Multimedia Systems and Applications

Midterm Exam

April 16, 2018

1. (15%) (a) What is Weber's Law?

(b)What is Nyquist Theorem?

(c) Please describe "aliasing."

2. (10%) Please answer the following questions.

(a)What is gamma correction for the display in the CRT system?

(b)If the color is out of gamut on a device, please provide one method to deal with this problem.

3. (15%) (a) Dithering is often used when converting greyscale images to monochrome. What is the basic idea of dithering algorithm?

(b) For the given 2x2 dither matrix, briefly describe the ordered dithering algorithm.

$$\begin{pmatrix} 0 & 2 \\ 3 & 1 \end{pmatrix}$$

(c) Use the same dither matrix, what is the result for the following input? Assume that the input is greyscale intensities ranging from 1 to 128.

66	18	3	19
54	13	56	37
70	99	88	46
67	17	67	98

4. (10%) My old SoundBlaster card is an 8-bit card

(a) What is the definition of Signal-to-Quantization-Noise (SQNR)

(b) What is the best SQNR it can achieve?

5. (10%) Suppose we decide to quantize an 8-bit grayscale image down to just 2 bits of accuracy. (a)What is the simplest way to do so? (b)What ranges of byte values in the original image are mapped to what quantized values?

6. (15%) Please describe the steps to devise a Color Lookup Table to make 8-bit lookup color out of 24-bit color. You can choose your own way or median-cut algorithm.

7. (10%) Please describe the steps of an end-point detection algorithm for a speech signal based on the functions of short-time energy and average zero-crossing rate.

8. (15%) Suppose we use a predictor as follows:

$$\hat{f}_n = trunc[\frac{1}{2}(\tilde{f}_{n-1} + \tilde{f}_{n-2})]$$

$$e_n = f_n - \hat{f}_n$$

Also, suppose we adopt the quantizer

$$\tilde{e}_n = Q[e_n] = 16 \times trunc[(255 + e_n)/16] - 256 + 8$$

$$\tilde{f}_n = \hat{f}_n + \tilde{e}_n$$

If the input signal has values as follows:

20 38 56 74 92 110 128

What is the output from a DPCM coder (without entropy coding)? You can assume $\tilde{e}_1 = 0$.