Homework #7
Due M 4/15

You must turn in your code as well as output files. Please generate a report that contains the code
and output in a single readable format.

Visit the book website to download companion software, including all the example problems.
`http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118414322.html`

Test Images
Download the sample images from the class website
`http://www.ee.unlv.edu/~b1morris/ee482/docs/hw07`

1. Viola and Jones

   In this problem, you will examine the Viola-Jones cascade object detector for faces. Use the
   code below to answer the following questions.

   (a) Compare the results on `visionteam.jpg` with the default `MergeThreshold`=4 and 0.
       Show the result side-by-side and comment on the parameter. Be sure to explain what
       the parameter does and how it affects the results.

   (b) Compare the results between the default model and the `FrontalFaceLBP` model (in order
       to get all detections use `MergeThreshold=0` for both models). Show results side-by-side
       and comment on the performance comparison.

   (c) Repeat the part (b) comparison by testing the performance on the soccer team images
       from the first homework (hw01). Give your processing time for each image (`tic.m`,
       `toc.m`).

```matlab
%% Viola Jones Face Detector
%read image
I = imread('visionteam.jpg');

MergeThreshold = 4;

%create Viola Jones detector
VJ = vision.CascadeObjectDetector('MergeThreshold',
    MergeThreshold);

%detect faces
tic
bboxes = VJ(I);
%time detector
t_VJ = toc

%annotate detected faces
Ifaces = insertObjectAnnotation(I, 'rectangle', bboxes, 'Face');

figure;
imshow(Ifaces, []);
title('Viola Jones Face Detector');
```

```
22
23 % more parameters https ://www.mathworks.com/help/vision/ref/
      vision.cascadeobjectdetector-system-object.html
24
25 %clean up
26 release(VJ);
```

2. Dalal and Triggs HOG Detector

In this problem, you will examine the HOG pedestrian detector. Use the code below to answer the following questions.

(a) Compare the results on `visionteam.jpg` and `visionteam1.jpg` using different parameter values. Show your "best" results side-by-side and give the parameters you used to generate each. Comment on where the HOG detector works well and where it fails.

(b) Compare the results between the default model and with different `WindowStride` values. Show results side-by-side and comment on the performance comparison. What are the advantages and disadvantage of different strides?

(c) Repeat the part (b) comparison by testing the performance on the soccer team images from the first homework (hw01). Give your processing time for each image (`tic.m`, `toc.m`).

```
1  %% HOG detector
2  %read image
3  I = imread('visionteam.jpg');
4  %I = imread('visionteam1.jpg');
5
6  %increase value when there are too many false positives
7  ClassificationThreshold = 0;
8
9  %adjust to group multiple responses
10 MergeDetections = false;
11
12 HOG = vision.PeopleDetector( 'ClassificationThreshold',
      ClassificationThreshold, 'MergeDetections', MergeDetections);
13
14 tic
15 [bboxes,scores] = HOG(I);
16 t_HOG = toc
17
18 Iped = insertObjectAnnotation(I,'rectangle',bboxes,scores);
19
20 figure;
21 imshow(Iped, []);
22 title('HOG Pedestrian Detector');
23 % notice detections contain area around the person (bounding
      boxes are not tight)
24
```

```
25 | % more parameters https://www.mathworks.com/help/vision/ref/
   |     vision.peopledetector-system-object.html
26 |
27 | %cleanup
28 | release(HOG);
```

3. Training a Detector

   In this problem, you will train a cascade object detector on a custom dataset and compare the performance for different feature types.

   (a) Read the Matlab Get Started with Cascade Object Detector page to better understand the training process and considerations. Be sure to read the help for `traincascadeobjectdetector` to understand the parameters.

   (b) Implement the 5-stage stop sign detector using `stopSignsAndCars.mat`. Show your output using on `stopSignTest.jpg` using `MergeThreshold=1`.

   (c) Increase the number of stages to 20. Compare the detectors using all three available `FeatureType`. Provide side-by-side comparison of test images for the different detectors (HOG, Haar, LBP). Give the final number of stages and training time for each. You may want to use the datastore input of textttvision.CascadeObjectDetector to process all four the sample images at once.

   (d) Repeat part (c) the evaluation using the rear car labels. Comment on results by comparison stop signs.

   (e) Try to improve the performance of the traffic sign detector using the Tiny Lisa Traffic Sign Dataset. You do not need a Kaggle account since the zip is part of the homework files. You need to only use the stop sign images. Again show your results on the four sample images.