

ME 5411 Robot Vision and AI

CA – AY25/26 Semester 1

Computing Project

You will be assigned to a random group of 3-4 students to work on the computing project. The software must be developed using MATLAB.

(https://nusit.nus.edu.sg/services/software_and_os/software/software-for-student/)

You are encouraged to rely on your own implementations for the different steps of this project. You will be rewarded doing so. Otherwise, you are allowed to use MATLAB's Imaging Toolbox and any other toolboxes related to Machine Learning.

In your report, you should include the following:

1. an introduction to the problem,
2. a description of your algorithm and flow chart,
3. screen captures of every stage of the image processing, and
4. a discussion and conclusion including an explanation on why you choose the method employed in your project, which investigation you performed, and what lessons you learned.

You should upload your report and software online to CA-Project under Assignments at NUS Canvas by 16 November 2025, 2359hrs Singapore time.

This is a group project. Please submit only one set of report and software. All members of the group will receive the same score. Name your submission as *Group XX.zip*. Please indicate the names and IDs of all group members on the cover page of your report.

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Figure 1 shows a BMP image of a label on a microchip. This image is available in a file with the name: **charact2.bmp**



Figure 1: Image 1

Perform the following tasks:

1. Display the original image on screen. Experiment with contrast enhancement of the image. Comment on the results.
2. Implement and apply a 5x5 averaging filter to the image. Experiment with filters of different sizes. Compare and comment on the results of the respective image smoothing methods.
3. Create a sub-image that includes the line – HD44780A00.
4. Convert the sub-image from Step 3 into a binary image.
5. Determine the outline(s) of characters in the image.
6. Segment the image to separate and label the different characters as clearly as possible.
7. A data set contained in the file *dataset_2025.zip* is provided on CANVAS. Divide this dataset into two portions: (a) a 75% portion that will be used as the training set, and (b) the remaining 25% portion as the validation (testing) set. Use these two sub-datasets to complete the following three tasks:

Task 1: Design a CNN to classify each characters in Image 1 (see Figure 1).

Task 2: Desing a classification system, using a **non-CNN-based** method (or a combination of such methods) selected from those methods that have been covered in Part 2 of this course, to classify each character in Image 1.

Task 3: Report the results obtained from Task 1 and Task 2, and compare the effectiveness and efficiency of the two approaches (i.e., one uses a CNN, the other does not) used in Task 1 and Task 2. Provide your

own explanation on any differences in the results between these two approaches.

Note: Do not use the characters in Image 1 as training data for your classifier.

8. In carrying out Step 7, also experiment with pre-processing of the data (e.g., padding/resizing the input images) as well as with hyperparameter tuning. In your report, discuss your findings and how sensitive your approach is to these changes.

The End

Deliverables:

- Matlab codes
- No more than 50 pages for your report. A good size is about 30+. Use Arial Font Size 11 and single line spacing to type your report.

What we are looking for in our grading:

- Correctness of solution
- Quality of solution
- Effort
- Proper report writing