

Name: \_\_\_\_\_

**Practice Quiz - 1**  
**CS 591Q/791V - Pattern Recognition**  
**Posted on: March 4, 2010**

**Note:**

Univariate normal density:  $N(\mu, \sigma^2) = \frac{1}{\sqrt{2\pi}\sigma} e^{\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]}$ .

1. [6 points] Briefly describe the following terms: (a) Bayes Risk; (b) Minimum Distance Classifier.
2. [8 points] Consider a two-category one-feature classification problem with the following Gaussian class-conditional densities:

$$p(x|\omega_1) \sim N(0, 1),$$

$$p(x|\omega_2) \sim N\left(\frac{1}{2}, 4\right).$$

Assume  $P(\omega_1) = P(\omega_2) = 1/2$  and a 0-1 loss function. Derive the Bayes decision boundary.

3. [6 points] Let  $\omega_{max}(\mathbf{x})$  be the state of nature for which  $P(\omega_{max}|\mathbf{x}) \geq P(\omega_i|\mathbf{x})$  for all  $i = 1, 2, \dots, c$ . Show that for the minimum error-rate decision rule, the average probability of error is given by

$$P(error) = 1 - \int P(\omega_{max}|\mathbf{x})p(x)dx.$$

4. [5 points] Compute the entropy of a univariate Gaussian distribution with mean 0 and variance  $\sigma^2$ .
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