The Hong Kong University of Science and Technology
Department of Computer Science and Engineering
COMP4421 (Fall 2018)

Assignment 2

Total = 100 marks
Due: 11:55pm, Nov. 16, 2018
Assignments must be submitted via Canvas
Late Policy: 10% reduction; only one day late is allowed, i.e., 11:55pm, Nov. 17.

Overview

Topics: Hough Transform and Image Warping

In this assignment, you need to finish two parts. The first one is to answer several simple questions, while the second part requires certain programming works.
Please submit your answers of the first part in PDF format, and all relevant codes and results of your second part together in a folder. You also need to **paste your result images of the second part in the PDF file**. **Please follow the structure of "Sample" folder to place your codes and result images (otherwise marks will be deducted)**. Then you should rename the "Sample" folder by your student ID and the programming language you use and compress it into a zip file. For example, if your student ID is "12345678" and you choose to use Matlab, then your folder should be "12345678_matlab".

This assignment should be submitted via the Canvas system on or before the due date.

1. Exercises

Answer the following question.

Part 1: Opening and Closing (10%)

Prove the validity of the duality expression of opening and closing.

$$(A \bullet B)^c = \left(A^c \circ \hat{B}\right).$$

Hint: You may use the duality relation of erosion and dilation without proof.

Part2: Dilation and Erosion (10%)

For the following given image A

0	0	0	0	0	0	0	0
0	0	0	0	0	**1**	**1**	0
0	0	0	0	**1**	**1**	**1**	0
0	0	0	0	**1**	**1**	0	0
0	0	**1**	**1**	0	0	0	0
0	**1**	**1**	**1**	0	0	0	0
0	**1**	**1**	0	0	0	0	0
0	0	0	0	0	0	0	0

and structuring elements B:

<1> B=

1	**1**	**1**
1	**1**	**1**
1	**1**	**1**

<2> B=

0	**1**	**0**
1	**1**	**1**
0	**1**	**0**

Calculate the dilation $A \oplus B$ and the erosion $A \ominus B$ using the structuring element <1> and <2> above.

2. Programming Tasks

Write programs to finish the following tasks.

2.1 Pre-requirement

2.1.1 Input: The input images are in the folder “input_imgs” (/Sample/input_imgs). You should test all the input images and paste the result images in the PDF file. Note that we will have some other test images for grading.

2.1.2 Language: Matlab/Octave/**Python 3.6**. For the students who choose to use Python, you need to transform our provided simple MAIN function into Python so that we can run your code.

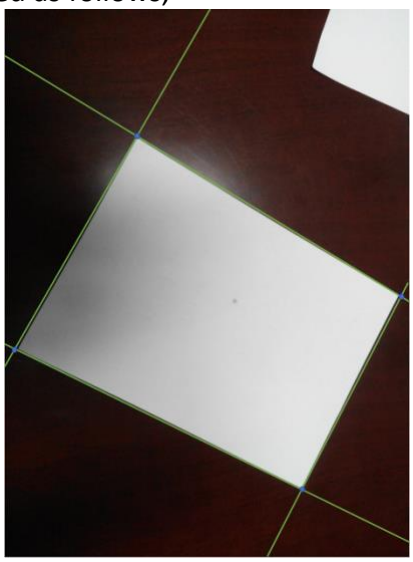
2.1.3 Functions to be used: In this assignment, you can use the built-in function for filtering and edge detection. However, you cannot use the built-in function relating to the Hough transform and image warping.

2.2 Hough Transform (40%)

For each input image, there is a piece of target A4 paper. Your task is to detect four sides of the target A4 paper by Hough transform and then compute 4 corners of the target. You should mark the lines and the corners in your result images. Here, an alternative framework for this part is provided:

a) Pre-processing: de-noise and edge extraction. You can try all the operators based on what you have learned in the previous lectures, for example, linear filtering or morphological image processing;
b) Hough transform. Please think about how to collect the target sides only since you will see there are some other unwanted edges in the input images.
c) Compute the corner points based on the 4 line functions.

The function prototype is given in the hough_transform.m.
A sample output is provided as follows,



2.3 Image Warping (40%)

Based on the 4 corner points computed from task 2.2, apply the image warping to transform the target A4 paper into a standard A4 form, that is, $210n * 297n$ for vertical direction and $297n * 210n$ for horizontal direction, where n is the parameter decided by the user. Inside your own image warping function, you also need implement your own bilinear interpolation.
The function prototype is given in the image_warping.m.
A sample output is provided as follows,