

國立臺北科技大學

106 學年第二學期電機系博士班資格考試

模糊控制(Fuzzy Control)試題

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注意事項：

1. 本試題共【4】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。
5. 不准使用任何形式之計算器。

1. Fuzzy set $A(x) \subset U$ and $B(y) \subset V$, $A = \frac{0.2}{-3} + \frac{0.7}{-2} + \frac{0.3}{-1} + \frac{0.6}{0} + \frac{0.2}{1} + \frac{0.8}{2} + \frac{0.3}{3} + \frac{0.1}{4}$ and fuzzy mapping

function $f(x) = x^2$. Find the fuzzy set $B(y) = f(A(x))$ using the extension principle. (25%)

2. Consider the three binary fuzzy relations defined by the relational matrices:

$$Q_1 = \begin{pmatrix} 0.4 & 0.5 & 0.6 \\ 0.1 & 0.2 & 0.3 \end{pmatrix}, Q_2 = \begin{pmatrix} 0.4 & 0.5 & 0.1 \\ 0.3 & 0.6 & 0.9 \\ 0.2 & 0.7 & 0.8 \end{pmatrix}, Q_3 = \begin{pmatrix} 0.1 & 0.2 \\ 0.3 & 0.4 \\ 0.5 & 0.6 \end{pmatrix}.$$

Compute the max-product compositions: (a) $Q_1 \circ Q_2$ (b) $Q_1 \circ Q_3$ and (c) $Q_1 \circ Q_2 \circ Q_3$. (25%)

3. Let $U = \{1, 3, 5, 7\}$ and $V = \{1, 2, 3\}$. Suppose that $x \in U$, $y \in V$ and use the following fuzzy IF-THEN rule:

IF x is A , *THEN* y is B

Where the fuzzy sets A and B are defined as

$$A = \frac{0.5}{1} + \frac{0.8}{3} + \frac{0.1}{5} + \frac{0.4}{7} \quad \text{and} \quad B = \frac{0.9}{1} + \frac{0.6}{2} + \frac{0.7}{3}$$

Compute the implications using (a) Mamdani minimum implication (b) Mamdani product implication. (25%)

4. Consider a two-input-one-output fuzzy system and two fuzzy rules:

IF x_1 is B and x_2 is A , *THEN* y is A

IF x_1 is A and x_2 is B , *THEN* y is B

Where A and B are fuzzy sets in \mathbf{R} with membership functions

$$\mu_A(u) = \begin{cases} 1 - |u + 1| & \text{if } -2 \leq u \leq 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\mu_B(u) = \begin{cases} 1 - |u| & \text{if } -1 \leq u \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

If the input to the fuzzy system is $(x_1^*, x_2^*) = (-0.2, 0.4)$ and use the singleton fuzzifier.

Determine the output of the fuzzy system y^* using product inference engine and center average defuzzifier. (25%)