CS474/674 Image Processing and Interpretation
## Fall 2021 – Dr. George Bebis
Programming Assignment 2
Due Date: 10/13/2020 @ 1pm

1. Correlation

(a) Write a program to perform spatial filtering (i.e., correlation) of an image. Both the size of the mask and its values (i.e., weights) need to be variables that can be input into your program.

(b) Test your program by computing the correlation between the two images below (can be downloaded from the course's webpage). Use the left image to define the weights of the mask.

(c) Show and discuss your results (i.e., correlation image). How could you use the results of correlation to find the location(s) of the pattern shown (i.e., left image) in the right image?
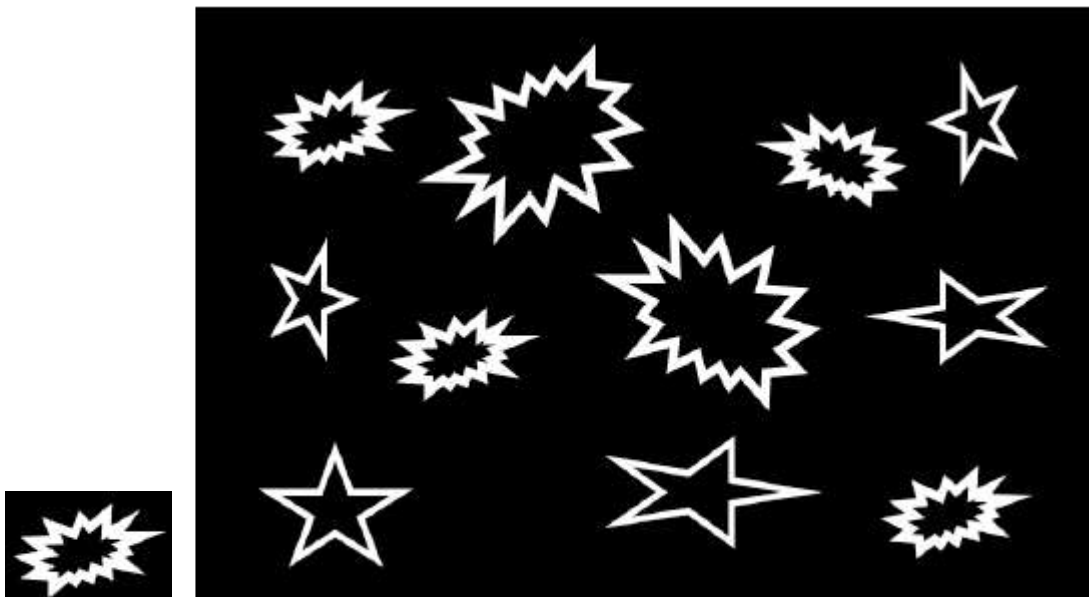
2. Averaging and Gaussian Smoothing

(a) Smooth the "lenna" and "sf" images using (1) 7x7 and 15x15 averaging filters and (2) 7x7 and 15x15 Gaussian filters (using the masks provided below). You should normalize the mask weights so they sum to one.

(b) Show and discuss your results both for averaging and Gaussian smoothing.

15 × 15 Gaussian mask

2	2	3	4	5	5	6	6	6	5	5	4	3	2	2
2	3	4	5	7	7	8	8	8	7	7	5	4	3	2
3	4	6	7	9	10	10	11	10	10	9	7	6	4	3
4	5	7	9	10	12	13	13	13	12	10	9	7	5	4
5	7	9	11	13	14	15	16	15	14	13	11	9	7	5
5	7	10	12	14	16	17	18	17	16	14	12	10	7	5
6	8	10	13	15	17	19	19	19	17	15	13	10	8	6
6	8	11	13	16	18	19	20	19	18	16	13	11	8	6
6	8	10	13	15	17	19	19	19	17	15	13	10	8	6
5	7	10	12	14	16	17	18	17	16	14	12	10	7	5
5	7	9	11	13	14	15	16	15	14	13	11	9	7	5
4	5	7	9	10	12	13	13	13	12	10	9	7	5	4
3	4	6	7	9	10	10	11	10	10	9	7	6	4	3
2	3	4	5	7	7	8	8	8	7	7	5	4	3	2
2	2	3	4	5	5	6	6	6	5	5	4	3	2	2

7 × 7 Gaussian mask

1	1	2	2	2	1	1
1	2	2	4	2	2	1
2	2	4	8	4	2	2
2	4	8	16	8	4	2
2	2	4	8	4	2	2
1	2	2	4	2	2	1
1	1	2	2	2	1	1

3. Median Filtering

(a) Implement median filtering; the size of the filter should be a parameter.

(b) Take the "lenna" and "boat" images and corrupt them with "salt and pepper" noise (i.e., randomly change X% of the pixels values to either black or white; for each image, use X=30 and X=50)

(c) Apply median filtering to each of the corrupted images. For comparison purposes, apply averaging too. Try two different mask sizes for each case: 7 x 7 and 15 x 15.

(d) Show and discuss your results for both median filtering and averaging.

4. Unsharp Masking and High Boost Filtering

(a) Implement unsharp masking (K=1) and high-boost filtering (K>1).

(b) Use the "lenna" and "f_16" images and perform unsharp masking and high-boost filtering. In the case of high-boost filtering experiment with different K values and choose the results that seems to be visually best. For smoothing purposes, use the 7x7 Gaussian mask.

(c) Show and discuss your results for both unsharp masking and high-boost filtering.

5. Gradient and Laplacian

(a) Sharpen the "lenna" and "sf" images using the Prewitt Sobel, and Laplacian masks shown below.

(c) Show and discuss your results in each case. Note that in the case of the Prewitt and Sobel masks, you need to show the "gradient magnitude" as well as the partial derivatives in the x- and y-direction.

Prewitt									
−1	−1	−1			−1	0	1		
0	0	0			−1	0	1		
1	1	1			−1	0	1		

Prewitt

−1	−1	−1
0	0	0
1	1	1

−1	0	1
−1	0	1
−1	0	1

Sobel

−1	−2	−1
0	0	0
1	2	1

−1	0	1
−2	0	2
−1	0	1

Laplacian

0	1	0
1	−4	1
0	1	0

Laboratory Write-up

For each programming assignment, you are to turn in a report (please, follow closely the instructions posted on the course's website). **The report is very important in determining your grade for the programming assignment.** Be well organized, type your reports, and include figure captions with a brief description for all the figures included in your report. Motivation and initiative are greatly encouraged and will earn extra points.