Concordia University
Department of Computer Science & Software Engineering

COMP 478/6771 Image Processing
Assignment 1
Due Date: October 2, 2017

Part I: Theoretical questions

1. Given two arbitrary images $f(x,y)$ and $g(x,y)$ and two arbitrary constants 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. 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.

2. 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

   a) Plot the histogram of a 1-D image array given in the table above.

   b) Let r_k be the GL given in the table, perform histogram equalization by:
      i) Calculate s_k from the table.
      ii) Plot the probability density functions $p_r(r_k)$ and $p_s(s_k)$.

   c) Plot the new histogram after performing the histogram equalization.

   d) Explain why the discrete histogram equalization technique does not, in general, yield a flat histogram.

   e) A digital image is subjected to histogram equalization. Does a second pass of histogram equalization (on the histogram-equalized image) produce a different or the same result as the first pass? Explain your answer.

3. Do problem 3.11 page 194 of the 3rd Edition (i.e. problem 3.14 page 240 of the 4th Edition) of the text book.

Part II: Programming question

Download the image from the course webpage.

1) Using Matlab or C/C++, write a program to read the grayscales of the image. The gray levels of image are from 0 to 255.

2) Write a program to calculate the histogram of the image and display the histogram chart.

3) Compare the calculated histogram obtained by using your own program with the one using the **imhist** function of Matlab.

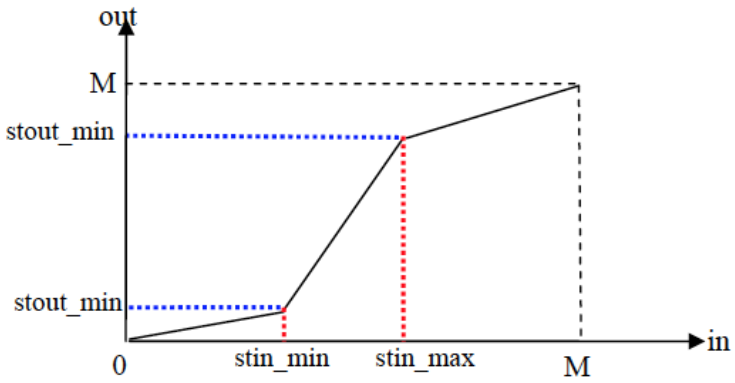
4) Using Matlab or C/C++, write a program to do histogram equalization on this image.

5) Compare the histogram-equalized image obtained by using your own program with the one by using **histeq** function of Matlab.

6) Write a Matlab function to do image histogram stretching

```
function  imgout = imhiststretch (imggray, stin_min,
stin_max, stout_min, stout_max)
```

where the mapping function is defined as follows and *M* is 256 in this case.



7) Inspect the input image and its histogram and then determine the values you will use for the parameters (*stin_min*, *stin_max*, *stout_min*, and *stout_max*) in order to achieve the best quality. Explain how you come up with your choices.
8) Plot the output image and its histogram (*n*=256) after the contrast stretching process.