

CS 479/679 Pattern Recognition
Spring 2013 – Prof. Bebis
Final Exam
10:15 AM – 12:15 PM

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

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 A classifier that maximizes the margin of separation between two classes has high VC dimension (or capacity).

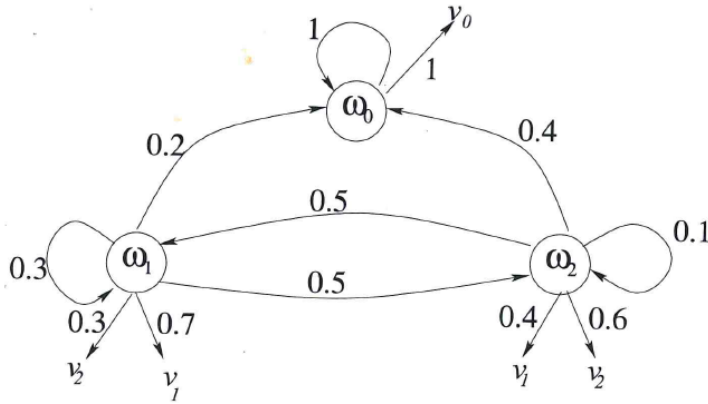
T F The Bayesian estimation solution is always of the assumed parametric form.

T F Linear Discriminant Analysis (LDA) projects the data in a space of lower dimensionality in a way that preserves as much information in the data as possible.

T F MAP is equivalent to ML when the prior probability of the parameters is uniform.

2. **[15 pts]** What is the EM algorithm? What kind of problems is it best for? Explain the main idea behind using EM to estimate the parameters of a Mixture of Gaussians (MoGs).

3. [20 pts] Consider an HMM model shown below; ω_0 is an absorbing state and v_0 is a unique symbol emitted at this state. **(a)** Suppose that the initial state at $t=0$ is ω_1 . Starting from $t=1$, what is the probability that the HMM generates the sequence $V=\{v_2, v_1, v_0\}$? **(b)** Given the above sequence V , what is the most probable sequence of states?



4. [15 pts] Consider the following probability distribution:

$$p(x) = \begin{cases} 2\theta x e^{-\theta x^2} & \text{if } x \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

Given n points x_1, x_2, \dots, x_n sampled from the above distribution, derive a formula for the maximum likelihood estimate of θ .

5. **[15 pts]** Consider the eigenface approach. Describe the steps for (i) recognizing a face, and (ii) detecting a face. **Note:** I am not asking for the steps to compute the eigenfaces; I am only asking for the steps to recognize a given face or to decide whether the input is a face or not.

6. **[10 pts]** What is the "kernel trick" and why is it useful?