INTRODUCTION TO DIGITAL IMAGE PROCESSING

ASSIGNMENT 1

Due date: Thursday, October 4, 2018 by 5 pm
Total marks: 5
Late penalty: 0.5 marks per day overdue. Late assignments will not be accepted after 5 pm on Monday, October 8, 2018, and a mark of zero will be given.

All assignments will be done in **groups** of 3-4, and the same final mark for the assignment will be assigned to all group members. Instructions for forming a group in OWL are given in the Appendix. You can use the Forum feature in OWL to search for potential partners. You are not required to keep the same group for each subsequent assignment. Graduate students can have overlapping members with their project groups. Moreover, undergraduate and graduate students may work together.

Instructions for submitting answers are given with each question below. Note that I allow you to keep resubmitting until the deadline. Only the last submission is available to the TAs for marking. I recommend that all group members should agree to a submission before uploading it.

CONVENTIONS

Fixed-point font (`Courier`) is used to denote MATLAB commands, variables and filenames.

OBJECTIVES

1. To gain experience with writing functions in MATLAB using programming statements (`function`, `for`, etc).

2. To help you become familiar with MATLAB's help facilities.

3. To determine how well you can translate word descriptions into functions.

PROBLEMS

Write a MATLAB function that accepts a `uint8` image matrix called `im` and outputs a vector `v` of size 1 x 256 such that `v(i)` is equal to the number of pixels with graylevel `i-1` where `i` is an integer such that $1 \leq i \leq 256$. The function header should be:

```
function v = countGL_#( im )
```

where # is your group number. For instance, if you are part of Assignment Group 1, your filename would be `countGL_1.m`. If you are part of Assignment Group 17, your filename would be `countGL_17.m`.

If the argument is not of type `uint8`, your function should warn the user by printing "Image matrix must be of type uint8", then set `v` to the empty vector using the statement `v = []` and exit the function. Note, generally we will not do any input checking when designing functions. However, I am simply asking you to do this minimal check so you can gain practice with using MATLAB's documentation. There are many other things we could check for, but these do not add to your learning experience so I have not broached them.

You can use any functions in MATLAB except `imhist`. You may also find some of the following MATLAB functions and operators useful but are not restricted to them only:

> `nargin`, `disp`, `return`, `isa`, `uint8`, `max`, `min`, `for…end` and relational operators such as `==`, `>=`, `<=`, `<`, `>`) and logical operators such as `~` and `&`

NOTE: You will have to use the `help` function in MATLAB to learn about the functions listed above. Part of the purpose of this assignment is to make you familiar with MATLAB's help features.

All code and answers requested below must be submitted using OWL. For the first assignment, I will demonstrate this in class, but I have included instructions here and will do so for every assignment. To provide answers via OWL:

1. **One group member should log into OWL and select "ECE 4445A 001 FW18".**
2. **From the left-hand side, select "Assignments".**
3. **From the page that comes up, select "Assignment 1".**
4. **You will now reach the submission page for Assignment 1. Follow the instructions below for each part to submit answers.**

(a) First, form a group as per the instructions in the Appendix. **You are required to use the OWL Groups feature to record your assignment partner choices as described in the Appendix.**

(b) **[4.5 marks]** Save the function in a file called `countGL_#.m` where # is your group number. For instance, if you are part of Assignment Group 1, your filename would be `countGL_1.m`. If you are part of Assignment Group 17, your filename would be `countGL_17.m`. **NOTE: Use the exact filename and function name as specified above. Uppercase/lowercase is important. Your function should be commented.**

When you are on the submission page in OWL for Assignment 1, scroll to the bottom and attach your M-file. Also, cut and paste this code into the text box taking care to label this as part (b).

(c) **[0.5 marks]** Generate an image using the following set of MATLAB commands:

```
>> row = uint8(0:255);
>> im = repmat(row, 100, 1);
```

Now, create a stem plot of the number of pixels at each graylevel 0, 1, …, 255 in `im` by typing the following:

```
>> stem( 0:255, countGL_#(im))
>> set(gca, 'xlim', [0, 255], 'ylim', [0, 150])
>> title('Assignment 1', 'fontsize', 16)
>> xlabel('Gray level')
>> ylabel('No. Pixels')
```

Note: In the first command (i.e., `stem`) the # symbol will be replaced with your actual group number.

Once you generate the stem plot, you should save the display by selecting "File" in the figure window and then "Save As…". In the dialog box that comes up, select "TIFF image (*.tif)" as the output type and for "File name", enter "1c_#" without quotes where # is your group number. This will save the figure in the file called "1c_#.tif". **Attach it in OWL as you did the M-file.**

In the text box on the assignment submission page, enter the name and student number of each group member.

MATLAB RESOURCES

All MATLAB guides can be found at:

http://www.mathworks.com/access/helpdesk/help/helpdesk.shtml

which can also be accessed by typing `doc` at the MATLAB prompt. For information on the image processing toolbox, select the link labelled "Image Processing Toolbox".

APPENDIX

Step 1: Log into OWL and click on Site Info. Click on the section near the bottom labelled Groups you can join**.** There should be a list of 50 potential groups to join. These are called "Assignment Group 1", "Assignment Group 2", …, "Assignment Group 50".

Step 2: Once a student joins a group you will see his/her name under **Members**. If you see your partner's name in a group, join that group by hitting the "Join" button. If you don't see your partner's name, join **any** empty group; when your partner goes to join a group they will see your name and join yours. If you joined the wrong group, you can leave or un-join the group.