

# CENG 391 Introduction to Image Understanding

October 20, 2016

## Image Smoothing & Sharpening

**Exercise (*Neighbourhood Operations*):** Write a C++/Python program that takes an argument as the name of an image and operates the following tasks.

1. Read the image ("graffiti.ppm")
2. Build your structure to visit each of pixel of the image.
3. Modify your code to be able processing pixel operations with various filters as it is illustrated in Figure 1.

### A. Applying Spatial Filters on an Image

Filters that you should apply to the image are given in Figure 3. You should modify each pixel value as it is depicted in Figure 2.

There are two main types of spatial filters which are smoothing and sharpening.

- Smoothing filters are used for removing noise from images. They are also useful for highlighting gross details on an image.
- Sharpening filters are used for emphasizing fine details. They also remove blurring from images and highlight edges.

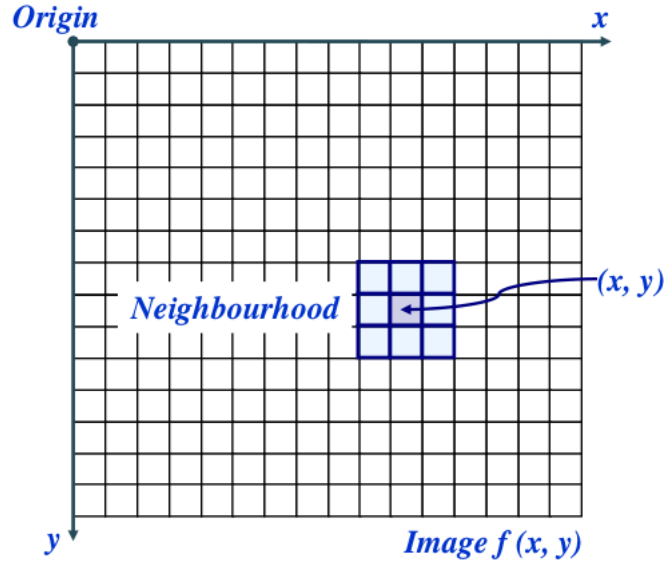


Figure 1: Applying neighbouring filter on  $(x,y)$ . Image is taken from Yalin Bastanlar, Digital Image Processing(2015).

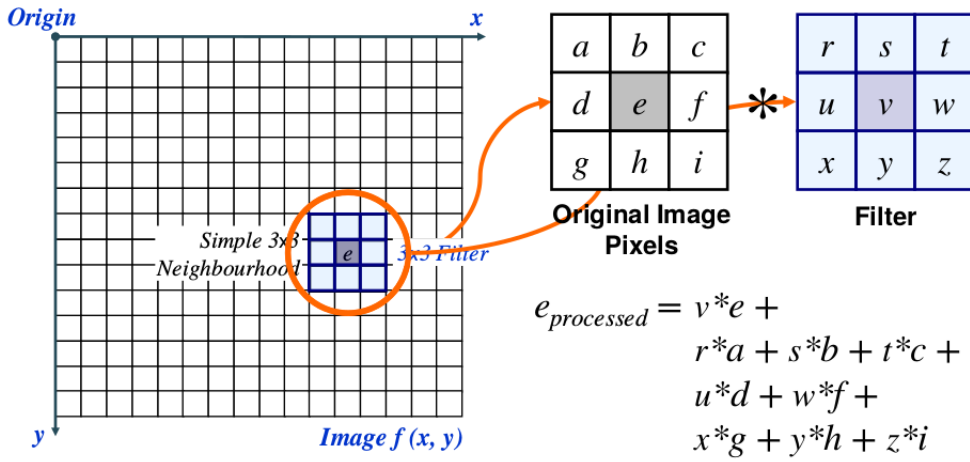


Figure 2: Applying linear spatial filter on  $(x,y)$  and calculating the filtered value of  $(x,y)$ . Image is taken from Yalin Bastanlar, Digital Image Processing(2015).

1/9	1/9	1/9	1/16	2/16	1/16	-1	-1	-1
1/9	1/9	1/9	2/16	4/16	2/16	-1	9	-1
1/9	1/9	1/9	1/16	2/16	1/16	-1	-1	-1
Averaging			Weighted Averaging			Sharpening		

Figure 3: Spatial Filters

## B. Applying Order-Statistics Filters on an Image

There are nonlinear spatial filters whose response is based on ordering (ranking) the pixels in the neighborhood.

The best known example is median filter, which replaces the value of the pixel by the median gray-level in the neighborhood as it shown in Figure 4.

Median filters are particularly effective to impulse noise also called as salt and pepper noise.

In order to observe the effect of the median filter on an image exposed to

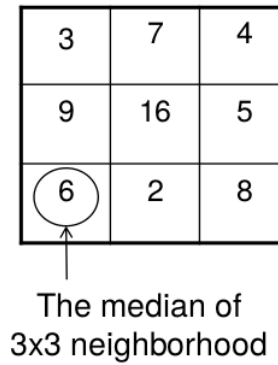


Figure 4: Applying median filter. Image is taken from Yalin Bastanlar, Digital Image Processing(2015).

salt and pepper noise read the image named as "sp\_noise\_graffiti.pgm" and apply the median filter. You can also apply the averaging smoothing filter to it and observe the differences between them.

### C. Operation on Image Edges

You should handle pixels located on edges of the image which are shown in Figure 5.

There are different options to deal with pixels on the edges:

- Omit missing pixels
- Pad (expand) the image with extra pixel
- Replicate border pixels

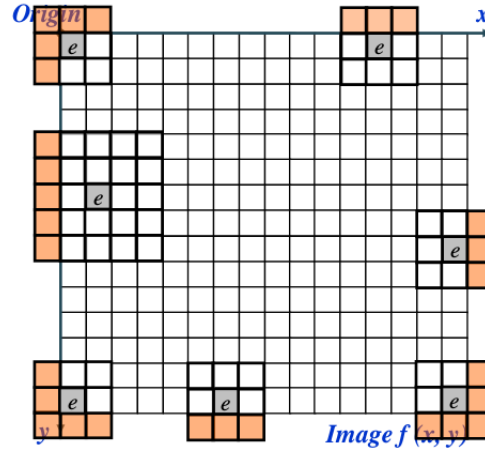


Figure 5: Example cases on the edges of an image. Image is taken from Yalin Bastanlar, Digital Image Processing(2015).