

CS 479/679 Pattern Recognition Sample Midterm Exam

1. [20 pts] True/False Questions – To get credit, you **must** give brief reasons for your answers.

T F The Bayes rule is always an optimum classification rule in the sense that it minimizes the average probability error.

T F Adding more features will in general improve classification accuracy.

T F A causal relationship typically exists between correlated events.

T F A linear discriminant function could optimally separate the data between two classes when the features in each class are uncorrelated.

T F Given a set of N random variables $X=\{X_1, X_2, \dots, X_N\}$, the pdf of any single random variable X_i can be computed from the joint pdf of X .

2. [15 pts]] Short answer questions.

a. Why do simpler models typically perform better than complex models in pattern recognition?

b. What are the fundamental similarities/differences between Maximum A-Posteriori parameter estimation (MAP) and Bayesian parameter estimation (BE)?

c. Under what conditions would the optimal decision boundary between two classes, each modeled by a Gaussian distribution, **not** pass from the midpoint of the line joining the means of the distributions?

d. How could a matrix A be diagonalized? Are all matrices A diagonalizable? Explain.

3. **[15 pts]** Consider a c -class classification problem; under what conditions would the optimal classifier be equivalent to (a) the minimum distance classifier? (b) the Mahalanobis distance classifier?

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

$$p(x) = \begin{cases} (\theta + 1)x^\theta & \text{for } 0 \leq x \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

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. **[20 pts]** Discuss the main ideas of the parameter estimation techniques presented in class and compare them with each other. Are their solutions always different? Explain.

6. [15 pts] Using the Bayesian network below, answer the following question: suppose all we know is that a fish is thin, has medium lightness, and was caught in south Atlantic; what season is it now, most likely?

