```python
#Importing basic libraries
import librosa #Here we are using librosa library
from matplotlib import pyplot as plt
import IPython.display as ipd
import librosa.display
filename='urban/fold1/101415-3-0-2.wav'
```

```python
data,sample_rate=librosa.load(filename)
data
```

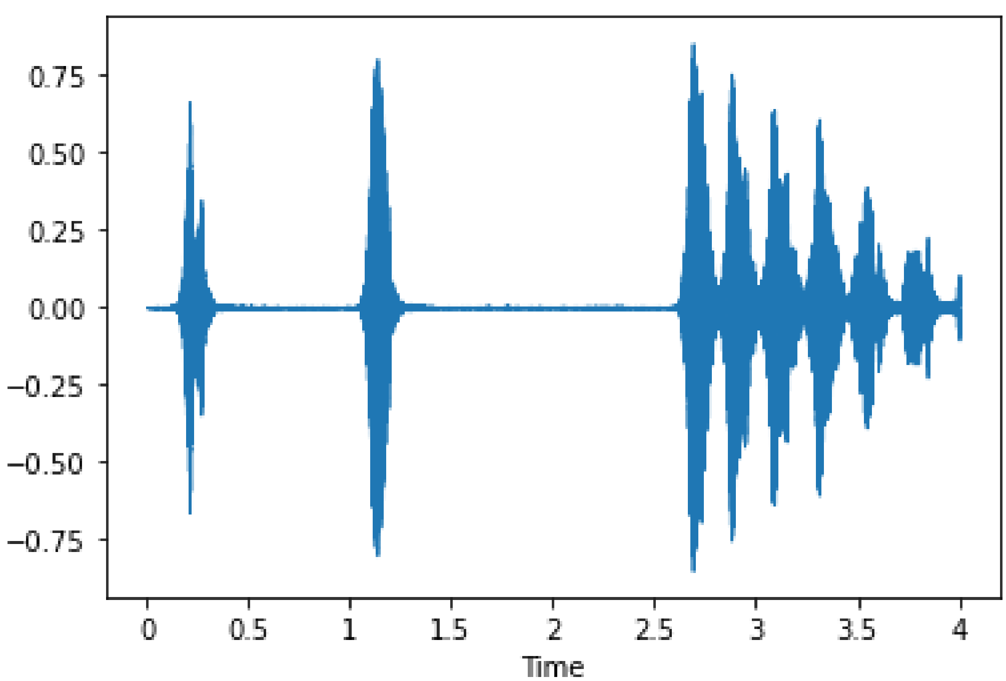
```
array([-0.00011662, -0.00017163, -0.00017833, ..., -0.04541198,
       -0.04675572, -0.05040179], dtype=float32)
```

```python
sample_rate
```

```
22050
```

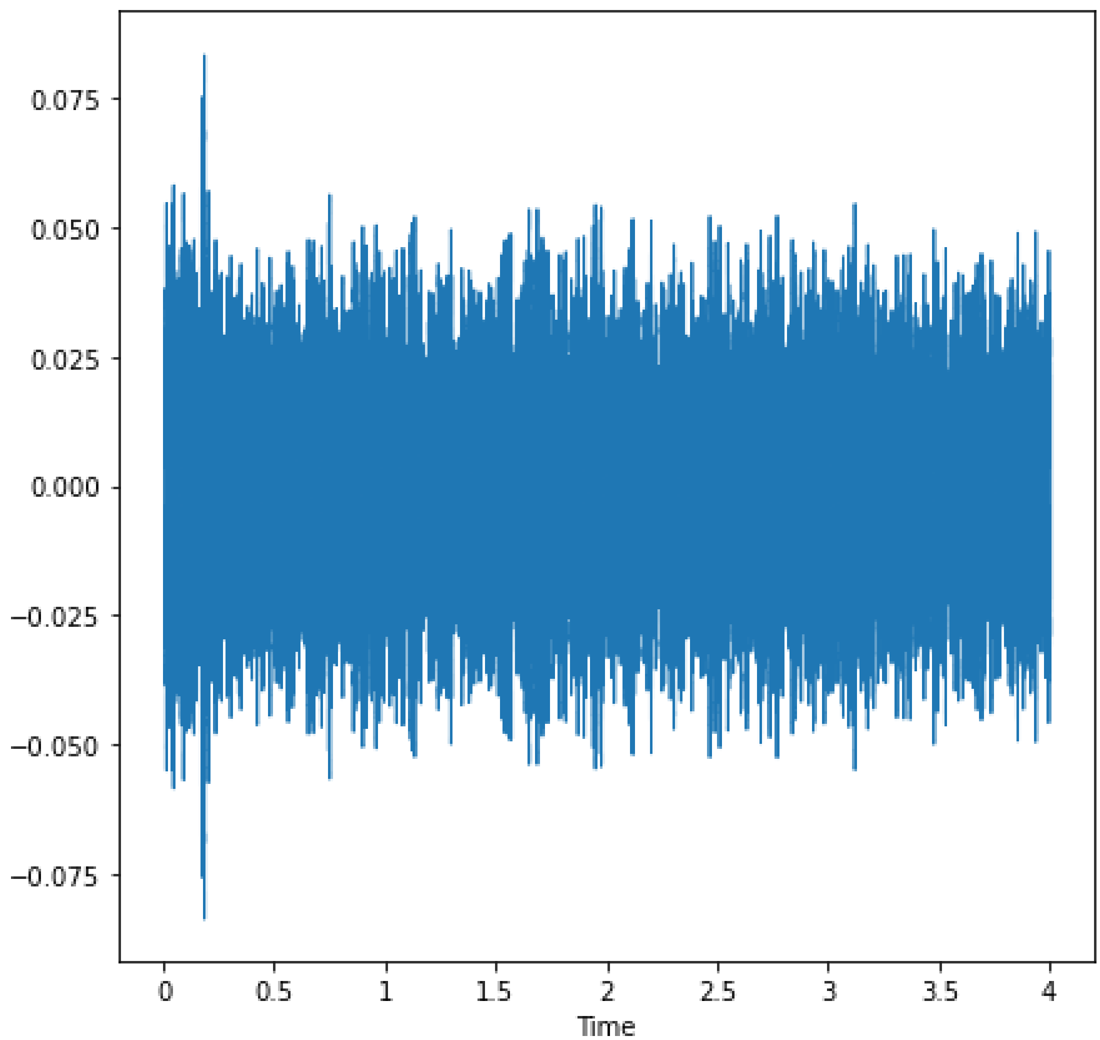
```python
#Showing our first wave of the audio data
librosa.display.waveshow(data,sr=sample_rate)
ipd.Audio(filename) #Audio clip of the first audio data
```

```
<IPython.lib.display.Audio object>
```



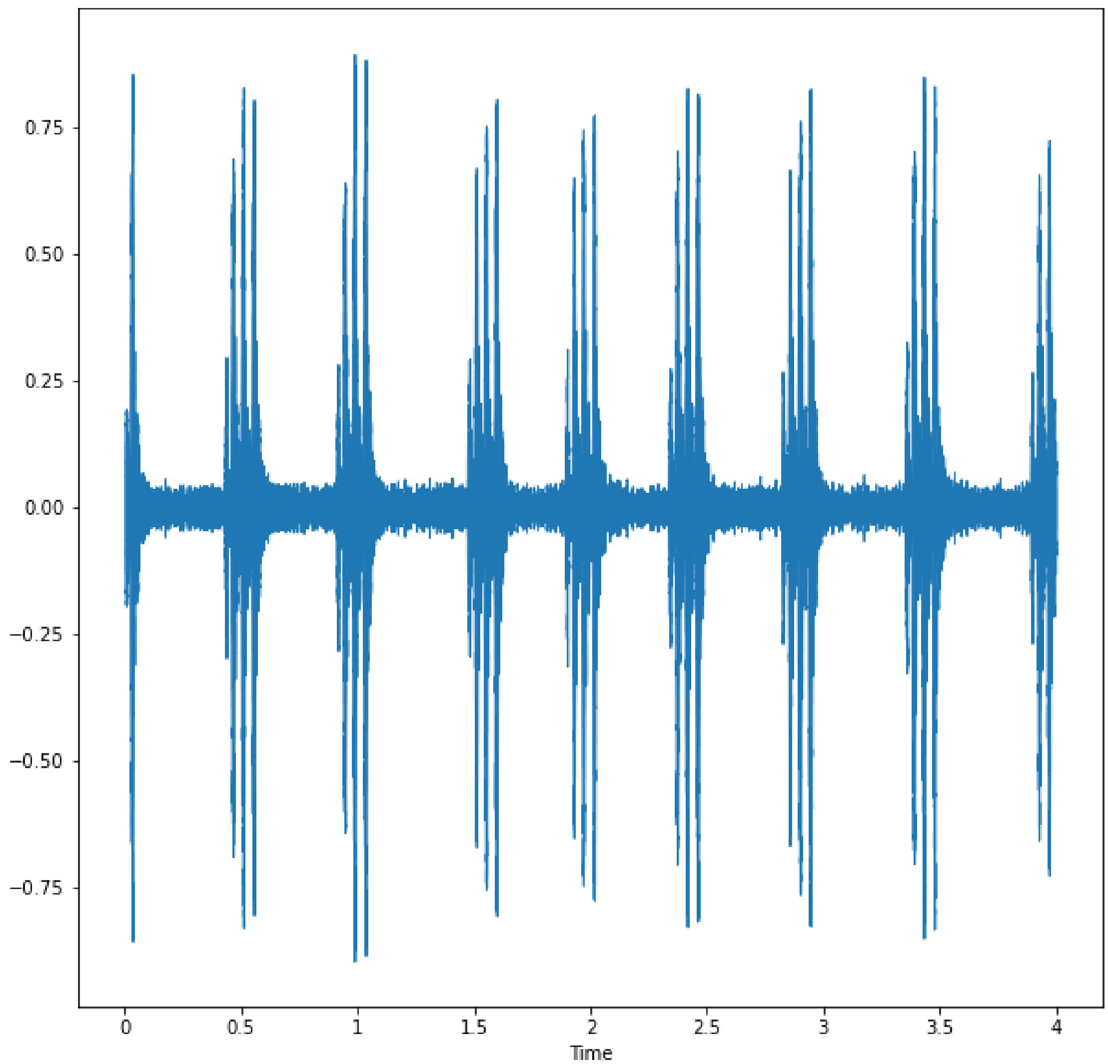

```python
#Same as previous but audio data is different
file='urban/fold9/103249-5-0-10.wav'
plt.figure(figsize=(7,7))
data,sample_rate=librosa.load(file)
librosa.display.waveshow(data,sr=sample_rate)
ipd.Audio(file)
```

```
<IPython.lib.display.Audio object>
```



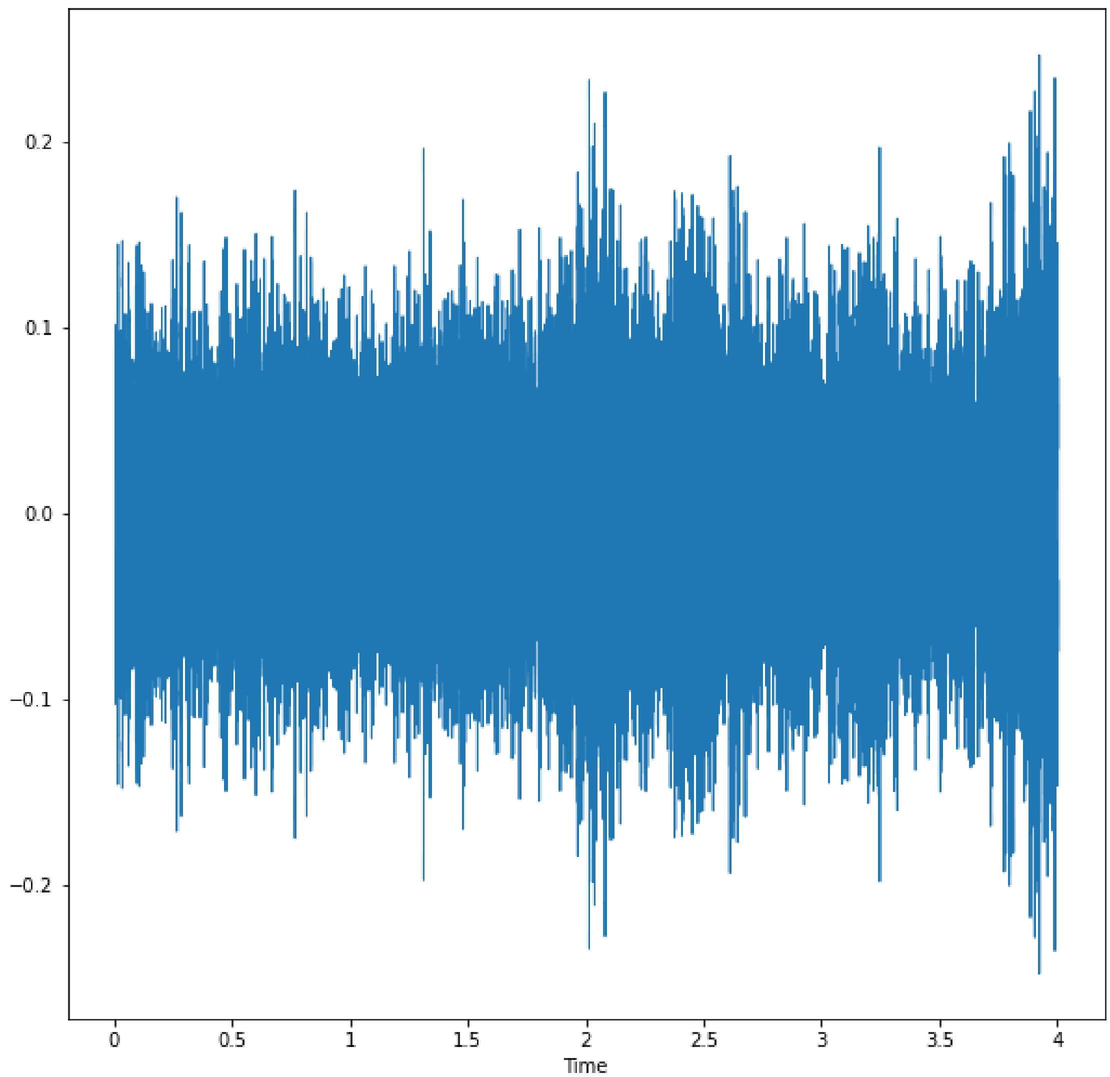

```
#Same as previous
file='urban/fold9/101729-0-0-24.wav'
plt.figure(figsize=(10,10))
data,sample_rate=librosa.load(file)
librosa.display.waveshow(data,sr=sample_rate)
ipd.Audio(file)
```

```
<IPython.lib.display.Audio object>
```




```
#Same
file='urban/fold4/115415-9-0-7.wav'
plt.figure(figsize=(10,10))
data,sample_rate=librosa.load(file)
librosa.display.waveshow(data,sr=sample_rate)
ipd.Audio(file)
```

```
<IPython.lib.display.Audio object>
```




```
#Reading the data
import pandas as pd
metadata=pd.read_csv('urban/UrbanSound8K.csv')
metadata.head()
```

```
      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
```

```
metadata['class'].value_counts()
```

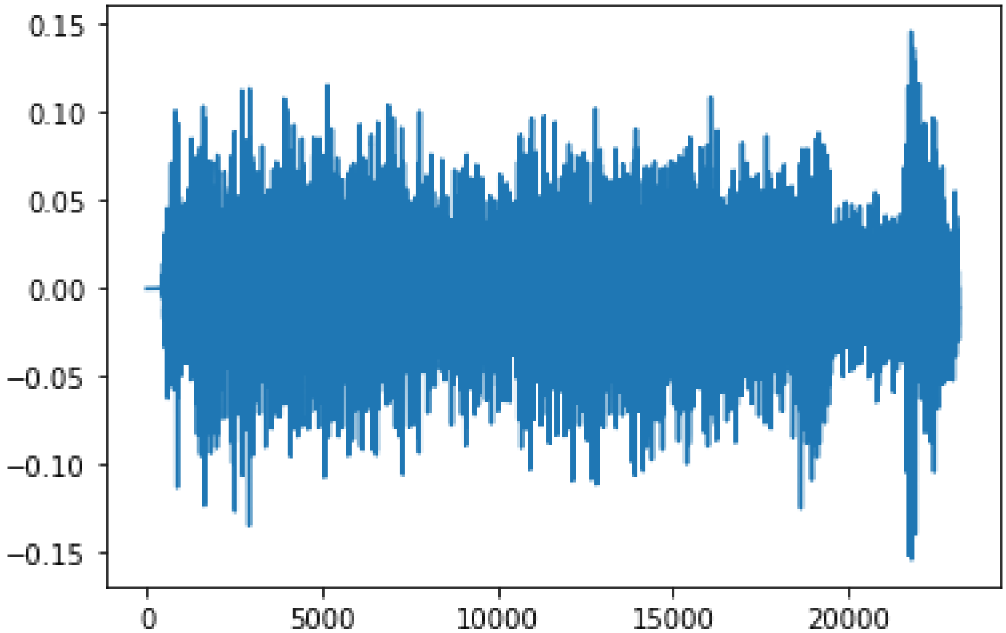
```
dog_bark            1000
children_playing    1000
air_conditioner     1000
street_music        1000
engine_idling       1000
jackhammer          1000
drilling            1000
siren                929
car_horn             429
gun_shot             374
Name: class, dtype: int64
```

```
file='urban/fold10/100648-1-1-0.wav'
data,sample_rate=librosa.load(file)
print(data)
```

```
[ 0.          0.          0.         ... -0.02467388 -0.01529006
  0.        ]
```

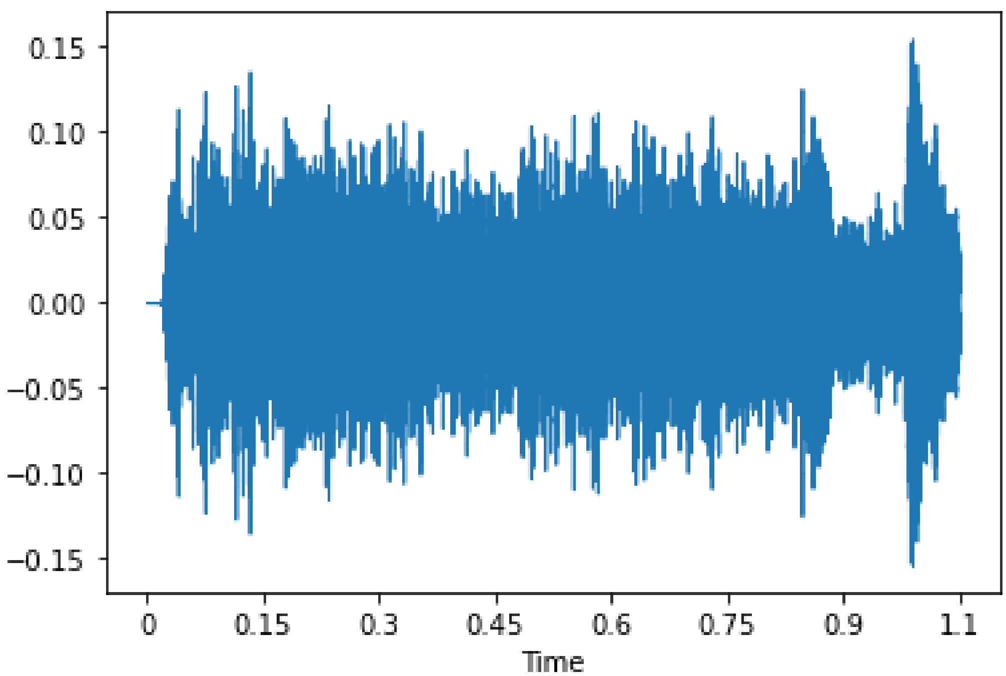
```
plt.plot(data)
```

```
[<matplotlib.lines.Line2D at 0x2c2e907e190>]
```




```
librosa.display.waveshow(data,sr=sample_rate)
```

```
<librosa.display.AdaptiveWaveplot at 0x2c2e90e0100>
```




```
ipd.Audio(file)
```

```
<IPython.lib.display.Audio object>
```

```python
#Mfccs- mel-frequency crapstral coefficients
mfccs=librosa.feature.mfcc(y=data,sr=sample_rate)
mfccs
```

```
array([[-3.81742462e+02, -2.39318420e+02, -2.00840012e+02,
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        -1.86303940e+02, -1.90227814e+02, -1.95716705e+02,
        -2.02454849e+02, -2.00424805e+02, -1.97105774e+02,
        -1.94880600e+02, -1.93831757e+02, -1.98339737e+02,
        -2.00449799e+02, -1.98790314e+02, -1.97436707e+02,
        -1.95979141e+02, -2.00547958e+02, -1.99036469e+02,
        -1.88400238e+02, -1.81872223e+02, -1.83758835e+02,
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        -2.01852585e+02, -1.98343140e+02, -2.08632095e+02,
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```

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 -2.87350311e+01, -2.31306686e+01, -2.22651405e+01,
```

```
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 -2.28066444e+01, -2.39559708e+01, -2.01163578e+01,
 -2.01141548e+01, -2.13130283e+01, -2.34836006e+01,
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 -7.73322582e+00],
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  7.28264713e+00,  3.88589710e-01, -2.38423586e+00,
  1.73954868e+00,  3.06093502e+00,  2.51255345e+00,
  6.06325817e+00,  4.76198769e+00, -1.95269001e+00,
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  1.40220327e+01,  1.02395020e+01,  3.56202745e+00,
  1.87834132e+00,  8.43403101e-01,  4.30684614e+00,
  3.94757843e+00,  8.00439262e+00,  1.30295110e+00,
  1.36065769e+00,  2.02003455e+00,  1.81072628e+00,
  2.08371729e-02, -8.29907417e+00, -5.05131340e+00,
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  4.94248104e+00],
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  1.96091533e-02, -3.60559797e+00, -4.54480553e+00,
```

```
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 -1.99061737e+01, -1.68402824e+01, -9.53046322e+00,
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  2.40114546e+00,  5.38342285e+00,  2.33076453e+00,
 -1.12093985e+00, -3.89142060e+00, -6.23959112e+00,
 -4.17407751e+00, -3.05383945e+00, -3.87846923e+00,
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 -8.46659660e+00, -1.37319546e+01, -1.80640144e+01,
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 -1.44138622e+01, -1.71179047e+01, -1.66639633e+01,
 -1.10698833e+01, -1.03836260e+01, -1.36423111e+01,
```

```
        -1.78512993e+01, -1.94019604e+01, -1.66434898e+01,
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        -1.65857868e+01, -1.49597702e+01, -1.71370354e+01,
        -2.14617462e+01, -1.97642155e+01, -1.85843811e+01,
        -1.81216927e+01, -1.04453297e+01, -8.64480591e+00,
        -1.24153481e+01, -1.13325462e+01, -1.32572460e+01,
        -2.43213673e+01, -2.13798561e+01, -1.60172844e+01,
        -1.05357866e+01],
       [ 3.97376895e-01,  1.83197141e+00,  4.31465769e+00,
         2.83439684e+00,  3.00364733e-01,  5.24890614e+00,
         5.18711329e+00,  1.81276190e+00,  2.44127703e+00,
         6.12378025e+00,  2.75625587e+00,  1.42039204e+00,
         1.17214918e+00,  2.48194575e-01,  4.90573359e+00,
         4.79383612e+00, -4.03649449e-01,  2.44086218e+00,
         5.24094868e+00,  3.46199965e+00,  1.98755980e+00,
         2.88928556e+00,  7.87460947e+00,  1.22666149e+01,
         7.56171846e+00, -1.48138165e-01,  5.47559834e+00,
         7.58895779e+00,  7.47483063e+00,  5.27701759e+00,
         7.35777187e+00,  6.44517422e+00,  1.18343413e+00,
         9.86786366e-01, -3.65467215e+00, -3.80321908e+00,
        -4.41240644e+00, -6.78113270e+00, -2.26358080e+00,
        -2.36710548e+00, -5.31309426e-01,  2.51292276e+00,
        -3.14756966e+00,  1.71539664e+00,  6.44806862e+00,
         6.14509583e+00]], dtype=float32)
```

```
mfccs.shape
```

```
(20, 46)
```

```
#Calculating mfcc for the audio data named as file
file='urban/fold8/103076-3-0-0.wav'
data,sample_rate=librosa.load(file)
mfccs2=librosa.feature.mfcc(y=data,sr=sample_rate)
mfccs2
```

```
array([[-515.92267  , -484.46594  , -398.35062  , ..., -481.6944   ,
        -485.69058  , -490.18924  ],
       [  18.905098 ,   56.696026 ,  125.05409  , ...,   50.337784 ,
          46.759377 ,   43.654747 ],
       [  10.733795 ,   32.066864 ,   17.022207 , ...,    7.900363 ,
           7.6215253,   10.265154 ],
       ...,
       [   6.400581 ,    4.0845275,    9.1847725, ...,  -11.392929 ,
         -12.2220335,  -13.293634 ],
       [   6.088352 ,    1.1501071,    5.451171 , ...,   -9.292716 ,
          -9.7056   ,  -10.057598 ],
       [   3.3120189,   -1.4564419,   -9.950499 , ...,   -5.2907166,
          -4.2817717,   -5.1364794]], dtype=float32)
```

```
mfccs2.shape
```

```
(20, 109)
```

```
audio_data_path='urban'
```

```
#Calulating mfcc for all the audio data
def features_extractor(file):
    audio_data, sample_rate = librosa.load(file_name,
res_type='kaiser_fast')
    mfccs_features = librosa.feature.mfcc(y=audio_data,
sr=sample_rate, n_mfcc=40)
    mfccs_scaled_features = np.mean(mfccs_features.T,axis=0)

    return mfccs_scaled_features
```

```
import numpy as np
from tqdm import tqdm
import os as o
extracted_features=[]

for index_num,row in tqdm(metadata.iterrows()):

file_name=o.path.join(o.path.abspath(audio_data_path),'fold'+str(row['
fold'])+'/',str(row['slice_file_name']))
    final_class_labels=row['class']
    data=features_extractor(file_name)
    extracted_features.append([data,final_class_labels])
```

```
3555it [03:02, 19.71it/s]C:\Users\VICKY R R\anaconda3\lib\site-
packages\librosa\util\decorators.py:88: UserWarning: n_fft=2048 is too
small for input signal of length=1323
  return f(*args, **kwargs)
8324it [06:35, 20.76it/s]C:\Users\VICKY R R\anaconda3\lib\site-
packages\librosa\util\decorators.py:88: UserWarning: n_fft=2048 is too
small for input signal of length=1103
  return f(*args, **kwargs)
8329it [06:36, 26.60it/s]C:\Users\VICKY R R\anaconda3\lib\site-
packages\librosa\util\decorators.py:88: UserWarning: n_fft=2048 is too
small for input signal of length=1523
  return f(*args, **kwargs)
8732it [06:52, 21.17it/s]
```

```
#Converting extracted_features into a dataframe
df=pd.DataFrame(extracted_features,columns=['features','class'])
df.head()
```

	features	class
0	[-217.35526, 70.22338, -130.38527, -53.282898,...	dog_bark
1	[-424.09818, 109.34077, -52.919525, 60.86475, ...	children_playing
2	[-458.79114, 121.38419, -46.520657, 52.00812, ...	children_playing
3	[-413.89984, 101.66373, -35.42945, 53.036354, ...	children_playing
4	[-446.60352, 113.68541, -52.402206, 60.302044,...	children_playing

```
df.shape
```

```
(8732, 2)
```

```
#Dividing the data into train and test
x=np.array(df['features'].tolist())
y=np.array(df['class'].tolist())
```

```
x
```

```
array([[-2.1735526e+02,  7.0223381e+01, -1.3038527e+02, ...,
        -1.6930529e+00, -6.1698371e-01,  3.8600543e-01],
       [-4.2409818e+02,  1.0934077e+02, -5.2919525e+01, ...,
         5.3489321e-01, -5.4468727e-01,  4.4632098e-01],
       [-4.5879114e+02,  1.2138419e+02, -4.6520657e+01, ...,
         2.0768483e+00,  1.6962963e+00, -9.6140963e-01],
       ...,
       [-3.0388824e+02,  1.1135945e+02, -4.5941563e+01, ...,
        -3.0292380e+00,  2.7170298e+00,  7.6197419e+00],
       [-3.4411008e+02,  1.2545021e+02, -5.4903442e+01, ...,
        -7.9082441e+00, -1.6414586e+00,  5.6668439e+00],
       [-3.1560281e+02,  9.4854805e+01, -3.7222340e+01, ...,
         6.1386460e-01, -1.1449189e+01, -6.0105853e+00]],
dtype=float32)
```

```
y
```

```
array(['dog_bark', 'children_playing', 'children_playing', ...,
       'car_horn', 'car_horn', 'car_horn'], dtype='<U16')
```

```
x.shape
```

```
(8732, 40)
```

```
y.shape
```

```
(8732,)
```

```
print(x.mean(),x.std())
```

```
-3.4118054 47.55431
```

```
#Applying label encoding to y
from tensorflow.keras.utils import to_categorical
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
y=to_categorical(le.fit_transform(y))
y
```

```
array([[0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 1., ..., 0., 0., 0.],
       [0., 0., 1., ..., 0., 0., 0.],
       ...,
```

```
       [0., 1., 0., ..., 0., 0., 0.],
       [0., 1., 0., ..., 0., 0., 0.],
       [0., 1., 0., ..., 0., 0., 0.]], dtype=float32)
```

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.30)
```

```
print(x_train.shape,x_test.shape,y_train.shape,y_test.shape)
```

```
(6112, 40) (2620, 40) (6112, 10) (2620, 10)
```

```
x_train
```

```
array([[-5.39083801e+02,  1.18879990e+02, -2.12978706e+01, ...,
         1.43910885e+00,  4.27504629e-01,  1.14806557e+00],
       [-3.85882782e+02,  1.58166977e+02, -2.13433208e+01, ...,
         6.21687412e-01, -1.46509886e+00, -3.36106420e+00],
       [-2.97461426e+02,  5.16823692e+01, -5.42805367e+01, ...,
         1.67091846e+00, -1.75430465e+00,  2.84418732e-01],
       ...,
       [-2.46721054e+02,  1.07195564e+02, -6.84187775e+01, ...,
         2.54747778e-01,  4.84547287e-01, -4.68080938e-01],
       [-2.19870026e+02,  1.05620338e+02, -1.92326412e+01, ...,
         1.99260962e+00,  1.96077079e-01,  3.28308463e+00],
       [-4.74945221e+02,  6.03058968e+01, -1.67592487e+01, ...,
         2.02000237e+00,  1.62229729e+00,  3.82520765e-01]],
dtype=float32)
```

```
x_train.shape
```

```
(6112, 40)
```

```
x_test.shape
```

```
(2620, 40)
```

```
y_train.shape
```

```
(6112, 10)
```

```
from tensorflow.keras import layers,models
```

```
#Building the model
nn=models.Sequential([

    layers.Dense(99,input_shape=(40,),activation='relu'),
    layers.Dense(34,activation='relu'),
    layers.Dense(10,activation='softmax')



])
```

```
nn.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 dense (Dense)               (None, 99)                4059      
                                                                 
 dense_1 (Dense)             (None, 34)                3400      
                                                                 
 dense_2 (Dense)             (None, 10)                350       
                                                                 
=================================================================
Total params: 7,809
Trainable params: 7,809
Non-trainable params: 0
_________________________________________________________________
```

```
#Fitting the model with x_train and y_train

nn.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['
accuracy'])
from tensorflow.keras.callbacks import ModelCheckpoint
from datetime import datetime

num_epochs = 25
num_batch_size = 32

checkpointer = 
ModelCheckpoint(filepath='saved_models/audio_classification.hdf5', 
                               verbose=1, save_best_only=True)
start = datetime.now()

nn.fit(x_train, y_train, batch_size=num_batch_size, epochs=num_epochs, 
validation_data=(x_test, y_test), callbacks=[checkpointer], verbose=1)


duration = datetime.now() - start
print("Training completed in time: ", duration)
```

```
Epoch 1/25
178/191 [==========================>...] - ETA: 0s - loss: 4.6245 - 
accuracy: 0.3308
Epoch 1: val_loss improved from inf to 1.50950, saving model to 
saved_models\audio_classification.hdf5
191/191 [==============================] - 1s 2ms/step - loss: 4.4245 
- accuracy: 0.3411 - val_loss: 1.5095 - val_accuracy: 0.5122
Epoch 2/25
154/191 [=======================>......] - ETA: 0s - loss: 1.5301 - 
accuracy: 0.5026
```

```
Epoch 2: val_loss improved from 1.50950 to 1.31360, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 1.5071
- accuracy: 0.5146 - val_loss: 1.3136 - val_accuracy: 0.5779
Epoch 3/25
139/191 [====================>.........] - ETA: 0s - loss: 1.2734 -
accuracy: 0.5911
Epoch 3: val_loss improved from 1.31360 to 1.21986, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 1.2739
- accuracy: 0.5924 - val_loss: 1.2199 - val_accuracy: 0.5977
Epoch 4/25
169/191 [=========================>....] - ETA: 0s - loss: 1.1138 -
accuracy: 0.6357
Epoch 4: val_loss improved from 1.21986 to 1.02237, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 1.1043
- accuracy: 0.6392 - val_loss: 1.0224 - val_accuracy: 0.6786
Epoch 5/25
180/191 [===========================>..] - ETA: 0s - loss: 1.0488 -
accuracy: 0.6587
Epoch 5: val_loss did not improve from 1.02237
191/191 [==============================] - 0s 1ms/step - loss: 1.0425
- accuracy: 0.6595 - val_loss: 1.0680 - val_accuracy: 0.6469
Epoch 6/25
169/191 [=========================>....] - ETA: 0s - loss: 0.9740 -
accuracy: 0.6857
Epoch 6: val_loss improved from 1.02237 to 0.98835, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 0.9658
- accuracy: 0.6857 - val_loss: 0.9884 - val_accuracy: 0.6756
Epoch 7/25
157/191 [=======================>......] - ETA: 0s - loss: 0.9184 -
accuracy: 0.7122
Epoch 7: val_loss did not improve from 0.98835
191/191 [==============================] - 0s 1ms/step - loss: 0.9076
- accuracy: 0.7140 - val_loss: 1.0136 - val_accuracy: 0.6718
Epoch 8/25
133/191 [===================>..........] - ETA: 0s - loss: 0.9186 -
accuracy: 0.7023
Epoch 8: val_loss improved from 0.98835 to 0.89379, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 0.8995
- accuracy: 0.7088 - val_loss: 0.8938 - val_accuracy: 0.7130
Epoch 9/25
143/191 [=====================>........] - ETA: 0s - loss: 0.8223 -
accuracy: 0.7356
Epoch 9: val_loss improved from 0.89379 to 0.84424, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 0.8208
```

```
- accuracy: 0.7382 - val_loss: 0.8442 - val_accuracy: 0.7244
Epoch 10/25
133/191 [===================>..........] - ETA: 0s - loss: 0.8080 -
accuracy: 0.7399
Epoch 10: val_loss did not improve from 0.84424
191/191 [==============================] - 0s 1ms/step - loss: 0.8312
- accuracy: 0.7333 - val_loss: 1.0630 - val_accuracy: 0.6710
Epoch 11/25
120/191 [=================>............] - ETA: 0s - loss: 0.7692 -
accuracy: 0.7492
Epoch 11: val_loss did not improve from 0.84424
191/191 [==============================] - 0s 1ms/step - loss: 0.7776
- accuracy: 0.7462 - val_loss: 0.8856 - val_accuracy: 0.7137
Epoch 12/25
179/191 [===========================>..] - ETA: 0s - loss: 0.7309 -
accuracy: 0.7629
Epoch 12: val_loss improved from 0.84424 to 0.77745, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 2ms/step - loss: 0.7366
- accuracy: 0.7598 - val_loss: 0.7775 - val_accuracy: 0.7538
Epoch 13/25
172/191 [==========================>...] - ETA: 0s - loss: 0.6918 -
accuracy: 0.7753
Epoch 13: val_loss did not improve from 0.77745
191/191 [==============================] - 0s 2ms/step - loss: 0.6869
- accuracy: 0.7768 - val_loss: 0.8056 - val_accuracy: 0.7492
Epoch 14/25
168/191 [=========================>....] - ETA: 0s - loss: 0.6654 -
accuracy: 0.7723
Epoch 14: val_loss improved from 0.77745 to 0.75681, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 1s 3ms/step - loss: 0.6605
- accuracy: 0.7755 - val_loss: 0.7568 - val_accuracy: 0.7565
Epoch 15/25
170/191 [=========================>....] - ETA: 0s - loss: 0.6533 -
accuracy: 0.7869
Epoch 15: val_loss improved from 0.75681 to 0.71018, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 2ms/step - loss: 0.6518
- accuracy: 0.7889 - val_loss: 0.7102 - val_accuracy: 0.7805
Epoch 16/25
182/191 [===========================>..] - ETA: 0s - loss: 0.6031 -
accuracy: 0.8029
Epoch 16: val_loss improved from 0.71018 to 0.69568, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 0.6020
- accuracy: 0.8032 - val_loss: 0.6957 - val_accuracy: 0.7794
Epoch 17/25
179/191 [===========================>..] - ETA: 0s - loss: 0.6022 -
accuracy: 0.7994
```

```
Epoch 17: val_loss did not improve from 0.69568
191/191 [==============================] - 0s 1ms/step - loss: 0.6001
- accuracy: 0.7999 - val_loss: 0.7174 - val_accuracy: 0.7813
Epoch 18/25
180/191 [===========================>..] - ETA: 0s - loss: 0.6091 -
accuracy: 0.7969
Epoch 18: val_loss improved from 0.69568 to 0.65698, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 1ms/step - loss: 0.6020
- accuracy: 0.7997 - val_loss: 0.6570 - val_accuracy: 0.7985
Epoch 19/25
127/191 [==================>...........] - ETA: 0s - loss: 0.5375 -
accuracy: 0.8238
Epoch 19: val_loss did not improve from 0.65698
191/191 [==============================] - 0s 1ms/step - loss: 0.5413
- accuracy: 0.8204 - val_loss: 0.7288 - val_accuracy: 0.7683
Epoch 20/25
135/191 [====================>.........] - ETA: 0s - loss: 0.5313 -
accuracy: 0.8315
Epoch 20: val_loss did not improve from 0.65698
191/191 [==============================] - 0s 1ms/step - loss: 0.5417
- accuracy: 0.8258 - val_loss: 0.6849 - val_accuracy: 0.7798
Epoch 21/25
183/191 [===========================>..] - ETA: 0s - loss: 0.5183 -
accuracy: 0.8272
Epoch 21: val_loss did not improve from 0.65698
191/191 [==============================] - 0s 1ms/step - loss: 0.5171
- accuracy: 0.8272 - val_loss: 0.7329 - val_accuracy: 0.7870
Epoch 22/25
166/191 [=========================>....] - ETA: 0s - loss: 0.5165 -
accuracy: 0.8270
Epoch 22: val_loss did not improve from 0.65698
191/191 [==============================] - 0s 1ms/step - loss: 0.5151
- accuracy: 0.8276 - val_loss: 0.6730 - val_accuracy: 0.7981
Epoch 23/25
142/191 [=====================>........] - ETA: 0s - loss: 0.4956 -
accuracy: 0.8319
Epoch 23: val_loss did not improve from 0.65698
191/191 [==============================] - 0s 1ms/step - loss: 0.4906
- accuracy: 0.8341 - val_loss: 0.6930 - val_accuracy: 0.7866
Epoch 24/25
180/191 [===========================>..] - ETA: 0s - loss: 0.4840 -
accuracy: 0.8403
Epoch 24: val_loss improved from 0.65698 to 0.64015, saving model to
saved_models\audio_classification.hdf5
191/191 [==============================] - 0s 2ms/step - loss: 0.4781
- accuracy: 0.8424 - val_loss: 0.6402 - val_accuracy: 0.8004
Epoch 25/25
178/191 [==========================>...] - ETA: 0s - loss: 0.4694 -
accuracy: 0.8408
```

```
Epoch 25: val_loss did not improve from 0.64015
191/191 [==============================] - 0s 2ms/step - loss: 0.4680
- accuracy: 0.8403 - val_loss: 0.6610 - val_accuracy: 0.7939
Training completed in time:  0:00:07.994652
```

```
#Evaluating the model
nn.evaluate(x_test,y_test)
```

```
82/82 [==============================] - 0s 779us/step - loss: 0.6610
- accuracy: 0.7939

[0.660993754863739, 0.7938931584358215]
```

```
x_test[0]
```

```
array([-3.07885376e+02,  1.16959885e+02, -2.37968731e+01,
5.06708374e+01,
       -1.15026798e+01,  1.17254210e+01, -2.68075600e+01, -
9.66017151e+00,
       -1.40686779e+01,  6.13431406e+00, -8.52104664e+00,
1.02833481e+01,
       -5.67926121e+00,  7.07702637e+00, -6.68003035e+00,
7.21004486e+00,
       -6.55538797e+00,  2.18808293e+00, -2.09531426e+00,
4.31734419e+00,
       -4.68917656e+00,  7.10129881e+00,  2.22657728e+00,
2.93233061e+00,
       -4.17351198e+00,  1.72676504e+00, -1.79248297e+00, -
1.06432699e-01,
       -1.91668153e+00,  1.12393749e+00, -1.21858978e+00, -
1.49600852e+00,
        6.49398804e-01,  1.18790329e+00, -1.59171557e+00, -
1.67435384e+00,
       -1.11851943e+00, -1.62678170e+00, -1.92182100e+00, -
1.76350689e+00],
      dtype=float32)
```

```
filename="../input/urbansound8k/fold1/101415-3-0-2.wav"
prediction_feature=features_extractor(filename)
prediction_feature=prediction_feature.reshape(1,-1)
y_pred=nn.predict(prediction_feature)
y_pred
```

```
1/1 [==============================] - 0s 78ms/step

array([[2.35994172e-04, 8.91029119e-01, 2.74627632e-03, 1.03534214e-
04,
        2.42649317e-02, 1.70655048e-03, 1.25769677e-03, 1.56417227e-
05,
        3.82983498e-03, 7.48103932e-02]], dtype=float32)
```

```
np.argmax(y_pred,axis=1)
```

```
array([1], dtype=int64)
```

```
#Testing with some random audio data
filename="urban/fold10/101382-2-0-20.wav"
audio, sample_rate = librosa.load(filename, res_type='kaiser_fast')
mfccs_features = librosa.feature.mfcc(y=audio, sr=sample_rate,
n_mfcc=40)
mfccs_scaled_features = np.mean(mfccs_features.T,axis=0)

print(mfccs_scaled_features)
mfccs_scaled_features=mfccs_scaled_features.reshape(1,-1)
print(mfccs_scaled_features)
print(mfccs_scaled_features.shape)
predicted_label=nn.predict(mfccs_scaled_features)
predicted_label=np.argmax(predicted_label,axis=1)
print(predicted_label)
prediction_class = le.inverse_transform(predicted_label)
prediction_class
```

```
[-2.9286816e+02  7.6148514e+01 -8.9283424e+01 -1.7439636e+01
 -3.5680817e+01 -2.1628220e+01 -2.3610415e+01 -1.7398737e+01
 -1.9349104e+01 -2.0335127e+01 -1.8246513e+01  6.0138435e+00
 -1.1755315e+01  4.6790963e-01 -5.9090028e+00 -1.2833057e-01
 -7.0852609e+00  8.7631667e-01 -5.6806302e+00 -6.3838940e+00
 -7.8490171e+00 -5.1395953e-01 -2.5704169e+00 -8.5713613e-01
 -3.8996730e+00 -1.2656254e+00 -4.9632006e+00 -3.8195801e+00
  2.9782119e+00 -1.1003333e+00  4.5313558e-01  4.1021395e+00
  2.5452676e+00  2.0834954e+00  1.1725211e+00  3.1504326e+00
  2.4951210e+00  1.8432283e+00  1.5362173e+00 -6.5870523e-01]
[[-2.9286816e+02  7.6148514e+01 -8.9283424e+01 -1.7439636e+01
  -3.5680817e+01 -2.1628220e+01 -2.3610415e+01 -1.7398737e+01
  -1.9349104e+01 -2.0335127e+01 -1.8246513e+01  6.0138435e+00
  -1.1755315e+01  4.6790963e-01 -5.9090028e+00 -1.2833057e-01
  -7.0852609e+00  8.7631667e-01 -5.6806302e+00 -6.3838940e+00
  -7.8490171e+00 -5.1395953e-01 -2.5704169e+00 -8.5713613e-01
  -3.8996730e+00 -1.2656254e+00 -4.9632006e+00 -3.8195801e+00
   2.9782119e+00 -1.1003333e+00  4.5313558e-01  4.1021395e+00
   2.5452676e+00  2.0834954e+00  1.1725211e+00  3.1504326e+00
   2.4951210e+00  1.8432283e+00  1.5362173e+00 -6.5870523e-01]]
(1, 40)
1/1 [==============================] - 0s 16ms/step
[2]
```

```
array(['children_playing'], dtype='<U16')
```

```
ipd.Audio(filename)
```

```
<IPython.lib.display.Audio object>
```

```
#Testing with some audio data
x='urban/fold10/100648-1-0-0.wav'
```

```
audio, sample_rate = librosa.load(x, res_type='kaiser_fast')
mfccs_features = librosa.feature.mfcc(y=audio, sr=sample_rate,
n_mfcc=40)
mfccs_scaled_features = np.mean(mfccs_features.T,axis=0)

print(mfccs_scaled_features)
mfccs_scaled_features=mfccs_scaled_features.reshape(1,-1)
print(mfccs_scaled_features)
print(mfccs_scaled_features.shape)
predicted_label=nn.predict(mfccs_scaled_features)
predicted_label=np.argmax(predicted_label,axis=1)
print(predicted_label)
prediction_class = le.inverse_transform(predicted_label)
prediction_class
```

```
[-196.822       113.993126    -13.813408      0.4022098   -20.145586
   -4.7625513   -40.68413       4.171539    -18.973984     -3.0413852
  -19.736597      7.505515    -21.69197      -4.053084    -20.116354
    4.8145556   -14.817319      0.9286656   -14.061541      8.725959
   -6.6515527     6.45562      -4.6819024     0.5490027    -9.6971445
   -0.34578848   -8.687981     -0.67337924   -6.8771744     5.059755
  -10.099091     -0.25963083   -2.8073726     4.441565     -7.439074
   -4.4811225    -1.9385126     3.842505     -5.9479365    -
0.9880176 ]
[[-196.822       113.993126    -13.813408      0.4022098   -20.145586
    -4.7625513   -40.68413       4.171539    -18.973984     -3.0413852
   -19.736597      7.505515    -21.69197      -4.053084    -20.116354
     4.8145556   -14.817319      0.9286656   -14.061541      8.725959
    -6.6515527     6.45562      -4.6819024     0.5490027    -9.6971445
    -0.34578848   -8.687981     -0.67337924   -6.8771744     5.059755
   -10.099091     -0.25963083   -2.8073726     4.441565     -7.439074
    -4.4811225    -1.9385126     3.842505     -5.9479365    -0.9880176
]]
(1, 40)
1/1 [==============================] - 0s 16ms/step
[4]

array(['drilling'], dtype='<U16')
```

```
ipd.Audio(x)
```

```
<IPython.lib.display.Audio object>
```

```
#Testing with random audio data
y='urban/fold10/100648-1-1-0.wav'
audio, sample_rate = librosa.load(y, res_type='kaiser_fast')
mfccs_features = librosa.feature.mfcc(y=audio, sr=sample_rate,
n_mfcc=40)
mfccs_scaled_features = np.mean(mfccs_features.T,axis=0)

print(mfccs_scaled_features)
```

```
mfccs_scaled_features=mfccs_scaled_features.reshape(1,-1)
print(mfccs_scaled_features)
print(mfccs_scaled_features.shape)
predicted_label=nn.predict(mfccs_scaled_features)
predicted_label=np.argmax(predicted_label,axis=1)
print(predicted_label)
prediction_class = le.inverse_transform(predicted_label)
prediction_class
```

```
[-203.38026    110.47649    -27.654587    13.878089   -25.771694
  -11.791375   -24.84813      3.826014   -27.55837      9.07529
  -20.859709     5.4129763  -24.00172      5.662438   -13.73274
   -3.0151746  -14.304382    -1.2490004  -14.489137     3.142862
  -11.586273     3.9236944   -8.836533    -1.4830024   -6.2751427
   -1.2972062   -8.606145     0.5964239   -9.304495     3.5240953
    0.5034145   -2.811972    -2.8778977    5.0855837   -8.883842
   -5.634365     6.706231     2.3156214  -13.47779      3.2116613]
[[-203.38026    110.47649    -27.654587    13.878089   -25.771694
   -11.791375   -24.84813      3.826014   -27.55837      9.07529
   -20.859709     5.4129763  -24.00172      5.662438   -13.73274
    -3.0151746  -14.304382    -1.2490004  -14.489137     3.142862
   -11.586273     3.9236944   -8.836533    -1.4830024   -6.2751427
    -1.2972062   -8.606145     0.5964239   -9.304495     3.5240953
     0.5034145   -2.811972    -2.8778977    5.0855837   -8.883842
    -5.634365     6.706231     2.3156214  -13.47779      3.2116613]]
(1, 40)
1/1 [==============================] - 0s 16ms/step
[1]
```

```
array(['car_horn'], dtype='<U16')
```

```
ipd.Audio(y)
```

```
<IPython.lib.display.Audio object>
```

```
v='urban/fold1/101415-3-0-2.wav'
audio, sample_rate = librosa.load(v, res_type='kaiser_fast')
mfccs_features = librosa.feature.mfcc(y=audio, sr=sample_rate,
n_mfcc=40)
mfccs_scaled_features = np.mean(mfccs_features.T,axis=0)

print(mfccs_scaled_features)
mfccs_scaled_features=mfccs_scaled_features.reshape(1,-1)
print(mfccs_scaled_features)
print(mfccs_scaled_features.shape)
predicted_label=nn.predict(mfccs_scaled_features)
predicted_label=np.argmax(predicted_label,axis=1)
print(predicted_label)
prediction_class = le.inverse_transform(predicted_label)
prediction_class
```

```
[-4.0345078e+02  9.3772453e+01  1.7812963e+01 -1.1735518e+01
 -7.2203588e+00  3.7652965e+00 -1.6174644e+01 -6.8593187e+00
 -1.0542680e+01 -5.1888270e+00  4.1709691e-02 -4.9357162e+00
  9.3806309e-01  1.2813916e+00  4.6511507e-01  6.1276870e+00
  2.8408828e+00  3.2279246e+00 -4.2884707e+00 -3.6228058e+00
 -1.8678902e+00 -3.1442461e+00 -3.5220675e+00 -5.6707931e+00
 -1.8247030e+00 -2.4657447e+00 -2.8244348e+00  7.6615348e-02
 -5.8698922e-01 -1.0786054e-01 -8.9683491e-01 -1.0526063e+00
 -2.6228976e+00 -5.0490838e-01 -1.9731140e+00 -2.9963651e+00
 -3.0717986e+00 -1.4866264e+00 -2.4471817e+00 -2.8644500e+00]
[[-4.0345078e+02  9.3772453e+01  1.7812963e+01 -1.1735518e+01
  -7.2203588e+00  3.7652965e+00 -1.6174644e+01 -6.8593187e+00
  -1.0542680e+01 -5.1888270e+00  4.1709691e-02 -4.9357162e+00
   9.3806309e-01  1.2813916e+00  4.6511507e-01  6.1276870e+00
   2.8408828e+00  3.2279246e+00 -4.2884707e+00 -3.6228058e+00
  -1.8678902e+00 -3.1442461e+00 -3.5220675e+00 -5.6707931e+00
  -1.8247030e+00 -2.4657447e+00 -2.8244348e+00  7.6615348e-02
  -5.8698922e-01 -1.0786054e-01 -8.9683491e-01 -1.0526063e+00
  -2.6228976e+00 -5.0490838e-01 -1.9731140e+00 -2.9963651e+00
  -3.0717986e+00 -1.4866264e+00 -2.4471817e+00 -2.8644500e+00]]
(1, 40)
1/1 [==============================] - 0s 0s/step
[3]
```

```
array(['dog_bark'], dtype='<U16')
```

```
ipd.Audio(v)
```

```
<IPython.lib.display.Audio object>
```