Fuzzy Logic

Lecture 4:

Algebraic Operations on Fuzzy Set

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Algebraic Operations on Fuzzy Set

Algebraic Product

- The product of two fuzzy sets in the same universe of discourse is the new fuzzy set A.B with a membership function that equal product of the membership function of A and the membership function of B.

$$\mu_{A.B}(x) = \{\mu_A(x) \cdot \mu_B(x) \mid x \in A, x \in B\}$$

Algebraic Operations on Fuzzy Set

Multiplying a fuzzy set by a crisp number

- When a fuzzy set A is multiplied by a crisp number a, then its membership function is given by

$$\mu_{a.A}(x) = a\mu_A(x)$$

Algebraic Operations on Fuzzy Set

Cartesian product

- The Cartesian product of two fuzzy sets A & B is a fuzzy set C denoted by A X B and defined as

$$C = A \, X \, B = \mu_c(x)/(a,b) \mid a \in A, \, b \in B$$

$$\mu_c(C) = \min(\mu_{A(a)}, \mu_{B(b)})$$

Algebraic Operations on Fuzzy Set

Algebraic Sum

The Algebraic sum of two fuzzy sets A & B is a fuzzy set C denoted by A + B and defined as

C=A + B= $\mu_c(x)=\mu_A(x) + \mu_B(x)-\mu_A(x).\ \mu_B(x)$

Algebraic Operations on Fuzzy Set

Bounded Sum

- The bounded sum of two fuzzy sets A and B in the universes X and Y with the membership functions $\mu_A(x)$ and $\mu_B(x)$ respectively is defined by

$$
\begin{aligned}
A \oplus B = \mu_{A \oplus B}(x) &= 1 \wedge (\mu_A(x) + \mu_B(y)) \\
&= \min(1,\ (\mu_A(x) + \mu_B(y))
\end{aligned}
$$

where the “+” sign is an arithmetic operator.

Algebraic Operations on Fuzzy Set

Bounded product

- The bounded product of two fuzzy sets A and B in the universes X and Y with membership functions $\mu_A(x)$ and $\mu_B(x)$ respectively is defined as

$$A \otimes B = \mu_{A \otimes B}(x) = 0 \vee (\mu_A(x) + \mu_B(x) - 1)$$
$$= \max(0, (\mu_A(x) + \mu_B(x) - 1)).$$

Algebraic Operations on Fuzzy Set

Bounded difference

- The bounded of difference of two fuzzy sets A and B is a fuzzy set C denoted by

$$C = A \ominus B = \mu_c(x) = \min(1, \mu_{A(x)} - \mu_{B(x)})$$

Example 7

- Let us consider two fuzzy sets

A={(1,0.6),(2,1.0),(3,0.5),(4,0.3),(5,0.8)

B={(2,0.5),(3,0.7)}

Find out the Algebraic product, Cartesian product, Algebraic sum, Bounded Sum, Bounded difference.

Solution 7

Algebraic product is calculated using equation $\mu_{A \cdot B}(x) = \{\mu_A(x) \cdot \mu_B(x) \mid x \in A, x \in B\}$

$$\mu_{A \cdot B}(2) = \{\mu_A(2) \cdot \mu_B(2) = 1.0 * 0.5 = 0.05$$

$$\mu_{A \cdot B}(3) = \{\mu_A(3) \cdot \mu_B(3) = 0.5 * 0.7 = 0.35$$

$$A \cdot B = \{(2, 0.05), (3, 0.35)\}$$

Cartesian product of fuzzy set A, & B is given by

$$C = A \times B = \mu_c(x)/(a,b) \mid a \in A, b \in B, \mu_c(c) = \min(\mu_{A(a)}, \mu_{B(b)})$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(1)}, \mu_{B(2)}) = \min(0.6, 0.5) = 0.5$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(1)}, \mu_{B(3)}) = \min(0.6, 0.7) = 0.6$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(2)}, \mu_{B(2)}) = \min(1.0, 0.5) = 0.5$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(2)}, \mu_{B(3)}) = \min(1.0, 0.7) = 0.7$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(3)}, \mu_{B(2)}) = \min(0.5, 0.5) = 0.5$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(3)}, \mu_{B(3)}) = \min(0.5, 0.7) = 0.5$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(4)}, \mu_{B(2)}) = \min(0.3, 0.5) = 0.3$$

Solution 7 cont…….

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(4)}, \mu_{B(3)}) = \min(0.3, 0.7) = 0.3$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(5)}, \mu_{B(2)}) = \min(0.8, 0.5) = 0.5$$

$$\mu_c(c)/(a,b), \mu_c(c) = \min(\mu_{A(5)}, \mu_{B(3)}) = \min(0.8, 0.7) = 0.7$$

$$C = A \times B = \{0.5/(1,2), 0.6/(1,3), 0.5/(2,2), 0.7/(2,3), 0.5/(3,2), 0.5/(3,3), 0.3/(4,2), 0.3/(4,3), 0.5/(5,2), 0.7/(5,3)\}$$

Algebraic Sum of two fuzzy sets A & B is a set C given by

$$C = A + B = \mu_c(x) = \mu_{A(x)} + \mu_{B(x)} - \mu_{A(x)} \cdot \mu_{B(x)}$$

$$\mu_{c(1)} = \mu_{A(1)} + \mu_{B(1)} - \mu_{A(1)} \cdot \mu_{B(1)} = 0.6 + 0.0 - 0.6*0.0 = 0.6$$

$$\mu_{c(2)} = \mu_{A(2)} + \mu_{B(2)} - \mu_{A(2)} \cdot \mu_{B(2)} = 1.0 + 0.5 - 1.0*0.5 = 1.0$$

$$\mu_{c(3)} = \mu_{A(3)} + \mu_{B(3)} - \mu_{A(3)} \cdot \mu_{B(3)} = 0.5 + 0.7 - 0.5*0.7 = 0.85$$

$$\mu_{c(4)} = \mu_{A(4)} + \mu_{B(4)} - \mu_{A(4)} \cdot \mu_{B(4)} = 0.3 + 0.0 - 0.3*0.0 = 0.3$$

$$\mu_{c(5)} = \mu_{A(5)} + \mu_{B(5)} - \mu_{A(5)} \cdot \mu_{B(5)} = 0.8 + 0.0 - 0.8*0.0 = 0.8$$

$$C = A + B = \{(1, 0.6), (2, 1.0), (3, 0.85), (4, 0.3), (5, 0.8)\}$$

Solution 7 cont…….

The Bounded Sum of two fuzzy sets A & B is a fuzzy set C given by

$$C = A \oplus B = \mu_c(x) = \min(1, \mu_{A(x)} + \mu_{B(x)})$$

$$\mu_{c(1)} = \min(1, \mu_{A(1)} + \mu_{B(1)}) = \min(1, 0.6 + 0.0) = 0.6$$

$$\mu_{c(2)} = \min(1, \mu_{A(2)} + \mu_{B(2)}) = \min(1, 1.0 + 0.5) = 1.0$$

$$\mu_{c(3)} = \min(1, \mu_{A(3)} + \mu_{B(3)}) = \min(1, 0.5 + 0.7) = 1.0$$

$$\mu_{c(4)} = \min(1, \mu_{A(4)} + \mu_{B(4)}) = \min(1, 0.3 + 0.0) = 0.3$$

$$\mu_{c(5)} = \min(1, \mu_{A(5)} + \mu_{B(5)}) = \min(1, 0.8 + 0.0) = 0.8$$

$$C = A \oplus B = \{(1,0.6), (2,1.0), (3, 1.0), (4, 0.3), (5, 0.8)\}$$

The Bounded difference of two fuzzy sets A & B is a fuzzy set C given by

$$C = A \ominus B = \mu_c(x) = \min(1, \mu_{A(x)} - \mu_{B(x)})$$

$$\mu_{c(1)} = \min(1, \mu_{A(1)} - \mu_{B(1)}) = \min(1, 0.6 - 0.0) = 0.6$$

$$\mu_{c(2)} = \min(1, \mu_{A(2)} - \mu_{B(2)}) = \min(1, 1.0 - 0.5) = 0.5$$

$$\mu_{c(3)} = \min(1, \mu_{A(3)} - \mu_{B(3)}) = \min(1, 0.5 - 0.7) = 0.0 \text{ (as } \mu_{A(3)} < \mu_{B(3)})$$

$$\mu_{c(4)} = \min(1, \mu_{A(4)} - \mu_{B(4)}) = \min(1, 0.3 - 0.0) = 0.3$$

$$\mu_{c(5)} = \min(1, \mu_{A(5)} - \mu_{B(5)}) = \min(1, 0.8 - 0.0) = 0.8$$

$$C = A \ominus B = \{(1,0.6), (2,0.5), (3, 0.0), (4, 0.3), (5, 0.8)\}$$

Properties of Fuzzy sets

1. **Associative Property**
2. **Commutative Property**
3. **Distributive Property**
4. **Idem Potency**
5. **Identity**
6. **Transitive**
7. **Involution**
8. **Demorgan's Law**

Properties of Fuzzy sets

Associative Property(الخاصية المشتركة)

$A \cup (B \cup C) = (A \cup B) \cup C$

or

$\max[\mu_A(X), \max\{\mu_B(Y), \mu_C(Z)\}] = \max[\{\max\{\mu_A(x), \mu_B(Y)\}, \mu_C(Z)]$

and $A \cap (B \cap C) = (A \cap B) \cap C$ or

$\min[\mu_A(X), \min\{\mu_B(Y), \mu_C(Z)\}] = \min[\{\min\{\mu_A(x), \mu_B(Y)\}, \mu_C(Z)]$

Properties of Fuzzy sets

Commutative Property(خاصية التبديل)

$$A \cup B = B \cup A \text{ or } \max[\mu_A(x),\ \mu_B(y)] = \max[\mu_B(x),\ \mu_A(y)]$$
$$\text{and } A \cap B = B \cap A \text{ or } \min[\mu_A(x),\ \mu_B(y)] = \min[\mu_B(x),\ \mu_A(y)].$$

Properties of Fuzzy sets

Distributive Property(خاصية التوزيع)

$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C) \text{ or}$$

$$\max\,[\mu_A(x),\ \min(\mu_B(x),\ \mu_c(z)] = \min[\max\{\mu_A(x),\ \mu_B(y)\},\ \max\{\mu_A(x),\ \mu_c(z)\}].$$

Properties of Fuzzy sets

Idem Potency

$$A \cup A = A \text{ means } \quad \max\{\mu_A(x),\ \mu_A(x)\} = \mu_A(x)$$
$$\text{and } A \cap A = A \text{ means } \quad \min\{\mu_A(x),\ \mu_A(x)\} = \mu_A(x).$$

Properties of Fuzzy sets

Identity

$$A \cup \phi = A \text{ means } \quad \max\{\mu_A(x), 0\} = \mu_A(x)$$
$$A \cap X = A \text{ means } \quad \min\{\mu_A(x), 1\} = \mu_A(x)$$
$$A \cap \phi = A \text{ means } \quad \min\{\mu_A(x), 0\} = 0$$
$$\text{and } A \cup X = X \text{ means } \quad \max\{\mu_A(x), 1\} = 1.$$

Properties of Fuzzy sets

Transitive

If $A \subseteq B$ and $B \subseteq C$ Then $A \subseteq C$

Properties of Fuzzy sets

Involution(الالتفاف)

A’’=A

$$1-(1-\mu_A(x)) = \mu_A(x).$$

Properties of Fuzzy sets

Demorgan's Law

$$\overline{A \cap B} = \overline{A} \cup \overline{B},$$
$$\overline{A \cup B} = \overline{A} \cap \overline{B}.$$

Prove

- Prove that the De Morgan's Laws hold for fuzzy sets that is

$$\overline{A \cap B} = \overline{A} \cup \overline{B},$$
$$\overline{A \cup B} = \overline{A} \cap \overline{B}.$$

Solution

To show that equation (1) is true, we have to prove

$$1 - \max(\mu_{A(x)}, \mu_{B(x)}) = \min[(1 - \mu_{A(x)}), (1 - \mu_{B(x)})]$$

Considering a case that, $\mu_{A(x)} > \mu_{B(x)}$

$\therefore$ L.H.S. of equation(3) is equal to $[1 - \mu_{A(x)}]$, and

R.H.S. of equation(3) is equal to $[1 - \mu_{A(x)}]$

And similarly for the case $\mu_{B(x)} > \mu_{A(x)}$

To show that equation (2) is true, we have to prove

$$1 - \min(\mu_{A(x)}, \mu_{B(x)}) = \max[(1 - \mu_{A(x)}), (1 - \mu_{B(x)})]$$

Considering a case that, $\mu_{A(x)} > \mu_{B(x)}$

$\therefore$ L.H.S. of equation(4) is equal to $[1 - \mu_{B(x)}]$, and

R.H.S. of equation(4) is equal to $[1 - \mu_{B(x)}]$

And similarly for the case $\mu_{B(x)} > \mu_{A(x)}$

Solve

Example 5. Show that $\mu_{A(x)} \wedge \mu_{B(x)} = \mu_{B(x)} \ominus (\mu_{B(x)} \ominus \mu_{A(x)})$

Taking L.H.S.

$$\mu_A(x) \wedge \mu_B(x) = \begin{cases} \mu_B(x), \text{ for } \mu_A(x) \geq \mu_B(x) \\ \mu_A(x), \text{ for } \mu_A(x) < \mu_A(x) \end{cases} \quad ...(1)$$

Solving for R.H.S. under the conditions

(a). $\mu_{A(x)} > \mu_{B(x)}$

$\Rightarrow \quad \mu_{B(x)} \ominus 0 \qquad \because \mu_{B(x)} \ominus \mu_{A(x)} = \min(1, \mu_{B(x)} - \mu_{A(x)}) = \min(1, 0) = 0$

$\Rightarrow \quad \mu_{B(x)}$ ...(2)

(b) $\mu_{B(x)} > \mu_{A(x)}$

$\Rightarrow \quad \mu_{B(x)} \ominus (\mu_{B(x)} - \mu_{A(x)}) \qquad \because \mu_{B(x)} \ominus \mu_{A(x)} = \min(1, \mu_{B(x)} - \mu_{A(x)}) = \mu_{B(x)} - \mu_{A(x)}$

$\Rightarrow \quad \mu_{B(x)} - (\mu_{B(x)} - \mu_{A(x)})$

$\Rightarrow \quad \mu_{B(x)}$ ...(3)

From equations (1), (2) and (3) one may conclude that

$$\mu_{A(x)} \wedge \mu_{B(x)} = \mu_{B(x)} \ominus (\mu_{B(x)} \ominus \mu_{A(x)})$$

Solve

Example 6. Show that $\mu_{A(x)} \vee \mu_{B(x)} = \mu_{A(x)} + (\mu_{B(x)} \ominus \mu_{A(x)})$

Taking L.H.S.

$$\mu_A(x) \vee \mu_B(x) = \begin{cases} \mu_A(x), \text{ for } \mu_A(x) \geq \mu_B(x) \\ \mu_B(x), \text{ for } \mu_B(x) > \mu_A(x) \end{cases} \quad \ldots(1)$$

Solving for R.H.S. under the conditions

(a) $\mu_{A(x)} \geq \mu_{B(x)}$

$\Rightarrow \quad \mu_{A(x)} + (\mu_{B(x)} \ominus \mu_{A(x)})$

$\Rightarrow \quad \mu_{A(x)} + 0 \qquad \because \quad \mu_{B(x)} \ominus \mu_{A(x)} = \min(1, \mu_{B(x)} - \mu_{A(x)}) = \min(1,0) = 0$

$\Rightarrow \quad \mu_{A(x)}$ ...(2)

(b) $\mu_{B(x)} > \mu_{A(x)}$

$\Rightarrow \quad \mu_{A(x)} + (\mu_{B(x)} \ominus \mu_{A(x)}) \qquad \because \quad \mu_{B(x)} \ominus \mu_{A(x)} = \min(1, \mu_{B(x)} - \mu_{A(x)}) = \mu_{B(x)} - \mu_{A(x)}$

$\Rightarrow \quad \mu_{A(x)} + (\mu_{B(x)} - \mu_{A(x)})$

$\Rightarrow \quad \mu_{B(x)}$ ...(3)

From (1), (2) and (3) one may conclude that

$$\mu_{A(x)} \vee \mu_{B(x)} = \mu_{A(x)} + (\mu_{B(x)} \ominus \mu_{A(x)})$$

Solve

1. For the given fuzzy set

$$\underset{\sim}{A} = \left\{ \frac{1}{1.0} + \frac{0.65}{1.5} + \frac{0.4}{2.0} + \frac{0.35}{2.5} + \frac{0}{3.0} \right\},$$

$$\underset{\sim}{B} = \left\{ \frac{0}{1.0} + \frac{0.25}{1.5} + \frac{0.6}{2.0} + \frac{0.25}{2.5} + \frac{1}{3.0} \right\},$$

$$\underset{\sim}{C} = \left\{ \frac{0.5}{1.0} + \frac{0.25}{1.5} + \frac{0}{2.0} + \frac{0.25}{2.5} + \frac{0.5}{3.0} \right\}.$$

Prove the associative and the distributive property for the above given sets.

Solution

- To prove associative property

1. $\underset{\sim}{A} \cup \left(\underset{\sim}{B} \cup \underset{\sim}{C}\right) = \left(\underset{\sim}{A} \cup \underset{\sim}{B}\right) \cup \underset{\sim}{C}$

LHS

$$\underset{\sim}{A} \cup \left(\underset{\sim}{B} \cup \underset{\sim}{C}\right)$$

$$\left(\underset{\sim}{B} \cup \underset{\sim}{C}\right) = \left\{\frac{0.5}{1.0} + \frac{0.25}{1.5} + \frac{0.6}{2.0} + \frac{0.25}{2.5} + \frac{1}{3.0}\right\}$$

$$\underset{\sim}{A} \cup \left(\underset{\sim}{B} \cup \underset{\sim}{C}\right) = \left\{\frac{1}{1.0} + \frac{0.65}{1.5} + \frac{0.6}{2.0} + \frac{0.35}{2.5} + \frac{1}{3.0}\right\}$$

RHS

$$\left(\underset{\sim}{A} \cup \underset{\sim}{B}\right) \cup \underset{\sim}{C}$$

$$\left(\underset{\sim}{A} \cup \underset{\sim}{B}\right) = \left\{\frac{1}{1.0} + \frac{0.65}{1.5} + \frac{0.6}{2.0} + \frac{0.35}{2.5} + \frac{1}{3.0}\right\}$$

$$\left(\underset{\sim}{A} \cup \underset{\sim}{B}\right) \cup \underset{\sim}{C} = \left\{\frac{1}{1.0} + \frac{0.65}{1.5} + \frac{0.6}{2.0} + \frac{0.35}{2.5} + \frac{1}{3.0}\right\}$$

Solution

- To prove distribute property

2. $\left(\underset{\sim}{A} \cap \left(\underset{\sim}{B} \cup \underset{\sim}{C}\right)\right) = \left(\underset{\sim}{A} \cap \underset{\sim}{B}\right) \cup \left(\underset{\sim}{A} \cap \underset{\sim}{C}\right)$

LHS

$$\underset{\sim}{A} \cap \left(\underset{\sim}{B} \cup \underset{\sim}{C}\right)$$

$$\left(\underset{\sim}{B} \cup \underset{\sim}{C}\right) = \left\{\frac{0.5}{1.5} + \frac{0.25}{1.5} + \frac{0.6}{2.0} + \frac{0.25}{2.5} + \frac{1}{3.0}\right\}$$

$$\underset{\sim}{A} \cap \left(\underset{\sim}{B} \cup \underset{\sim}{C}\right) = \left\{\frac{0.5}{1.0} + \frac{0.25}{1.5} + \frac{0.4}{2.0} + \frac{0.25}{2.5} + \frac{0}{3.0}\right\} \quad (2.11)$$

RHS

$$\left(\underset{\sim}{A} \cap \underset{\sim}{B}\right) = \left\{\frac{0}{1.0} + \frac{0.25}{1.5} + \frac{0.4}{2.0} + \frac{0.25}{2.5} + \frac{0}{3.0}\right\}$$

$$\left(\underset{\sim}{A} \cap \underset{\sim}{C}\right) = \left\{\frac{0.5}{1.0} + \frac{0.25}{1.5} + \frac{0}{2.0} + \frac{0.25}{2.5} + \frac{0}{3.0}\right\}$$

$$\left(\underset{\sim}{A} \cap \underset{\sim}{B}\right) \cup \left(\underset{\sim}{A} \cap \underset{\sim}{C}\right) = \left\{\frac{0.5}{1.0} + \frac{0.25}{1.5} + \frac{0.4}{2.0} + \frac{0.25}{2.5} + \frac{0}{3.0}\right\} \quad (2.12)$$

Solve

Example 2.10. Consider the following fuzzy sets

$$A = \left\{ \frac{0.8}{10} + \frac{0.3}{15} + \frac{0.6}{20} + \frac{0.2}{25} \right\},$$

$$B = \left\{ \frac{0.4}{10} + \frac{0.2}{15} + \frac{0.9}{20} + \frac{0.1}{25} \right\}.$$

Calculate the Demorgan's law $\overline{A \cup B} = \bar{A} \cap \bar{B}$, and $\overline{A \cap B} = \bar{A} \cup \bar{B}$

Solve

3. Consider two fuzzy sets *A*∼ and *B*∼ find Complement, Union, Intersection, Difference, and De Morgan's law.

$$\underset{\sim}{A} = \left\{ \frac{1}{2} + \frac{0.5}{3} + \frac{0.6}{4} + \frac{0.2}{5} + \frac{0.6}{6} \right\},$$

$$\underset{\sim}{B} = \left\{ \frac{0.5}{2} + \frac{0.8}{3} + \frac{0.4}{4} + \frac{0.7}{5} + \frac{0.3}{6} \right\}.$$

Solve

4. Given the classical sets,

A = {9, 5, 6, 8, 10} B = {1, 2, 3, 7, 9} C = {1, 0}

Prove the classical set properties associativity and distributivity.

Solve

5. Consider, *X = {a, b, c, d, e, f, g, h}.* and the set *A is defined as {a, d, f}. So for this classical set prove the identity* property.

Solution

Solution. Given, $X = \{a, b, c, d, e, f, g, h\}$,
$A = \{a, d, f\}$.
The identity property is given as

1. $A \cup \phi = A$.
2. $A \cap \phi = A$.
   ϕ is going to be a null set, hence it is clearly understood, that, $A \cup \phi$ &
   $A \cap \phi$ will give as the same set A.
3. $A \cap X = A$.

$$A \cap X = \{a, d, f\},$$
$$A = \{a, d, f\}.$$
$$\text{Hence, } A \cap X = A.$$

4. $A \cup X = X$,

$$A \cup X = \{a, b, c, d, e, f, g, h\},$$
$$X = \{a, b, c, d, e, f, g, h\}.$$

Hence, $A \cup X = X$.
This identity property is proved.

Homework

1. Determine all possible α-level sets of A = {(1, 0.6), (2, 0.7), (3, 0.5), (4, 0.3), (5, 0.8)}.
2. Determine all possible strong α-level sets of A = {(1, 0.6), (2, 0.5), (3, 0.6), (4, 0.3), (5, 0.8), (6, 0.5), (7, 0.8)}.
3. Determine Support, and crossover point for set A = {(1, 0.6), (2, 0.4), (3, 0.7), (4, 0.5), (5, 0.8), (6, 0.4), (7, 0.9), (8, 0.0)}.
4. Let A = {(1, 0.3), (3, 0.8), (4, 0.6), (5, 0.7), (6, 0.6)} and B = {(1, 0.2), (3, 0.4), (4, 0.5), (5, 0.6), (6, 0.4)}; determine

   (*i*) A', (*ii*) B', (*iii*) $A - B$, (*iv*) $B - A$.
5. Given A = {(1, 0.2), (2, 0.4), (3, 0.5), (4, 0.8)} and B = {(1, 0.2), (3, 0.4), (4, 0.5), (5, 0.6), (6, 0.4)}, determine

   (*i*) $(A \cap B)'$, (*ii*) $(A \cap B)'$, (*iii*) $A' \cap B'$, (*iv*) $B' \cap A'$.

Homework

6. Given A = {(2, 0.4), (3, 0.6), (5, 0.5)} and **B** = {(1, 0.2), (3, 0.4)}, determine the Cartesian product of two sets *i.e.*, A×B.
7. Given A = {(1, 0.2), (2, 0.4), (3, 0.5), (4, 0.8)} and **B** = {(1, 0.5), (2, 0.4), (3, 0.6), (4, 0.6), (6, 0.4)}, determine
   (*i*) Algebraic product, (*ii*) CON(A)
   (*iii*) CON(B) (*iv*) DIL(A)
   (*v*) DIL(B)
8. Given A = {(1, 0.6), (2, 0.7), (3, 0.5), (4, 0.3), (5, 0.8)}, and **B** = {(1, 0.4), (2, 0.5), (3, 0.6), (4, 0.5), (5, 0.4), (6, 0.5), (7, 0.8)}. Represent Graphically Fuzzy Set A, B and their complements.
9. Determine graphically union and intersection of fuzzy sets whose values are A = {(1, 0.6), (2, 0.5), (3, 0.6), (4, 0.3), (5, 0.8), (6, 0.5), (7, 0.8)}, and **B** = {(1, 0.4), (2, 0.3), (3, 0.2), (4, 0.7), (5, 0.4), (6, 0.8), (7, 0.9), (8, 1.0)}
10. Given A = {(2, 0.4), (3, 0.6), (5, 0.5), (6, 0.7), (7, 0.9)} and **B** = {(2, 0.5), (3, 0.7), (5, 1.0), (6, 0.5), (7, 0.8)} determine the Algebraic sum & Bounded sum of the two sets.
11. Given A = {(1, 0.2), (2, 0.4), (3, 0.5), (4, 0.8)} and **B** = {(1, 0.5), (2, 0.4), (3, 0.6), (4, 0.6), (6, 0.4)}, determine
   (*i*) A – B, (*ii*) B – A, (*iii*) A⊖B, and (*iv*) B⊖A.

Thank you…

Any questions??

يرجى مسح رمز الاستجابة السريعة QR Code لتعبئة نموذج التغذية الراجعة حول المحاضرة.
ملاحظاتكم مهمة لتحسين المحاضرات القادمة.

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