

EEL 6825

Spring 05 Gao

HW #4 Part I due March 8

Read Ch 2

A1 (a) Is it possible for the Bhattacharyya bound to be less than the Bayes error? Assume that you are given the exact distributions, parameters and a priori probabilities. Explain why or why not.

(b) Is it possible for the Bhattacharyya bound to be greater than  $1/2$  for a two-class classification problem? Explain why or why not.

A2 Find a discriminant function  $g(x)$  that successfully classifies the following data points. Class  $\omega_1$  points are given by:

$$\begin{bmatrix} 0 \\ 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

Class  $\omega_2$  points are given by:

$$\begin{bmatrix} 0 \\ 1 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

A3 Given sampled data points, a student found that a linear classifier outperformed the Bayes classifier. Since she correctly assumed that the data was generated by Normal distributions, what probably was the explanation? (The Bayes classifier is supposed to be optimal!)

A4 Given the following data points, find the  $w$  vector that minimizes the Fisher criterion. Assume  $P(\omega_1) = P(\omega_2)$ . Make sure that you normalize  $w$  and that it points in the proper direction. Justify your answer.

Class  $\omega_1$  points are given by:

$$\begin{bmatrix} 0 \\ 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

Class  $\omega_2$  points are given by:

$$\begin{bmatrix} 1 \\ 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix} \begin{bmatrix} 2 \\ 2 \end{bmatrix}$$

A5 Given the following data points, find the  $w$  vector that minimizes the Fisher criterion. Assume  $P(\omega_1) = P(\omega_2)$ . Make sure that you normalize  $w$  and that it points in the proper direction. Justify your answer.

Class  $\omega_1$  points are given by:

$$\begin{bmatrix} 0 \\ 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Class  $\omega_2$  points are given by:

$$\begin{bmatrix} 1 \\ 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$