

# CSE4084 Multimedia Systems

## HW1 Report

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### Intro

This homework consists of applying several filtering techniques and convolution into given image examples. It challenged me to handle those techniques practically and helped me visualize them. As programming language, I used MATLAB.

### Problem 1

Goal of this problem is to implement spatial-domain low-pass filtering into an image. Also, through the steps, which I will explain down below, evaluating Mean Squared Error(MSE) and Peak Signal to Noise Ratio (PSNR) values.

**Step1** and **Step2** consists of reading the image file and converting its pixel values into double type. To achieve this, I used built-in functions “imread” and “im2double” defined in MATLAB. This is because, it needs to match filter and image matrix types.

After having resulting informations, newly created filter matrix (size of 3x3 with 1/9 values) at **Step3** is used at **Step4** in purpose of low-pass filtering the original image. Low-pass filter basically emphasizes low frequency components of an image, drop the high ones. This has effects on image such as: blurring effect. Here, a built-in function called “imfilter” used.

At the final step, **Step5**, MSE and PSNR values are calculated between original image and the filtered image by the given formula. One thing needs to be mentioned, while calculating MSE value inside the nested loop, every corresponding index value is multiplied by 255. Because, in double type its value was naturally divided by 255. It needed to be converted back to int type again.

At below figures are compared in case of their visuality. It is clearly seen that, after applying the specified filter, a blurring effect appeared in the image.



Original Image



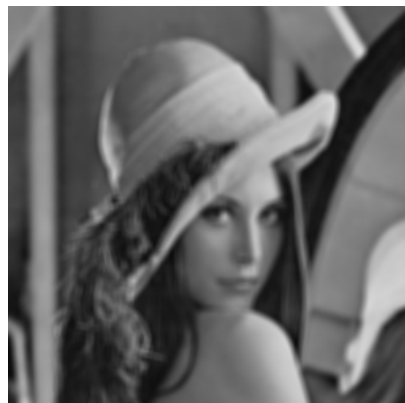
Filtered Image

## Problem 2

Problem definition and steps applied for this problem are the same with the Problem 1. Only thing that differs from it is that, a different filter is applied (size of 5x5 with 1/25 values). At below figures are compared in case of their visuality. It is clearly seen that, by given larger size and lower values of filter, blurring effect has increased.



Original Image



Filtered Image

### Problem 3

This problem consists of changing resolution of the image by several techniques such as down sampling and up sampling.

**Step1** consists of reading the image file and converting its pixel values into double type. To achieve this, I used built-in functions “imread” and “im2double” defined in MATLAB. This is because, it needs to match filter and image matrix types.

At **Step2**, a newly created filter matrix (size of 3x3 with 1/9 values) is used in purpose of low-pass filtering the original image. This step is done because, aliasing needs to be avoided. Here, a built-in function called “imfilter” used.

For the **Step3**, purpose is applying the down-sampling to the image result at Step2. In this purpose, every even numbered index rows and columns are deleted by assigning those indexes an empty vector in MATLAB. Down-sampled image will be resulting in size of 180x240.

After having the down-sampled image, at **Step4**, up-sampling this image to the original resolution via spatial domain processing. Up-sampling consists of two parts.

Firstly, a new matrix created size of 359x479 having the all-zero values. Its every odd valued row index and column index are filled with the matrix value coming from the image which result in Step3.

At second part as the **Step5**, a certain convolution filter is applied to image resulted in Step4. Here, a built-in function called “imfilter” is used and it concludes the up-sampling step.

At the final step, **Step5**, MSE and PSNR values are calculated between up sampled image and the original image by the given formula. One thing needs to be mentioned, while calculating MSE value inside the nested loop, every corresponding index value is multiplied by 255. Because, in double type its value was naturally divided by 255. It needed to be converted back to int type again.

At below figures are compared in case of their visuality.



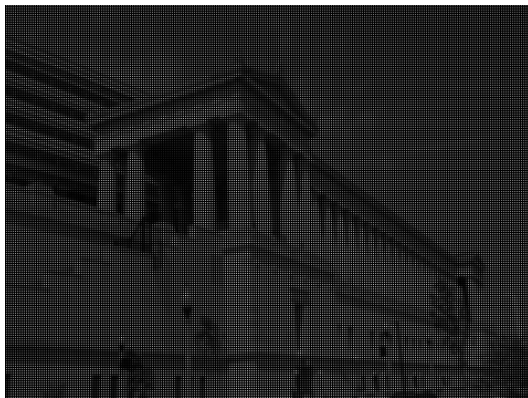
Original Image



Filtered Image



Down-sampled Image



Zeros Inserted Image



Up-sampled Image