

## CS 479/679 Pattern Recognition Sample Final Exam

1. [25 pts] True/False Questions – To get credit, you **must** give brief reasons.

**T F** The decision boundary of a two-class classification problem where the data of each class is modeled by a multivariate Gaussian distribution is always linear.

**T F** The Maximum Likelihood estimation solution is always of the assumed parametric form.

**T F** Genetic Algorithms is an example of a heuristic search algorithm for feature selection.

**T F** Linear Discriminant Analysis (LDA) finds a space of lower dimensionality by choosing the directions where the data varies most.

**T F** The convergence of the EM algorithm is highly dependent on the choice of the learning rate.

2. **[20 pts]** What numerical computational issues arise in practice when using PCA or LDA on data of high dimensionality (e.g., images)? How do we deal with them?

3. **[15 pts]** (a) What is the EM algorithm?

(b) What kind of problems is EM best for?

(c) Explain the main idea behind applying EM algorithm for estimating the parameters of a Mixture of Gaussians (MoGs).

4. **[15 pts]** How would one perform Bayesian classification assuming that classification errors are not all equally important?

5. **[15 pts]** (a) What is the criterion being optimized by SVMs?

(b) What is the meaning of the support vectors and why are they important?

(c) How do SVMs handle the case of non-linearly separable data?

6. **[10 pts]** What is the geometric interpretation of the value  $g(\mathbf{x})$  computed by a linear discriminant function  $g(\mathbf{x}) = \mathbf{w}^T \mathbf{x} + w_0$  given some feature vector  $\mathbf{x}$ ? Prove it.

7. [15 pts] (Graduate Students Only) Derive the "Perceptron" rule and explain how it works.