Assignment 1: Get Ready for LaTeX

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Problems

Problem: 无标号问题

在一个 10 类的模式识别问题中, 有 3 类单独满足多类情况 1, 其余的类别满足多类情况 2. 问该模式识别问题所需判别函数的最少数目是多少?

Answer: 答案写在此处.

Problem 1

Consider the following decision rule for a two-category one-dimensional problem: Decide ω_1 if $x > \theta$; otherwise decide ω_2.

    (a) Show the probability of error for this rule is given by

$$P(\text{error}) = P(\omega_1) \int_{-\infty}^{\theta} p(x|\omega_1)\,\mathrm{d}x + P(\omega_2) \int_{\theta}^{\infty} p(x|\omega_2)\,\mathrm{d}x.$$

    (b) By differentiating, show that a necessary condition to minimize $P(\text{error})$ is that satisfy

$$p(\theta|\omega_1)P(\omega_1) = p(\theta|\omega_2)P(\omega_2).$$

    (c) Does this equation define θ uniquely?

    (d) Give an example where a value of θ satisfying the equation actually maximizes the probability of error.

Answer: 考虑分类错误率的条件概率:

$$P(\text{error}|x) = \begin{cases} p(\omega_1|x), & \text{if we decide } \omega_2, \\ p(\omega_2|x), & \text{otherwise.} \end{cases} \tag{P1.1}$$

根据式 (P1.1) 对 x 进行积分, 可得:

$$P(\text{error}) = \int_{-\infty}^{\infty} P(\text{error}|x)p(x)\mathrm{d}x \tag{P1.2}$$

$$= P(x \le \theta, x \text{ is } \omega_1) + P(x > \theta, x \text{ is } \omega_2) \tag{P1.3}$$

$$= p(x \le \theta|\omega_1)P(\omega_1) + p(x > \theta|\omega_2)P(\omega_2) \tag{P1.4}$$

$$= P(\omega_1) \int_{-\infty}^{\theta} p(x|\omega_1)\,\mathrm{d}x + P(\omega_2) \int_{\theta}^{\infty} p(x|\omega_2)\,\mathrm{d}x. \tag{P1.5}$$

Computer Exercises

Several of the computer exercises will rely on the following data.

此处还可以插入一些说明.

Computer Exercise 1

Illustrate the fact that the average of a large number of independent random variables will approximate a Gaussian by the following:

(a) Write a program to generate n random integers from a uniform distribution $U(x_l, x_u)$.

(b) Now write a routine to choose x_l and x_u randomly, in the range $-100 \le x_l < x_u \le 100$, and n (the number of samples) randomly in the range $0 < n \le 1000$.

(c) Generate and plot a histogram of the accumulation of 10^4 points sampled as just described.

(d) Calculate the mean and standard deviation of your histogram, and plot it.

(e) Repeat the above for 10^5 and for 10^6. Discuss your results.

Answer: 答案写在此处,如代码 1 所示.

```
1  print('Hello, world!')
```

<div align="center">Listing 1: 代码测试</div>

为了得到 $p(x|\omega) \sim \mathcal{N}(0, 1)$:

$$p(x|\omega_i) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right] \tag{C1.1}$$

对式 (C1.1),我们可以进行一些计算.