

## Exam for CS4520, Fall 2019

due by 15:40, December 5, 2019

1. (20%) Given a color image (a) *Pumpkin.jpg* with 800 rows and 736 columns. Display the image and find its histogram and corresponding mean, median, and mode for R, G, B signals, respectively.
  - (b) Given a color image (b) *machupicchu02.jpg* with *Row* rows and *Col* columns where  $Row = Col$ . Display the image and find its histogram and corresponding mean, median, and mode for R, G, B signals, respectively, what is *Row*?
  
2. (20%) Given  $128 \times 128$  gray level images *I2a.raw* and *I2b.raw*.
  - (a) Display the image *I2a.raw*, its histogram, and the result of histogram equalization of 4 levels (show the 4 levels used for your display).
  - (b) Display the image *I2b.raw*, its histogram, and the result of histogram equalization of 4 levels (show the 4 levels used for your display).
  
3. (20%) Given a shape (closed boundary) representation with the first lines of 5 integers  $X0, Y0, Length, R, C$  indicating the first point location with (0,0) being the top leftmost position, the length of the chain code, and the number of rows,  $R$ , and the number of columns,  $C$ , followed by the chain code representation as given in the lecture notes.
  - (a) Display the shape *S1.txt* from  
  
<http://www.cs.nthu.edu.tw/~cchen/CS4520/cs4520.html>
  - (b) Display the shape *S2.txt* from  
  
<http://www.cs.nthu.edu.tw/~cchen/CS4520/cs4520.html>

**4.(20%)** Given an  $8 \times 8$  block from some gray level image. Find the quantized DCT coefficients based on the quantization table as given in class, and give a representation of (# of bits, DC value), followed by {(0 run length, # of bits, AC value)} until the end of block, *EOB*, also show the PSNR value for each block. Two blocks are given below.

(a) Block A: *block4a.txt* is from

<http://www.cs.nthu.edu.tw/~cchen/CS4520/cs4520.html>

(b) Block B: *block4b.txt* is from

<http://www.cs.nthu.edu.tw/~cchen/CS4520/cs4520.html>

**5.(20%)** Let  $f(x) = e^{-x^2/(2\sigma^2)} \cos(2\pi\beta x)$ ,  $-\infty < x < \infty$ .

(a) Computer the Fourier transform of

$$F(u) = \int_{-\infty}^{\infty} f(x)e^{-j2\pi ux} dx$$

(b) Let  $\sigma = 2$ ,  $\beta = 3$ , plot  $x - f(x)$  and  $u - \text{abs}(F(u))$ .