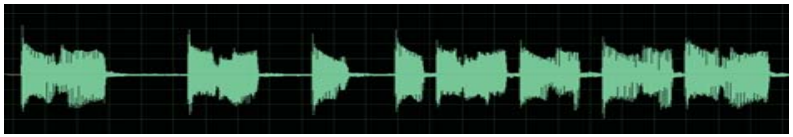
Homework #1

Homework

- **목표 : music 신호의 기본 주파수를 검출하여 note 인식**
  - Melody 인식기 또는 speech pitch 인식기
- **문제 : "input16k.raw"의 총 8개의 note에 대하여, 각 note에 해당하는 신호의 스펙트럼을 구하고, 각 note 인식**

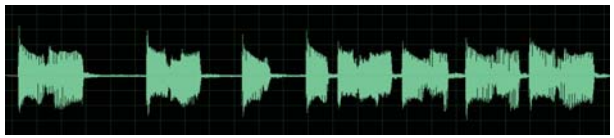


Tool

- **Goldwave 사용하여 waveform display와 sound play**
  - www.goldwave.com 에서 evaluation version down
- **File format**
  - 16kHz sampling, PCM signed 16-bit, little endian mono

Binary File Input

- **한 sample 값이 16-bit integer로 표현**
- **File pointer** File *fin;
- **File open** fopen_s(&fin,"input16k.raw", "rb"); // input binary file
- **Data read** short data;
  fread(&data, 2, 1, fin); data ← x[n]



input16k.raw

16 bits

x[0]
x[1]
x[2]
...

Sample Code

```
#include <stdio.h>
#include <math.h>
#define   N  1600

main()
{
        int         i;   // note index
        float       note_freq[8] = {0.0,};
        int         skip[8] = {xx, xx, ...};
        FILE        *fin;

        fopen_s(&fin,“input16kraw", "rb");

        for(i=0;i<8;i++) {
           ……
           note_freq[i]  = ……..;
        }
        _fcloseall();
}
```

0.1sec, 1600 samples

Sample Code

```
{
        float       signal[N], spec_real[N], spec_imag[N], spec_mag[N], freq;
        short       data;
        int         n;

        // skip to the start
        for(n=0;n<skip[i];n++ )
            fread(&data, 2, 1, fin);

        // read data
        for(n=0;n<N;n++ ) {
            fread(&data, 2, 1, fin);
            signal[n] = (float)data; // input array
        }

        // windowing -> N-point DFT -> peak magnitude -> freq (Hz)
        ……
        ……
}
```

DFT

- N-point DFT 구현
  - FFT 대신에 DFT 공식을 그대로 programming
  - Real과 imaginary 별로 summation 구현

$$X[k] = \sum_{n=0}^{N-1} x[n] e^{-j\frac{2\pi}{N}kn}, \qquad 0 \le k < N$$

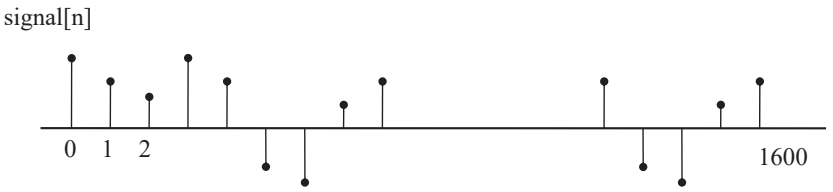
$$X_{real}[k] = \sum_{n=0}^{N-1} x[n]\cos(\frac{2\pi}{N}kn)$$

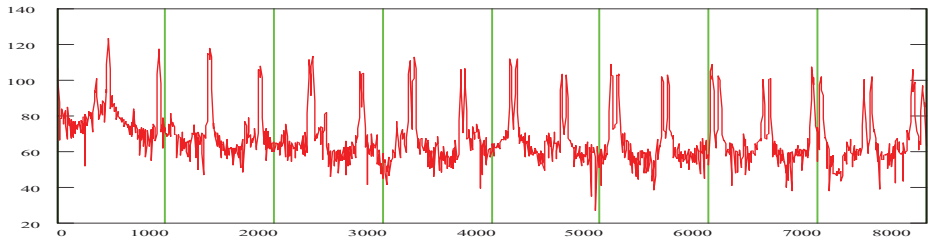
$$X_{imag}[k] = -\sum_{n=0}^{N-1} x[n]\sin(\frac{2\pi}{N}kn)$$

spectrum magnitude

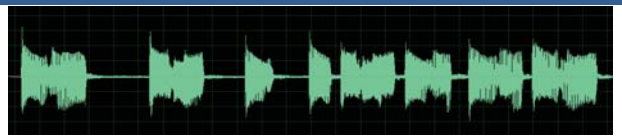
$$|X[k]|^2 = |X_{real}[k]|^2 + \left|X_{imag}[k]\right|^2$$

DFT

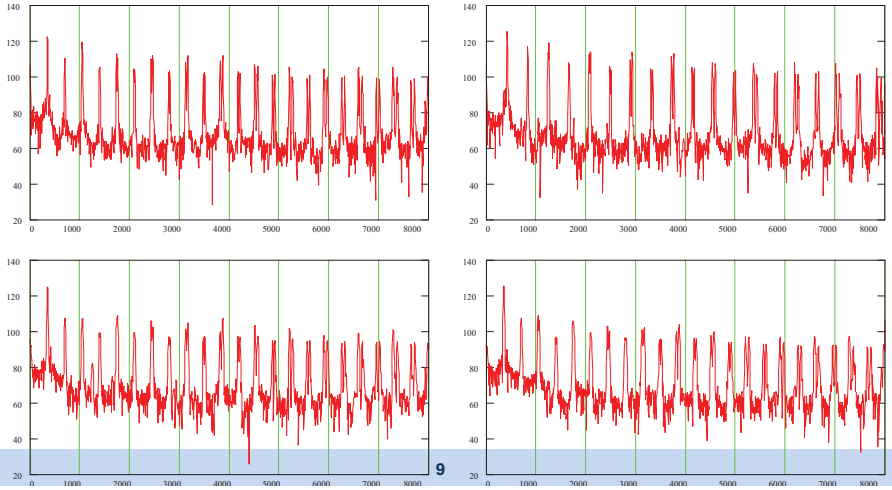




Solution

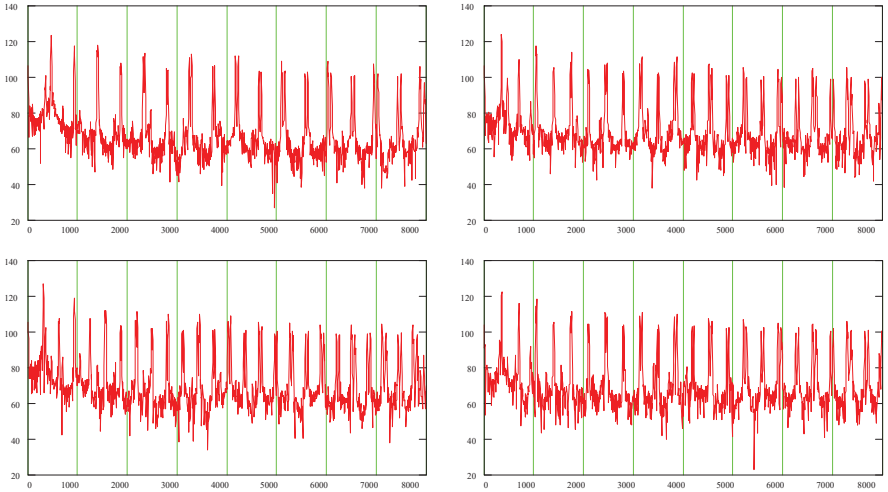


note#1 ~ note#4

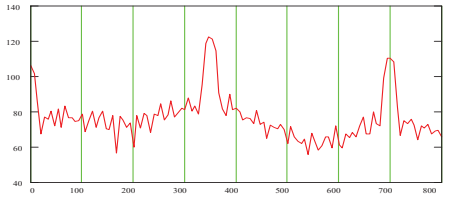


Solution

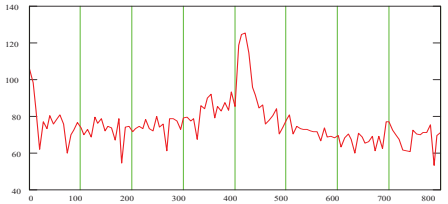
note#5 ~ note#8



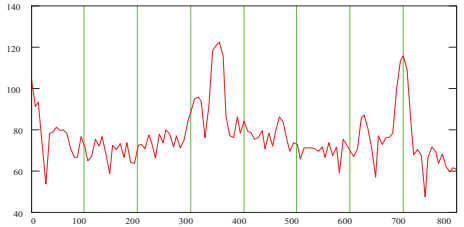
Solution



note #1

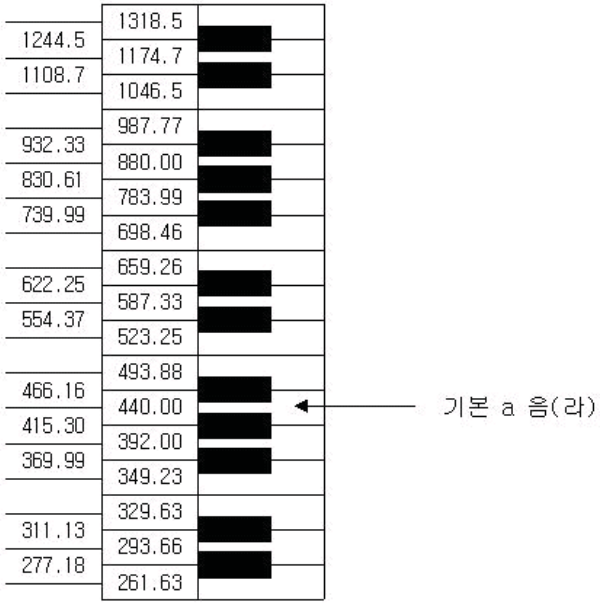


note#2: 420Hz(G#)



note #8

Solution



Solution

	Fund. Freq.	Note
1		
2	420Hz	G# (솔#)
3		
4		
5		
6		
7		
8		

제출 내용

- **다음을 4월 5일(월) 23:59까지 제출 (5주차)**
  - C code
  - 동작 과정, 이론, 파형, spectrum, 최종 결과 등등
- **제출 방법**
  - KLAS 과제 관리 site에 online 제출
    - 결과보고서 형태의 file
    - File name : AI_Speech_HW1_이름_학번.hwp, docx, pdf

- **개인별 과제, 개인별 평가**
  - 반드시 혼자 힘으로 해결
  - Copy, cheating 주의!
  - 과제 solution 제공 site 활용하면 안 됨 (ex: happy campus)