Homework 3 (Due: 4/29th)

(1) Write a Matlab or Python program that can convert a numbered musical notation (簡譜) into a music file (*.wav).

Example: (Twinkle twinkle little stars)

```
score = [1, 1, 5, 5, 6, 6, 5];     % 1: Do, 2: Re, 3: Mi, …..
beat=[ 1, 1, 1, 1, 1, 1, 2];       % 拍子
name= 'twinkle';
getmusic(score, beat, name)    % generate the music file twinkle.wav
```

The Matlab / Python code should be handed out by NTUCool.

With basic requirement (score, beat, name): 24 scores

程式的功能越多，考慮的因素越多，分數越高 (30 scores)

(2) (a) In the noiseless case, in what condition we cannot use the variation of amplitude to separate a speech signal into several syllables?

(b) Why a music signal always has the chord (和弦) phenomenon? (10 scores)

(3) (a) Why a music signal is easier to compress than other vocal signals? (Write at least 3 reasons) (b) Why a cartoon / mark image is easier to compress than other images? (Write at least 2 reasons) (10 scores)

(4) (a) Why the YCbCr color space is applied instead of RGB in the 4:2:2 and 4:2:0 techniques? (b) What is the compression ratio of 4:2:0? (10 scores)

(5) (a) Why we always use the DCT instead of the DFT and the KLT to image compression? (Write two reasons). (b) Which of the following compression techniques are lossless? (i) 4:2:0; (ii) DC difference; (iii) zigzag; (iv) quantization table; (v) the Huffman code. (10 scores)

(6) Suppose that $P(x = \text{'a'}) = 0.5$, $P(x = \text{'b'}) = 0.3$, $P(x = \text{'c'}) = 0.1$, $P(x = \text{'d'}) = 0.1$.

(a) Determine the coding tree of x when using the Huffman code in the binary (二進位) system.

(b) What is the entropy of x?

(c) What is the result of the arithmetic coding if x = 'aba'?

(d) Suppose that length(x) = 100,000. Estimate the range of the total coding lengths in the binary system when using the arithmetic code. (20 scores)

(7) Write at least three conditions that applying the NRMSE may not well reflect the similarity of two vocal signals. (10 scores)

(Extra): Answer the questions according to your student ID number.

(ended with (3, 8), (4, 9), (0, 5), (1, 6))