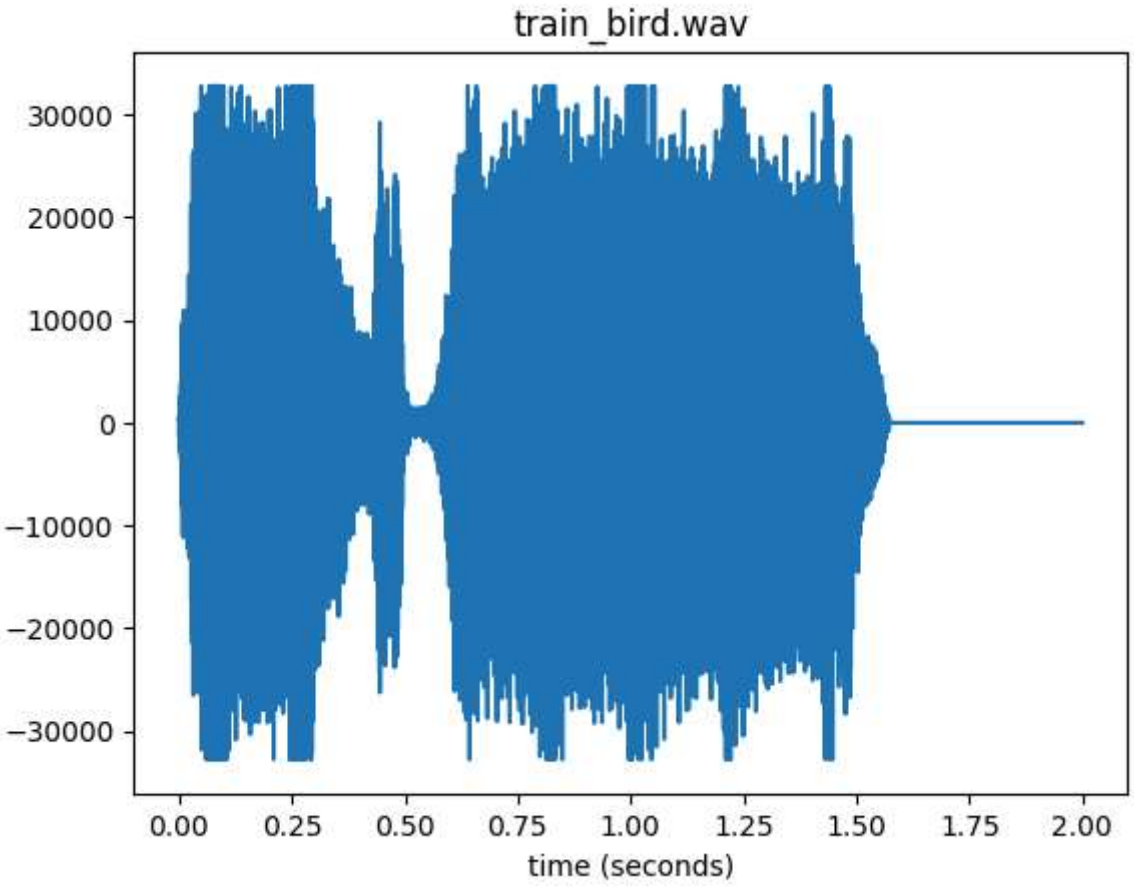
In [216…
```
from IPython.display import Audio
import scipy.io.wavfile
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
Fs, y = scipy.io.wavfile.read('train_bird.wav')
Audio(y, rate=Fs)
```

Out[216…

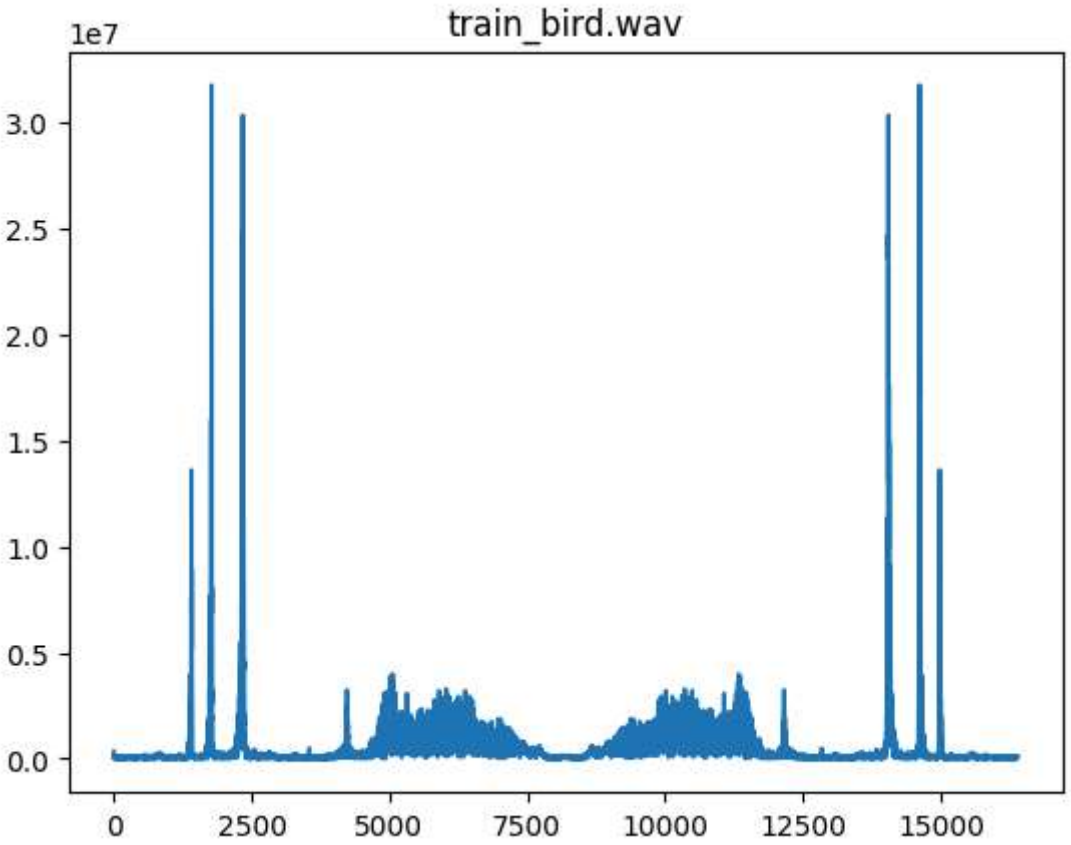
In [217…
```
seconds=2
N = seconds * Fs
t = np.arange(N)/Fs
y = np.pad(y, (0, N - len(y)), 'constant', constant_values=(0, 0))

plt.plot(t, y)
plt.xlabel('time (seconds)')
plt.title('train_bird.wav')
plt.show()
```



In [218…
```
f = np.arange(N) / N * 2 * Fs
Y = scipy.fft.fft(y)
plt.plot(f, np.abs(Y))
```

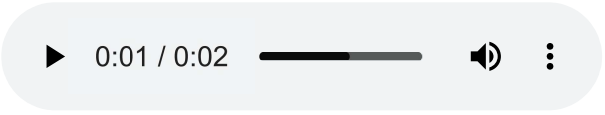
```
plt.title('train_bird.wav')
plt.show()
```



In [219…

```
# Low pass filter
Q = np.ones_like(Y)
for i in range(4500, 10000):
    Q[i] = 0
    Q[-i] = 0
Y_LP = Y * Q
y_filtered = np.real(scipy.fft.ifft(Y_LP))
Audio(y_filtered, rate=Fs)
```

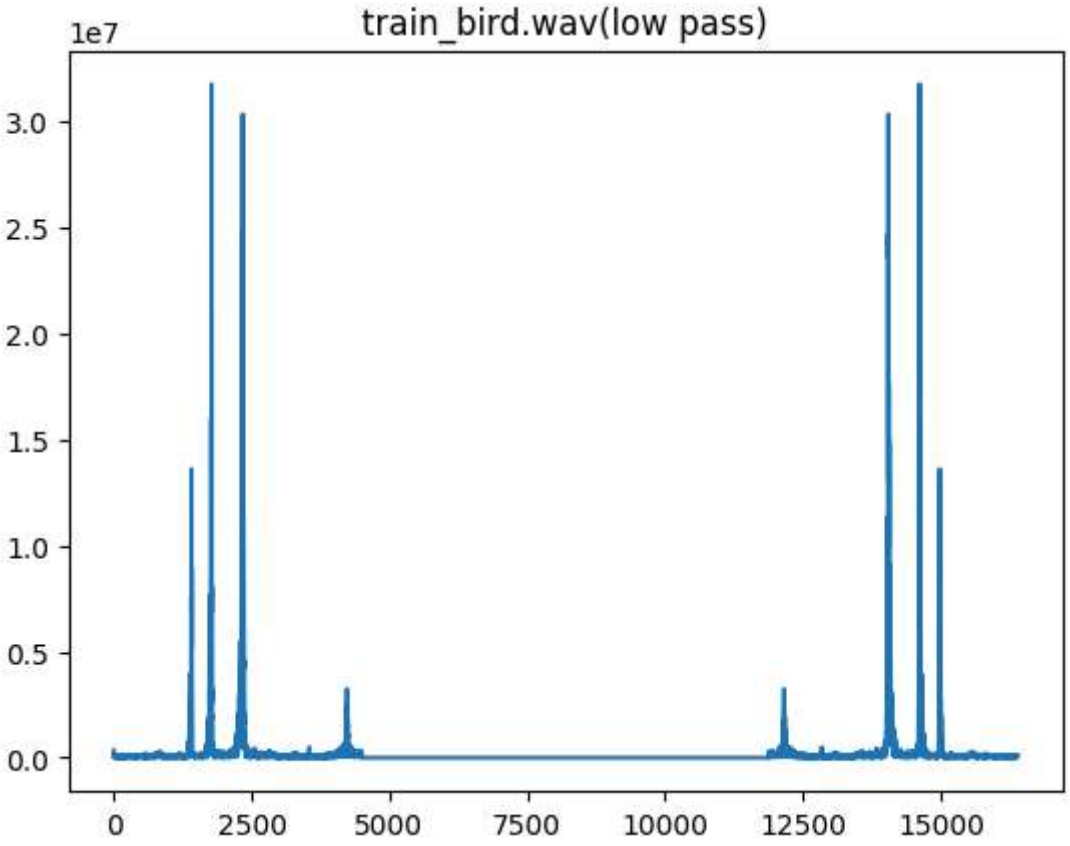
Out[219…

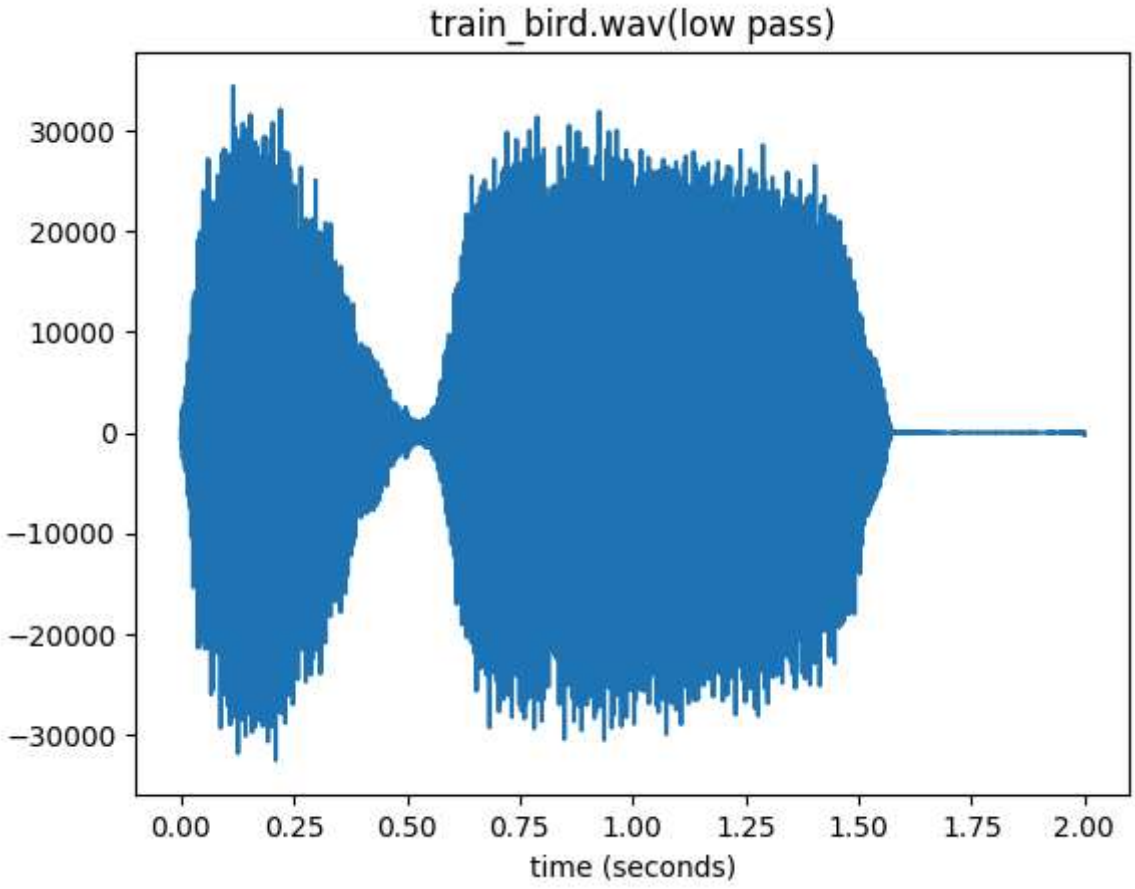


In [220…

```
Y_LP = scipy.fft.fft(y_filtered)
plt.plot(f, np.abs(Y_LP))
plt.title('train_bird.wav(low pass)')
plt.show()

plt.plot(t, y_filtered)
plt.xlabel('time (seconds)')
plt.title('train_bird.wav(low pass)')
plt.show()
```





In [221…

```
# High pass filter
Q = np.ones_like(Y)
```

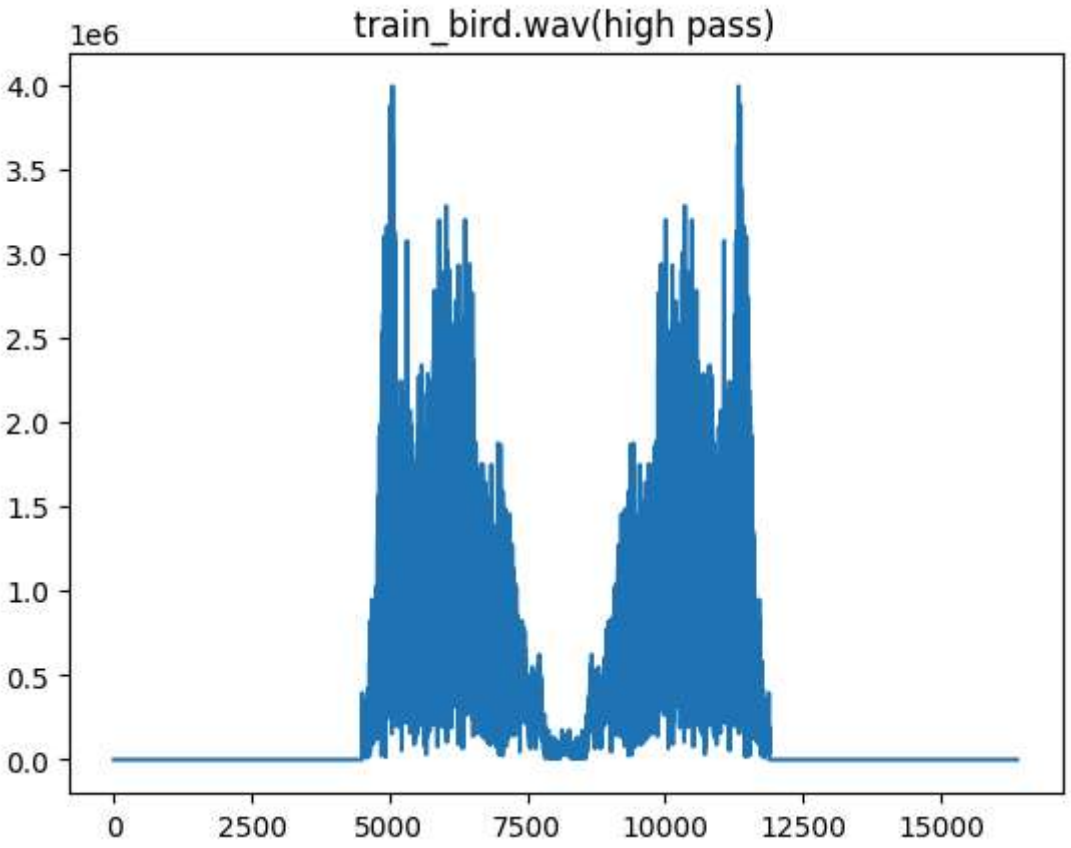
```
for i in range(0, 4500):
    Q[i] = 0
    Q[-i] = 0
Y_HP = Y * Q
y_filtered = np.real(scipy.fft.ifft(Y_HP))
Audio(y_filtered, rate=Fs)
```

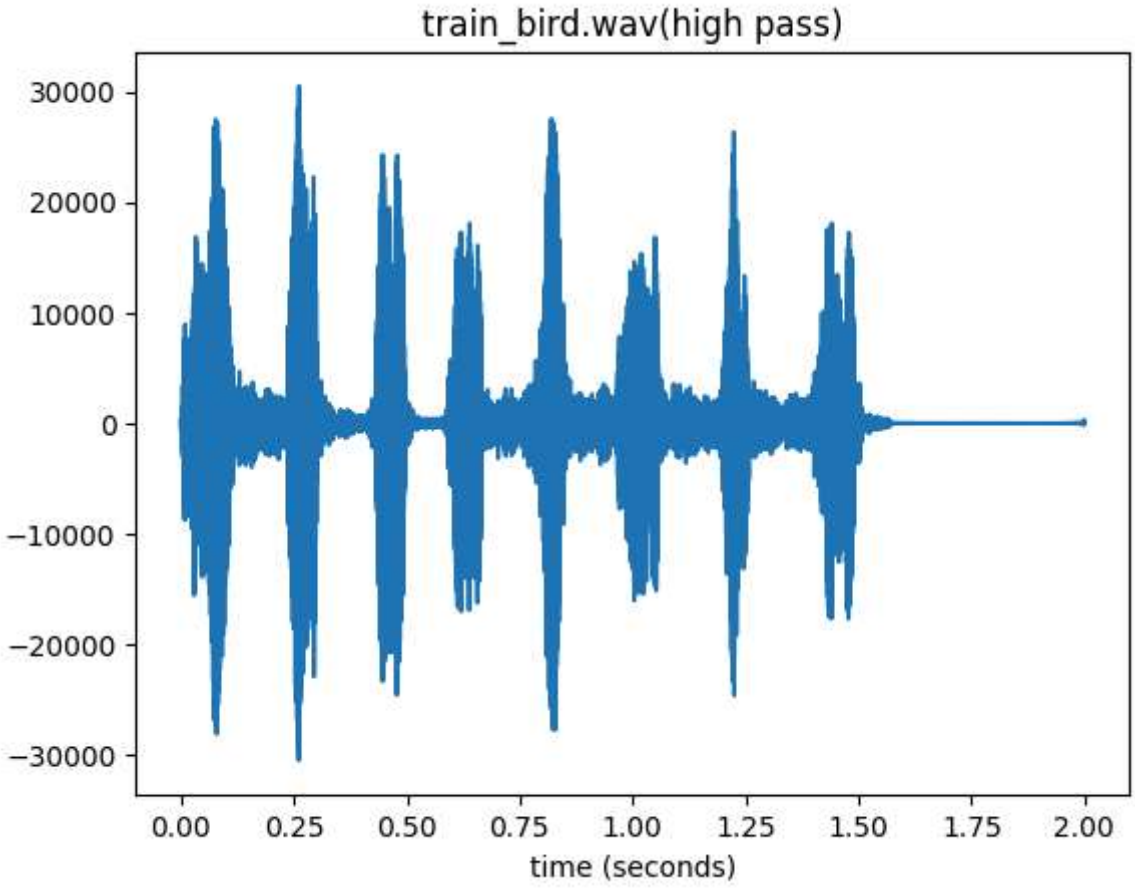
Out[221…

In [222…

```
Y_HP = scipy.fft.fft(y_filtered)
plt.plot(f, np.abs(Y_HP))
plt.title('train_bird.wav(high pass)')
plt.show()

plt.plot(t, y_filtered)
plt.xlabel('time (seconds)')
plt.title('train_bird.wav(high pass)')
plt.show()
```




train_bird.wav(high pass)
30000
20000
10000
0
−10000
−20000
−30000
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
time (seconds)