GI14 / M054 Machine Vision: Homework #1
Due 13th November 2013 at 23:55pm
Worth 10% of your overall grade
Submit online, through Moodle

For this homework, we'll revisit the practical from the 3rd week: Mixtures of Gaussians. There are two parts (plus optional extra credit), so please read the instructions carefully. Everything you turn in must be YOUR OWN WORK, with one exception (in this case): the new images and their ground truth mask images. See below for more details, but as always, list names/references for anything you're submitting that is not your own work.
Late Policy: Within 24 hours late: 90% of marks, within 24-48 hours late: 80% of marks, later than 48 hours: 0%.

What to turn in (all inside one .zip file):

- One file containing your report, in .PDF format
- One folder containing your photos of apples
- One folder containing image masks for your apples
- One folder containing your code for Parts I, II, and the optional Extra Credit

Part I

A), B), C) Do parts A, B, and C of the Mixtures of Gaussians practical. Some of the TO DO's are tagged a-j.

For every figure or plot that is generated by the code, put a copy in your report, and write 1-3 sentences (maximum) explaining what the figure shows or pros/cons of what is happening.

DO NOT put your code in the report. Instead, for every "TO DO (●)" annotated with a letter (a-j) where you added your code, write (*in the report*) a 1-2 sentence (maximum) explanation of what is happening in this part of the code or why. It IS NOT SUFFICIENT to just say things like "update the variable."

You do NOT need to do the 4th part, practicalMixGaussD.

Part II (note: for-loops will be VERY slow, so try to avoid them!)

A) Download and unzip the file apples.zip. Notice that for every color photo containing apples, there is a corresponding binary image mask. In a mask image, white pixels indicate locations where the corresponding photo is an apple. Note that *these* mask images are inexact! While a perfect ground-truth mask image's black pixels should correspond to non-apples, these masks were painted in a hurry, so the white areas were painted conservatively. LoadApplesScript.m is there to help you.

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B) Train a mixture of Gaussians model for distinguishing apple vs. non-apple pixels. Use red, green, and blue as your dimensions for now. Make any other decisions you need to, and document them in your report.

C) Download the file testApples.zip. Put figures into your report, showing each pixel's posterior probability of being "apple."

D) For the test image with a ground-truth mask, quantify and report your result. Hint: consider applying a range of thresholds to the posterior to produce sets of {True Positives (TP), True Negatives (TN), False Positives (FP), and False Negatives (FN)} and using an ROC curve. Learn about ROC on Wikipedia or see Peter Flach's chapter on the subject.

E) Download two non-copyrighted photos with apples (maybe http://search.creativecommons.org/ or some other source of images that are not copyrighted). Make good ground-truth masks for them. You can use Windows Paint, or more sophisticated programs like Gimp (free). Use these as extra test-images. Report your qualitative and quantitative results.

F) We should really be using three separate sets of files: a training set, a validation set, and a test set! Explain why.

Extra Credit

(extra points help you reach a perfect score for the two courseworks only, so a maximum of 20% of the overall grade).

- Consider manipulating the photographs' colors to improve the classification
- Consider running 2D Gabor filters on the photos to get additional channels of data, in place or in addition to red, green, and blue.
- Consider using an alternate model to mixture of Gaussians and compare to MoG.