

Homework #2: Spatial Domain Image Manipulation

Assigned: 17.05.2021 Due: 03.06.2021

1. Objective

The purpose of this homework is to make you practice image processing techniques in the spatial domain. You can use Matlab, Python, or Octave in your assignment.

2. Assignment

Task 1 – Point Processing and Image Histograms

For this task, you are given four input images ([click here to download](#)). For each input image, apply the following point processing transformations: a) Adding 128 to each pixel, subtracting 128 from each pixel, b) multiplying each pixel value by 2, c) dividing each pixel value by 2, d) taking the negative of the image. For each transformation, generate a figure as shown in Figure 1. There are 6 fields in the figure: 1) Original image, 2) Transformation function, 3) Modified image, 4) Histogram of the original image, 5) Image statistics of both original and modified images, 6) Histogram of the modified image.

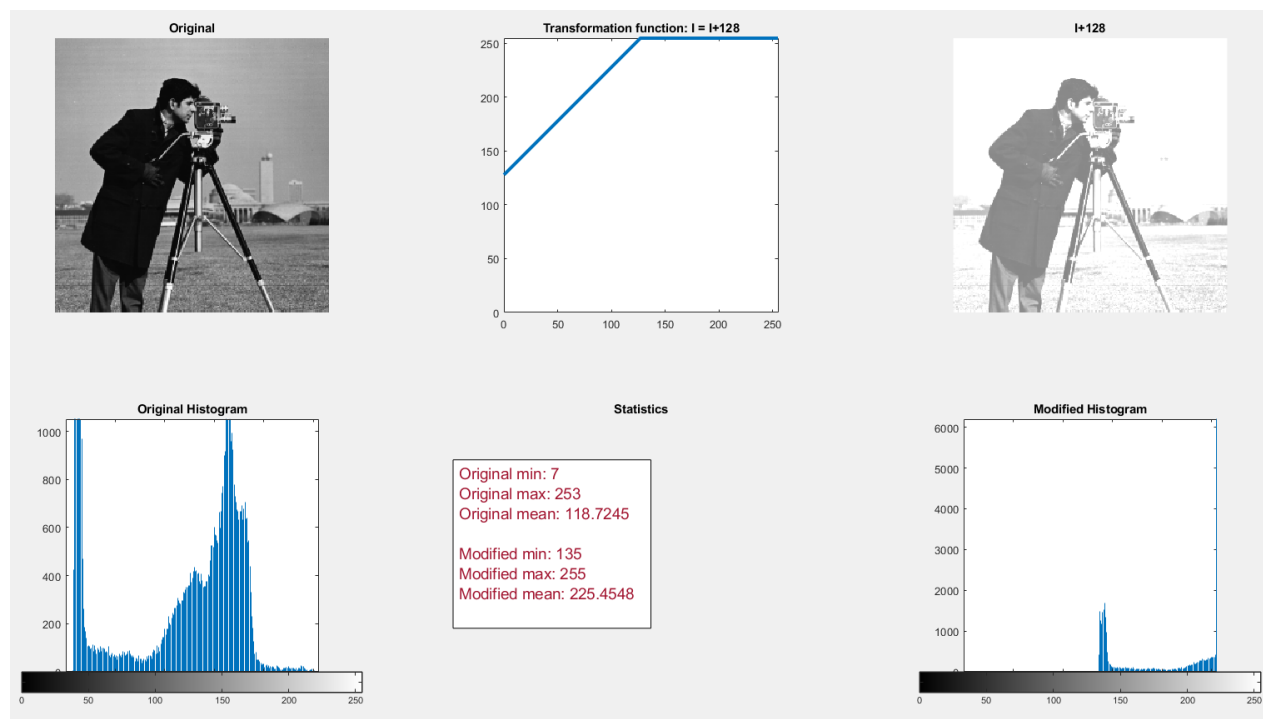


Figure 1: Sample output for Task 1.

Task 2 – Image Steganography

Steganography refers to the method of hiding data inside any form of digital media such as audio, video, image, etc. The most basic image steganography technique is based on the Least Significant Bit (LSB) encoding. The idea behind this technique is that any modification in the LSB bitplane of the image will not be much perceptible by the human visual system. The general process for LSB based image steganography includes bitplane slicing of the image and gathering the LSB bitplane, then inserting the ASCII code of the message into this bitplane.

You are given input images numbered from 00 to 99, [here](#). Each of them is an 8-bit grayscale 256x256 pixels image. Each image contains a unique, meaningful textual message encoded in the LSB bitplane, using slightly different strategies and sentinel values. In [this Excel file](#), check the sentinel value and encoding strategy for the input images. Your task is to implement a decoder for the given image and extract the hidden message. As the output of your program, the hidden text message in the image should be printed. You will select one of the images as input, according to your student ID as follows:

- If you are doing the homework individually, you will select the image based on the last two digits of your student ID. (i.e., if your student ID is 123456789, you will use input image **89.tif**)
- If you are doing the homework in pairs, you can select one of the two alternatives in this way: Assume that student ID1 is 123456789 and student ID2 is 987654321, you can select **91.tif** or **19.tif** as the input image.

The text messages are encoded in the LSB bitplane of the images, using different sentinel values and encoding strategies, as stated in the Excel file. Sentinel character is used to indicate the end of the secret message. In this assignment, eight different encoding strategies, Strategy0 through Strategy 7, were employed. These strategies are explained with an example below. Assume that we have an 8-bit 10x5 pixels grayscale image and we want to encode text message “msg” in the LSB bitplane of this image. For this example, we will use “#” character as the sentinel value, to indicate the end of the message. We use the binary ASCII codes of each character in the message, as shown in the below table. The encoding procedure for each strategy is illustrated in Figure 2. For each strategy, LSB bitplane is shown and X symbols in the figure correspond to “don’t care”.

Task 3 – Report

Write a brief report including:

- A title page (name, surname, ID of each member)
- Development tools (Matlab/Octave/Python, version, required packages, etc.)
- Explain the results in Task1 based on the characteristics of the input images, along with their screenshots.
- Write the hidden message you decoded in Task2.
- Conclusions (what you have learnt, difficulties you have faced, etc.)

Character	ASCII code (decimal)	ASCII code (binary)
m	109	01101101
s	115	01110011
g	103	01100111
#	35	00100011

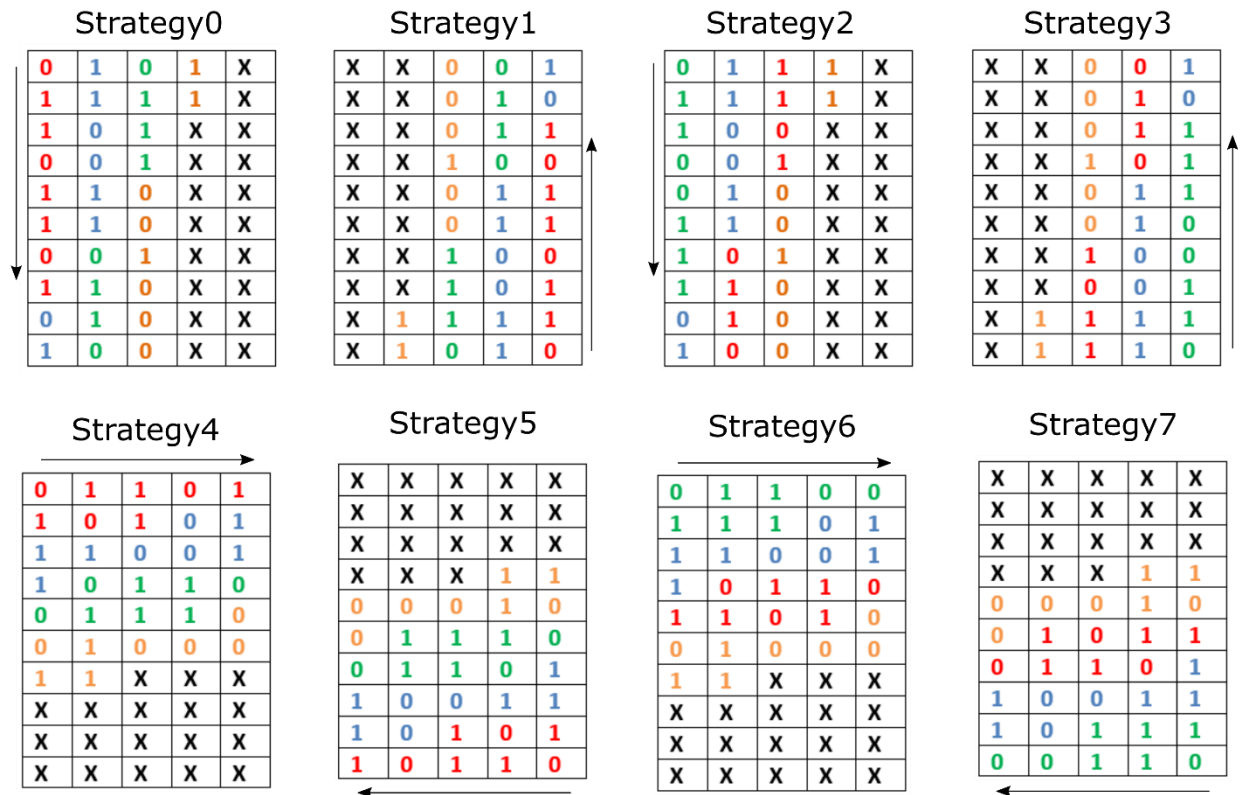


Figure 2: LSB-based steganography strategies explained.

3. Submission

- This homework can be done individually or in pairs.
- At the top of your source files, write your names, surnames, and student IDs as a comment.
- Your submission directory will include the following files:
 - HW2_Task1.m (or .mlx or .py)
 - HW2_Task2.m (or .mlx or .py)
 - A report in pdf format
- Place all your files in a zip archive with the name **HW2_StudentID1_ StudentID2.zip** and submit it through the MS Teams submission module.
- If you have further questions, you can send me an e-mail.

4. Late Submission Policy

The deadline for homework submissions is **23:59** at the specified date. For each additional day, a **25% cut-off** will be applied.