

A9 – Playing Notes by Image Processing

Introduction

In this activity, you will try to extract musical notes from a digitized score sheet and play these notes in Scilab, Matlab or Python with the proper frequency and duration. This is an activity where you need to integrate everything you've learned in class.

Do you know that you can make Scilab “sing”? Try out these lines:

```
function n = note(f, t)
    n = sin (2*pi*f*t);
endfunction;

C = 261.63*2;
D = 293.66*2;
E = 329.63*2
t=soundsec(0.25);

s = [note(E,t), note(D,t),note(C,t), note(D,t),
note(E,t) note(E,t) note(E,t)];
sound(s);
```

In Matlab

```
t = [0:1/9000:0.25];
note = @(f) sin(2*pi*f*t);
C = 261.63*2;
D = 293.66*2;
E = 329.63*2;
s = [note(C), note(D),note(E)];
sound(s);
```

In Python you can use

```
import winsound

frequency = 2500 # Set Frequency To 2500 Hertz

duration = 1000 # Set Duration To 1000 ms == 1
second

winsound.Beep(frequency, duration)
```

In musical notation, notes are written on a five-lined staff. Each space and line on the staff represents one note in a heptatonic (7-note) scale. Do-re-mi-fa-sol-la-ti is represented by the letters C-D-E-F-G-A-B, respectively (Figure 1).

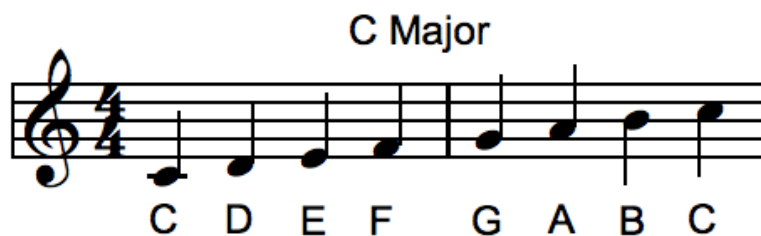


Figure 1: C-Major Scale (image from <http://www.piano-lessons-made-simple.com/images/notes.png>)

Each of these notes have specific sound wave frequencies which you can find in the Handbook of Engineering or even in the web (see for example <http://www.phy.mtu.edu/~suits/notefreqs.html>).

Different note symbols have different durations. Scilab can be made to generate a sinusoidal wave with a certain frequency and duration which can be passed to the computer's speaker to create sound. Any air vibration between 20Hz and 22 kHz is audible to humans.

Procedure

1. Look for a simple musical score sheet image on the web (no sharps or flats, but if you are up to the challenge, go ahead). Alternatively, you may digitally scan a score from a music book. A simple score will have only one note along the same column.
2. Use all the image processing skills you've learned to determine the notes and their duration in the score.
3. Check if you got them correctly by playing the tune in the score sheet.

4. Bonus: for added fidelity:

- a) modulate the amplitude of each note by multiplying its sinusoid with a sound envelope
(https://www.image-line.com/support/FLHelp/html/glossary_envelope.htm)
- b) figure out how to put rests in the sound matrix.