuracy: 0.7437
Epoch 00078: val_loss did not improve from 0.72218
6985/6985 [==============================] - 0s 50us/sample - loss: 0.7563 - accuracy: 0.7462 - val_loss: 0.7658 - val_accuracy: 0.7544
Epoch 79/350
6784/6985 [===========================>.] - ETA: 0s - loss: 0.7546 - accuracy: 0.7471
Epoch 00079: val_loss did not improve from 0.72218
6985/6985 [==============================] - 0s 57us/sample - loss: 0.7530 - accuracy: 0.7477 - val_loss: 0.7584 - val_accuracy: 0.7573
Epoch 80/350
6528/6985 [==========================>..] - ETA: 0s - loss: 0.7458 - accuracy: 0.7492
Epoch 00080: val_loss improved from 0.72218 to 0.72103, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.7461 - accuracy: 0.7497 - val_loss: 0.7210 - val_accuracy: 0.7739
Epoch 81/350
6016/6985 [========================>…] - ETA: 0s - loss: 0.7403 - accuracy: 0.7522
Epoch 00081: val_loss improved from 0.72103 to 0.71503, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 0.7330 - accuracy: 0.7556 - val_loss: 0.7150 - val_accuracy: 0.7733
Epoch 82/350
6272/6985 [=========================>…] - ETA: 0s - loss: 0.7549 - accuracy: 0.7479
Epoch 00082: val_loss improved from 0.71503 to 0.71418, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.7568 -

accuracy: 0.7449 - val_loss: 0.7142 - val_accuracy: 0.7676
Epoch 83/350
6336/6985 [===========================>…] - ETA: 0s - loss: 0.7437 - accuracy:
0.7500
Epoch 00083: val_loss improved from 0.71418 to 0.68875, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.7373 -
accuracy: 0.7519 - val_loss: 0.6887 - val_accuracy: 0.7779
Epoch 84/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.7183 - accuracy:
0.7634
Epoch 00084: val_loss did not improve from 0.68875
6985/6985 [==============================] - 0s 49us/sample - loss: 0.7206 -
accuracy: 0.7621 - val_loss: 0.7163 - val_accuracy: 0.7647
Epoch 85/350
6272/6985 [=========================>…] - ETA: 0s - loss: 0.7285 - accuracy:
0.7502
Epoch 00085: val_loss did not improve from 0.68875
6985/6985 [==============================] - 0s 49us/sample - loss: 0.7267 -
accuracy: 0.7502 - val_loss: 0.7135 - val_accuracy: 0.7722
Epoch 86/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.7114 - accuracy:
0.7566
Epoch 00086: val_loss did not improve from 0.68875
6985/6985 [==============================] - 0s 48us/sample - loss: 0.7243 -
accuracy: 0.7530 - val_loss: 0.7079 - val_accuracy: 0.7699
Epoch 87/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.7175 - accuracy:
0.7622
Epoch 00087: val_loss did not improve from 0.68875
6985/6985 [==============================] - 0s 48us/sample - loss: 0.7201 -
accuracy: 0.7612 - val_loss: 0.6965 - val_accuracy: 0.7750
Epoch 88/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.7088 - accuracy:
0.7597
Epoch 00088: val_loss did not improve from 0.68875
6985/6985 [==============================] - 0s 48us/sample - loss: 0.7121 -
accuracy: 0.7591 - val_loss: 0.6943 - val_accuracy: 0.7705
Epoch 89/350
6528/6985 [===========================>..] - ETA: 0s - loss: 0.7003 - accuracy:
0.7624
Epoch 00089: val_loss did not improve from 0.68875
6985/6985 [==============================] - 0s 48us/sample - loss: 0.7008 -
accuracy: 0.7619 - val_loss: 0.7197 - val_accuracy: 0.7630
Epoch 90/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.6906 - accuracy:
0.7655
Epoch 00090: val_loss did not improve from 0.68875

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6985/6985 [==============================] - 0s 48us/sample - loss: 0.7010 -
accuracy: 0.7626 - val_loss: 0.7078 - val_accuracy: 0.7808
Epoch 91/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.7000 - accuracy:
0.7565
Epoch 00091: val_loss did not improve from 0.68875
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6988 -
accuracy: 0.7585 - val_loss: 0.6991 - val_accuracy: 0.7642
Epoch 92/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.7013 - accuracy:
0.7638
Epoch 00092: val_loss improved from 0.68875 to 0.67524, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.7037 -
accuracy: 0.7632 - val_loss: 0.6752 - val_accuracy: 0.7859
Epoch 93/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.6985 - accuracy:
0.7637
Epoch 00093: val_loss did not improve from 0.67524
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6993 -
accuracy: 0.7639 - val_loss: 0.6806 - val_accuracy: 0.7762
Epoch 94/350
6272/6985 [=========================>…] - ETA: 0s - loss: 0.6812 - accuracy:
0.7726
Epoch 00094: val_loss improved from 0.67524 to 0.66731, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.6853 -
accuracy: 0.7708 - val_loss: 0.6673 - val_accuracy: 0.7785
Epoch 95/350
6080/6985 [=========================>…] - ETA: 0s - loss: 0.6789 - accuracy:
0.7701
Epoch 00095: val_loss did not improve from 0.66731
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6834 -
accuracy: 0.7682 - val_loss: 0.6794 - val_accuracy: 0.7739
Epoch 96/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.6940 - accuracy:
0.7694
Epoch 00096: val_loss did not improve from 0.66731
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6962 -
accuracy: 0.7685 - val_loss: 0.6928 - val_accuracy: 0.7670
Epoch 97/350
6592/6985 [==========================>..] - ETA: 0s - loss: 0.6729 - accuracy:
0.7674
Epoch 00097: val_loss did not improve from 0.66731
6985/6985 [==============================] - 0s 56us/sample - loss: 0.6737 -
accuracy: 0.7665 - val_loss: 0.7131 - val_accuracy: 0.7653
Epoch 98/350
6528/6985 [==========================>..] - ETA: 0s - loss: 0.6982 - accuracy:
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0.7636
Epoch 00098: val_loss did not improve from 0.66731
6985/6985 [==============================] - 0s 48us/sample - loss: 0.6957 -
accuracy: 0.7645 - val_loss: 0.7073 - val_accuracy: 0.7670
Epoch 99/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.6811 - accuracy:
0.7683
Epoch 00099: val_loss improved from 0.66731 to 0.64907, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.6821 -
accuracy: 0.7686 - val_loss: 0.6491 - val_accuracy: 0.7894
Epoch 100/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.6837 - accuracy:
0.7679
Epoch 00100: val_loss did not improve from 0.64907
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6826 -
accuracy: 0.7672 - val_loss: 0.6882 - val_accuracy: 0.7728
Epoch 101/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.6770 - accuracy:
0.7678
Epoch 00101: val_loss improved from 0.64907 to 0.64250, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6719 -
accuracy: 0.7709 - val_loss: 0.6425 - val_accuracy: 0.7905
Epoch 102/350
6336/6985 [========================>…] - ETA: 0s - loss: 0.6891 - accuracy:
0.7694
Epoch 00102: val_loss did not improve from 0.64250
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6860 -
accuracy: 0.7702 - val_loss: 0.6550 - val_accuracy: 0.7819
Epoch 103/350
6336/6985 [========================>…] - ETA: 0s - loss: 0.6699 - accuracy:
0.7710
Epoch 00103: val_loss did not improve from 0.64250
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6681 -
accuracy: 0.7712 - val_loss: 0.6687 - val_accuracy: 0.7790
Epoch 104/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.6581 - accuracy:
0.7735
Epoch 00104: val_loss improved from 0.64250 to 0.62501, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.6599 -
accuracy: 0.7718 - val_loss: 0.6250 - val_accuracy: 0.7974
Epoch 105/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.6577 - accuracy:
0.7775
Epoch 00105: val_loss did not improve from 0.62501
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6508 -

accuracy: 0.7797 - val_loss: 0.6508 - val_accuracy: 0.7853
Epoch 106/350
6144/6985 [==========================>…] - ETA: 0s - loss: 0.6498 - accuracy: 0.7848
Epoch 00106: val_loss improved from 0.62501 to 0.61848, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.6437 - accuracy: 0.7874 - val_loss: 0.6185 - val_accuracy: 0.7945
Epoch 107/350
6208/6985 [==========================>…] - ETA: 0s - loss: 0.6579 - accuracy: 0.7780
Epoch 00107: val_loss did not improve from 0.61848
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6488 - accuracy: 0.7822 - val_loss: 0.6207 - val_accuracy: 0.7928
Epoch 108/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.6432 - accuracy: 0.7820
Epoch 00108: val_loss did not improve from 0.61848
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6415 - accuracy: 0.7831 - val_loss: 0.6505 - val_accuracy: 0.7796
Epoch 109/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.6471 - accuracy: 0.7768
Epoch 00109: val_loss did not improve from 0.61848
6985/6985 [==============================] - 0s 48us/sample - loss: 0.6428 - accuracy: 0.7792 - val_loss: 0.6309 - val_accuracy: 0.7979
Epoch 110/350
6208/6985 [==========================>…] - ETA: 0s - loss: 0.6397 - accuracy: 0.7838
Epoch 00110: val_loss improved from 0.61848 to 0.61041, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 0.6360 - accuracy: 0.7841 - val_loss: 0.6104 - val_accuracy: 0.7979
Epoch 111/350
6080/6985 [==========================>…] - ETA: 0s - loss: 0.6445 - accuracy: 0.7832
Epoch 00111: val_loss improved from 0.61041 to 0.60892, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.6499 - accuracy: 0.7797 - val_loss: 0.6089 - val_accuracy: 0.8025
Epoch 112/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.6301 - accuracy: 0.7839
Epoch 00112: val_loss did not improve from 0.60892
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6376 - accuracy: 0.7822 - val_loss: 0.6277 - val_accuracy: 0.7894
Epoch 113/350
6016/6985 [=========================>…] - ETA: 0s - loss: 0.6238 - accuracy:

0.7842
Epoch 00113: val_loss did not improve from 0.60892
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6383 -
accuracy: 0.7788 - val_loss: 0.6361 - val_accuracy: 0.7922
Epoch 114/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.6272 - accuracy:
0.7875
Epoch 00114: val_loss did not improve from 0.60892
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6259 -
accuracy: 0.7871 - val_loss: 0.6170 - val_accuracy: 0.7979
Epoch 115/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.6289 - accuracy:
0.7862
Epoch 00115: val_loss improved from 0.60892 to 0.60387, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.6254 -
accuracy: 0.7875 - val_loss: 0.6039 - val_accuracy: 0.8019
Epoch 116/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.6210 - accuracy:
0.7866
Epoch 00116: val_loss did not improve from 0.60387
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6292 -
accuracy: 0.7818 - val_loss: 0.6440 - val_accuracy: 0.7779
Epoch 117/350
6336/6985 [========================>…] - ETA: 0s - loss: 0.6292 - accuracy:
0.7855
Epoch 00117: val_loss did not improve from 0.60387
6985/6985 [==============================] - 0s 48us/sample - loss: 0.6281 -
accuracy: 0.7853 - val_loss: 0.6424 - val_accuracy: 0.7911
Epoch 118/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.6257 - accuracy:
0.7887
Epoch 00118: val_loss did not improve from 0.60387
6985/6985 [==============================] - 0s 48us/sample - loss: 0.6204 -
accuracy: 0.7911 - val_loss: 0.6258 - val_accuracy: 0.7951
Epoch 119/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.6256 - accuracy:
0.7878
Epoch 00119: val_loss did not improve from 0.60387
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6244 -
accuracy: 0.7878 - val_loss: 0.6181 - val_accuracy: 0.7997
Epoch 120/350
6528/6985 [=========================>..] - ETA: 0s - loss: 0.6137 - accuracy:
0.7929
Epoch 00120: val_loss improved from 0.60387 to 0.58747, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.6096 -
accuracy: 0.7948 - val_loss: 0.5875 - val_accuracy: 0.8117

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Epoch 121/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.6064 - accuracy:
0.7909
Epoch 00121: val_loss improved from 0.58747 to 0.58711, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.6022 -
accuracy: 0.7901 - val_loss: 0.5871 - val_accuracy: 0.8105
Epoch 122/350
6080/6985 [=========================>…] - ETA: 0s - loss: 0.6207 - accuracy:
0.7834
Epoch 00122: val_loss did not improve from 0.58711
6985/6985 [==============================] - 0s 51us/sample - loss: 0.6177 -
accuracy: 0.7857 - val_loss: 0.6253 - val_accuracy: 0.7951
Epoch 123/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.6133 - accuracy:
0.7934
Epoch 00123: val_loss did not improve from 0.58711
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6121 -
accuracy: 0.7936 - val_loss: 0.5934 - val_accuracy: 0.7991
Epoch 124/350
6528/6985 [==========================>..] - ETA: 0s - loss: 0.6164 - accuracy:
0.7843
Epoch 00124: val_loss improved from 0.58711 to 0.57108, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.6152 -
accuracy: 0.7850 - val_loss: 0.5711 - val_accuracy: 0.8168
Epoch 125/350
6016/6985 [========================>…] - ETA: 0s - loss: 0.6112 - accuracy:
0.7916
Epoch 00125: val_loss did not improve from 0.57108
6985/6985 [==============================] - 0s 51us/sample - loss: 0.6014 -
accuracy: 0.7947 - val_loss: 0.5816 - val_accuracy: 0.8117
Epoch 126/350
6144/6985 [========================>…] - ETA: 0s - loss: 0.6167 - accuracy:
0.7873
Epoch 00126: val_loss did not improve from 0.57108
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6109 -
accuracy: 0.7904 - val_loss: 0.5932 - val_accuracy: 0.7956
Epoch 127/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.6122 - accuracy:
0.7899
Epoch 00127: val_loss did not improve from 0.57108
6985/6985 [==============================] - 0s 48us/sample - loss: 0.6067 -
accuracy: 0.7924 - val_loss: 0.5722 - val_accuracy: 0.8180
Epoch 128/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.5937 - accuracy:
0.7951
Epoch 00128: val_loss improved from 0.57108 to 0.56718, saving model to
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audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 0.5905 -
accuracy: 0.7966 - val_loss: 0.5672 - val_accuracy: 0.8111
Epoch 129/350
6272/6985 [==========================>…] - ETA: 0s - loss: 0.5990 - accuracy:
0.7999
Epoch 00129: val_loss did not improve from 0.56718
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6018 -
accuracy: 0.7977 - val_loss: 0.6219 - val_accuracy: 0.7956
Epoch 130/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.6065 - accuracy:
0.7918
Epoch 00130: val_loss did not improve from 0.56718
6985/6985 [==============================] - 0s 49us/sample - loss: 0.6030 -
accuracy: 0.7920 - val_loss: 0.6210 - val_accuracy: 0.7945
Epoch 131/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.6064 - accuracy:
0.7894
Epoch 00131: val_loss did not improve from 0.56718
6985/6985 [==============================] - 0s 48us/sample - loss: 0.6113 -
accuracy: 0.7875 - val_loss: 0.6075 - val_accuracy: 0.8048
Epoch 132/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.5779 - accuracy:
0.8048
Epoch 00132: val_loss improved from 0.56718 to 0.55876, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5789 -
accuracy: 0.8054 - val_loss: 0.5588 - val_accuracy: 0.8100
Epoch 133/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.5704 - accuracy:
0.8094
Epoch 00133: val_loss did not improve from 0.55876
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5718 -
accuracy: 0.8094 - val_loss: 0.5598 - val_accuracy: 0.8094
Epoch 134/350
6016/6985 [========================>…] - ETA: 0s - loss: 0.5783 - accuracy:
0.7987
Epoch 00134: val_loss improved from 0.55876 to 0.55724, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.5812 -
accuracy: 0.7986 - val_loss: 0.5572 - val_accuracy: 0.8151
Epoch 135/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.5567 - accuracy:
0.8068
Epoch 00135: val_loss did not improve from 0.55724
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5603 -
accuracy: 0.8067 - val_loss: 0.5733 - val_accuracy: 0.8094
Epoch 136/350
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6208/6985 [===========================>…] – ETA: 0s – loss: 0.5722 – accuracy:
0.8056
Epoch 00136: val_loss did not improve from 0.55724
6985/6985 [==============================] – 0s 50us/sample – loss: 0.5740 –
accuracy: 0.8066 – val_loss: 0.5821 – val_accuracy: 0.8117
Epoch 137/350
6464/6985 [===========================>…] – ETA: 0s – loss: 0.5713 – accuracy:
0.8055
Epoch 00137: val_loss improved from 0.55724 to 0.55460, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] – 0s 50us/sample – loss: 0.5695 –
accuracy: 0.8054 – val_loss: 0.5546 – val_accuracy: 0.8197
Epoch 138/350
6016/6985 [=========================>…] – ETA: 0s – loss: 0.5803 – accuracy:
0.7994
Epoch 00138: val_loss improved from 0.55460 to 0.55233, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] – 0s 53us/sample – loss: 0.5745 –
accuracy: 0.8023 – val_loss: 0.5523 – val_accuracy: 0.8157
Epoch 139/350
6208/6985 [===========================>…] – ETA: 0s – loss: 0.5794 – accuracy:
0.8035
Epoch 00139: val_loss did not improve from 0.55233
6985/6985 [==============================] – 0s 51us/sample – loss: 0.5782 –
accuracy: 0.8042 – val_loss: 0.5625 – val_accuracy: 0.8019
Epoch 140/350
6080/6985 [========================>…] – ETA: 0s – loss: 0.5813 – accuracy:
0.8028
Epoch 00140: val_loss did not improve from 0.55233
6985/6985 [==============================] – 0s 50us/sample – loss: 0.5736 –
accuracy: 0.8034 – val_loss: 0.5772 – val_accuracy: 0.8071
Epoch 141/350
6400/6985 [==========================>…] – ETA: 0s – loss: 0.5508 – accuracy:
0.8116
Epoch 00141: val_loss improved from 0.55233 to 0.54001, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] – 0s 51us/sample – loss: 0.5549 –
accuracy: 0.8119 – val_loss: 0.5400 – val_accuracy: 0.8243
Epoch 142/350
6272/6985 [========================>…] – ETA: 0s – loss: 0.5790 – accuracy:
0.8012
Epoch 00142: val_loss did not improve from 0.54001
6985/6985 [==============================] – 0s 49us/sample – loss: 0.5769 –
accuracy: 0.8024 – val_loss: 0.5514 – val_accuracy: 0.8180
Epoch 143/350
6144/6985 [========================>…] – ETA: 0s – loss: 0.5731 – accuracy:
0.8052
Epoch 00143: val_loss did not improve from 0.54001
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6985/6985 [==============================] - 0s 50us/sample - loss: 0.5732 -
accuracy: 0.8049 - val_loss: 0.5438 - val_accuracy: 0.8145
Epoch 144/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.5634 - accuracy:
0.8097
Epoch 00144: val_loss did not improve from 0.54001
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5618 -
accuracy: 0.8107 - val_loss: 0.5540 - val_accuracy: 0.8140
Epoch 145/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.5351 - accuracy:
0.8156
Epoch 00145: val_loss did not improve from 0.54001
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5317 -
accuracy: 0.8163 - val_loss: 0.5525 - val_accuracy: 0.8151
Epoch 146/350
6016/6985 [=======================>…] - ETA: 0s - loss: 0.5633 - accuracy:
0.8085
Epoch 00146: val_loss did not improve from 0.54001
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5536 -
accuracy: 0.8109 - val_loss: 0.5479 - val_accuracy: 0.8191
Epoch 147/350
5696/6985 [======================>…] - ETA: 0s - loss: 0.5513 - accuracy:
0.8123
Epoch 00147: val_loss did not improve from 0.54001
6985/6985 [==============================] - 0s 53us/sample - loss: 0.5495 -
accuracy: 0.8143 - val_loss: 0.5751 - val_accuracy: 0.8054
Epoch 148/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.5835 - accuracy:
0.7981
Epoch 00148: val_loss did not improve from 0.54001
6985/6985 [==============================] - 0s 48us/sample - loss: 0.5882 -
accuracy: 0.7969 - val_loss: 0.5426 - val_accuracy: 0.8157
Epoch 149/350
6528/6985 [==========================>..] - ETA: 0s - loss: 0.5446 - accuracy:
0.8125
Epoch 00149: val_loss improved from 0.54001 to 0.53621, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5468 -
accuracy: 0.8117 - val_loss: 0.5362 - val_accuracy: 0.8294
Epoch 150/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.5388 - accuracy:
0.8152
Epoch 00150: val_loss did not improve from 0.53621
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5370 -
accuracy: 0.8162 - val_loss: 0.5437 - val_accuracy: 0.8197
Epoch 151/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.5572 - accuracy:
0.8142
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Epoch 00151: val_loss did not improve from 0.53621
6985/6985 [==============================] - 0s 48us/sample - loss: 0.5554 -
accuracy: 0.8140 - val_loss: 0.5679 - val_accuracy: 0.8071
Epoch 152/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.5628 - accuracy:
0.8028
Epoch 00152: val_loss improved from 0.53621 to 0.53418, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5634 -
accuracy: 0.8039 - val_loss: 0.5342 - val_accuracy: 0.8277
Epoch 153/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.5299 - accuracy:
0.8137
Epoch 00153: val_loss did not improve from 0.53418
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5291 -
accuracy: 0.8127 - val_loss: 0.5386 - val_accuracy: 0.8174
Epoch 154/350
6144/6985 [========================>…] - ETA: 0s - loss: 0.5411 - accuracy:
0.8125
Epoch 00154: val_loss improved from 0.53418 to 0.52042, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.5360 -
accuracy: 0.8146 - val_loss: 0.5204 - val_accuracy: 0.8226
Epoch 155/350
6272/6985 [========================>…] - ETA: 0s - loss: 0.5454 - accuracy:
0.8128
Epoch 00155: val_loss improved from 0.52042 to 0.51701, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5502 -
accuracy: 0.8105 - val_loss: 0.5170 - val_accuracy: 0.8386
Epoch 156/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.5350 - accuracy:
0.8165
Epoch 00156: val_loss did not improve from 0.51701
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5351 -
accuracy: 0.8166 - val_loss: 0.5298 - val_accuracy: 0.8260
Epoch 157/350
6016/6985 [=======================>…] - ETA: 0s - loss: 0.5372 - accuracy:
0.8130
Epoch 00157: val_loss did not improve from 0.51701
6985/6985 [==============================] - 0s 52us/sample - loss: 0.5329 -
accuracy: 0.8139 - val_loss: 0.5207 - val_accuracy: 0.8226
Epoch 158/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.5457 - accuracy:
0.8134
Epoch 00158: val_loss improved from 0.51701 to 0.51334, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5418 -
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accuracy: 0.8157 - val_loss: 0.5133 - val_accuracy: 0.8334
Epoch 159/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.5398 - accuracy: 0.8136
Epoch 00159: val_loss did not improve from 0.51334
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5376 - accuracy: 0.8143 - val_loss: 0.5213 - val_accuracy: 0.8260
Epoch 160/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.5295 - accuracy: 0.8134
Epoch 00160: val_loss did not improve from 0.51334
6985/6985 [==============================] - 0s 48us/sample - loss: 0.5369 - accuracy: 0.8110 - val_loss: 0.5227 - val_accuracy: 0.8243
Epoch 161/350
6272/6985 [=========================>…] - ETA: 0s - loss: 0.5330 - accuracy: 0.8149
Epoch 00161: val_loss did not improve from 0.51334
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5284 - accuracy: 0.8163 - val_loss: 0.5225 - val_accuracy: 0.8254
Epoch 162/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.5272 - accuracy: 0.8176
Epoch 00162: val_loss improved from 0.51334 to 0.51170, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 54us/sample - loss: 0.5270 - accuracy: 0.8183 - val_loss: 0.5117 - val_accuracy: 0.8248
Epoch 163/350
5888/6985 [=======================>…] - ETA: 0s - loss: 0.5290 - accuracy: 0.8169
Epoch 00163: val_loss improved from 0.51170 to 0.51034, saving model to audio_classification_lstm.h5
6985/6985 [==============================] - 0s 53us/sample - loss: 0.5259 - accuracy: 0.8198 - val_loss: 0.5103 - val_accuracy: 0.8323
Epoch 164/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.5095 - accuracy: 0.8220
Epoch 00164: val_loss did not improve from 0.51034
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5095 - accuracy: 0.8203 - val_loss: 0.5371 - val_accuracy: 0.8271
Epoch 165/350
5952/6985 [=======================>…] - ETA: 0s - loss: 0.5411 - accuracy: 0.8127
Epoch 00165: val_loss did not improve from 0.51034
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5311 - accuracy: 0.8160 - val_loss: 0.5260 - val_accuracy: 0.8306
Epoch 166/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.5149 - accuracy: 0.8227

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Epoch 00166: val_loss improved from 0.51034 to 0.49270, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5194 -
accuracy: 0.8208 - val_loss: 0.4927 - val_accuracy: 0.8392
Epoch 167/350
6080/6985 [=========================>…] - ETA: 0s - loss: 0.5161 - accuracy:
0.8238
Epoch 00167: val_loss did not improve from 0.49270
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5190 -
accuracy: 0.8223 - val_loss: 0.5081 - val_accuracy: 0.8329
Epoch 168/350
6272/6985 [=========================>…] - ETA: 0s - loss: 0.4965 - accuracy:
0.8194
Epoch 00168: val_loss did not improve from 0.49270
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5038 -
accuracy: 0.8173 - val_loss: 0.5172 - val_accuracy: 0.8254
Epoch 169/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.5223 - accuracy:
0.8175
Epoch 00169: val_loss did not improve from 0.49270
6985/6985 [==============================] - 0s 48us/sample - loss: 0.5151 -
accuracy: 0.8218 - val_loss: 0.5281 - val_accuracy: 0.8254
Epoch 170/350
6528/6985 [==========================>..] - ETA: 0s - loss: 0.5039 - accuracy:
0.8295
Epoch 00170: val_loss did not improve from 0.49270
6985/6985 [==============================] - 0s 48us/sample - loss: 0.5083 -
accuracy: 0.8278 - val_loss: 0.5368 - val_accuracy: 0.8231
Epoch 171/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.5013 - accuracy:
0.8239
Epoch 00171: val_loss did not improve from 0.49270
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5020 -
accuracy: 0.8243 - val_loss: 0.5115 - val_accuracy: 0.8288
Epoch 172/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.5155 - accuracy:
0.8194
Epoch 00172: val_loss did not improve from 0.49270
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5117 -
accuracy: 0.8205 - val_loss: 0.5160 - val_accuracy: 0.8323
Epoch 173/350
5888/6985 [=======================>…] - ETA: 0s - loss: 0.5096 - accuracy:
0.8264
Epoch 00173: val_loss improved from 0.49270 to 0.48599, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 55us/sample - loss: 0.5094 -
accuracy: 0.8258 - val_loss: 0.4860 - val_accuracy: 0.8363
Epoch 174/350
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6272/6985 [==========================>…] - ETA: 0s - loss: 0.5125 - accuracy:
0.8232
Epoch 00174: val_loss did not improve from 0.48599
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5068 -
accuracy: 0.8269 - val_loss: 0.5009 - val_accuracy: 0.8283
Epoch 175/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.4998 - accuracy:
0.8312
Epoch 00175: val_loss improved from 0.48599 to 0.47877, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5002 -
accuracy: 0.8309 - val_loss: 0.4788 - val_accuracy: 0.8449
Epoch 176/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.4993 - accuracy:
0.8273
Epoch 00176: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4987 -
accuracy: 0.8281 - val_loss: 0.5141 - val_accuracy: 0.8334
Epoch 177/350
6272/6985 [==========================>…] - ETA: 0s - loss: 0.5158 - accuracy:
0.8197
Epoch 00177: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 48us/sample - loss: 0.5158 -
accuracy: 0.8200 - val_loss: 0.5050 - val_accuracy: 0.8277
Epoch 178/350
6528/6985 [==========================>..] - ETA: 0s - loss: 0.4986 - accuracy:
0.8298
Epoch 00178: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4979 -
accuracy: 0.8299 - val_loss: 0.4895 - val_accuracy: 0.8374
Epoch 179/350
6080/6985 [==========================>…] - ETA: 0s - loss: 0.5014 - accuracy:
0.8266
Epoch 00179: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5029 -
accuracy: 0.8275 - val_loss: 0.4937 - val_accuracy: 0.8369
Epoch 180/350
6208/6985 [==========================>…] - ETA: 0s - loss: 0.4991 - accuracy:
0.8315
Epoch 00180: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 50us/sample - loss: 0.5000 -
accuracy: 0.8321 - val_loss: 0.4954 - val_accuracy: 0.8397
Epoch 181/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.5167 - accuracy:
0.8158
Epoch 00181: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 49us/sample - loss: 0.5166 -
accuracy: 0.8146 - val_loss: 0.4941 - val_accuracy: 0.8414
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Epoch 182/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.4864 - accuracy:
0.8301
Epoch 00182: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4863 -
accuracy: 0.8309 - val_loss: 0.5014 - val_accuracy: 0.8392
Epoch 183/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.5022 - accuracy:
0.8296
Epoch 00183: val_loss did not improve from 0.47877
6985/6985 [==============================] - 0s 51us/sample - loss: 0.5014 -
accuracy: 0.8289 - val_loss: 0.5030 - val_accuracy: 0.8357
Epoch 184/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4778 - accuracy:
0.8343
Epoch 00184: val_loss improved from 0.47877 to 0.46226, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 61us/sample - loss: 0.4824 -
accuracy: 0.8312 - val_loss: 0.4623 - val_accuracy: 0.8454
Epoch 185/350
6976/6985 [============================>.] - ETA: 0s - loss: 0.4820 - accuracy:
0.8321
Epoch 00185: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 52us/sample - loss: 0.4819 -
accuracy: 0.8321 - val_loss: 0.4814 - val_accuracy: 0.8397
Epoch 186/350
6336/6985 [=========================>…] - ETA: 0s - loss: 0.4843 - accuracy:
0.8311
Epoch 00186: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4793 -
accuracy: 0.8328 - val_loss: 0.4848 - val_accuracy: 0.8420
Epoch 187/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4759 - accuracy:
0.8355
Epoch 00187: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4799 -
accuracy: 0.8345 - val_loss: 0.5132 - val_accuracy: 0.8334
Epoch 188/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4906 - accuracy:
0.8319
Epoch 00188: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4852 -
accuracy: 0.8339 - val_loss: 0.5032 - val_accuracy: 0.8346
Epoch 189/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.4766 - accuracy:
0.8333
Epoch 00189: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 53us/sample - loss: 0.4753 -
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accuracy: 0.8338 - val_loss: 0.4933 - val_accuracy: 0.8386
Epoch 190/350
6464/6985 [===========================>…] - ETA: 0s - loss: 0.4834 - accuracy:
0.8294
Epoch 00190: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4800 -
accuracy: 0.8295 - val_loss: 0.4827 - val_accuracy: 0.8483
Epoch 191/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.4911 - accuracy:
0.8320
Epoch 00191: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4931 -
accuracy: 0.8316 - val_loss: 0.5103 - val_accuracy: 0.8346
Epoch 192/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.4755 - accuracy:
0.8378
Epoch 00192: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4730 -
accuracy: 0.8379 - val_loss: 0.4706 - val_accuracy: 0.8403
Epoch 193/350
6912/6985 [============================>.] - ETA: 0s - loss: 0.4938 - accuracy:
0.8267
Epoch 00193: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 54us/sample - loss: 0.4914 -
accuracy: 0.8278 - val_loss: 0.4863 - val_accuracy: 0.8397
Epoch 194/350
6464/6985 [===========================>…] - ETA: 0s - loss: 0.4700 - accuracy:
0.8368
Epoch 00194: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4672 -
accuracy: 0.8378 - val_loss: 0.4979 - val_accuracy: 0.8294
Epoch 195/350
6528/6985 [===========================>..] - ETA: 0s - loss: 0.4739 - accuracy:
0.8327
Epoch 00195: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 47us/sample - loss: 0.4733 -
accuracy: 0.8334 - val_loss: 0.4692 - val_accuracy: 0.8454
Epoch 196/350
6464/6985 [===========================>…] - ETA: 0s - loss: 0.4703 - accuracy:
0.8402
Epoch 00196: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4670 -
accuracy: 0.8399 - val_loss: 0.4932 - val_accuracy: 0.8363
Epoch 197/350
6848/6985 [===========================>.] - ETA: 0s - loss: 0.4692 - accuracy:
0.8394
Epoch 00197: val_loss did not improve from 0.46226
6985/6985 [==============================] - 0s 54us/sample - loss: 0.4678 -

accuracy: 0.8402 - val_loss: 0.4680 - val_accuracy: 0.8454
Epoch 198/350
6848/6985 [============================>.] - ETA: 0s - loss: 0.4591 - accuracy:
0.8360
Epoch 00198: val_loss improved from 0.46226 to 0.45773, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 57us/sample - loss: 0.4598 -
accuracy: 0.8358 - val_loss: 0.4577 - val_accuracy: 0.8523
Epoch 199/350
6016/6985 [=========================>…] - ETA: 0s - loss: 0.4589 - accuracy:
0.8396
Epoch 00199: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4601 -
accuracy: 0.8395 - val_loss: 0.4896 - val_accuracy: 0.8437
Epoch 200/350
6080/6985 [=========================>…] - ETA: 0s - loss: 0.4711 - accuracy:
0.8304
Epoch 00200: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4658 -
accuracy: 0.8322 - val_loss: 0.4945 - val_accuracy: 0.8340
Epoch 201/350
6528/6985 [===========================>..] - ETA: 0s - loss: 0.4512 - accuracy:
0.8404
Epoch 00201: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4538 -
accuracy: 0.8397 - val_loss: 0.4702 - val_accuracy: 0.8409
Epoch 202/350
6400/6985 [==========================>…] - ETA: 0s - loss: 0.4716 - accuracy:
0.8314
Epoch 00202: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4699 -
accuracy: 0.8334 - val_loss: 0.4648 - val_accuracy: 0.8460
Epoch 203/350
6080/6985 [=========================>…] - ETA: 0s - loss: 0.4543 - accuracy:
0.8401
Epoch 00203: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4596 -
accuracy: 0.8389 - val_loss: 0.4677 - val_accuracy: 0.8454
Epoch 204/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.4650 - accuracy:
0.8397
Epoch 00204: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4605 -
accuracy: 0.8421 - val_loss: 0.4664 - val_accuracy: 0.8454
Epoch 205/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.4731 - accuracy:
0.8364
Epoch 00205: val_loss did not improve from 0.45773

```
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4710 -
accuracy: 0.8366 - val_loss: 0.4636 - val_accuracy: 0.8460
Epoch 206/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.4637 - accuracy:
0.8358
Epoch 00206: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4608 -
accuracy: 0.8372 - val_loss: 0.5028 - val_accuracy: 0.8351
Epoch 207/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.4590 - accuracy:
0.8384
Epoch 00207: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4634 -
accuracy: 0.8368 - val_loss: 0.4807 - val_accuracy: 0.8380
Epoch 208/350
6016/6985 [========================>…] - ETA: 0s - loss: 0.4670 - accuracy:
0.8401
Epoch 00208: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4707 -
accuracy: 0.8374 - val_loss: 0.4771 - val_accuracy: 0.8466
Epoch 209/350
6080/6985 [=========================>…] - ETA: 0s - loss: 0.4564 - accuracy:
0.8390
Epoch 00209: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4592 -
accuracy: 0.8387 - val_loss: 0.4805 - val_accuracy: 0.8414
Epoch 210/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.4543 - accuracy:
0.8391
Epoch 00210: val_loss did not improve from 0.45773
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4517 -
accuracy: 0.8401 - val_loss: 0.4675 - val_accuracy: 0.8466
Epoch 211/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4460 - accuracy:
0.8379
Epoch 00211: val_loss improved from 0.45773 to 0.45038, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4428 -
accuracy: 0.8398 - val_loss: 0.4504 - val_accuracy: 0.8529
Epoch 212/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.4481 - accuracy:
0.8484
Epoch 00212: val_loss did not improve from 0.45038
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4469 -
accuracy: 0.8490 - val_loss: 0.4643 - val_accuracy: 0.8449
Epoch 213/350
6208/6985 [=========================>…] - ETA: 0s - loss: 0.4651 - accuracy:
0.8363
```

```
Epoch 00213: val_loss did not improve from 0.45038
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4582 -
accuracy: 0.8389 - val_loss: 0.4631 - val_accuracy: 0.8460
Epoch 214/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4715 - accuracy:
0.8317
Epoch 00214: val_loss improved from 0.45038 to 0.44892, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4703 -
accuracy: 0.8326 - val_loss: 0.4489 - val_accuracy: 0.8540
Epoch 215/350
6272/6985 [========================>…] - ETA: 0s - loss: 0.4642 - accuracy:
0.8371
Epoch 00215: val_loss did not improve from 0.44892
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4619 -
accuracy: 0.8374 - val_loss: 0.4952 - val_accuracy: 0.8454
Epoch 216/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4525 - accuracy:
0.8441
Epoch 00216: val_loss did not improve from 0.44892
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4514 -
accuracy: 0.8441 - val_loss: 0.4500 - val_accuracy: 0.8517
Epoch 217/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4534 - accuracy:
0.8458
Epoch 00217: val_loss did not improve from 0.44892
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4535 -
accuracy: 0.8452 - val_loss: 0.4573 - val_accuracy: 0.8443
Epoch 218/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4600 - accuracy:
0.8370
Epoch 00218: val_loss did not improve from 0.44892
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4547 -
accuracy: 0.8395 - val_loss: 0.4541 - val_accuracy: 0.8523
Epoch 219/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4243 - accuracy:
0.8527
Epoch 00219: val_loss improved from 0.44892 to 0.44415, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 61us/sample - loss: 0.4290 -
accuracy: 0.8515 - val_loss: 0.4441 - val_accuracy: 0.8552
Epoch 220/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4535 - accuracy:
0.8400
Epoch 00220: val_loss did not improve from 0.44415
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4543 -
accuracy: 0.8405 - val_loss: 0.4688 - val_accuracy: 0.8432
Epoch 221/350
```

```
6080/6985 [==========================>…] - ETA: 0s - loss: 0.4481 - accuracy:
0.8457
Epoch 00221: val_loss improved from 0.44415 to 0.43718, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 52us/sample - loss: 0.4474 -
accuracy: 0.8425 - val_loss: 0.4372 - val_accuracy: 0.8586
Epoch 222/350
6208/6985 [==========================>…] - ETA: 0s - loss: 0.4290 - accuracy:
0.8549
Epoch 00222: val_loss did not improve from 0.43718
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4302 -
accuracy: 0.8534 - val_loss: 0.4635 - val_accuracy: 0.8454
Epoch 223/350
6080/6985 [==========================>…] - ETA: 0s - loss: 0.4463 - accuracy:
0.8424
Epoch 00223: val_loss did not improve from 0.43718
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4441 -
accuracy: 0.8437 - val_loss: 0.4461 - val_accuracy: 0.8483
Epoch 224/350
6848/6985 [===========================>.] - ETA: 0s - loss: 0.4515 - accuracy:
0.8433
Epoch 00224: val_loss did not improve from 0.43718
6985/6985 [==============================] - 0s 55us/sample - loss: 0.4517 -
accuracy: 0.8428 - val_loss: 0.4458 - val_accuracy: 0.8569
Epoch 225/350
6912/6985 [===========================>.] - ETA: 0s - loss: 0.4281 - accuracy:
0.8482
Epoch 00225: val_loss did not improve from 0.43718
6985/6985 [==============================] - 0s 54us/sample - loss: 0.4284 -
accuracy: 0.8482 - val_loss: 0.4528 - val_accuracy: 0.8546
Epoch 226/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4425 - accuracy:
0.8456
Epoch 00226: val_loss did not improve from 0.43718
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4391 -
accuracy: 0.8481 - val_loss: 0.4721 - val_accuracy: 0.8460
Epoch 227/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.4225 - accuracy:
0.8501
Epoch 00227: val_loss did not improve from 0.43718
6985/6985 [==============================] - 0s 53us/sample - loss: 0.4224 -
accuracy: 0.8501 - val_loss: 0.4488 - val_accuracy: 0.8558
Epoch 228/350
6976/6985 [===========================>.] - ETA: 0s - loss: 0.4389 - accuracy:
0.8452
Epoch 00228: val_loss improved from 0.43718 to 0.43475, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 56us/sample - loss: 0.4385 -
```

```
accuracy: 0.8454 - val_loss: 0.4347 - val_accuracy: 0.8523
Epoch 229/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.4217 - accuracy:
0.8532
Epoch 00229: val_loss did not improve from 0.43475
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4220 -
accuracy: 0.8527 - val_loss: 0.4475 - val_accuracy: 0.8546
Epoch 230/350
6144/6985 [=========================>…] - ETA: 0s - loss: 0.4239 - accuracy:
0.8519
Epoch 00230: val_loss did not improve from 0.43475
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4219 -
accuracy: 0.8530 - val_loss: 0.4573 - val_accuracy: 0.8500
Epoch 231/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4348 - accuracy:
0.8480
Epoch 00231: val_loss improved from 0.43475 to 0.43234, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4321 -
accuracy: 0.8488 - val_loss: 0.4323 - val_accuracy: 0.8603
Epoch 232/350
6016/6985 [========================>…] - ETA: 0s - loss: 0.4198 - accuracy:
0.8514
Epoch 00232: val_loss did not improve from 0.43234
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4243 -
accuracy: 0.8497 - val_loss: 0.4459 - val_accuracy: 0.8580
Epoch 233/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4388 - accuracy:
0.8462
Epoch 00233: val_loss did not improve from 0.43234
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4386 -
accuracy: 0.8464 - val_loss: 0.4334 - val_accuracy: 0.8712
Epoch 234/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4222 - accuracy:
0.8503
Epoch 00234: val_loss did not improve from 0.43234
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4207 -
accuracy: 0.8517 - val_loss: 0.4523 - val_accuracy: 0.8523
Epoch 235/350
6528/6985 [=========================>..] - ETA: 0s - loss: 0.4228 - accuracy:
0.8537
Epoch 00235: val_loss improved from 0.43234 to 0.42805, saving model to
audio_classification_lstm.h5
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4212 -
accuracy: 0.8544 - val_loss: 0.4280 - val_accuracy: 0.8592
Epoch 236/350
6336/6985 [==========================>…] - ETA: 0s - loss: 0.4132 - accuracy:
0.8600
```

```
Epoch 00236: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4123 -
accuracy: 0.8597 - val_loss: 0.4612 - val_accuracy: 0.8523
Epoch 237/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.4234 - accuracy:
0.8504
Epoch 00237: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4195 -
accuracy: 0.8521 - val_loss: 0.4444 - val_accuracy: 0.8477
Epoch 238/350
6976/6985 [=============================>.] - ETA: 0s - loss: 0.4235 - accuracy:
0.8519
Epoch 00238: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 53us/sample - loss: 0.4232 -
accuracy: 0.8521 - val_loss: 0.4292 - val_accuracy: 0.8540
Epoch 239/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4318 - accuracy:
0.8496
Epoch 00239: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4353 -
accuracy: 0.8480 - val_loss: 0.4396 - val_accuracy: 0.8563
Epoch 240/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4283 - accuracy:
0.8493
Epoch 00240: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4267 -
accuracy: 0.8488 - val_loss: 0.4341 - val_accuracy: 0.8620
Epoch 241/350
6464/6985 [=========================>…] - ETA: 0s - loss: 0.4410 - accuracy:
0.8482
Epoch 00241: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4406 -
accuracy: 0.8480 - val_loss: 0.4291 - val_accuracy: 0.8586
Epoch 242/350
6144/6985 [========================>…] - ETA: 0s - loss: 0.4189 - accuracy:
0.8579
Epoch 00242: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 50us/sample - loss: 0.4174 -
accuracy: 0.8564 - val_loss: 0.4420 - val_accuracy: 0.8489
Epoch 243/350
6208/6985 [========================>…] - ETA: 0s - loss: 0.4304 - accuracy:
0.8492
Epoch 00243: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 49us/sample - loss: 0.4312 -
accuracy: 0.8485 - val_loss: 0.4625 - val_accuracy: 0.8558
Epoch 244/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4511 - accuracy:
0.8402
```

```
Epoch 00244: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4505 -
accuracy: 0.8397 - val_loss: 0.4343 - val_accuracy: 0.8661
Epoch 245/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.4358 - accuracy:
0.8498
Epoch 00245: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4382 -
accuracy: 0.8488 - val_loss: 0.4427 - val_accuracy: 0.8575
Epoch 246/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4424 - accuracy:
0.8439
Epoch 00246: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4404 -
accuracy: 0.8451 - val_loss: 0.4510 - val_accuracy: 0.8540
Epoch 247/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.4332 - accuracy:
0.8482
Epoch 00247: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4334 -
accuracy: 0.8478 - val_loss: 0.4353 - val_accuracy: 0.8580
Epoch 248/350
6464/6985 [==========================>…] - ETA: 0s - loss: 0.4390 - accuracy:
0.8487
Epoch 00248: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4411 -
accuracy: 0.8468 - val_loss: 0.4494 - val_accuracy: 0.8552
Epoch 249/350
6592/6985 [===========================>..] - ETA: 0s - loss: 0.4097 - accuracy:
0.8582
Epoch 00249: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 47us/sample - loss: 0.4127 -
accuracy: 0.8573 - val_loss: 0.4461 - val_accuracy: 0.8558
Epoch 250/350
6400/6985 [=========================>…] - ETA: 0s - loss: 0.4091 - accuracy:
0.8575
Epoch 00250: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 48us/sample - loss: 0.4096 -
accuracy: 0.8573 - val_loss: 0.4501 - val_accuracy: 0.8558
Epoch 251/350
6080/6985 [========================>…] - ETA: 0s - loss: 0.4354 - accuracy:
0.8484
Epoch 00251: val_loss did not improve from 0.42805
6985/6985 [==============================] - 0s 51us/sample - loss: 0.4307 -
accuracy: 0.8492 - val_loss: 0.4554 - val_accuracy: 0.8472
```

Plotting accuracy vs val accuracy while training

```
[92]: plt.plot(history.history['accuracy'])
      plt.plot(history.history['val_accuracy'])
      plt.title('model_accuracy')
      plt.ylabel('accuracy')
      plt.xlabel('epoch')
      plt.legend(['train','val'])
      plt.show()

      plt.plot(history.history['loss'])
      plt.plot(history.history['val_loss'])
      plt.title('model_loss')
      plt.ylabel('loss')
      plt.xlabel('epoch')
      plt.legend(['train','val'])
      plt.show()
```
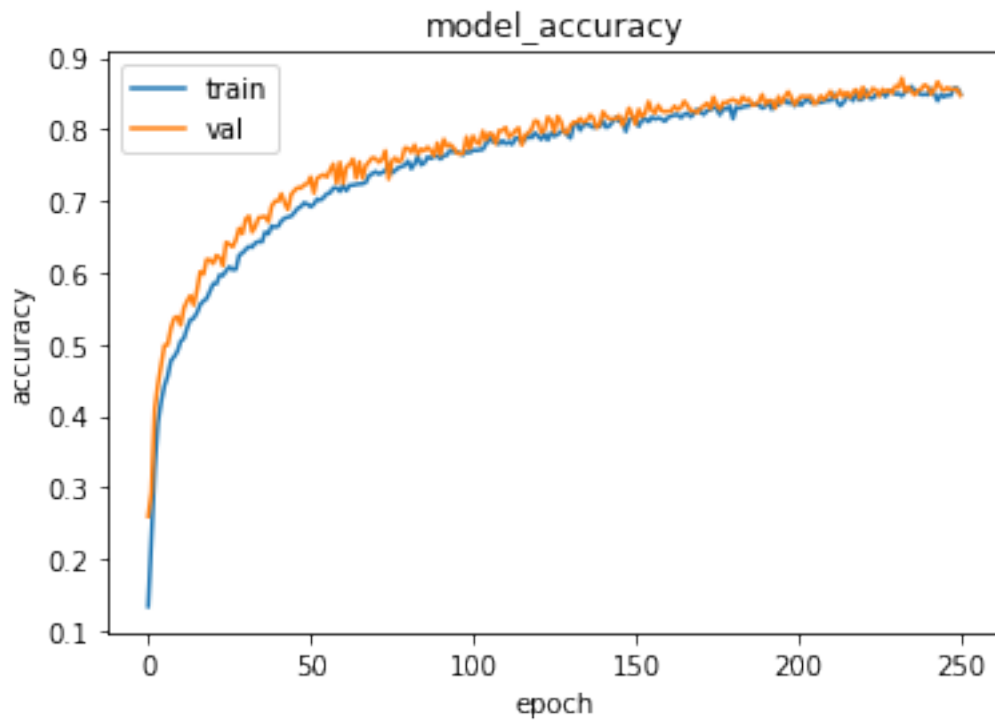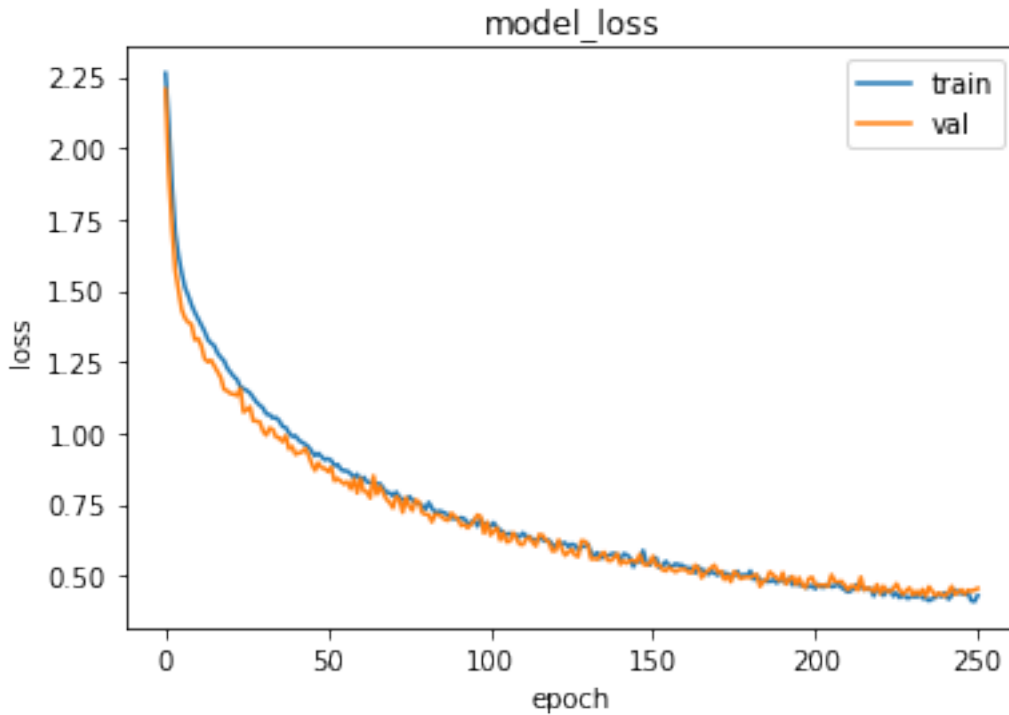
Model Evaluation

```
[93]: print('Validation loss is {0} , validation accuracy is {1}'.format(history.
      ↪history['val_loss'][-1],history.history['val_accuracy'][-1]))
```

Validation loss is 0.45535503258757 , validation accuracy is 0.8471665978431702

```
[94]: y_pred_le_lstm = model_lstm.predict(X_test_lstm)
      y_pred_le_lstm = y_pred_le_lstm.reshape(y_pred_le_lstm.shape[0],y_pred_le_lstm.
      ↪shape[2])
      y_pred_le_lstm = np.argmax(y_pred_le_lstm,axis=1)
      y_pred_lstm = le.inverse_transform(y_pred_le_lstm)
```

```
[95]: X_test_lstm.shape
```

```
[95]: (1747, 1, 40)
```

classification report

```
[96]: print(classification_report(y_test,y_pred_lstm))
```

	precision	recall	f1-score	support
air_conditioner	0.92	0.89	0.90	200
car_horn	0.96	0.87	0.91	86

```
       children_playing      0.72       0.79       0.75        200
              dog_bark        0.85       0.71       0.77        200
              drilling        0.91       0.91       0.91        200
         engine_idling        0.88       0.94       0.91        200
              gun_shot        0.78       0.77       0.78         75
            jackhammer        0.92       0.97       0.94        200
                 siren        0.96       0.94       0.95        186
          street_music        0.72       0.75       0.74        200

              accuracy                              0.86       1747
             macro avg        0.86       0.85       0.86       1747
          weighted avg       0.86       0.86       0.86       1747
```

confusion matrix

```
[97]: lstm_cnf_matrix = confusion_matrix(y_test,y_pred_lstm)
      disp_lstm = ConfusionMatrixDisplay(lstm_cnf_matrix,le.classes_)
      disp_lstm.plot(values_format='d',xticks_rotation='vertical')
```

[97]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
      0x7f8e7504c490>
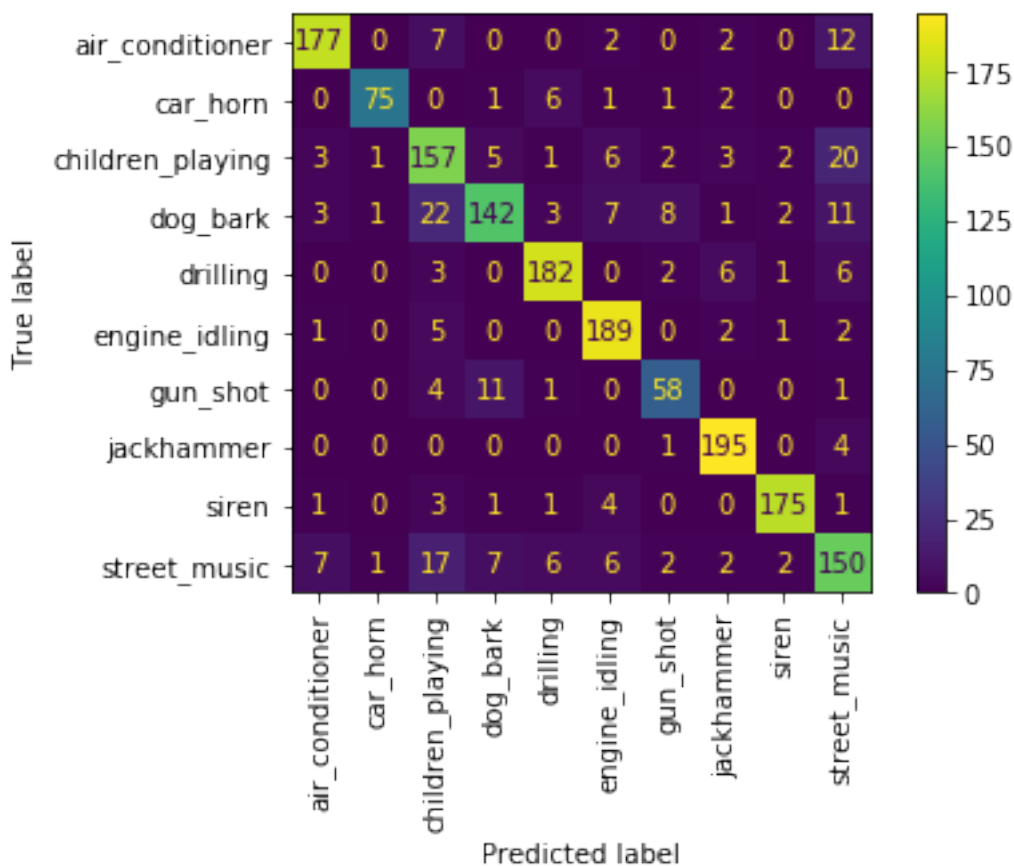
**sensitivity, specificity and precision**

```
[98]: lstm_met = get_metrics(lstm_cnf_matrix)
      lstm_met
```

```
[98]:         Metric air_conditioner car_horn children_playing dog_bark drilling  \
      0  Sensitivity            0.88     0.87             0.78     0.71     0.91
      1  Specificity            0.99      1.0             0.96     0.98     0.99
      2    Precision            0.92     0.96             0.72     0.85     0.91

         engine_idling gun_shot jackhammer siren street_music
      0           0.94     0.77       0.98  0.94         0.75
      1           0.98     0.99       0.99  0.99         0.96
      2           0.88     0.78       0.92  0.96         0.72
```

roc curve

```
[99]: plot_multiclass_roc(model_lstm, X_test_lstm, y_test, n_classes=10, figsize=(15,␣
      ↪6),name="LSTM")
```
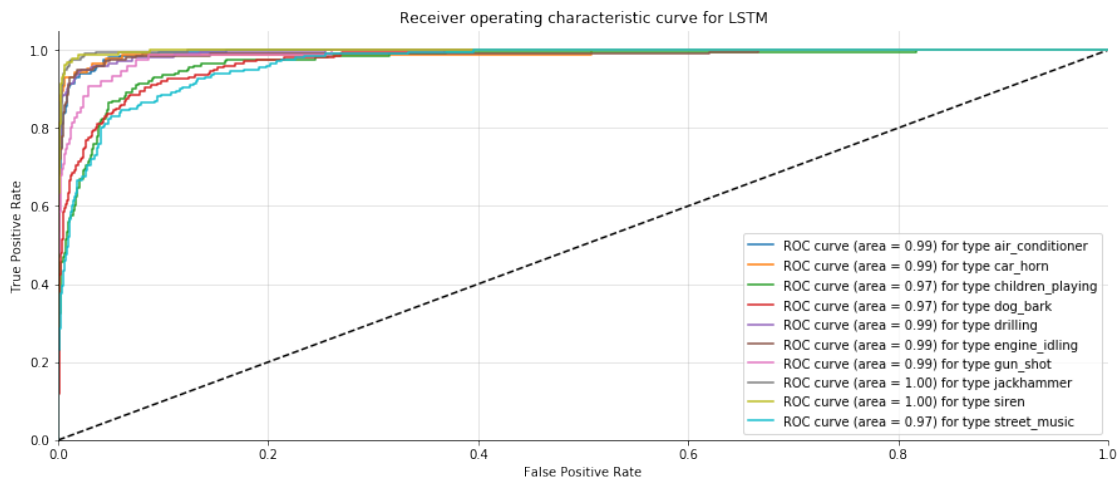

Inferencing model

```
[100]: def predict_lstm(folder_path,file_name):
           loaded_model = load_model("audio_classification_lstm.h5")
           file_path = folder_path + '/' + file_name
           feature = extract_features(file_path)
           feature = feature.reshape(1,40)
           feature = scaler.transform(feature)
           feature = feature.reshape(1,1,40)
```

```
        predicted_val = loaded_model.predict(feature)[0]
        prediction = le.inverse_transform([np.argmax(predicted_val)])
        print('Predicted Class is : ',prediction[0])
        print ('Real Class is : ',df[df['slice_file_name']==file_name]['class'].
        →values[0])
```

[101]: ```
predict_lstm('urbansound8k/fold7','24965-3-2-0.wav')
```

```
Predicted Class is :  dog_bark
Real Class is :  dog_bark
```

[102]: ```
predict_lstm('urbansound8k/fold7','28385-9-0-9.wav')
```

```
Predicted Class is :  jackhammer
Real Class is :  street_music
```

[103]: ```
predict_lstm('urbansound8k/fold10','7913-3-2-0.wav')
```

```
Predicted Class is :  dog_bark
Real Class is :  dog_bark
```

Architecture of Nueral Networks 4 Hidden layers with 100 nuerons are used. Relu is used for activation since, it can recover most information. Drop out rate of 0.15 is used to regularize and avoid overfitting.Anything beyond 0.15, the network is underfitting. Batch Normalization is used since it reduces training time and also goes along well with Dropout. Learning rate of 0.0006 is used for Adam since it's giving best accuracy. Early stopping is implemented with epoch patience of 30, since learning rate is very small. Checkpoint is set to update weights of the best model.

No. of epochs used is 350, since early stopping is added in callbacks, it will not go beyond 30 epochs when its not learning.Both models are stopping beyond 250 epochs.restore_best_weights is set to true to get best model with best weights.

Looking at History of model with Nueral Network and LSTM model architectures, the model is learning smoothly and there is no over fitting and under fitting with a loss of around .4

Confusion Matrix, commmon metrics such as acuracy,precision and sensitivity are calculated and displayed. ROC curves are displayed too..

Models are saved in.h5 format and audio functions are tested on LSTM model.

Model with LSTM cell untis is doing similar model with out any but both have very similar metrics.

[ ]: