**INTRODUCTION TO DIGITAL IMAGE PROCESSING ASSIGNMENT 1**

## Due date: Feb. 10, 2024, by 11:55 pm Eastern Time.

**Total marks: 5**

**Late penalty: 0.5 marks per day overdue. Late assignments will not be accepted after 11:55 pm on Thursday (Eastern Time), Feb. 12, 2024, and a mark of zero will be given.**

All assignments will be done **individually or in a group (up to two students)**, and the final mark for the assignment will be assigned to each of you by myself. If the assignment has been conducted in a group, every student in the group will be assigned the same mark. If you are in a group, please submit only ONE assignment document in OWL but includes ALL team members name. Otherwise, one of your team member will not receive marks.

Note that I allow you to keep resubmitting until the deadline. Please get in touch with TA if you are unable to resubmit your files.

## CONVENTIONS

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

## OBJECTIVES

1. Learn to use SIFT feature with multilayer perceptron.
2. Using Matlab or Python to conduct basic Image Classification research

## Topics

## PROBLEM 1 (5 points)

Write MATLAB files that conduct a basic image classification problem. Here are several steps to follow:

1. Download a dataset for image classification from the internet. You can choose the IMAGE dataset from the UCI dataset library (<https://archive.ics.uci.edu/ml/datasets.php>) or select one from MATLAB (<https://www.mathworks.com/help/deeplearning/ug/data-sets-for-deep-learning.html>). If the dataset is too large, simplify it by reducing the number of classes to 2, making it a binary classification problem.
2. Normalize the images as needed. Use the SIFT feature detector discussed in class to extract SIFT features from all images. You can refer to the in-class demo shared in the OWL for guidance.
3. Randomly split the data samples into two parts: one for training and the other for testing.
4. Use the MLP network discussed in class. To speed up the process, you can use the Neural Network Toolbox in MATLAB. If you'd like a challenge, modify the in-class demo shared in the OWL to train the network instead of using the toolbox. Be sure to set all MLP training parameters carefully.
5. Report the training and testing accuracy in a PDF report for the assignment.
6. Use the same dataset again, but this time, skip step 2 and directly convert the raw image into a vector-based shape. Then complete steps 3 to 4 with this new data. Compare the training and testing accuracy obtained from the SIFT-based results with those from the non-SIFT based results.

Important Note: a) You could name your m function by yourself. However, we need at least two functions in the main file, one for SIFT feature extraction, one for NN training. b) If the image is colorful images, convert it to grayscale image using built-in MATLAB function rgb2gray. c) all the MATLAB functions are available to use d) There is ample room for creativity and experimentation in the design of the algorithms. Feel free to include additional functions if necessary. e) It is important to achieve consistent results for both training and testing accuracy. An accuracy of 100% in training but only 10% in testing would indicate a problem. However, unless the performance is extremely low, no points will be deducted. f) Network architecture: You could free to use any MLP network architecture as long as MLP has more than two hidden layers.

## Submission

please submit two .m script files to owl.

1. The **main.m** script file, which includes the following functionability (as mentioned above):

* Extract SIFT features (could be one or two subfunction files)
* Training MLP (could be at least one subfunction file)
* Display the performance (could be at least one subfunction file)

1. Multiple **MATLAB function** files, which implements the operations mentioned above. You can name the function file as you want. However, only the MATALB function format file can be accepted. About MATLAB function format, please refer this link ((<https://www.mathworks.com/help/matlab/ref/function.html>)
2. If you work with another student in a group, only one of you should submit the assignment, not both. Please make sure to include your name and your partner’s name in the Assignment Report.
3. Please submit your MATLAB codes files along with the assignment report through OWL.

# All code and PDF report requested below must be submitted using OWL. To provide answers via OWL:

* 1. **You should log into OWL and access the course web site accordingly.**
  2. **Select the “Assignments” tool.**
  3. **From the page that comes up, select “Assignment 1”.**
  4. **You will now reach the submission page for Assignment 1. Attach the m files you did.**