(1) Write the Matlab 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 Matlab file should be mailed to displab531@gmail.com.

(Note: The command rgb2ycbcr cannot be used.)   (25 scores)

(2) Suppose that the cepstrum of a causal and stable signal $x[n]$ is

$$\hat{x}[0]=1.5, \quad \hat{x}[1]=1, \quad \hat{x}[2]=0.5, \quad \hat{x}[n]=0 \quad otherwise$$

Determine $x[n]$ using the Z transform and exp( ).   (10 scores)

(3) (a) Suppose that, for an instrument, the frequency of Do is 200 Hz. What are the frequencies of Mi and Fa for the instrument?

(b) Why the music signal is easier to recognition than a speech signal? (Write at least 2 reasons)

(c) Why the music signal is easier to compress than a speech signal? (Write at least 3 reasons)   (15 scores)

(4) Write two concepts you learned from the oral presentation on 5/4. (10 scores)

(5) (a) Why it is better to divide the input image into 8x8 blocks before using the DCT? (b) Why it is better to encode the DC difference instead of the DC value in the JPEG process?   (15 scores)

(6) Suppose that $P(x = 1) = 0.45$, $P(x = 2) = 0.22$, $P(x = 3) = 0.13$, , $P(x = 4) = 0.06$, $P(x = 5) = 0.05$, $P(x = 6) = 0.04$, $P(x = 7) = 0.03$, $P(x = 8) = 0.01$, $P(x = 9) = 0.006$, $P(x = 10) = 0.004$, $P(x = n) = 0$ 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 length$(x) = 500,000$. 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)