5358 HW

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1. Prove the *law of importation* for Boolean (crisp) logic.

$$\left(\left(\bigcap_i A_i\right) \to C\right) \equiv \left(\bigcup_i (A_i \to C)\right)$$

2. Consider the following fuzzy rule as a component to disjunctive Combs control:

$$\begin{array}{ccc} n & \to & z \\ z & \to & p \\ p & \to & n \end{array}$$

where n = negative, z = (near) zero and p = positive. Both the antecedent and the consequent have the same membership functions as shown in Figure 1.

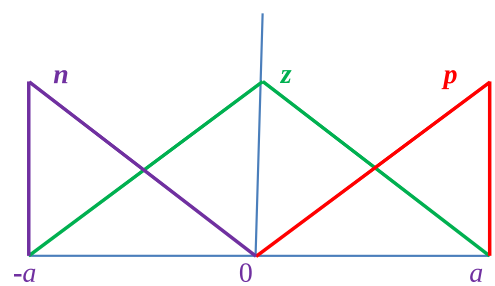

Figure 1: Figure for Problem 3.

- For the antecedent, $a = 2$ and the memberships are a function of x.
- For the consequent, $a = 1$ and the memberships are a function of y.

Evaluate the corresponding actuator function, $y = f(x)$, when

(a) Defuzzification using the center of mass of the weighted sum of the consequent membership functions.

(b) Defuzzification using the mode of the weighted sum of the consequent membership functions.

(c) Defuzzification using clipping of the consequent membership functions.

(d) Any comments or conclusions from your result?

$y \downarrow \ x \rightarrow$	n	z	p
n	p	p	z
z	p	z	n
p	z	n	n

Table 1: Table for Problem 3.

3. Consider the Mamdani fuzzy rule table in Table 1. The fuzzy membership functions in Figure 1 apply for the antecedents x and y and the consequent z. Let $a = 1$. Plot the two dimensional control surface, $z = f(x, y)$, when defuzzification uses

   (a) $\cdots$ the center of mass of the weighted sum of the consequent membership functions.

   (b) $\cdots$ the mode of the weighted sum of the consequent membership functions.

   (c) $\cdots$ clipping of the consequent membership functions.

   (d) Any comments or conclusions from your result?