**ECE 8527: Introduction to Machine Learning and Pattern Recognition**

# HW No. 5: Applications of HMMs

For the data set you have selected, compare classification using a basic PCA approach to an HMM approach. Select a frame duration small enough that events can be subdivided into at least 10 frames. For your baseline PCA system, assume each event is modeled by a concatenated vector consisting of a concatenation of each feature vector for each frame. For example, your events might be 10 frames long. Your input to PCA will be a supervector that is a concatenation of these 10 vectors. Use PCA to rotate this large vector down to *D* dimensions where *D* is on the order of 10 or 20. Build models for each class and use class-dependent PCA to classify the data. Compute your error rate as a function of *D*.

For your HMM system, model each event using a 3-state HMM. Build one HMM model for each class in your system. Evaluate performance as a function of the number of Gaussian mixture distributions allocated per state.

To do this experiment properly, you will need to partition your data into training and evaluation sets. The evaluation set should represent about 20% of the data and be disjoint from the training set.

Analyze the differences in performance between the HMM system and the PCA system. Comment on any trends you see in the error patterns.