

# HOMework ASSIGNMENT #1

## Image Enhancement and Noise Removal

**Due Date: 11:59pm on 03/24/2021**

Please read the **submission guideline** carefully before getting started. All images in this homework can be downloaded from our NTU COOL website. Images are all in the JPEG format, and the details of all files offered are listed in the appendix. You are **NOT** allowed to use other functions to obtain the result directly except I/O, plotting and basic functions.

### Problem 1: WARM-UP (10 points)

- (a) The goal of this problem is to get familiar with converting a color image to a grayscale one. Please convert the given color image, **sample1.jpg**, to a grayscale image named **1\_result.jpg**.
- (b) Please also perform horizontal flipping on **sample1.jpg** and output the result as **2\_result.jpg**.

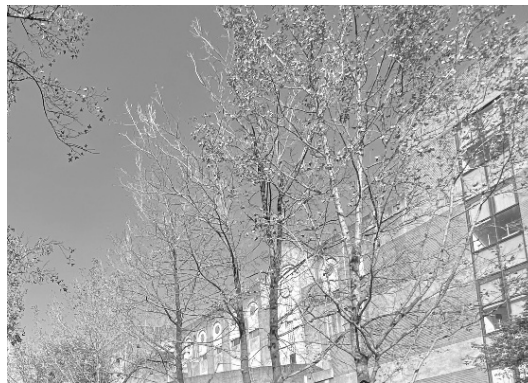


sample1.jpg

## Problem 2: IMAGE ENHANCEMENT (60 points)

Given gray-level images **sample2.jpg**, **sample3.jpg** and **sample4.jpg**, please follow the instructions below to create several new images.

- Decrease the brightness of **sample2.jpg** by dividing the intensity values by 5 and output the image as **3\_result.jpg**.
- Increase the brightness of **3\_result.jpg** by multiplying the intensity values by 5 and output the image as **4\_result.jpg**.
- Plot the histograms of **sample2.jpg**, **3\_result.jpg** and **4\_result.jpg**. What can you observe from these three histograms?
- Perform global histogram equalization on **sample3.jpg** and output the results as **5\_result.jpg**.
- Perform local histogram equalization on **sample3.jpg** and output the results as **6\_result.jpg**.
- Plot the histograms of **5\_result.jpg** and **6\_result.jpg**. What is the main difference between local and global histogram equalization?
- Please design a transfer function to enhance **sample4.jpg** as best as you can. Output the result as **7\_result.jpg** and specify all the parameters. Show the resultant image(s) and the corresponding histogram(s). Please provide some discussions on the results as well.



sample2.jpg



sample3.jpg



sample4.jpg

### Problem 3: NOISE REMOVAL (30 points)

Given an original image named **sample5.jpg** and two images corrupted by noise as shown in **sample6.jpg** and **sample7.jpg**, please follow the instructions below to create some new images.

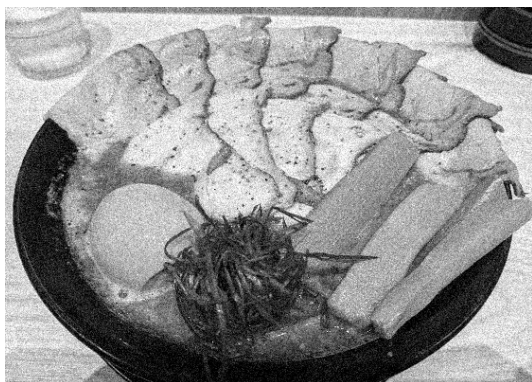
- (a) Design proper filters to remove noise from **sample6.jpg** and **sample7.jpg**, and output the resultant images as **8\_result.jpg** and **9\_result.jpg**, respectively.

Please detail the steps of the denoising process and specify all the corresponding parameters. Provide some discussions about the reason why those filters and parameters are chosen.

- (b) Compute the PSNR values of **8\_result.jpg** and **9\_result.jpg** and provide some discussions.



sample5.jpg



sample6.jpg



sample7.jpg

## Appendix

### Problem 1: WARM-UP

sample1.jpg	400×560	color
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### Problem 2: IMAGE ENHANCEMENT

sample2.jpg	400×560	gray-scale
sample3.jpg	400×560	gray-scale
sample4.jpg	400×560	gray-scale

### Problem 3: NOISE REMOVAL

sample5.jpg	400×560	gray-scale
sample6.jpg	400×560	gray-scale
sample7.jpg	400×560	gray-scale