CS6410 Homework 4

Dr. Jundong Liu

Due: Dec. 5, Tuesday, before class

Tasks

In this project, we are asked to implement (or find an implementation of) two versions of Gaussian Mixture Models (GMM), and apply them to segment human brain MR images.

1. The first version is a univariate (one-dimensional) GMM, and you will take it to cluster the pixels of a T1-weighted MRI into Gray Matter (GM), White Matter (WM) and Cerebrospinal fluid (CSF). The parameter estimation should be carried out through the expectation-maximization (EM) algorithm, outlined in our lecture notes *Lect_GMM_EM_MRF_Brain.pdf* and the *Mixture Models and EM* chapter of Bishop's PRML book `http://www.cse.psu.edu/~rtc12/CSE586Spring2010/papers/prmlMixturesEM.pdf`. *K*-means can be used to initialize the model parameters.

2. The second implementation is to process a pair of matched T1-T2 images. A multivariate (two-dimensional) GMM is expected to be implemented to achieve the same goal – clustering pixels into GM/WM/CSF classes.

Data and Evaluations

Data: a pair of T1 and T2 weighted images from the same subject are attached. The images are t1_pn0_img.png and t2_pn0_img.png, respectively. The ground truth segmentation, gt_img.png, is also provided so you can evaluate the performance of the two solutions. gt_img has three intensity values: CSF class has intensity of 1, Gray Matter class is 2, White Matter is 3.

To measure the segmentation accuracy, you can use a **metric** called misclassification ratio (MCR), which is defined as:

$$\text{MCR} = \frac{\text{number of mis-classified pixels}}{\text{total number of pixels}} \tag{1}$$

Grades

This project is 100 points and worth 8 final points.

1) The 1D GMM implementation is worth 30 points.

2) The 2D GMM implementation is worth 40 points.

3) The report, which should include evaluations and some discussions of the algorithm implementation and performance, is worth 30 points.

4) If your GMM implementations were modified from certain online code, cite the source, and explain what modifications you have made.

Turn In

Email your report to `liuj1@ohio.edu` , with the subject "CS6410 Homework 4". For the source code, you can either integrate it into your report, or attach it as a separate file in the email.