CS 5420	**Visual Data Processing**	Test 2
Name:	Winter 2005	Max Pts: 44

Important: This is an open book test. You can use any books, notes, or paper, but not exchange anything with other students. You are not allowed to use any electronic/communication devices, including a calculator. *Do not log into the computer during the test*. Any calculations and rough work can be done on the back side of the test pages. You will lose five points for not writing your name.

1. [8 pt] Explain the difference between an averaging filter and a median filter. What is the effect of each of these filters to remove noise?

2. [8 pt] Consider two 8-bit images – (a) and (b) – whose gray levels span the full range from 0 to 255.

   (a) Discuss the limiting effect of repeatedly subtracting image (b) from image (a).

   (b) Would reversing the order of the images yield a different result?

3. [8 pt] You are given an image $f(x, y)$. You convert the image in frequency domain by applying the Fourier transform, getting $F(u, v)$. Let us say that you apply the ideal lowpass filter

$$H(u,v) = \begin{cases} 1 & \text{if } D(u,v) \leq D_0 \\ 0 & \text{otherwise} \end{cases}$$

on $F(u, v)$. D_0 is a specified nonnegative quantity, and $D(u, v)$ is the distance from point (u, v) to the center of the frequency rectangle. Consider the following steps:

$$\begin{aligned} F'(u,v) &= H(u,v)F(u,v) \\ F''(u,v) &= H(u,v)F'(u,v) \end{aligned}$$

What is the difference between $F'(u, v)$ and $F''(u, v)$? If we apply the filter repeatedly to the resulting image in frequency domain, what happens?

4. [6 pt] While discussing the Fourier transform, we said that the spatial domain image is converted into frequency domain resulting in complex numbers. Then, the frequency domain image is operated on, and converted back into spatial domain through inverse Fourier transform. After conversion back into spatial domain, we throw away the imaginary components, retaining only the real part of the complex number. Discuss why is this step necessary?

5. [6 pt] Characterize the difference between luminance, radiance, and brightness in light. Enumerate their units of measurement as well.

6. [4 pt] The number of colors that can be faithfully reproduced in any system is 256. Yet, we defined the number of safe colors as 216. Why?

7. [4 pt] What component of color in HSI space should be modified to change the tone in the image?