



Week 9 Exercises

Fys-2010

Spring 2019

Exercise 1

Implement a program that performs median filtering with a given mask size. Try the median filter on Fig 3.43 a (3.35 a). Show the histogram before and after filtering. Remember to zero-pad.

Exercise 2

Problems from the book (3rd edition): 4.1, 4.4 (a), 4.4 (b) and 4.5

(4th edition): 4.2, 4.10 (a), 4.10 (b) and 4.11

Exercise 3

Given a signal (f) with the following values:

$$f = [0 \ 0 \ 0 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 0 \ 0 \ 0];$$

- (a) Find the Fourier transform of f and plot its magnitude and phase. Use the *stem* function in Matlab (*plt.stem* in Python) when displaying the results. Try to use the *fftshift* (Matlab) or *np.fft.fftshift* (Python), and evaluate the difference between shifting and not. Relate this to Eq (4-76) (4.6-8).
- (b) Add at least 5 zeros on both the sides of the signal f , take the Fourier transform of f , and display the magnitude and phase. What happens when zero-padding f in the frequency domain?

Exercise 4

Take the Fourier transform of figure 4.23 a (4.24 a), and display its magnitude and phase (Hint: take the log-transform and *fftshift* of the Fourier transform). Do the same with figure 4.24 a (4.25 a). Try also to rotate the images 45 degrees before taking the Fourier transform. Evaluate the results.

Exercise 5 (Exam question June 2016)

We will in this problem study the role of the histogram in image processing.

- (a) Describe the role of histograms in image processing.
- (b) Histograms can be used to automatically enhance contrast in images. However, sometimes we instead want to *specify* a particular histogram for our output image. Explain how both these operations can be performed.
- (c) Given the 3-bit 4×4 image

$$M = \begin{array}{|c|c|c|c|} \hline 0 & 0 & 0 & 4 \\ \hline 1 & 1 & 1 & 5 \\ \hline 1 & 2 & 2 & 7 \\ \hline 2 & 2 & 2 & 7 \\ \hline \end{array}$$

perform histogram equalization and find the resulting image.

- (d) Given a 3×3 image

$$f = \begin{array}{|c|c|c|} \hline 0 & 2 & 4 \\ \hline 2 & 4 & 6 \\ \hline 4 & 6 & 8 \\ \hline \end{array}$$

we want to enlarge the image to a 5×5 image. Explain nearest neighbor and bilinear interpolation and show how the resulting 5×5 image will look for each of the two interpolation methods.

Note: As there are multiple valid interpolation results in the nearest neighbor case it is enough to show one valid result for the nearest neighbor interpolation.