r2knowle_a4q5

March 19, 2023

1 A4-Q5: Audio Enhancing

```python
[44]: import numpy as np
      import matplotlib.pyplot as plt
      import scipy.io.wavfile
      from IPython.display import Audio
```

```python
[45]: # Load the audio recording
      Omega, f = scipy.io.wavfile.read('recording.wav')
      Audio(f, rate=Omega)
```

```
[45]: <IPython.lib.display.Audio object>
```

```python
[46]: # Some useful values
      N = len(f)      # total number of samples
      L = N / Omega # length of sound clip (in seconds)
      t = np.arange(0,N) * L/N  # array of time stamps for samples
```

```python
[47]: # Corresponding array of sampled frequencies
      omega = np.fft.fftshift(np.arange(-N/2, N/2)) / L
```
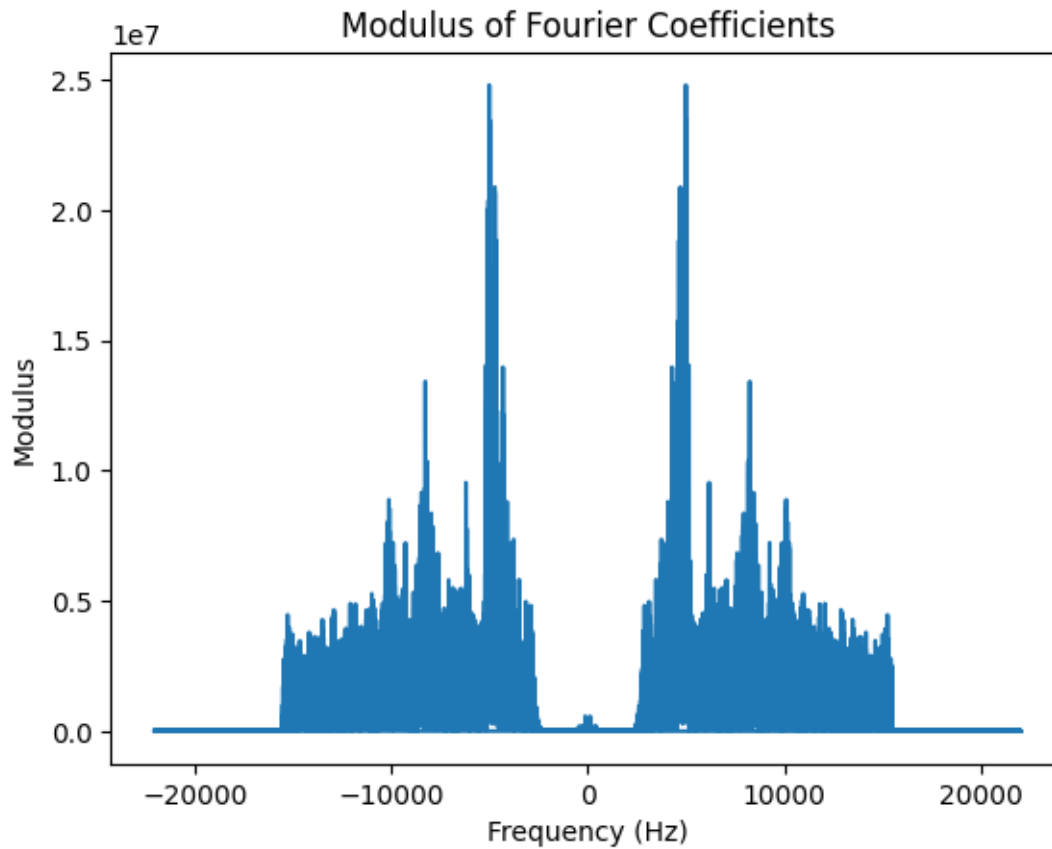
```python
[48]: plt.plot(t, f)
      plt.title('Sound')
      plt.xlabel('Time (seconds)')
      plt.ylabel('Amplitude');
```
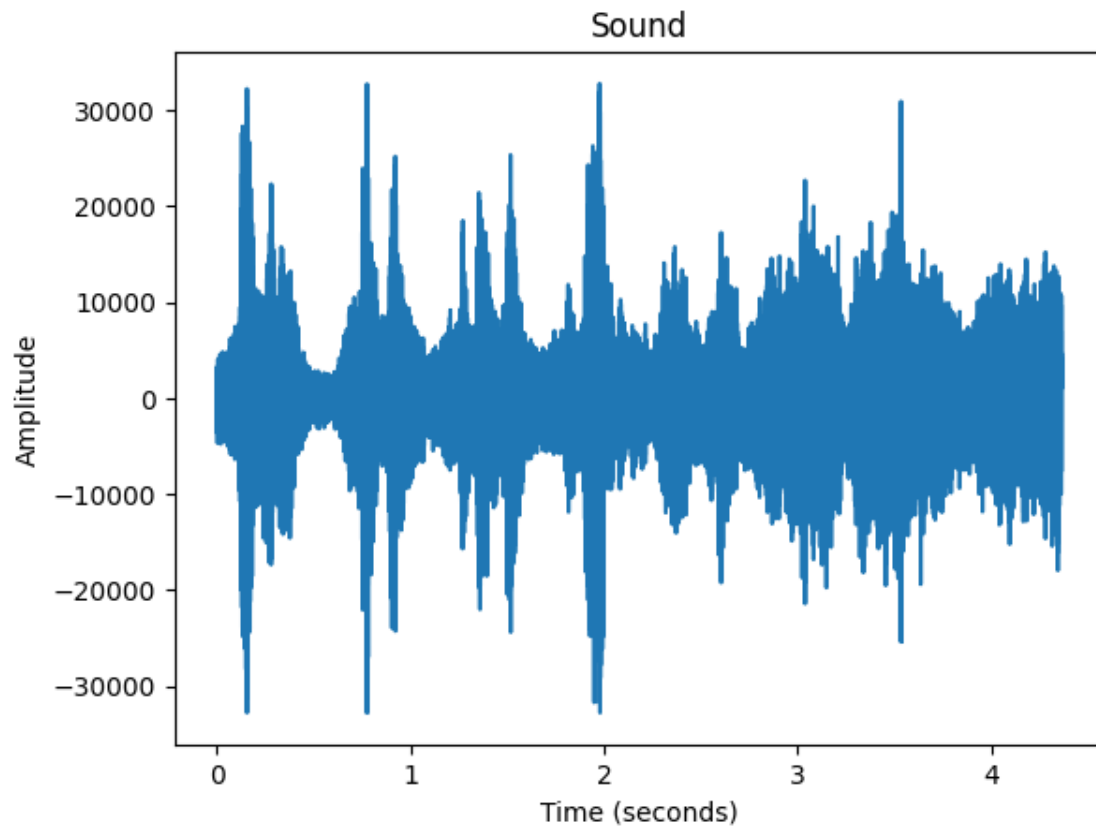
1.1 (a)

```
[49]: coeffs = np.fft.fft(f)
```

```
[50]: plt.plot(omega, np.abs(coeffs))
      plt.title('Modulus of Fourier Coefficients')
      plt.xlabel('Frequency (Hz)')
      plt.ylabel('Modulus');
```

1.2 (b)

```
[119]: threshold = 4000
       filteredCoeffs = coeffs.copy();
       for x in range(0, N):
           if (np.abs(omega[x]) > threshold):
               filteredCoeffs[x] = 0;
```
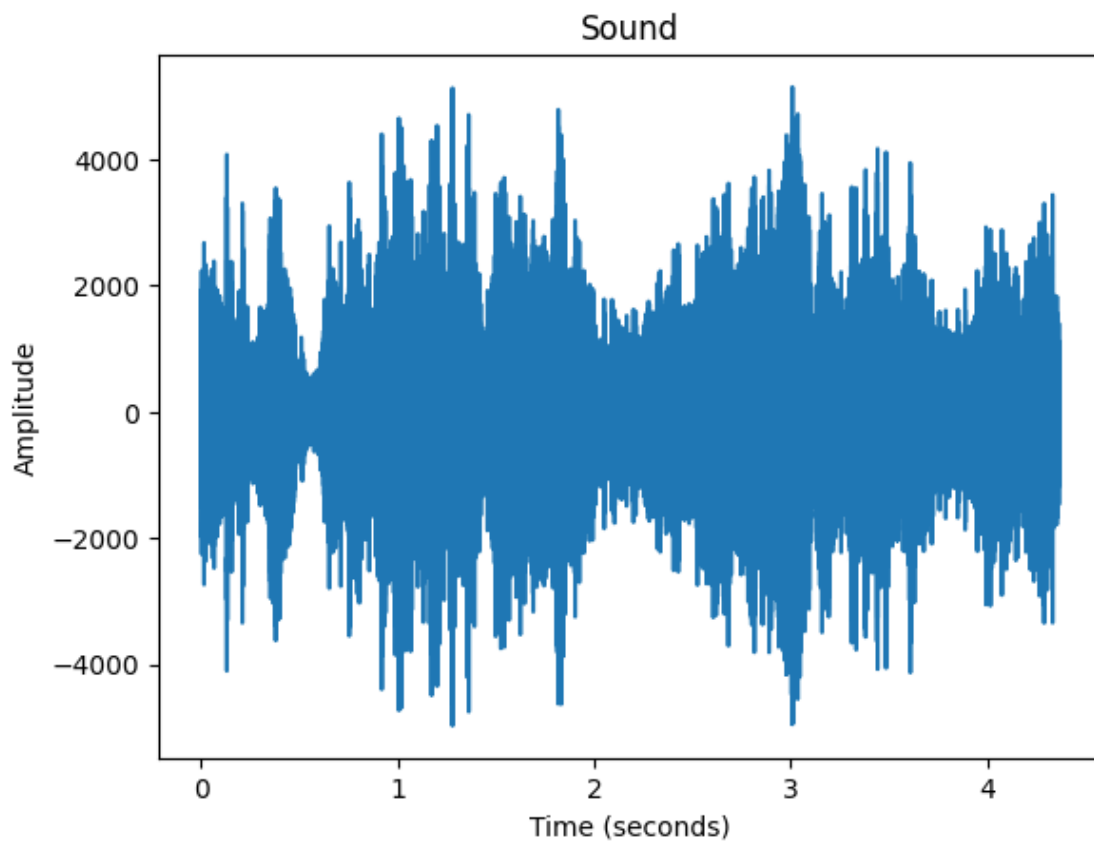
```
[120]: plt.plot(omega, np.abs(filteredCoeffs))
       plt.title('Modulus of Fourier Coefficients (after filter)')
       plt.xlabel('Frequency (Hz)')
       plt.ylabel('Modulus');
```
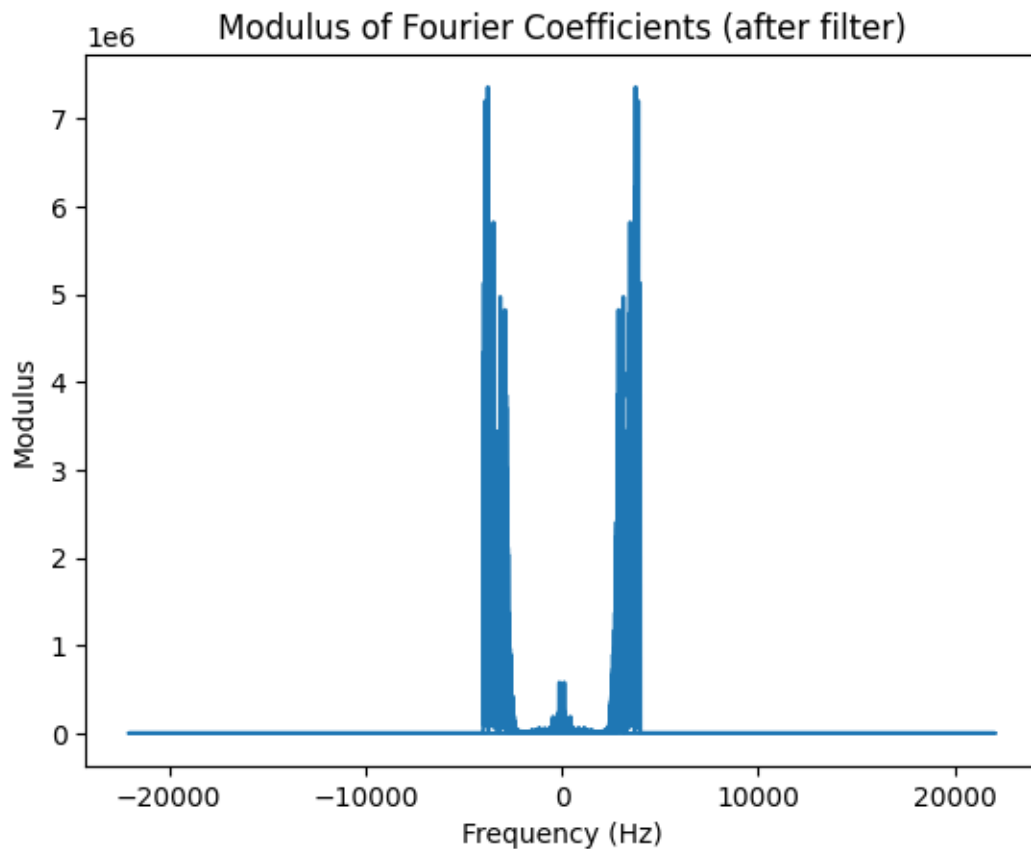
1.3 (c)

```
[121]: ReconstructedAudio = np.fft.ifft(filteredCoeffs)
```

```
[122]: plt.plot(t, ReconstructedAudio)
       plt.title('Sound')
       plt.xlabel('Time (seconds)')
       plt.ylabel('Amplitude');
```

Sound

[123]: Audio(ReconstructedAudio, rate=Omega)

[123]: <IPython.lib.display.Audio object>

[118]: Audio(f, rate=Omega)

[118]: <IPython.lib.display.Audio object>

1.4 (d)

He said: "Robert, hes dead. I killed him". Which seems like an odd thing to say to his dentist?