Q2 Report

The GUI part is implement using python `tkinter`

File input

- The function `read_wav()` is for file input, which returns a "wav file path".

```
wav_path = filedialog.askopenfilename(initialdir=os.getcwd(),
                                      title="Please select a wav file:")
if wav_path == '':
    exit()
```

  - I use the `filedialog` in tkinter library to ask user to choose an input file.
  - If user open the dialog box but did not choose any file, the program finish

File processing

The function `wav_to_binary()` convert a wav file to binary file, and returns the binary in an array.

- Firstly, the function read the input file and divide it into two parts
  - `header` contains the first 44 bytes in the file, which is the **header of wav file**. It stores the detailed information about the file, such as the file size, audio format, and sample rate, etc.
  - `data` contains the rest of the file, which is the **actual sound data**.
- Then calculate the **number of frames** in the sound file, the calculation method for each type of wav file is:

```
    if header[34] == 16:
        nframes = (int)((wav_length - 44) / 2)
    elif header[34] == 8:
        nframes = wav_length-44
    elif header[34] == 24:
        nframes = (int)((wav_length-44) / 3)
    else:
        print("Sorry, we don't support this file")
        exit()
```

  - `header[34]` indicates the **bits per sample**.
- Next, I put the data in `data` array into array `frames`.
  - Since python does not convert the binary to signed integer automatically, I convert it by the formula:

    ```
    frames[j] = frame[j] - 2^(n-1)
    ```

    where n is the number of bits per sample.

fade in fade out

I use a linear fade in fade out method. Since the vertical axies indicate the voltage of the sound, the faded sound is calculate by multiply a factor with the original data.

- for the first half of the samples, it is faded in, every frame multiple $i/middle$ with i increase in a linear speed:

```
    for i in range(middle):
        faded_frames[i] = frames[i]*i/middle
```

- for the second half of samples, it is faded out, every frames multiple $(len(frames) - i)/middle$ with i increase in a linear speed:

```
    for i in range(middle, len(frames)):
        faded_frames[i] = frames[i]*(len(frames)-i)/middle
```

Display the output waveform

The function `plot_frames()` use a tkinter widget `Canvas` to show the sound wave.

- First draw the axies:
  - x-axies with scale on it, the scale is depend on the length of the sound file.

```
canvas.create_line(50,480, 790,480, fill="white", arrow=LAST) # x
x_range = int(time * 10 + 2)
for i in range(1,x_range):
    x = i*700/x_range
    canvas.create_line(x+x0, 480, x+x0, 475, fill="white")
    canvas.create_text(x+x0, 490, fill="white",
text=str(round(0.1*i,1)))
canvas.create_text(780, 490, fill="white", text="time")
```

- Then draw the y-axies:
  - y-axis with scale on it, the scale is depend on the maximum value in the samples. Different sample rates use different scale.

```
canvas.create_line(50,480, 50,10, fill="white", arrow=LAST) # y
for i in range(start, end, step):
    y = (i/step) * 60
    canvas.create_line(x0, y+y0, x0+5, y+y0, fill="white")
    canvas.create_text(x0-25, y+y0, fill="white", text=str(-i))
```

    where `start`, `end`, `step` are different in different sample size.

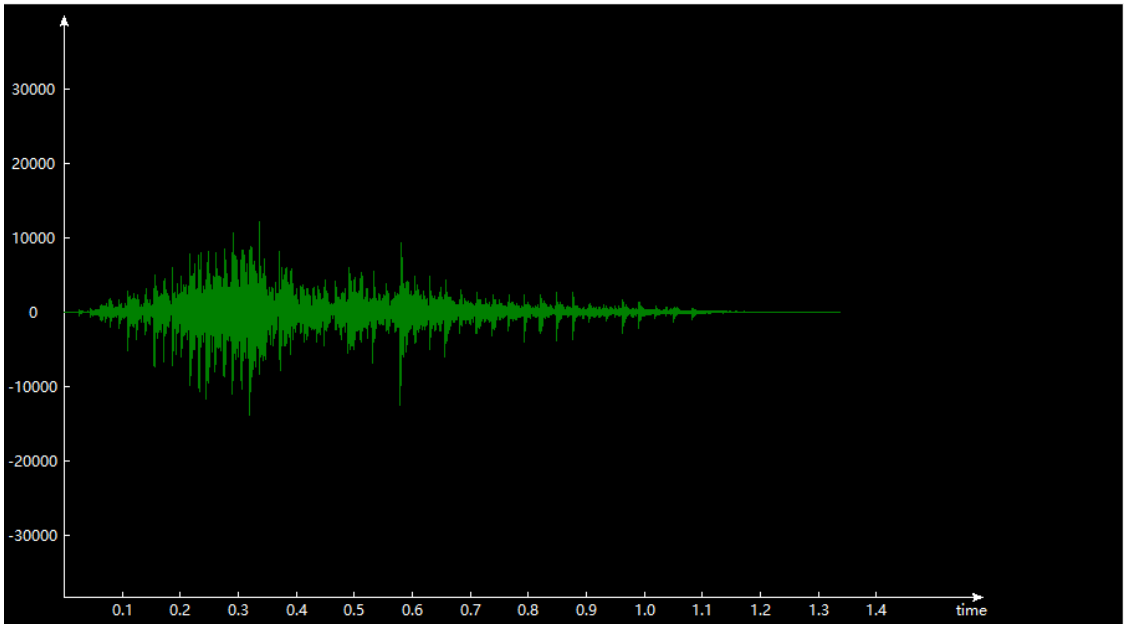
- Calculate the frame's position for each frame and draw it on `canvas`
  - calculate x:

```
 x = x0 + 10 * 700/x_range * (t * sample_time)
```

  - calculate y:

```
y = (y0-faded_frames[t]/step*60)
```

- Sample screenshot

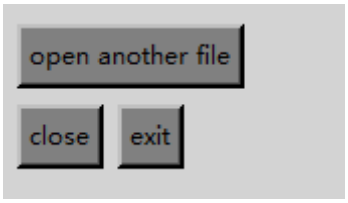


Display information

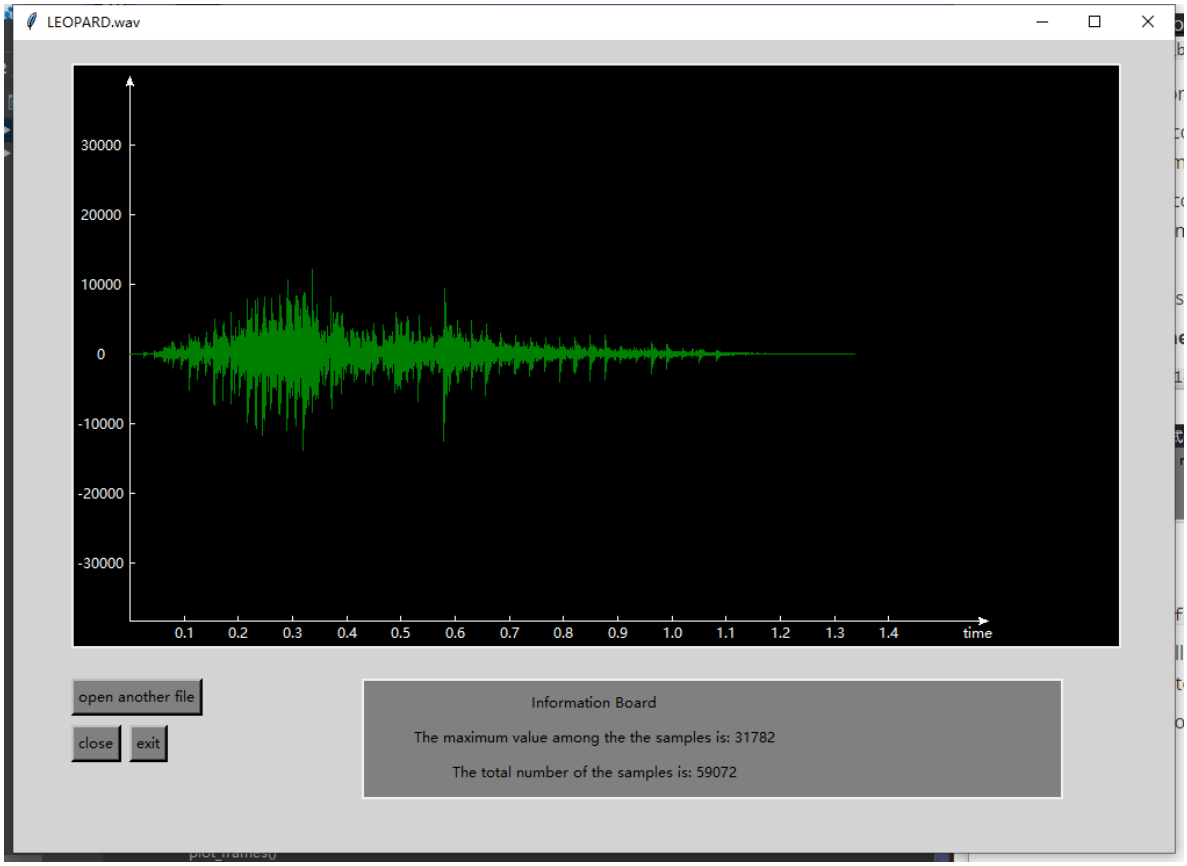
`info_frame` is an area to show the information required.

Buttons

- `open another file` button allows user to open another file and processing it.
- `close` button allows user to close the GUI window. Be caution that it only destroy the GUI window, but not terminate the program.
- `exit` button allows user to terminate the program.



The whole window display:


LEOPARD.wav
30000
20000
10000
0
-10000
-20000
-30000
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
time
open another file
close
exit
Information Board
The maximum value among the the samples is: 31782
The total number of the samples is: 59072