CS 355 Homework #6:
Simple Image Processing Operations

For all of the problems that follow, if you need to use pixel values outside of the given images, use 0 padding, i.e., assume pixel values of 0 for all pixels outside the images. For questions 1-4, round to the nearest whole number. For question 5, round to one decimal point.

1. Spatially filter (convolve) the image on the left with the 3 x 3 mask (kernel) shown.

0	0	0	0	0
0	0	1	0	0
0	1	2	1	0
0	0	3	0	0
0	0	0	0	0

Input Image

*

1	2	1
2	4	2
1	2	1

Mask

=

Output Image

2. What is the result of mean filtering (averaging pixels with their 8-connected neighbors) for the following image?

10	11	9	25	22
8	10	9	26	28
9	99	9	24	25
11	11	12	23	22
10	11	9	22	25

Input Image

Output Image

3. What is the result of median filtering (using 8-connected neighbors) for the following image?

10	11	9	25	22
8	10	9	26	28
9	99	9	24	25
11	11	12	23	22
10	11	9	22	25

Input Image

Output Image

4. What is the result of unsharp masking using an $A = 1$ (a 5 in the center) mask?

10	11	9	25	22
8	10	9	26	28
9	8	9	24	25
11	11	12	23	22
10	11	9	22	25

Input Image

Output Image

5. This question walks through the computational steps for gradient-magnitude edge detection for the following image: (For this question, don't worry about the border pixels.)

10	11	9	25	22
8	10	9	26	28
9	8	9	24	25
11	11	12	23	22
10	11	9	22	25

Input Image

(a) What is the result of applying the x-derivative Sobel filter? (Remember to divide by 8.)

X	X	X	X	X
X				X
X				X
X				X
X	X	X	X	X

(b) What is the result of applying the y-derivative Sobel filter? (Remember to divide by 8.)

X	X	X	X	X
X				X
X				X
X				X
X	X	X	X	X

(c) What is the gradient magnitude at each pixel?

X	X	X	X	X
X				X
X				X
X				X
X	X	X	X	X