Music Synthesis

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Note: Each box is worth 1pt.

2. Build some chords and listen

- *Write down your last line of code from* `get_freq`.

f= **(semitone_mult^semitone_jump)*middle_A_freq;**

- *What is the frequency of key number 9?*

207.6523Hz Hz

- *Write down the line of code inside the for loop in* `get_chord_wave`.

X = X + **get_wave(notes{i, 1}, notes{i, 2}, duration, fs);**

3. Visualize frequency of recorded and synthesized sounds

- *What* differences *do you notice between the time domain plots of the real and synthesized signals?*

There are several differences:

Firstly, the real signal decays very quickly, almost exponentially, as time increases, while the synthesized signal is periodic and does not decay.
This is most likely because there is friction in real life.

Lastly, the relative absolute magnitudes of the two signals are very different. The synthesized signal has a much greater amplitude, while the real signal, even at the beginning when it's greatest, is still lower than the synthesized one. This difference is also most likely caused by friction. In real life, getting the string to vibrate probably has some resistance, and as a result, it is much harder to vibrate.

- *What* similarities *do you notice between the frequency domain plots of the real and synthesized signals?*

Both graphs (synthesized and real) of a given chord share the fact that there are three spikes on the graph, which correspond to the fundamental frequencies that make up that chord. For all other frequencies,
the magnitude is either low (if it's a multiple of one of the fundamental frequencies) or just 0 as in the synthesized graph.

- What differences do you notice between the frequency *domain plots?*

Firstly, the synthesized signals have much higher magnitudes on the graph compared to the real signals. This is most likely due to friction in real life.

Secondly, the main difference is that all the frequencies present on the synthesized graph are all relatively close (within 1 octave of each other), however, the frequencies on the real signal are all spread out. There are now several additional "bumps" in the graph where multiples of one of the frequencies are present with significantly lower magnitude. These small bumps are the harmonics of the three fundamental frequencies that make the chord. They occur because of the way a physical chord might be pulled/vibrated,

- *What does the spectrogram have in common with your frequency domain C chord plot?*

Both graphs have a spike in magnitude at the three fundamental frequencies. For the spectrogram, this doesn't appear as an actual spike but rather three very red lines, which indicate these three frequencies have a very high (relative) magnitude compared to all other frequencies. On the spectrogram, we can see that as we increase or decrease the frequency away from the three fundamental frequencies, their magnitudes get much lower. Similarly, on the frequency graph, the magnitudes for all other frequencies is very low. Lastly, the spectrogram appears to not vary with time (if we ignore the blue band at t=1s). This means that, for a synthesized chord, the frequencies present stay the same.

4. Synthesize a song

- *Write down your second argument in the call to* `get_chord_wave` *inside* `get_song_wave`.

beat_length*song{i, 2}

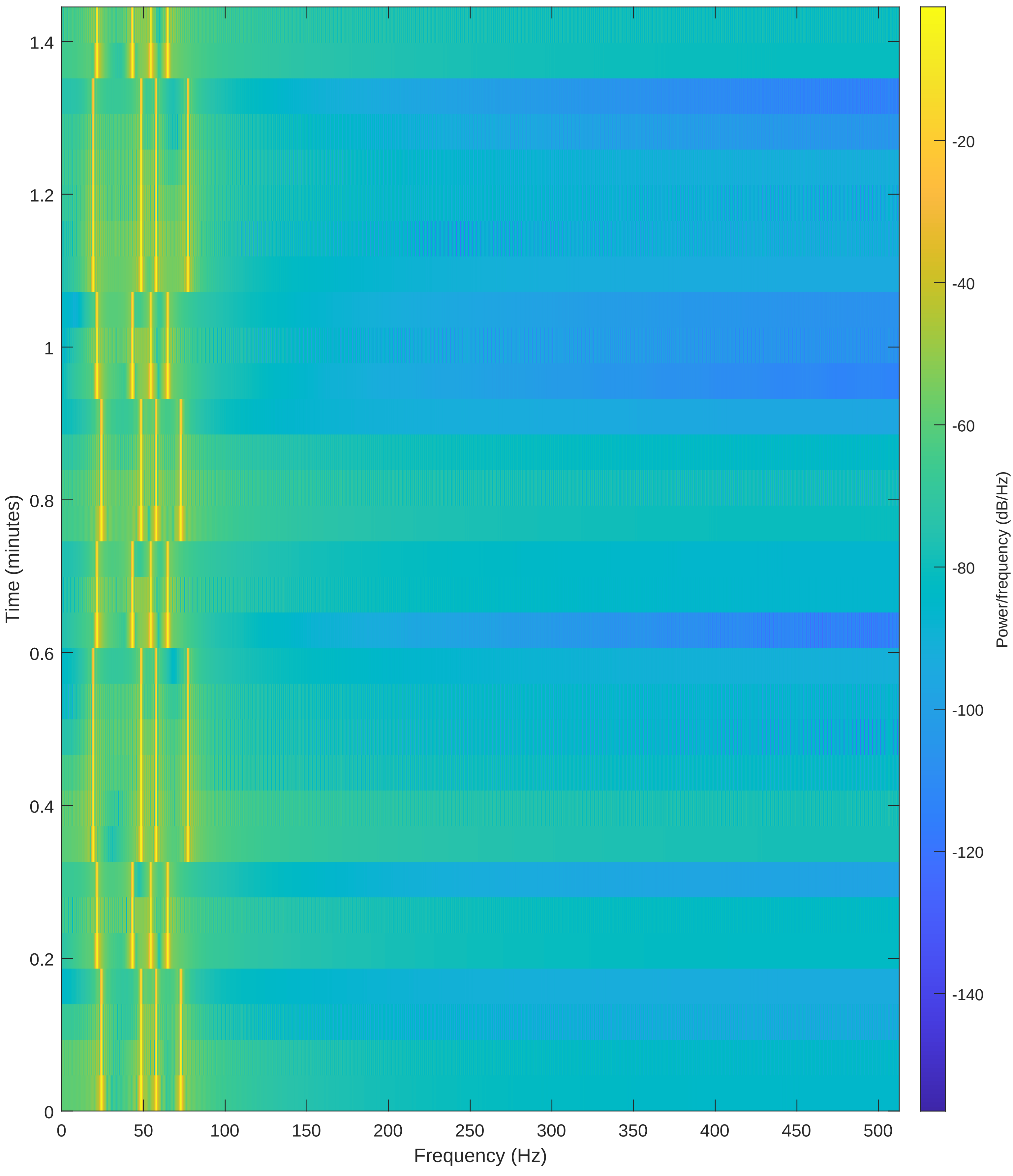
- *Before using the ADSR envelope, use audiowrite to save your song to a file called 'first.wav' with 44100 sampling rate.*

- *Generate the final version of your song and use audiowrite to save your song to a file called 'second.wav' with 44100 sampling rate.*

- *Include the spectrogram plot for your song and attach as the second page to this document.*

Please submit:
*- ***This*** document completed*
- first.wav
- second.wav
- Spectrogram output of second.wav attached to this document

Note: the song is supposed to be Jimi Hendrix' "All Along the Watchtower"



Time (minutes)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Frequency (Hz)
0
50
100
150
200
250
300
350
400
450
500
Power/frequency (dB/Hz)
-20
-40
-60
-80
-100
-120
-140