The Hong Kong University of Science and Technology
Department of Computer Science and Engineering
CSIT 5410 (Spring 2020)

Assignment 2

Total = 100 marks
Due: 11:55pm, April 10, 2020
Assignments must be submitted via Canvas
Late Policy: 10% reduction; only one day late is allowed, i.e. 11:55pm, April 11

Overview

This assignment consists of two sections: programming section and written section. Both programming and written parts should be submitted via the Canvas system. If you would like to finish the written assignment with handwriting, you may scan and upload it.
In the programming section, you need to finish an incomplete function for Histogram equalization and Fisher linear discriminant. A set of M-files can be obtained from Canvas and the code skeleton has been implemented. You need to complete the missing implementations in the programming section.
In the written section, you need to answer one questions about image registration.

Programming assignment specifics (70%)

M-file: *csit5410_assign2*
The routine csit5410_assign2 involves two sub-routines *histogram_routine* and *fld_routine*, which complete the following two tasks respectively:
Task 1: Histogram Equalization
Task 2: Fisher Linear Discriminant

(Task 1) Task 1: Histogram Equalization
The routine *histogram_routine* involves a series of operations on the histograms of images. You are required to implement the function *myhistogram_eq* which performs histogram equalization on a gray level image, returning a gray scale image whose histogram is approximately flat. Then, finish the following sub-tasks in the routine *histogram_routine*:

1. Given a gray level image *G*, compute and display its histogram. Note: you need to compute the histogram by yourself.
2. Perform histogram equalization on *G*, then compute and display the histogram of the result image.
3. Given a color image *C* in RGB mode, perform histogram equalization on the R, G, B channels of C separately. Rebuild a RGB image from these histogram-equalized channels.
4. Compute the histograms on R, G, B channels separately and then calculate an average histogram from these three histograms. Use this average histogram as the basis to obtain a single-valued histogram equalization intensity transformation function. Apply this function to the R, G, B channels individually. Rebuild an RGB image from these processed channels. (Ref: P5-P7 in assign2_ppt)

(Task 2) Task 2: Fisher Linear Discriminant
The function *myfld* classifies an input sample into either class 1 or class 2, from samples of class 1 (class1_samples) and samples of class 2 (class2_samples). Detailed descriptions regarding the input parameters, output parameters and program requirements can be found in the *myfld.m* file.

For all submitted files in this assignment, you cannot use the following predefined functions: `imhist, histeq, ClassificationDiscriminant, CLASSIFY`. In other words, you need to compute the histogram by your own, implement the histogram equalization, histogram matching and FLD by yourself. Otherwise, no marks will be given.

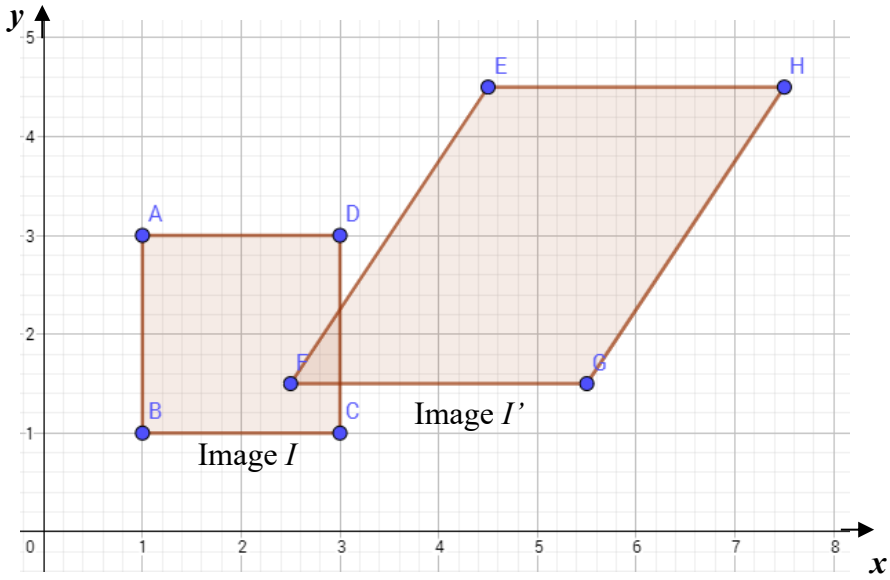
Sample runs of the programming assignment

sample_output.pdf is the sample output. You are supposed to obtain similar output on the screen when you run the following command in the MATLAB environment:
>> csit5410_assign2

Written assignment specifics (30%)

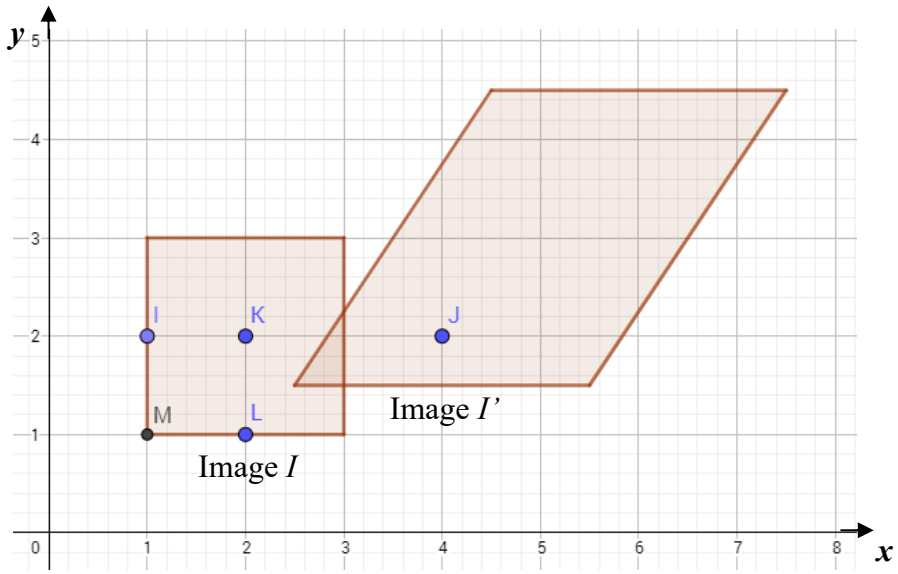
(a) Spatial Transformation and Gray-level Assignment [10 points]

There is an image *I* shown as follows. The transformation is defined as $T(\vec{x}) \equiv \overleftrightarrow{S}\vec{x}$, where $\overleftrightarrow{S} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and $\vec{x} = \begin{pmatrix} x \\ y \end{pmatrix}$. After the transformation using T, point A, B, C and D are transformed to point E, F, G and H respectively. Find the transformation matrix $\overleftrightarrow{S}$.



(**Hint**: For a 2x2 matrix $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, the matrix inverse is $A^{-1} = \frac{1}{ad-bc}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$.)

(2) Suppose the intensity values of point I, K, L and M are 2, 5, 9 and 15 respectively. Find the intensity value of point J using **Bilinear Interpolation**. (You can give answer in matrix form)



Hint: Bilinear Interpolation: $g(x, y) = ax + by + cxy + d$, where *a, b, c* and *d* are coefficients.

Assignment Submission and Marking

Your submitted programs should be *histogram_routine*, *myhistogram_eq*, *myfld* and *fld_routine* plus all the other related M-files**. Your submitted written assignment should be typed/written-and-scanned in a file with the format of either PDF or MS Word**. You must compress all your files with the following filename format: [your 8-digit student ID]_assign2.rar (or zip), e.g: 07654321_assign2.rar (or zip), into one file.

Note that we take plagiarism seriously. You are allowed to discuss or share your idea to your classmate, but **you are not allowed to share your code/pseudocode of your assignment**. Please also follow the referencing skills at https://libguides.ust.hk/referencing/plagiarism to avoid plagiarism.

If your assignment compressed file has been submitted multiple times before the due date (including late submission date), the newer version will replace the old version in marking.

~~ End of Assignment 2 ~~