國 立 臺 北 科 技 大 學

九十七學年第二學期電機系博士班資格考試

模糊控制試題(公告用)

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. If t-norm is defined as the following:

Any function $t:[0,1]\times[0,1]\to[0,1]$ satisfying axioms t_1 - t_4 is called the fuzzy t-norm.

$t_1: t(0,0)=0,\ t(a,1)=t(1,a)=a$ (boundary condition)

$t_2: t(a,b)=t(b,a)$ (commutative condition)

$t_3:$ if $a\le a'$ and $b\le b'$, then $t(a,b)\le t(a',b')$ (non-decreasing condition)

$t_4: t(t(a,b),c)=t(a,t(b,c))$ (associative condition)

Prove that $t_{dp}(a,b)\le t(a,b)\le \min(a,b)$ $\forall a,b\in[0,1]$, where $t_{dp}(.)$ is the drastic product. (20%)

2. Given a function $T(a,b)=\dfrac{ab}{max\{a,b,0.5)}$, show that the function T(·) is an operation of t norm. (15%)

3. Suppose f is a function mapping ordered pairs from U_1 = {-2, -1, 0, 1, 2} and U_2 = {-2, 0, 2} to V, and $f(x_1, x_2) = 2x_1^2 + x_2^2 - 6x_1x_2$. Given two fuzzy sets $A \subset U_1$ and $B \subset U_2$ such that A = 0.5/-2 + 0.3/-1 + 0.9/0 + 0.4/1 + 0.7/2 and B = 0.7/-2 + 0.2/0 + 0.4/2, (15%)

(a) find A^2+3 and 5B+4A

(b) find f(A, B).

(c) find f($\bar{A}$, B).

4. (a) If s-norm and t-norm are Yager t-norm and Yager s-norm, respectively, show that c (s_ω (a,b)) = t_ω (c(a), c(b)), where the c(·) denotes the regular fuzzy complement. (b) if the algebraic sum $s_{as}(a, b) = a+b-ab$ and algebraic product $t_{ap}(a,b) = ab$, please show that $c(s_{as}(a,b)) = t_{ap}(c(a),c(b))$. (20%)

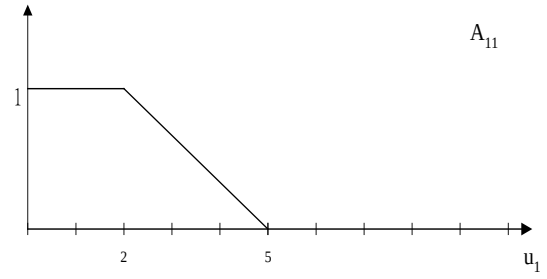
Yager clase of t-norms: $t_\omega(a,b) = 1 - \min(1, ((1-a)^\omega + (1-b)^\omega)^{1/\omega})$, $\omega \in (0, \infty)$.

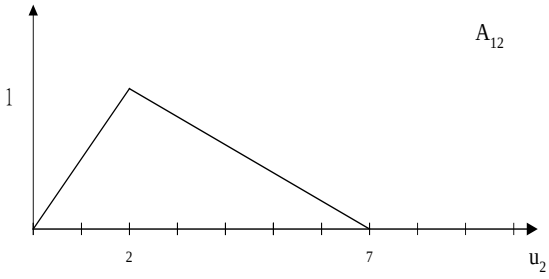
Yager class of s-norms: $s_\omega(a,b) = \min(1, (a^\omega + b^\omega)^{1/\omega})$, $\omega \in (0, \infty)$.

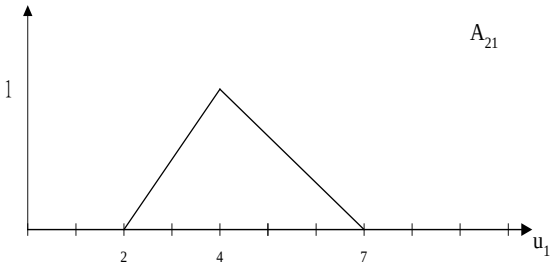
5. Given a fuzzy rule base as follows, please write a computer program to implement this fuzzy rule base and calculate the output of this fuzzy inference system. Within your computer program, you should also include a part that allows you calculate the fuzzy output for any input values of u_1 and u_2. Please state what approach you have adopted for the defuzzification and implement it in your computer program. Note that you are allowed to use any computer language **except** the MATLAB commands. (30%)

if u_1 is A_{11} and u_2 is A_{12} then $y = 4+u_1+4u_2$
if u_1 is A_{21} and u_2 is A_{22} then $y = 2+2.5u_1-3u_2$
if u_1 is A_{31} and u_2 is A_{32} then $y = 4+5u_1-2u_2$

where A_{11}, A_{12}, A_{21}, A_{22}, A_{31} and A_{32} are described as followings.


A11
1
2
5
u1


A12
1
2
7
u2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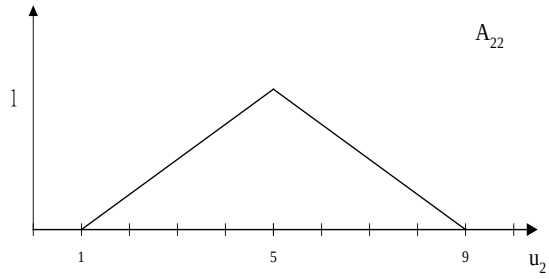
1
2
4
7
u1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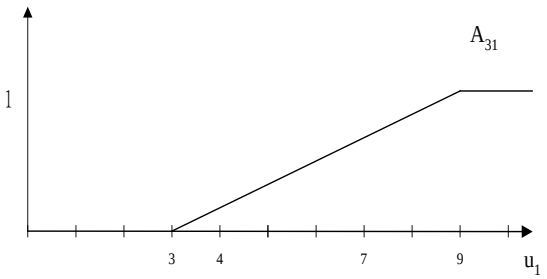
1
1
5
9
u2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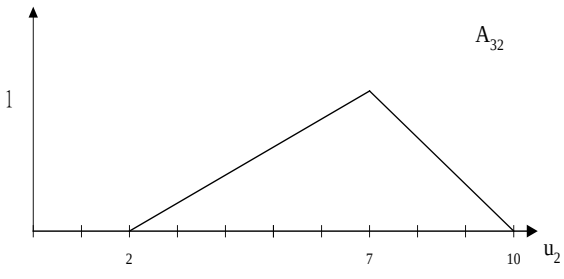
1
3
4
7
9
u1


A32
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2
7
10
u2