CS 6420	**Topics in Image Processing and Multimedia**	**Test 1**
Name:	Spring 2015	Max Pts: 56

Important: This is an open book test. You can use any books, notes, or paper but no electronic device, except a non-programmable calculator. *Do not log into the computer during the test, or use any electronic or communications device. Switch off your cell phones*. 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. [10 pt] Given a $2^J \times 2^J$ image, does a $J + 1$-level pyramid reduce or expand the amount of data required to represent the image? What is the compression or expansion ratio?

2. [10+10+10 pt] You are given an image containing eight discrete intensity levels $(a_1, \ldots, a_8)$, with distribution given by

$$0.16, 0.06, 0.07, 0.30, 0.08, 0.20, 0.10, 0.03$$

Compute (a) Huffman code, (b) Golomb code $G_4(n)$, and (c) Arithmetic code for the signal

$$a_7, a_5, a_5, a_2, a_5, a_6, a_4, a_6$$

You will compute the first two codes in binary but express both of them as a hexadecimal number; add any padding to the end of the code to make the number of bits as a multiple of 8. If you need to map the input alphabet $(a_1 \ldots, a_8)$ to integers, you may do so.

3. [10 pt] Comment on the validity of the statement: *The opening and closing operation on an arbitrary image are equivalent.*

4. [6 pt] Why do we need to threshold the gradient while looking for edges?