

The Hong Kong University of Science and Technology
Department of Computer Science and Engineering
MSBD 5010 (Fall 2024)

Assignment 2

Total = 100 marks

Due: 11:55 pm, November 18, 2024

Assignments must be submitted via CANVAS

Late Policy: Late assignments will incur a 10 scores penalty; only one day late is allowed, i.e., 11:55 pm, November 19, 2024

Programming assignments

In this assignment, you will use Python to complete 4 tasks. They are *color_complement_rgb/hsi* for color complement transformation, *bilinear_interpolation* for image upsampling to higher resolution version, *em_segmentation* for image segmentation using expectation maximization algorithm, and *image_registration* for image registration using the RANSAC algorithm.

You need to complete the missing implementations in the corresponding Jupyter Notebook (ipynb) file. You can download the ipynb file (*MSBD5010_hw2.ipynb*) and related files from the course CANVAS website.

Assignment Submission and Marking

1. Your submitted Jupyter Notebook file must be *MSBD5010_hw2.ipynb*.
 2. **Runtime requirement:** your program must be able to finish all the above tasks within **5** minutes.
 3. You must compress all your files into one file with the following filename format: [your 8-digit student ID]_assign2.rar (or zip), e.g., 09654321_assign2.rar.
 4. If your assignment compressed file has been submitted multiple times before the due date (including late submission date), the new version will replace the old version in marking.
 5. Note that we take plagiarism seriously. You are allowed to discuss or share your ideas with your classmates, but you are not allowed to share your assignment's code/pseudocode. Please also follow the referencing skills at <https://libguides.ust.hk/referencing/plagiarism> to avoid plagiarism.
 6. Marks will be deducted if any violations of the above requirements exist.
 7. Grading criteria:
 - a. The correctness and efficiency of the implemented algorithm.
 - b. The clarity and quality of the results.
 - c. The program's organization and documentation.
 - d. Adherence to the assignment requirements and submission guidelines.
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Written assignments

Assignment Submission:

1. You must submit your written assignment in PDF format with the following filename: [your 8-digit student ID]_w-assign2.pdf, e.g., 09654321_w-assign2.pdf.
2. You must include your pdf file in the rar/zip file mentioned above.

Question W1: Morphological Image Processing

Opening on an image A with a structuring element B is defined as

$$A \circ B = \bigcup \{(B)_z \mid (B)_z \subseteq A\}.$$

Performing opening on the following input image and complete the output image accordingly.

Input Image							
0	0	0	0	0	0	0	0
0	1	0	1	1	0	0	0
0	1	1	0	1	1	1	1
0	1	0	1	1	0	0	1
0	0	1	0	1	1	0	1
0	0	1	1	1	1	1	0
1	1	1	0	1	0	1	1
0	0	0	0	0	0	1	0

Output Image							
*	*	*	*	*	*	*	*
*							*
*							*
*							*
*							*
*							*
*							*
*	*	*	*	*	*	*	*

Structuring element (SE) B with the origin located at the center of the matrix:

0	1	0
0	1	1
0	1	0

Question W2: Hough transform

(1) Given the following image with points denoted by the coordinate (x, y) . Perform Hough transform to detect lines, show the all steps and plot the parameter plane.

$(0, 0)$		$(0, 2)$
$(1, 0)$	$(1, 1)$	
$(2, 0)$		$(2, 2)$

(2) Let the threshold be 3, how many lines can we find?

(3) Given the following image with points denoted by its coordinate (x, y) , if we perform Hough transform to detect circles, what will be the parameters to best match the points?

		$(1, 2)$	
	$(2, 1)$		$(2, 3)$
		$(3, 2)$	