國 立 臺 北 科 技 大 學

一百學年第二學期電機系博士班資格考試

圖形識別 試題

注意事項：

1. 本試題共【6】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 pattern recognition (PR)? Can you provide a brief introduction to the problem of PR and find out in detail how the PR can help solve your PR problems (e.g., PR system, PR design cycles, PR related fields and some PR problem examples).

2. (20 points) What is high-dimensional PR problem? Describe in detail, its definition, characteristics, applications, features and classification techniques.

3. (15 points) Likelihood Ratio: Prove that if $R(\alpha_1|x) < R(\alpha_2|x)$ is equivalent to
   if $\frac{p\langle x|\omega_1\rangle}{p\langle x|\omega_2\rangle} > \frac{(\lambda_{12}-\lambda_{22})}{(\lambda_{21}-\lambda_{11})}\frac{p(\omega_1)}{p(\omega_2)}$, then take action α_1. Otherwise take action α_2.
   where x, ω and α denote feature vectors, states of nature and actions respectively, and $\lambda_{ij}=\lambda(\alpha_i|\omega_j)$ is the loss incurred for taking action α_i when the state of nature is ω_j.

4. (15 points) Prove the invariance property of maximum likelihood estimators, i.e., that if $\hat{\theta}$ is the maximum likelihood estimate of θ, then for any differentiable function $\tau(\cdot)$, the maximum likelihood estimate of $\tau(\theta)$ is $\tau(\hat{\theta})$.

5. (15 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., $P(\omega_1) = P(\omega_2) = 1/2$?

6. (15 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?

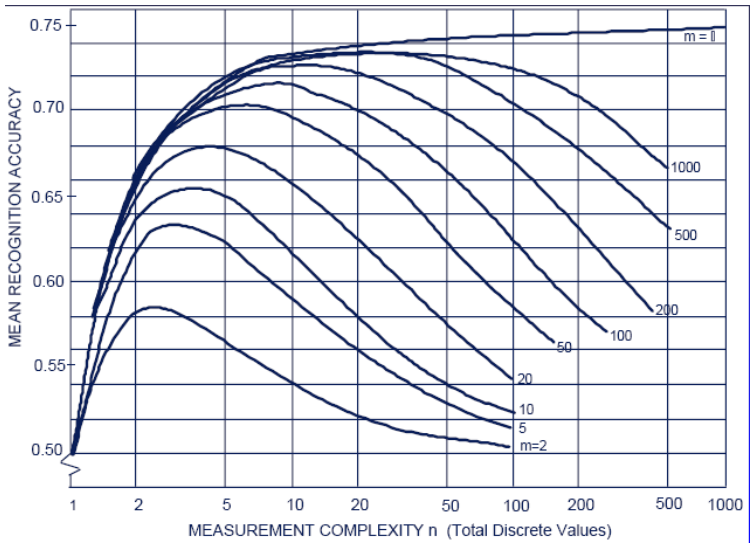

Fig. Hughes Effect or Hughes phenomenon.

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.