

Concordia University

Department of Computer Science & Software Engineering

COMP 478/6771 Image Processing

Assignment 1 - Due Date: *October 4, 2022*

Part I: Theoretical questions

- (5 points)** Explain why the discrete histogram equalization technique does not, in general, yield a flat histogram.
 - (5 points)** Suppose that a digital image is subjected to histogram equalization. Please elaborate why a second pass of histogram equalization (on the histogram-equalized image) will produce exactly the same result as the first pass.
- (5 points)** Given two arbitrary images $f(x,y)$ and $g(x,y)$ and two arbitrary constant a and b , H is said to be a linear operator if:

$$H [af(x,y) + bg(x,y)] = aH [f(x,y)] + bH [g(x,y)]$$

The median m of a set of numbers is such that half the values in the set are below m and the other half are above it (the mid-point value by population). Is an operator that computes the median of a set of pixels of a sub-image area linear or nonlinear? Explain your answer by giving examples.

- The purpose of this question is to perform histogram equalization to a given histogram and plot the resulting histogram. Given the following histogram where **GL** is Gray level, and **NP** is Number of pixels:

GL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NP	0	5	13	57	100	39	21	12	7	2	0	0	0	0	0	0

- (5 points)** Plot the histogram of the image given in the table above.
- (10 points)** Let r_k be the GL given in the table, perform histogram equalization by:
 - Calculate s_k from the table.
 - Plot the probability density functions $p_r(r_k)$ and $p_s(s_k)$.

- c) **(5 points)** Plot the new histogram after performing the histogram equalization.
4. **(5 points)** The Given two images $f(x,y)$ and $g(x,y)$ with histogram h_f and h_g . Assuming that all the pixels of image $g(x,y)$ have the same intensity equal to a non-zero positive constant value c . The gray levels of the pixels of both images have positive values. Please explain the relationship between the histograms of $f(x,y)$ and the new images formed by $f(x,y) + g(x,y)$ and $f(x,y)*g(x,y)$

Part II: Programming questions

1. Download the image from the assignment folder, and perform the following operations using MATLAB or any software packages you are familiar with. Please show your steps in the report.
 - 1) **(1 point)** Write a program to read the grayscales of the image.
 - 2) **(3 points)** Write a program to calculate the histogram of the image and display the histogram chart.
 - 3) **(2 points)** Compare the calculated histogram obtained by using your own program with the one using the **imhist** function in MATLAB.
 - 4) **(3 points)** Write a program to do histogram equalization on this image.
 - 5) **(1 point)** Compare the histogram-equalized image obtained by using your own program with the one by using **histeq** function in MATLAB.