CMPE 362 - Introduction to Signals for Computer Engineers Homework 3

June 19, 2020

1 Question 1 - Convolution filter for images

Figure 1: Initial image

In this homework, you will learn to use convolution filtering on images. In the first homework, you learned to read an image in MATLAB as a 3-dimensional matrix. You can consider that there are 3 2-dimensional matrices for 3 colors.(red-green-blue) In this case, our filter is a 2-dimensional smaller matrix(3x3,5x5 or 9x9) and it can be called "kernel matrix". In order to apply filter, flip the kernel matrix in both horizontal and vertical directions and slide it over the input matrix. Then, calculate the weighted sum for overlapping regions and write that value into a new matrix.Repeat that for all 3 colors and form a new 3 dimensional array for your new image. See figure 2.

You may realize that there is a problem with edges and corners. Therefore, you add rows and columns that consist of 0's to your image matrix. This process is called zero padding. The size of your kernel filter and zero padding is left to your decision. As a rule of thumb, the size of filter
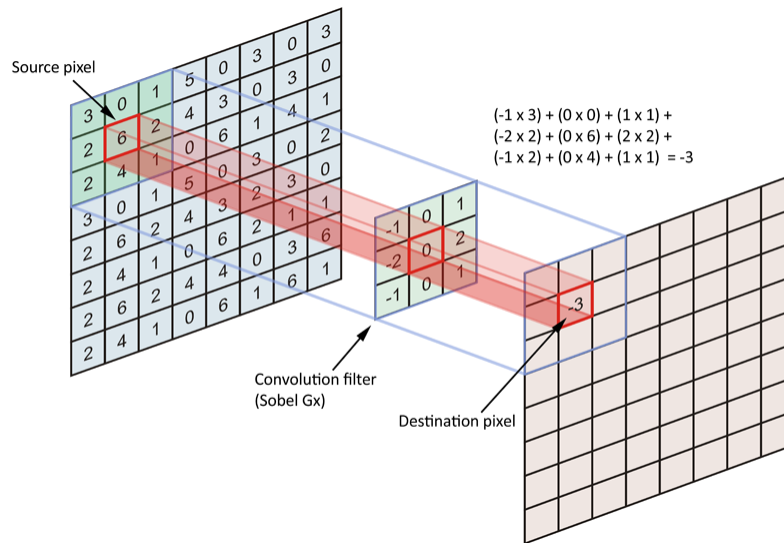
Figure 2: Convolution illustration(Filter is flipped already.)

should be uneven, the sum of the numbers of your filter is generally one. Please, read more about zero padding and convolution filter on web. In the following parts, you will implement basic image processing and the initial image 1 can be found on moodle webpage.

1.1 Part A

In this subsection design a kernel that adds blur to your image.(Figure : 3)

1.2 Part B

In this subsection design a kernel that sharpens your image found in part A to get rid of the blur.(Figure : 4)

1.3 Part C

In this subsection design a kernel that highlights edges in your image.(Figure : 5)

1.4 Part D

In this subsection design a kernel that makes your image embossed.(Figure : 6)

You can find values for your filters easily on web. You have to implement convolution by yourself since it is the only thing you should do in this part. All pre-defined functions are not allowed except imread, imwrite and data type conversion functions.

Figure 3: Image with blur

2 Question 2 - Object detection and replacement

You will get 50 bonus points, if you can detect the cigarette and replace it with a flower. You can crop cigarette part of your image as a separate image and use the following link: https://www.mathworks.com/help/vision/examples/object-detection-in-a-cluttered-scene-using-point-feature-matchi html

Deadline: 27 June 2020 23:59

Prepare a report (pdf file) includes images for each part, your code, explanations and comments of your code. You will compress everything into a zip file. Name it as YourNumber-CmpE362-HW3.zip and submit it via Moodle.

The Moodle upload limit is 2MB, do not forget to shrink your report pdf before submission. I will not accept any e-mail submissions. When copying is detected, both parties will get zero.
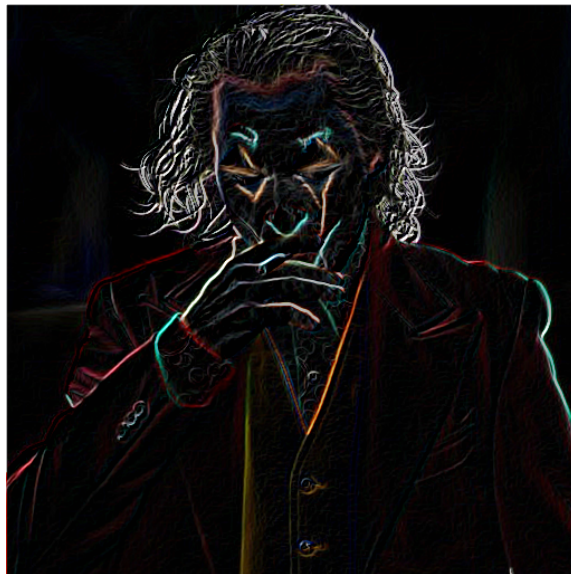
Figure 4: Image with sharpening

Figure 5: Image with edges

Figure 6: Image embossed