Important: This is an open book test. You can use any books, notes, or paper. *Change your cell phones to silent mode.* Any calculations and rough work can be done on a separate paper that can be handed in at the end. If there is a syntax error in any program segment, just write it down and you will get full credit for the problem.

1. [6 pt] Write the convolution matrix associated with the convolution kernel

$$g(x) = [1\ 3\ 6\ 3\ 1]$$

   Assume an input of length 5, and that the input is extended by replicating the values.

2. [6 pt] For each of the smoothing kernels below, specify the normalizing constant a:

   (a) $\frac{1}{a}[1\ 3\ 6\ 3\ 1]$

   (b) $\frac{1}{a}[22\ 99\ 22]$

   (c) $\frac{1}{a}[3\ 16\ 109\ 16\ 3]$

3. [6 pt] What is the limiting effect of repeatedly dilating an image? Assume that a trivial (one point) structuring element is not used.

4. [6 pt] Briefly describe the hit-or-miss transform?

5. [6 pt] What is the significance of Nyquist rate?

6. [6 pt] What is the discrete Fourier transform of $[\underline{1}\ 0\ \cdots\ 0]$?

7. [6 pt] What is spectral power distribution?

8. [6 pt] Convert the gamma-corrected color $(R', G', B') = (20, 40, 200)$ to HSI color space.