

# 國立臺北科技大學

## 九十九學年第一學期電機系博士班資格考試

### 圖形識別試題

填學生證號碼

第一頁 共二頁

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#### 注意事項：

1. 本試題共【5】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間：二小時。

1. (20 points) What is a pattern recognition (PR) system? Describe the definition of PR, its design cycles, applications and related fields.
2. (20 points) What is high-dimensional PR? Describe its definition, characteristics, applications, features and classification techniques.
3. (20 points) Likelihood Ratio: Prove that if  $R(\alpha_1/x) < R(\alpha_2/x)$  is equivalent to

$$\text{if } \frac{P\langle x | \omega_1 \rangle}{P\langle x | \omega_2 \rangle} > \frac{(\lambda_{12} - \lambda_{22}) P(\omega_1)}{(\lambda_{21} - \lambda_{11}) P(\omega_2)}, \text{ then take action } \alpha_1. \text{ Otherwise take action } \alpha_2.$$

where  $x$ ,  $\omega$  and  $\alpha$  denote feature vectors, states of nature and actions respectively, and  $\lambda_{ij} = \lambda(\alpha_i/\omega_j)$  is the loss incurred for taking action  $\alpha_i$  when the state of nature is  $\omega_j$ .

4. (20 points) Consider the Bayes decision boundary for two-category classification in  $d$  dimensions.
  - (a). Prove that for any arbitrary hyperquadric in  $d$  dimensions, there exist normal distributions  $p(\mathbf{x}/\omega_i) \sim N(\boldsymbol{\mu}_i, \boldsymbol{\Sigma}_i)$  and priors  $P(\omega_i)$ ,  $i = 1, 2$ , that possess this hyperquadric as their Bayes decision boundary.
  - (b). Is your answer to part (a) true if the priors are held fixed and nonzero, e.g.,  $P(\omega_1) = P(\omega_2) = 1/2$ ?

5. (20 points) (a).What are the problems of dimensionality in PR? (b).What is the curse of dimensionality? Can you explain what the Hughes effect is?

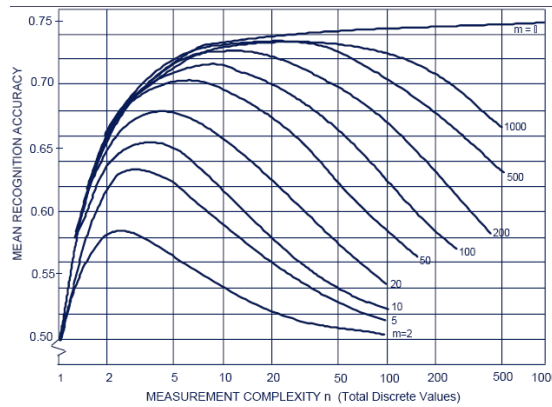


Fig. Hughes Effect or Hughes phenomenon.

where m is the number of training sample patterns and n is total number of test samples of discrete values. REF: G.F. Hughes, "On the mean accuracy of statistical pattern recognizers," IEEE Trans. Inform. Theory, Vol. IT-14, pp. 55-63, 1968.