CSE428: Image Processing

Problem Set 2

Lecture 5: Neighborhood Processing

Question 1

Consider an input image with pixel intensities given in the following table:

6	2	1	9
2	0	2	4
1	9	9	5
2	0	1	2

You are given the following 3 × 3 gaussian kernel:

$$\frac{1}{16} \times \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$

a. Determine **minimum padding width** so that after convolution (stride = 1) with the above kernel, the height and width of the output image remains the same as the input image.

b. Consider that there is no padding. Determine the **blurred output image** we will get after convolution (stride = 1) with the above kernel. Clip the pixel values where necessary.

c. Calculate the unsharp mask using the input image and the blurred image determined in **b**.

d. Determine the sharpened image you will get using **unsharp masking** (k=1).

e. Determine the sharpened image you will get using **high boost filtering** (k=2).

Question 2

Consider the following image. Design one edge detection filter that can detect almost all the edges in this picture. *{Hint: Think about the directions of the edges}*.

Question 3

Consider the following image. Design one edge detection filter that can detect almost all the edges in this picture. *{Hint: Think about the directions of the edges}*.

Question 4

Figure 1. Digital image corrupted with noise

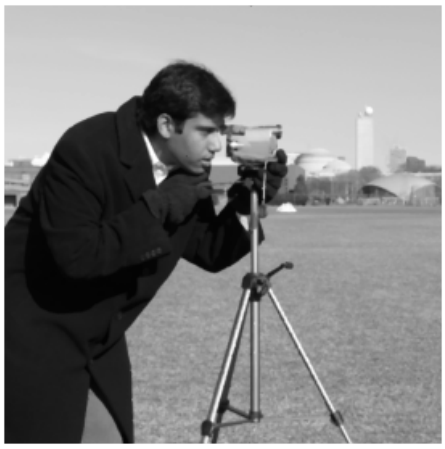


Figure 2. A filtered version of figure 1

(a) What is the name of the noise present in Figure 1?

(b) Suggest a non-linear filter that can be used to clean up figure 1 (the noisy image), as in figure 2 (the filtered image). Justify your suggestion.

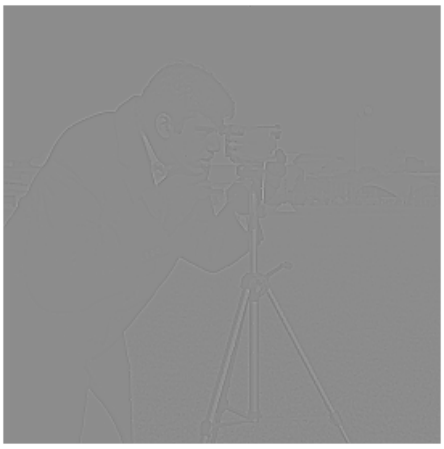


Figure 3. Detected soft edges of figure 2

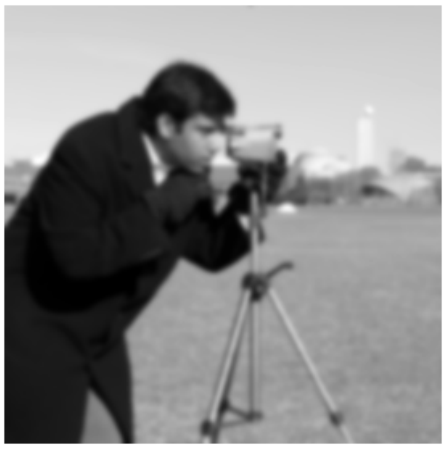


Figure 4. Blurred version of figure 2

(c) Derive a 2D kernel that can be used to produce Figure 3 from Figure 2.

(d) Can Figure 3 be used to sharpen Figure 2? If your answer is “yes”, mention the steps in detail, and if your answer is “no”, explain why not.

(e) Can Figure 4 be used to sharpen Figure 2? If your answer is “yes”, mention the steps in detail, and if your answer is “no”, explain why not.

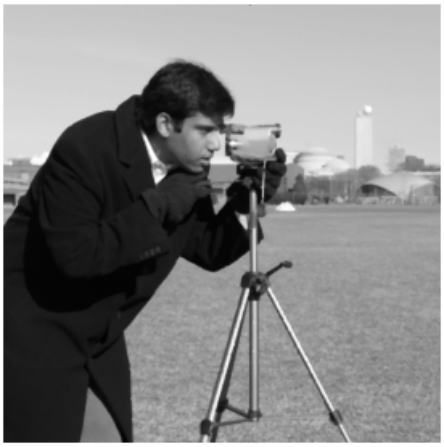
Lecture 6: Image Processing in Frequency Domain

Question 1-5

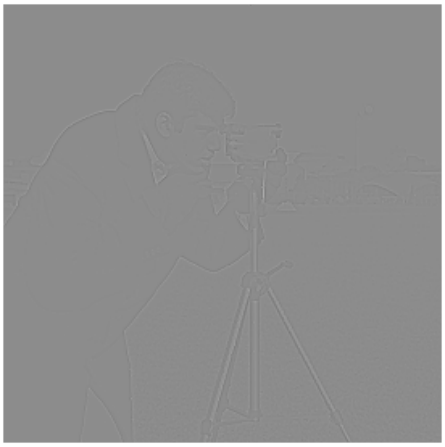
Solve **Example Problems 1-5** from **Lecture 6.1**.

Question 6

What kind of Frequency Domain filters should we use to generate **output images 1 & 2** from the **input image** below? Draw the filters and explain your choices.



Input Image



Output Image 1

Output Image 2