University of Tehran

School of Electrical and Computer Engineering

# Digital Image Processing

Instructor: Hamid Soltanian-Zadeh

## Assignment 2

Chapter 3 – Intensity Transformations and Spatial Filtering

Due Date:

Thursday, 19th of Esfand

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## Problem 1

The focus of this problem is to experiment with intensity transformations. Load the "spine.tif" image, then:

a. Apply a suitable log transformation to enhance the contrast of the image. Display the resultant images with different parameter values and plot its histogram by "subplot" function.

b. Implement the transformations given in Fig. 1, display the transformed images, and comment on the quality of the transformed images. Use the image "pout.tiff". In Fig. 1, two points of $(r_1, s_1)$ and $(r_2, s_2)$ is equal to (80,40) and (160,210). Compare the output to the original image.

c. Implement a program to perform bit plane slicing and extract/display the resulting plane images as separate images and from MSB to LSB. You should use the image "dollar.tif". You may wish to consider displaying a mosaic of several different bit-planes from an image using the "subplot" function. Reconstruct the image using 4 of the most significant bits and compare the result with the original image.

**Hint:** You can use the "**bitget**" function.

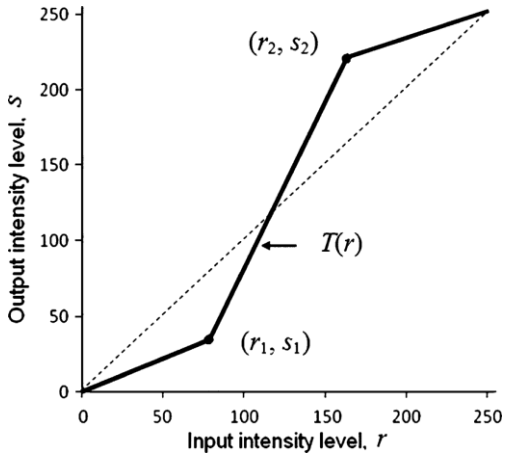


Fig 1. Intensity transformation

## Problem 2:

a. Write a program to compute the histogram of images "bands.png", "sf.gif", and "squares.tif".

b. Apply histogram equalization on the three images and show histograms after equalization with the corresponding images.

c. Apply adaptive histogram equalization on "square.tiff". Try various block sizes to reach an optimal result (at least 3 different block sizes).

Modify the histogram of "bean.png" in such a way that the resulting histogram nearly approximates the histogram of "peppers.gif". Display and discuss the original image/histogram, the specified histogram, and the output.

**Note**: You are **not allowed** to use MATLAB built-in functions in this problem.

## Problem 3:

a. Calculate the mean and standard deviation of "sf.gif". Stretch this image for mean brightness of *m* and standard deviation of *s*. Find optimal *m* and *s* that generate the best result.

b. Try Min-Max Stretching on "x-ray.PNG". In this method, the intensity range of image stretches to [0,255]. Compare the result to the original image. Why isn't the contrast of the output good? Now, search about Percentile Stretching and use this method for contrast stretching. Compare the result with that of the Min-Max Stretching method.

**Note**: You are **not allowed** to use MATLAB built-in functions in this problem.

## Problem 4:

In this problem, we investigate the sharpening filter described in Section 3.6.3 of the textbook, *unsharp masking and highboost filtering*, which

1. blurs the original image,
2. subtracts the blurred image from the original image,
3. adds the mask (the result of the former part) with various weights to the original image.

a. First implement the convolution operator. Then, apply and compare the following smoothing filters on "bone-scan.tif". The filters are described in the lecture slides and the textbook.

   Mean filter: sizes 3*3, 5*5, and 9*9. What effect has the size of the filter kernel?

a. Apply this sharpening method on the original and the best smoothed image of the previous part. Then, show the input images and the best sharpened image (chosen from the results obtained by different weights).

**Note**: You are **not allowed** to use MATLAB built-in functions in this problem.

## Descriptive Assignments

Please solve the following questions of the 3rd Chapter of the textbook.

6, 14, 21, 28, 33.

## Notes:

1. Put written codes for each problem in one m-file, and for each section, intercept them by %%.
2. Analytical problems can be solved on papers, and there is no need to type the answers. The only thing that matters is the quality of your pictures. Scanning your answer sheets is recommended. If you are using your smartphones, you may use apps such as CamScanner or Google Drive Application.
3. Simulation problems need report as well as source code and results. This report must be prepared as a standard scientific report.
4. Your report is particularly important in the correction process. Please mention all the notes and assumptions you made for solving problems in your report.
5. You have to prepare your final report, including the analytical problems answer sheets and your simulation report in a single pdf file.
6. Finalized report and your source codes must be uploaded to the course page as a ".zip" or ".rar" file with the file name format as:

   Fullname_StudentNumber_HW#.rar

7. Plagiarisms will be strictly penalized.
8. You may ask your questions from the corresponding TA of each assignment.