BLG354E
Homework-1

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- You should write all your code in Python language.
- Cheating is highly discouraged. If you are planning to use different libraries or functions, please ask me about it.

1 (25 pts) - The Radio

Well, the radio has 'pressed concerns about what you did last night
I can't wait to see you come back home
Every Fourier transform has born a thorn on my side
I can't wait to see you come back home

TRHECAWYDLN, Superfamily

I was on the Taurus mountains. Walked a long way from home. Still cannot remember my exact location or the time. I could not remember even the weather that day. My handheld radio was only getting a scratchy sound from Bayrak FM. No matter what was playing on the radio, I was hearing your voice.

bayrakfm.wav has a a song from the radio with a hidden message. The message was hid using the following method.

- Both the song (x) and the message (y) was divided into parts ($x_0, x_1, ..., x_N$ and $y_0, y_1, ..., y_M$) for each second.
- For every x_i&y_i, Fourier transform is done and arrays for frequency domain are obtained ($f(x_i), f(y_i)$).
- Second half of the $f(x_i)$ was replaced with first half of $f(y_i)$.
- The resulting $f(x_i)$ is inversely transformed to time space.

Using the information above, reobtain the message. Use **"librosa.load"** function to load the audio file.

2 (25 pts) - System Simulation

Simulate the system $H(z) = \frac{1-\frac{7}{4}z^{-1}-1/2z^{-2}}{1+\frac{1}{4}z^{-1}-\frac{1}{8}z^{-2}}$ on the hidden message obtained from the first part.

3 (25 pts) - Listen To Your Heart, Closely

Work of the eyes is done, now
go and do heart-work
on all the images imprisoned within you; for you

Turning Point (Wendung), Rainer Maria Rilke

In this part, we will work on a maze game. A screenshot from the game is given in Figure 1.

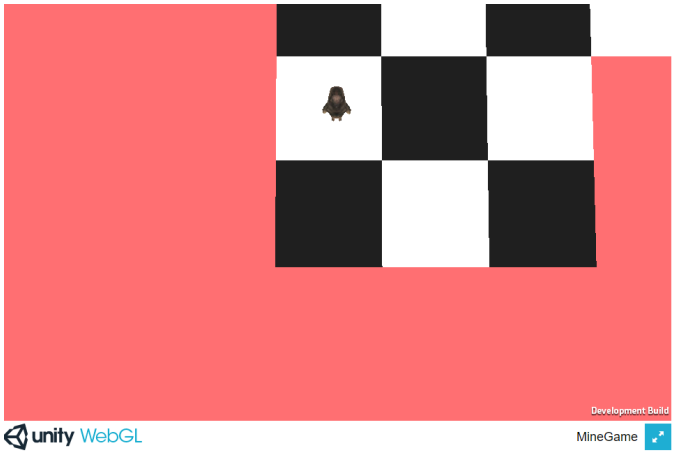

Figure 1: A screen from the game

In this game, we should move a monster along an L-shaped platform. However, some tiles on this platform are mined. To reach our goal, we should listen to the monster's heart. The monster's heartbeat is shaped as a triangle wave if it is in a safe spot. The heartbeat changes into a square wave if it is close to a mined tile. To be specific, being close to a mined tile by the 1/6 of the tile distance is necessary to change the beat. Example heartbeat signals are given in Figure 2. These signals are hard to hear. However, by recording them using Python, you can examine them.

The first library we will benefit in this part is **soundcard**. Using soundcard library, we can capture the computer's system audio. Thus, we can decide on the monster's path according to the captured signal. An example usage of the library is given below.

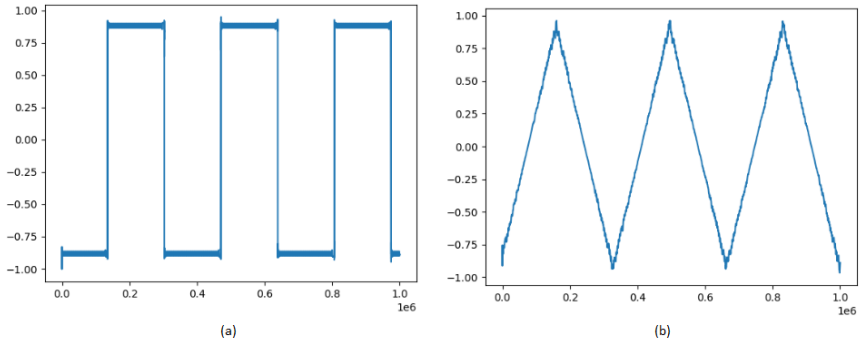

Figure 2: Heartbeats of the monster. (a) Safe, (b) In danger.

```python
import soundcard as sc

mics = sc.all_microphones(include_loopback=True)
default_mic = mics[1]   #this value could be changed according to your default audio output.

with default_mic.recorder(samplerate=148000) as mic:
    data = mic.record(numframes=1000000)
```

Another useful library for this homework is **pyautogui**, which is used to simulate mouse and keyboard interactions with Python. The example script given below clicks random keyboard buttons.

```python
import pyautogui

pyautogui.keyDown('shift')

pyautogui.keyDown('w')
time.sleep(1)
pyautogui.keyUp('w')

pyautogui.keyUp('shift')

#pyautogui.keyUp and pyautogui.keyDown functions are used to simulate holding a button. For simple presses, pyautogui.press can be used.
```

You can visit my website[1] for the game. Write a Python script using pyautogui and soundcard libraries to make the monster reach the end of the platform. (It may fall down after winning the game, it's OK.)

[1] https://web.itu.edu.tr/sahinyu/mine_project_web/

4 (25 pts) - Bode Plots

For the transfer functions $H_1(j\omega) = \frac{10(1+j\omega)}{(1+j\omega/10)(1+j\omega/10)}$ and $H_2(s) = \frac{1}{(1+j\omega/10)}$ find the Bode plots. Then, Find the bode plot for the cascade representation of these systems. Explain your results.