CSE 562 Midterm Exam

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I. Question

For a two-class problem, for the four cases of Gaussian densities in Table 5.1, derive $\log \frac{P(C_1|x)}{P(C_2|x)}$.

II. Question

Given three normal distributions

$$p(x|C_1) \sim \mathcal{N}(1,1)$$
$$p(x|C_2) \sim \mathcal{N}(2,4)$$
$$p(x|C_3) \sim \mathcal{N}(3,1)$$

and the priors

$$P(C_1) = \frac{1}{2}$$
$$P(C_2) = \frac{1}{4}$$
$$P(C_3) = \frac{1}{4}$$

calculate the Bayes' discriminant points analytically.

III. Question

Give the sequence of S and G boundary sets computed by the CANDIDATE-ELIMINATION algorithm if it is given the sequence of training examples from Table below.

Sky	AirTemp	Humidity	Wind	Water	Forecast	EnjoySport
Sunny	Warm	High	Strong	Cool	Change	Yes
Rainy	Cold	High	Strong	Warm	Change	No
Sunny	Warm	Normal	Strong	Warm	Same	Yes
Sunny	Warm	High	Strong	Warm	Same	Yes

IV. Question

Given the Bayesian graph in Figure 3.5, how do you generate random data from that structure? Give an example.

V. Question

Assume our hypothesis class is the set of lines, and we use a line to separate the positive and negative examples. Show that the VC dimension of a line is 3.

VI. Question

In many pattern classification problems one has the option either to assign the pattern to one of K classes, or to reject it as being unrecognizable. If the cost for rejects is not too high, rejection may be a desirable action. Let

$$\begin{aligned}\lambda(\alpha_i|C_j) &= 0 \quad i = j\\ \lambda(\alpha_i|C_j) &= \lambda_r \quad i = K+1\\ \lambda(\alpha_i|C_j) &= \lambda_s \quad otherwise\end{aligned}$$

where λ_r is the loss incurred for choosing the (K + 1) action, rejection, and λ_s is the loss incurred for making any error. Show that the minimum risk is obtained if we decide C_i if $P(C_i|x) \leq P(C_j|x)$ for all j and if $P(C_i|x) \leq 1 - \frac{\lambda_r}{\lambda_s}$, and reject otherwise.