

### Homework 3 (Due: 5/25<sup>th</sup>)

- (1) Write a Matlab or Python program for the 4:2:0 image compression technique.  
B = C420(A), A is the input color image and B is the reconstructed image.  
Just use the interpolation method for reconstruction. The code should be submitted to [ceiba](#). (Note: The command `rgb2ycbcr` cannot be used.)  
(25 scores)
- (2) Write two concepts you learned from the oral presentation on 5/1. (10 scores)
- (3) (a) Suppose that, for an instrument, the frequency of Do is 300 Hz. What are the frequencies of So and La for the instrument?  
(b) Why the music signal is easier to recognition than a speech signal? (Write at least 2 reasons)  
(c) In the noiseless case, in what condition we cannot use the variation of amplitude to separate a speech signal into several syllables?  
(d) Is it possible to hear ultrasound or infrasound? Why? (20 scores)

(4) (a) Write two possible methods to compress a cartoon image efficiently. (b) Write two possible ways to compress a song more efficiently. (10 scores)

(5) (a) Why we always use the DCT instead of the DFT and the KLT to image compression? (Write two reasons). (b) Why we always use the 8x8 DCT instead of performing the DCT on the whole image for compression? (Write three reasons) (10 scores)

(6) Suppose that  $P(x = 1) = 0.4$ ,  $P(x = 2) = 0.22$ ,  $P(x = 3) = 0.17$ ,  $P(x = 4) = 0.1$ ,  
 $P(x = 5) = 0.04$ ,  $P(x = 6) = 0.03$ ,  $P(x = 7) = 0.02$ ,  $P(x = 8) = 0.01$ ,  
 $P(x = 9) = 0.006$ ,  $P(x = 10) = 0.004$ ,  $P(x = n) = 0$  otherwise.

(a) Determine the coding tree of  $x$  when using the Huffman code in the binary (二進位) system. (10 scores)

(b) Suppose that  $\text{length}(x) = 100,000$ . Estimate the range of the total coding lengths in the  $k$ -ary ( $k$  進位) system when using (i) the Huffman code and (ii) the arithmetic code. Express the solution in terms of  $k$ . (15 scores)

(Extra): 根據你的學號來回答 5/8, 5/15 上課影片中的問題 (一題)