CS474/674 Image Processing and Interpretation
Sample Final Exam

Name:_____

1. **[20 points – 4pts each]** True/False Questions – To get credit, **you must give brief reasons for each answer!**

   T F The lower the frequency of a sinusoidal, the more samples must be taken to gain an accurate representation of the wave.

   T F Arithmetic coding requires knowledge of pixel intensity frequencies.
   .

   T F The Fourier transform of the product of two functions is the product of the Fourier transforms of the functions (i.e., F[f(x)g(x)] = F[f(x)] F[g(x)])

   T F Inverse filtering will yield as good results as Wiener filtering when processing an image which has been degraded by motion blurring **only** .

   T F Median filtering can be implemented efficiently using convolution.

2. [15 points] Prove the following property of the Fourier Transform:

$$f(x)e^{j2\pi u_0 x} \leftrightarrow F(u-u_0)$$

3. **[15 pts]** When sampling a band-limited function, aliasing can be avoided by obtaining a sufficient number of samples, as stated by the Nyquist criterion. In practice, however, aliasing cannot be avoided in general, even if the Nyquist criterion is satisfied. Explain why this is the case and justify your answer.

4. [15 pts] The following image is given:

21 21 21 95 169 243 243 243
21 21 21 95 169 243 243 243
21 21 21 95 169 243 243 243
21 21 21 95 169 243 243 243

(a) Compute its first order entropy.

(b) Construct the Huffman code for this image.

(c) What is the average number of bits/pixel in this case? Is this a good code?

5. [15 points] Explain how homomorphic filtering works. What is the reason that we first apply the log() function on the image?

6. [20 points] How does progressive JPEG work? Discuss at least two different progressive JPEG methods.

7. (Graduate Students Only) This problem is on image restoration.

(a) [10 points] What do we mean in image restoration when we say that the degradation function H is linear and shift-invariant?

(b) [10 points] How is the degradation process modeled assuming linearity and shift invariance? **Prove it.**