Homework 1

BIOM 693: Advanced Biometrics
Instructor: Dr. Arun Ross
Due Date: March 5, 2009

Note: You are permitted to discuss the following questions with others in the class. However, you *must* write up your *own* solutions to these questions. Any indication to the contrary will be considered an act of academic dishonesty.

1. Consider the following hand geometry database: [click here for data]. Each row has 15 entries. The first entry indicates the user number, while the remaining 14 entries correspond to the feature values of the hand. Features were extracted based on the algorithm described in the paper "A Prototype Hand Geometry-based Verification System" by Jain et al. [PDF copy]. Generate a set of genuine and impostor scores for this database by utilizing the following distance/similarity measures:

   - Euclidean distance;
   - Manhattan distance;
   - Chessboard distance;
   - Cosine similarity.

   (a) [20 points] Plot the histogram of genuine and impostor scores corresponding to each measure. Report the mean and variance of the genuine and impostor scores in each case.

   (b) [20 points] Plot the ROC curves for each set of genuine and impostor scores, and compute the corresponding EER and d-prime values. Which of the four measures results in the best matching performance? Hint: To appreciate the differences in performance, use the semi-log scale to plot the ROC curve.

2. [25 points] Describe the following in the context of biometrics with an example: (a) Negative recognition; (b) Identity creep; (c) Functionality creep; (d) Template; (e) Multibiometrics.

3. [20 points] What are wolves, goats, lambs and sheep in Doddington's zoo? Explain with examples. Why is it necessary to characterize biometric users in this fashion?

4. Let $\widehat{p}(\text{s}|\text{genuine}) \sim \text{N}(70,25)$ and $\widehat{p}(\text{s}|\text{impostor}) \sim \text{N}(50,15)$ for a certain biometric system. Suppose the following decision rule is employed: assign s to the *genuine* class if $s > \eta$, else assign s to the *impostor* class. Here, $\eta \in (-\infty, \infty)$.

(a) [10 points] Plot these two distributions. If $\eta = 60$, what is the FAR and FRR of the biometric system?

(b) [5 points] Report the EER and d-prime value based on these distributions.
