Homework 3 (Due: May 3ʳᵈ)

(1) Write a Matlab or Python code 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 handed out by NTUCool. (Note: The command rgb2ycbcr cannot be used.)

(25 scores)

(2) Suppose that there is a multipath system $y[n] = x[n] + 0.3x[n-15] + 0.2x[n-25]$. (a) Find $p[n]$ such that $y[n] = x[n] * p[n]$. (b) Design the lifter to remove the effect of $p[n]$ and try to not destroy $x[n]$ as possible.   (10 scores)

(3) Suppose that there are three vocal signals: (i) $\cos(300\pi t)$, (ii) $-\sin(1200\pi t)$, (iii) $\sin(6000\pi t)$. (a) Which voice sounds louder? (b) Which voice signal can be propagated to a longest distance?   (10 scores)

(4) Suppose that for a stringed instrument the frequency of Do is 240 Hz. (a) Determine the frequencies of Mi and So for the instrument. (b) Suppose that the rate of wave propagation is 340m/sec. Determine the lengths of the strings to generate Mi and So for the stringed instrument.   (10 scores)

(5) In addition to the DCT, which is adopted by MP3, write at least three possible ways that can compress a music signal more efficiently.   (10 scores)

(6) In the JPEG process, (a) why the DCT is used instead of the DFT for transformation?   Write at least two reasons. (b) Why the input image is separated into several 8x8 blocks before using the DCT? Write at least two reasons. (c) Why the DC difference is encoded instead of the original DC value? (d) Why zigzag is beneficial for AC term encoding?   (20 scores)

(Continued)

(7) Suppose that $P(x = n) = e^{-\lambda}\lambda^n/(n!)$ for $n = 0, 1, 2, 3....., 40$ where $\lambda = 0.97$. Also suppose that length(x) = 50000. Estimate <u>the range of the total coding lengths</u> in the binary system when using (i) the Huffman code and (ii) the arithmetic code. (15 scores)

(Extra): Answer the questions according to your student ID number.
    (ended with 0, 1, 3, 4, 5, 6, 8, 9)