EEL6825: Homework 2

FALL 2003

Note: This homework is a mini-project and will take more time than a regular homework. Your final project could build off of the base this homework creates. Submit detailed and complete solutions, including well commented programming code and runtime listings. **See the homework submission guidelines.**

The purpose of this homework is to do a real-world classification problem. To classify complicated data, sophisticated models are required. Therefore, you are asked to build a mixture of Gaussians model for the given data. These models require the use of the EM algorithm to learn their parameters.

1. (100 points) On the homework website, you are given two sets of training images: {coke1.ppm, coke2.ppm, coke3.ppm} and {dietcoke1.ppm, dietcoke2.ppm, dietcoke3.ppm}. The first set represents a regular coke can and the second set represents a diet coke can. For the number of components, k, equal to 2, build a k-mixture of Gaussians model in the RGB color space of each object using the training images. Use the EM algorithm to learn the parameters of each model. You may use Dr. Nechyba's or any web available code, however, we highly recommend you write your own. (From experience, it can be faster and more educational to write your own code rather than figuring out what others did.)

2. (50 points) Repeat part (1) for $k = \{3, 4, 5\}$.

3. (100 points) On the homework website, you are given two test images: test1.ppm and test2.ppm, which represent unknown objects. Your task is to classify each image as either a "coke" or a "diet coke" object. To accomplish this, compare posterior probabilities $P(\text{“}coke''|x)$ and $P(\text{“}diet\ coke''|x)$ for each pixel and by majority voting decide the identity of the object. Classify the test images using each of the models from parts (1) and (2), that is, for each value of $k = \{2, 3, 4, 5\}$.

4. (50 points) Knowing that the test image test1.ppm is a coke can and that test2.ppm is a diet coke can, plot the percentage of erroneously classified pixels from part (3) in each image for each value of $k = \{2, 3, 4, 5\}$. What is the best model?