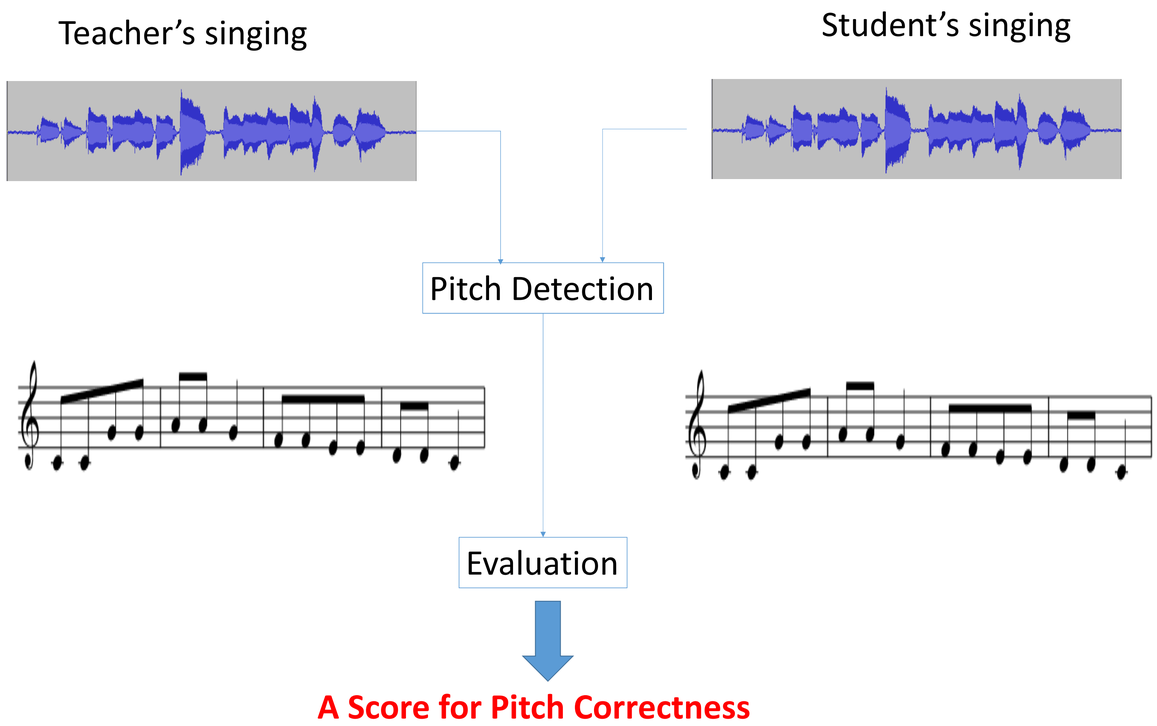
Pitch Detection
in Singing Evaluation (Scoring, 採点) in Karaoke
using Pyaudio, Pygame and VPython

00. Introduction

Pitch detection in human singing signal has a popular application in a KaraOke machine with scoring function.
(eg.**精密採点 in** カラオケ@DAM)

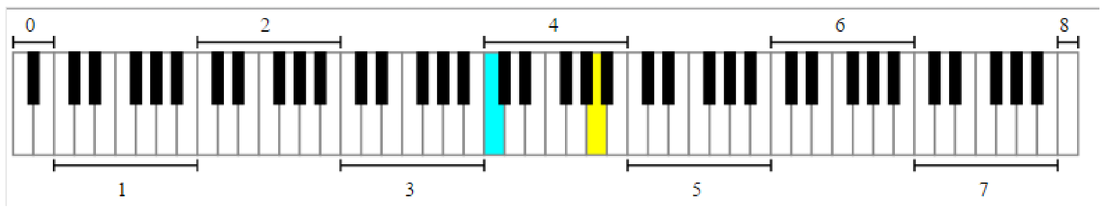
01. Task Definition



02. Fundamental music theory

- A frequency of 440 Hz was recommended as the standard pitch for Concert A tone.
[https://en.wikipedia.org/wiki/Music_theory]
- the frequency *f* of the n^{th} key, where A440 is the 49th key (the yellow key) on the idealized piano

$$f(n) = 2^{\frac{n-49}{12}} \times 440\,\mathrm{Hz}$$



03. Kernel code for Pitch Detection

https://gist.github.com/endolith/255291

- It estimated fundamental frequency using autocorrelation method in spectrum domain.
- Although there were some bugs in this gist, it helped me to have a good start points.

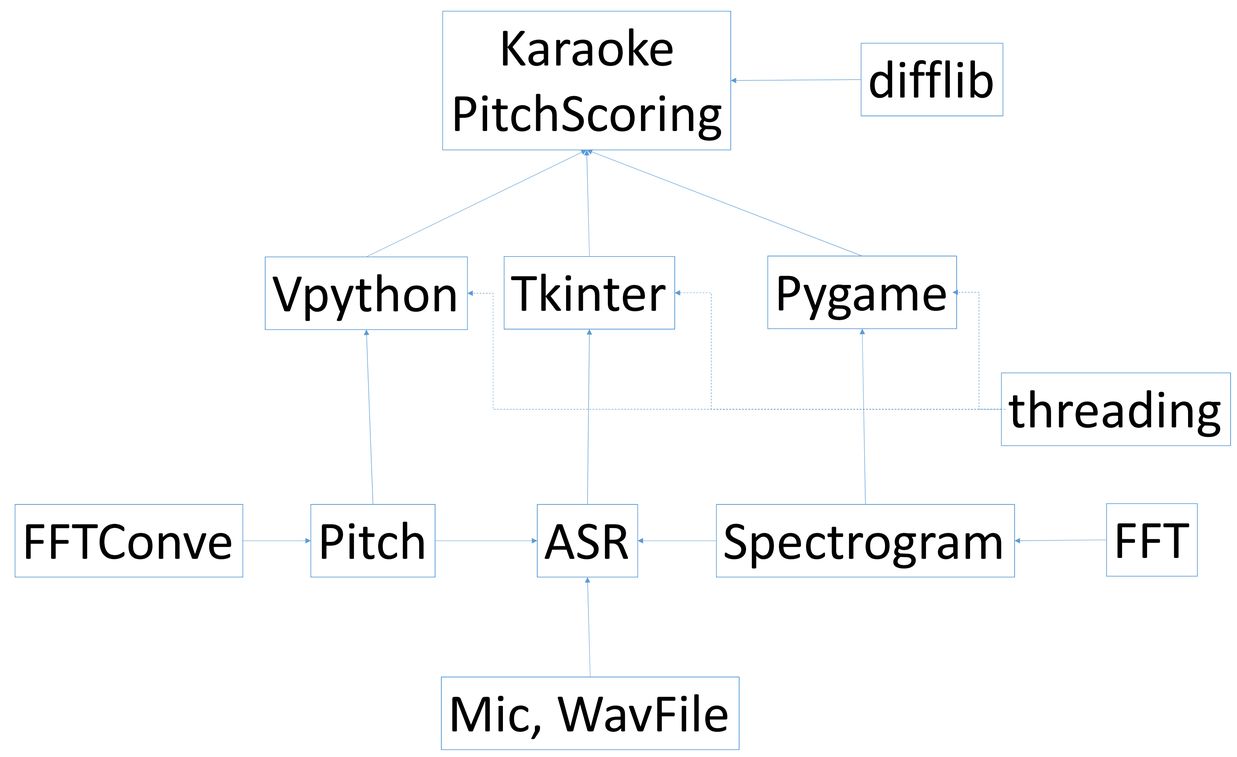
04. The Evaluation/Scoring method

- Sequence comparison based on dynamic programming
- Deal with the insertion, and deletion types of error

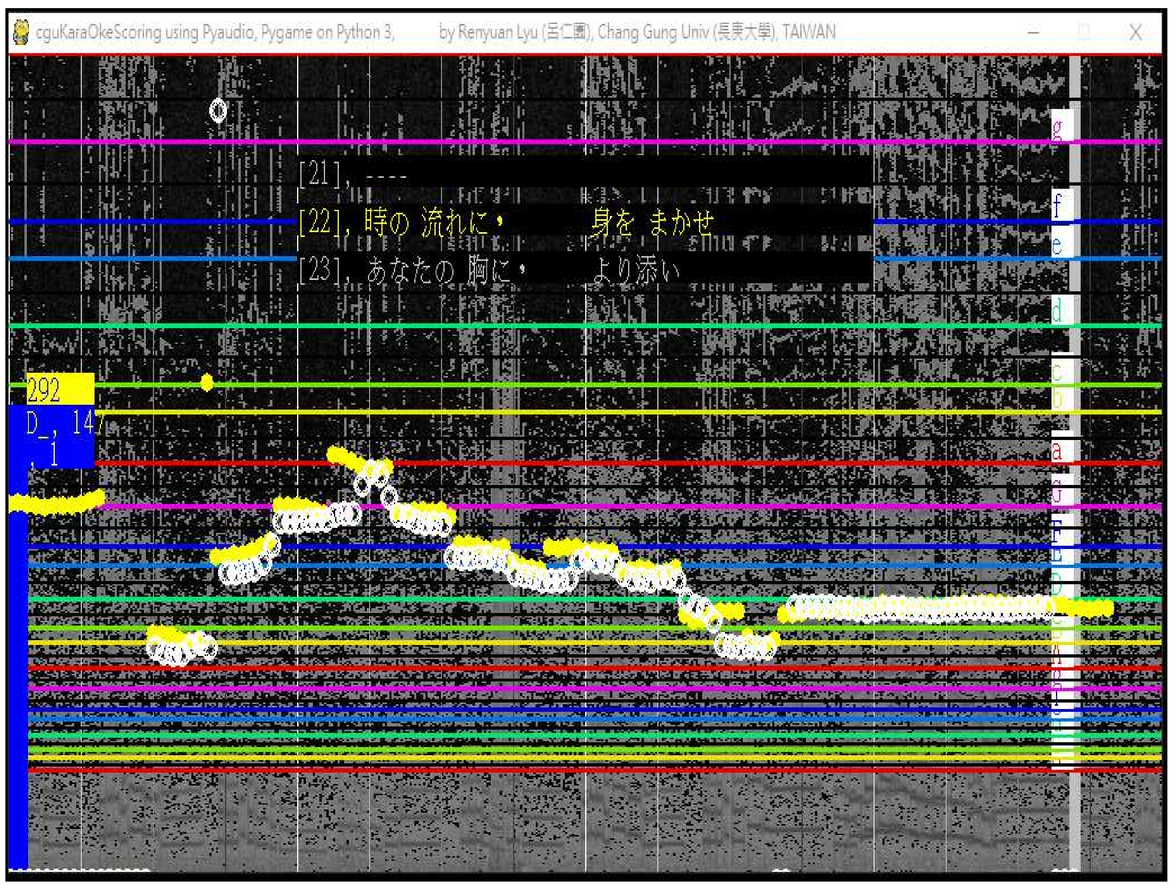
```
import difflib

sm= difflib.SequenceMatcher()
x= [69, 70, 71, 72]
y= [69, 70, 80, 71, 72]
sm.set_seqs(x,y)

r=  sm.ratio()
mb= sm.get_matching_blocks()
op= sm.get_opcodes()

r, mb, op
```

```
r == 0.89,
mb== [
      Match(a=0, b=0, size=2),
      Match(a=2, b=3, size=2),
      Match(a=4, b=5,
      size=0)],
op=[
      ('equal', 0, 2, 0, 2),
      ('insert', 2, 2, 2, 3),
      ('equal', 2, 4, 3, 5)])
```

05. The Modules



06. Prototype



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