ME 5405 Machine Vision

CA – AY23/24 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.

In your report, you should include the followings for Image 1 and Image 2.

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 to course site of NUS Canvas by 18 November 2023 (Saturday).

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: Chromosomes (Available on NUS Canvas ME5405 course site – chromo.txt)

Image 1 is a 64x64 32-level image. It is a coded array that contains an alphanumeric character for each pixel. The range of these characters is 0-9 and A-V, which corresponds to 32 levels of gray.

Perform the following tasks:

1. Display the original image on screen.
2. Threshold the image and convert it into binary image.
3. Determine an one-pixel thin image of the objects.
4. Determine the outline(s).
5. Label the different objects.
6. Rotate the original image by 30 degrees, 60 degrees and 90 degrees respectively.

Image 1

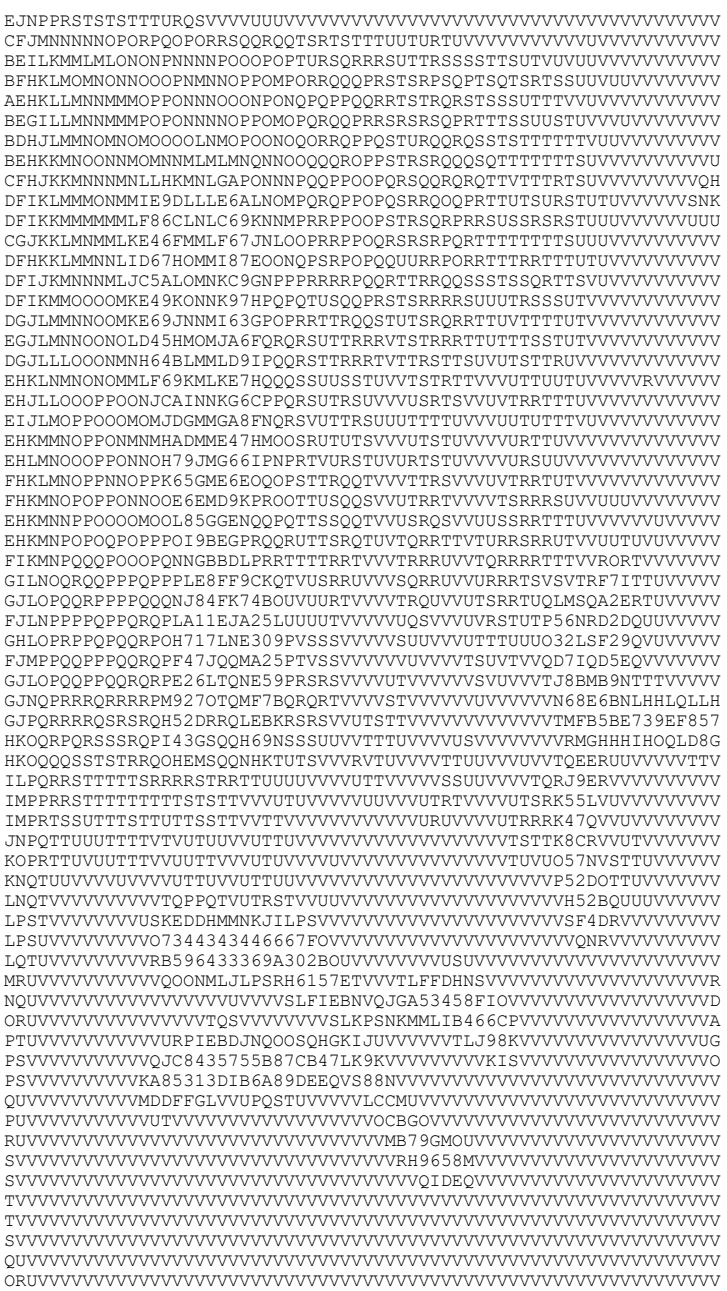

Image 2: Characters (Available on NUS Canvas ME5405 course site – hello_world.jpg)

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 LumiNUS (*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 1, 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.

Image 2