The Hong Kong University of Science and Technology
Department of Computer Science and Engineering
CSIT 5410 (Spring 2021)

Assignment 2

Total = 100 marks
Due: 11:55pm, 9 April 2021
Assignments must be submitted via Canvas
Late Policy: 10% reduction; only one day late is allowed, i.e., 11:55pm, 10 April 2021

Overview

This assignment consists of two sections: programming section and written section. Both sections should be submitted via the Canvas system.

In the programming section, you need to finish two tasks. The skeleton code is prepared in MATLAB and can be obtained from CANVAS. You need to complete the missing implementations in the corresponding M-files.

In the written section, you need to answer one question about image registration. If you would like to finish the written assignment with handwriting, you may scan and upload it.

You must compress all your files with the following filename format: [your 8-digit student ID]_assign2.zip, e.g.: 12345678_assign2.zip, into one file. Your compressed file should include: (1) All M-files and input images related to the programming section, (2) a PDF file for the written section, and (3) a README.txt file indicating the programming software (Octave/MATLAB) that you are using for this assignment.

If your 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.

Programming section (70%)

M-file: *csit5410_assign2*
The routine csit5410_assign2 calls two functions: *hough_transform* and *myfld*. This routine completes the following two tasks:

Task 1: Hough Transform for Line Detection
Task 2: Fisher Linear Discriminant

You are not allowed to modify the *csit5410_assign2.m* file.

(Task 1) Function: *hough_transform*

There is a piece of target A4 paper in each input image. Your task is to detect and plot the four sides of the target A4 paper by Hough transform. A framework for this task is provided:

a) Pre-processing: Perform denoising on the input image.

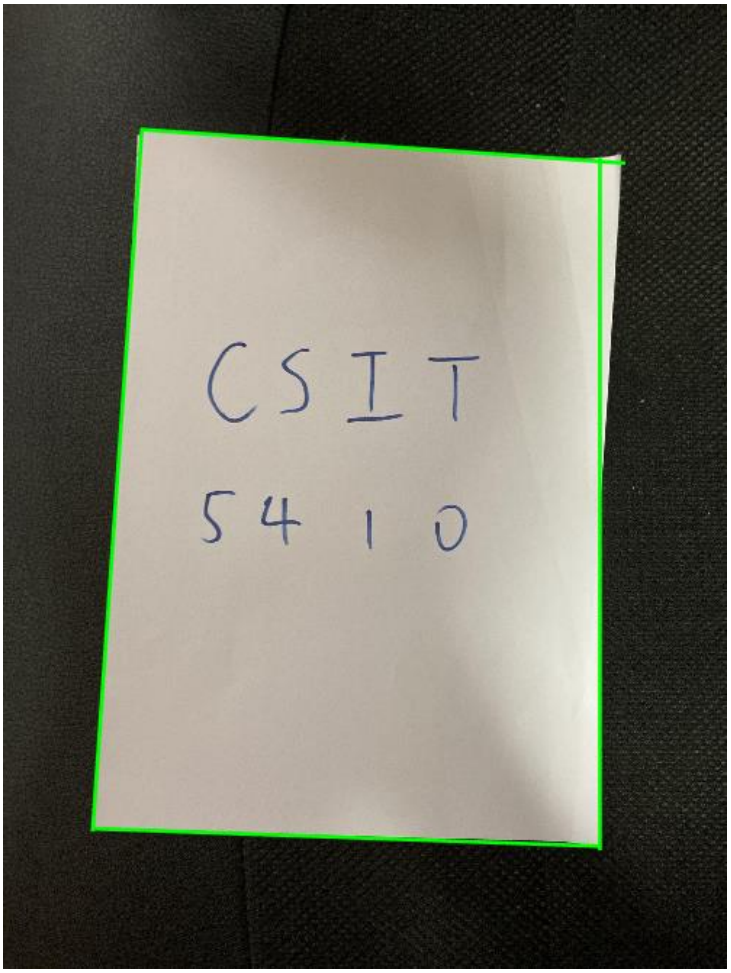
b) Edge extraction: You can use any operators based on what you have learned in this course.

c) Hough transform: Use Hough transform to find four straight lines that segment the A4 paper. **You CANNOT use the built-in functions related to Hough transform (e.g., `Hough`, `Houghpeaks`, `Houghlines`, etc.).**

d) Output: Plot the four sides of the A4 paper. You need to draw the green lines with LineWidth =2 on top of the input images.

The function prototype is given in the *hough_transform.m* file. You can modify this M-file if the provided skeleton code does not fit your implementation. There are 3 input images in total. You are supposed to show all 3 output figures for Task 1 when you run the command ">> csit5410_assign2" in the MATLAB environment.

A sample output figure is provided as follows:



(Task 2) Function: *myfld*

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. **You CANNOT use the built-in functions related to Fisher Linear Discriminant (e.g., `ClassificationDiscriminant`, `CLASSIFY`, `eval`, `mahal`, etc.).**

You are supposed to obtain the following output for Task 2 when you run the command ">> csit5410_assign2" in the MATLAB environment:

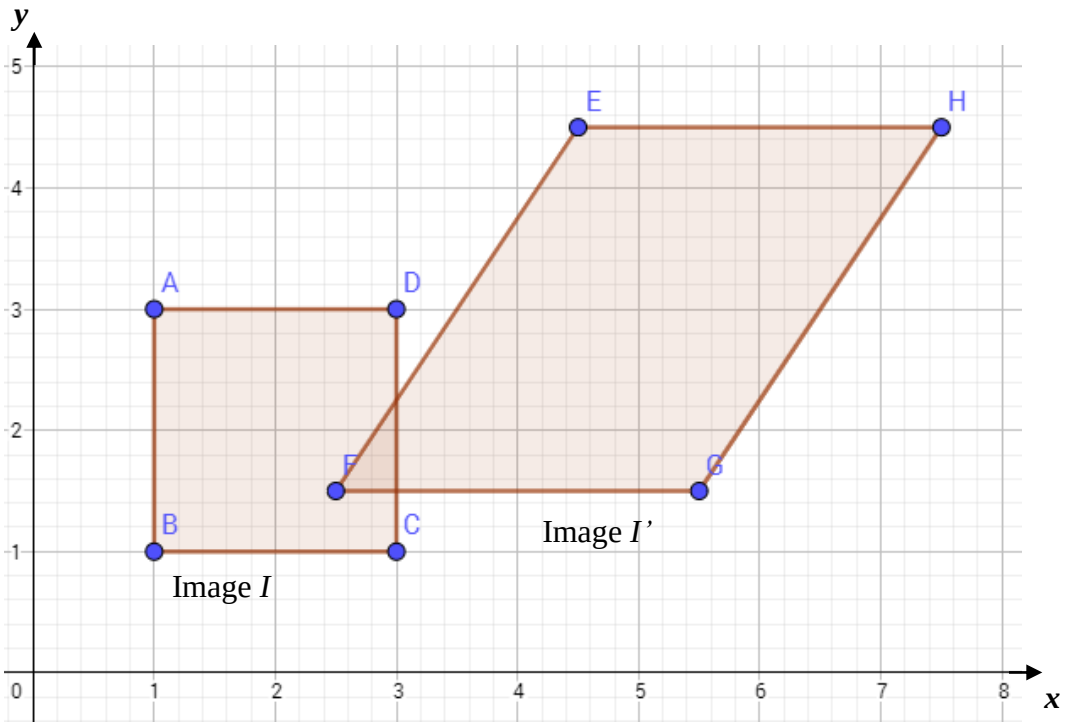
```
************************************************
Task 2: Fisher Linear Discriminant
************************************************


output_class =

     1


w =

    0.4472
    0.8944
```

The above sample output is for the input data in *fld_routine.m*. Your function *myfld* should be flexible to any class 1 and class 2 input data (i.e., different dimension and number of data point).

Written section (30%)

Spatial Transformation and Gray-level Assignment

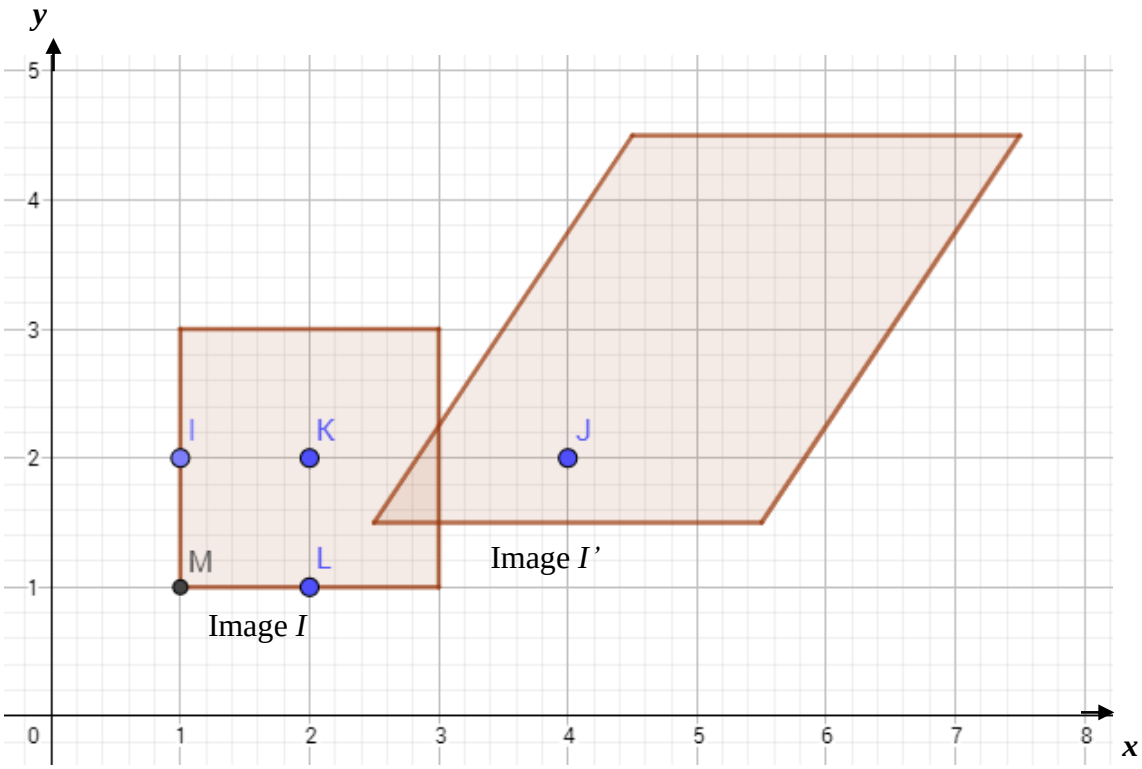
There is an image *I* shown as follows. The transformation is defined as $T(\vec{x}) \equiv \overleftrightarrow{S}\vec{x}$, where $\overleftrightarrow{S} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and $\vec{x} = \begin{pmatrix} x \\ y \end{pmatrix}$. After the transformation using T, point A, B,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



Answer:

Suppose the intensity values of point I, K, L and M are 4, 10, 18 and 30 respectively.

Find the intensity value of point J using Bilinear Interpolation.



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

Answer:

~~ End of Assignment 2 ~~