

## ME 5405 Machine Vision

### CA – AY24/25 Semester 1

#### *Computing Project*

You will be assigned to a random group of 2-3 students to work on the computing project. The software must be developed using MATLAB. 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. Indicate the toolboxes you used and

**Do not use ChatGPT or any AI program to generate code!**

In your report, you should include the following:

1. an introduction to the tasks,
2. a description of your algorithms and flow charts,
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 to course site of NUS Canvas by 20 November 2024 (Wednesday).

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.

**Image 1: Hello.jpg**

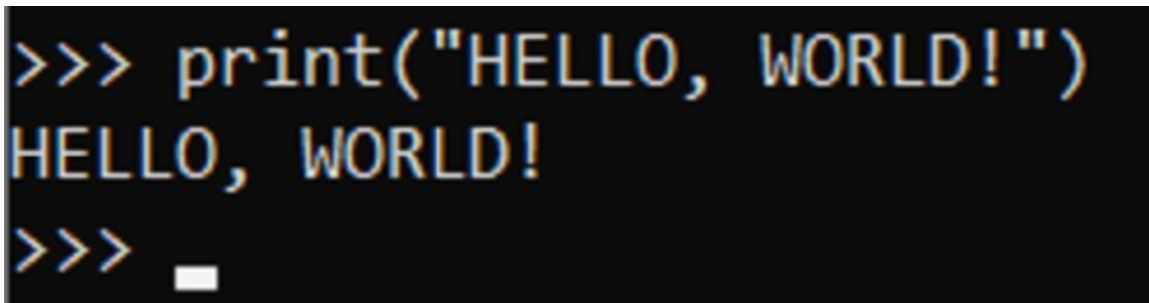


Perform the following tasks in sequence:

1. Display the original image on screen. Convert the image to grayscale image. Experiment with contrast enhancement of the image. Comment on the results.
2. Straighten the characters “HELLO!” in the image using the three different interpolation methods mentioned in class. Compare and comment on the results.
3. 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 smoothing methods.
4. Implement and apply a high-pass filter on the image in the frequency domain. Compare and comment on the resultant image in the spatial domain.
5. Segment the image to separate and label the different characters as clearly as possible.

### Image 2: hello\_world.jpg

Image 2 is a JPEG color image, comprising three lines of characters.



Perform the following tasks:

1. Display the original image on screen.
2. Create an image which is a sub-image of the original image comprising the middle line – HELLO, WORLD.
3. Create a binary image from Step 2 using thresholding.
4. Determine a one-pixel thin image of the characters.
5. Determine the outline(s) of characters of the image.
6. Segment the image to separate and label the different characters.
7. Using the training dataset provided on Canvas (*p\_dataset\_26.zip*), train the (conventional) unsupervised classification method of your choice (i.e., self-ordered maps (SOM), k-nearest neighbors (kNN), or support vector machine (SVM)) to recognize the different characters (“H”, “E”, “L”, “O”, “W”, “R”, “D”). You should use 75% of the dataset to train your classifier, and the remaining 25% for validation (testing). Then, test your trained classifier on each characters in Image 2, reporting the final classification results. **Do not use the characters in Image 2 as training data for your classifier.**
8. Throughout step 7 (training of the classifier), also experiment with pre-processing of the data (e.g., padding/resizing input images) as well as with hyperparameter tuning. In your report, discuss how sensitive your approach is to these changes.

Bonus Task:

Recognize the different characters (“H”, “E”, “L”, “O”) in Image 1. Comment on the results.