CS 5420	**Digital Image Processing**	Test 1
Name:	Fall 2014	Max Pts: 60

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 and e-books. *Do not log into the computer during the test. Switch off your cell phones. Any device with an* ON-OFF *switch should have its switch in the* OFF *position.* 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] A CCD camera chip of dimensions 4×4mm and having 128×128 elements is focused on a square flat area 8m away. How many line pairs per mm will this camera be able to resolve? The camera is equipped with a 35mm lens.

2. [10 pt] Consider the two image subsets S_1 and S_2, shown in the following figure. For $V = \{1\}$, determine whether these subsets are (a) 4-adjacent, (b) 8-adjacent, or (c) m-adjacent.

S_1					S_2				
0	0	1	0	0	0	0	1	1	1
0	1	0	1	1	0	1	0	0	1
0	0	0	0	1	1	1	0	0	0
1	0	1	0	1	0	1	0	1	1
1	1	0	0	1	0	1	0	0	1

3. [10 pt] Show that the median filter is a nonlinear filter.

4. [10 pt] With respect to the following figures, sketch the set $(A \cap B) \cup (A \cup B)^c$. Treat A^c as complement of A.

A

1	1	1	0	0
1	1	1	1	0
0	1	0	1	0
0	0	0	0	1
0	1	0	1	1

B

0	0	1	0	1
0	1	1	0	0
1	1	0	1	0
1	1	0	0	0
0	0	1	0	1

5. [10 pt] The probability distribution of pixel intensities in a 3-bit image is given as
   0.21, 0.08, 0.09, 0.07, 0.27, 0.19, 0.04, 0.05
   Create a lookup table to equalize this histogram.

6. [10 pt] Propose a set of intensity-slicing transformations capable of producing all the individual bit planes of an 8-bit monochrome image. For example, a transformation function with the property

$$T(r) = \begin{cases} 0 & \text{if } r \in [0, 127] \\ 255 & \text{if } r \in [128, 255] \end{cases}$$

produces an image of the 8th bit plane in a 8-bit image. It will be nice to show a single function that will output the ith bit plane with the input being an `unsigned char` and i, with the output being the pixel value for ith bit plane.