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FACULTY OF EGINEERING AND TECHNOLOGY

Soft Computing

LECTURE -10

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OUTLINE

- **Fuzzy Operations**
- **Union**
- **Intersection**
- **Complement**
- **Fuzzy Operators**
- **Fuzzy set vs. Crisp Set**
- **Reference**

FUZZY OPERATIONS

Fuzzy Operations

Union:

Let μ_A and μ_B be membership functions that define the fuzzy sets A and B, respectively, on the universe X. The union of fuzzy sets A and B is a fuzzy set defined by the membership function:

$$\mu_{A \cup B}(x) = Max(\mu_A(x), \mu_B(x))$$

Intersection:

Let µA and μ_B be membership functions that define the fuzzy sets A y B, respectively, on the universe X. The intersection of fuzzy sets A and B is a fuzzy set defined by the membership function:

$$\mu_{A \cap B}(x) = Min(\mu_A(x), \mu_B(x))$$

Complement:

Let μ_A be a membership function that defines the fuzzy set A, on the universe X. The complement of A is a fuzzy set defined by the membership function:

$$\mu_{A^c}(x) = 1 - \mu_A(x)$$

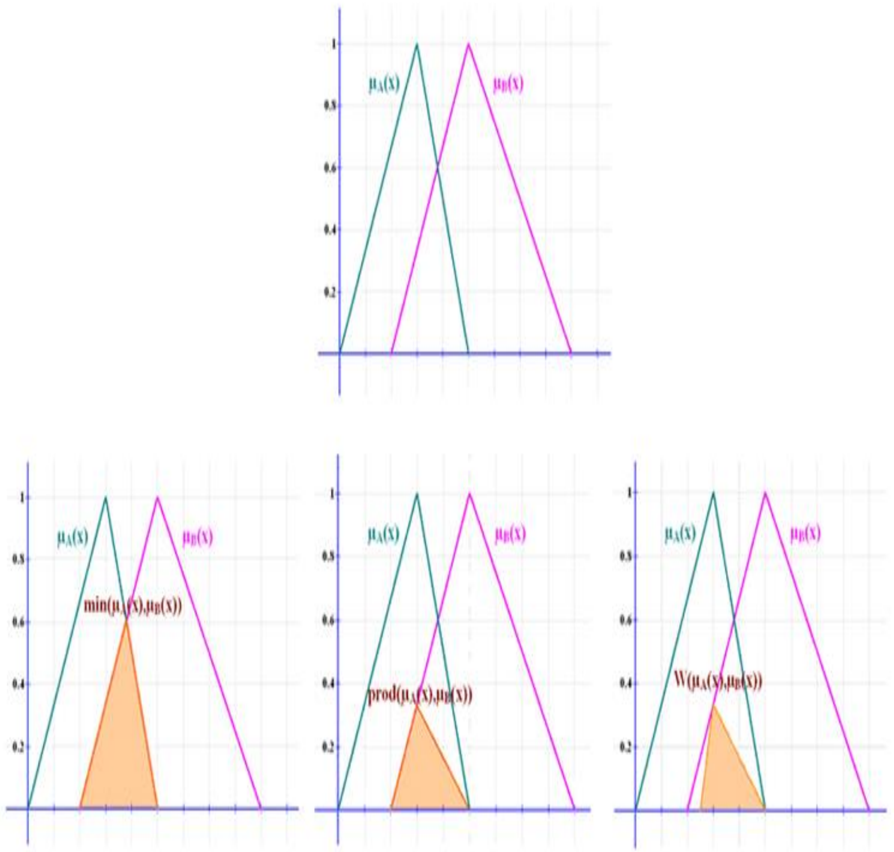
Fuzzy Operators

t-norms and t-conorms are binary operators that generalize intersection and union operations, respectively.

t-norm: it is a binary operation T: [0,1] x [0,1] → [0,1] which satisfies the following properties:

- **Commutativity:** T(a,b) = T(b,a)
- **Associativity:** T(a, T(b,c)) = T(T(a,b), c)
- **Identity element:** T(a,1) = T(1,a) = a
- **Monotonicity:** if a ≤ c and b ≤ d then T(a,b) ≤ T(c,d)

These operators represent the intersection of two fuzzy sets. Some examples of t-norms are the minimum min(a,b), the product prod(a,b) = a•b and Lukasiewicz W(a,b)=max(0,a+b-1).



FUZZY OPERATORS

t-conorm: it is a binary operation S: [0,1] x [0,1] → [0,1] which satisfies the following properties:

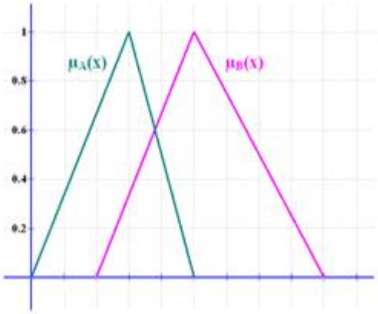
Commutativity: S(a,b) = S(b,a)

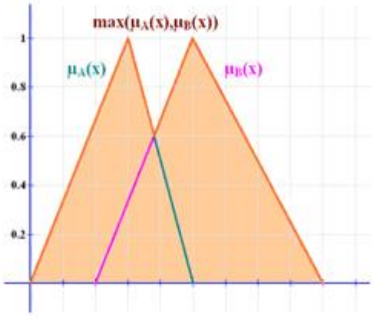
Associativity: S(a, S(b,c)) = S(S(a,b), c)

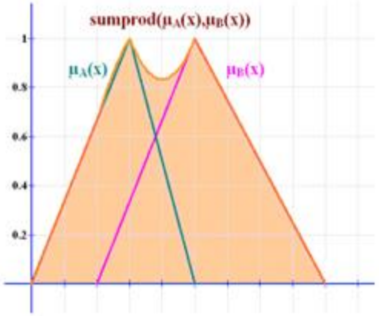
Identity element: S(a,0) = S(0,a) = a

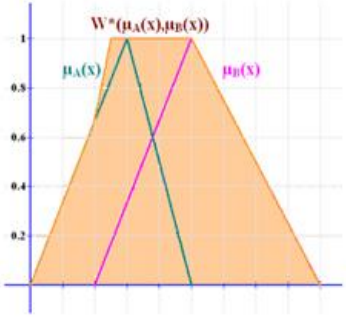
Monotonicity: if a ≤ c and b ≤ d then S(a,b) ≤ S(c,d)

These operators represent the union of two fuzzy sets. Some examples of t-conorms are the maximum *max(a,b)*, the probabilistic sum or sum-product *sum-prod (a,b) = a+b - a•b* and Lukasiewicz *W*(a,b)=min(1,a+b)*.



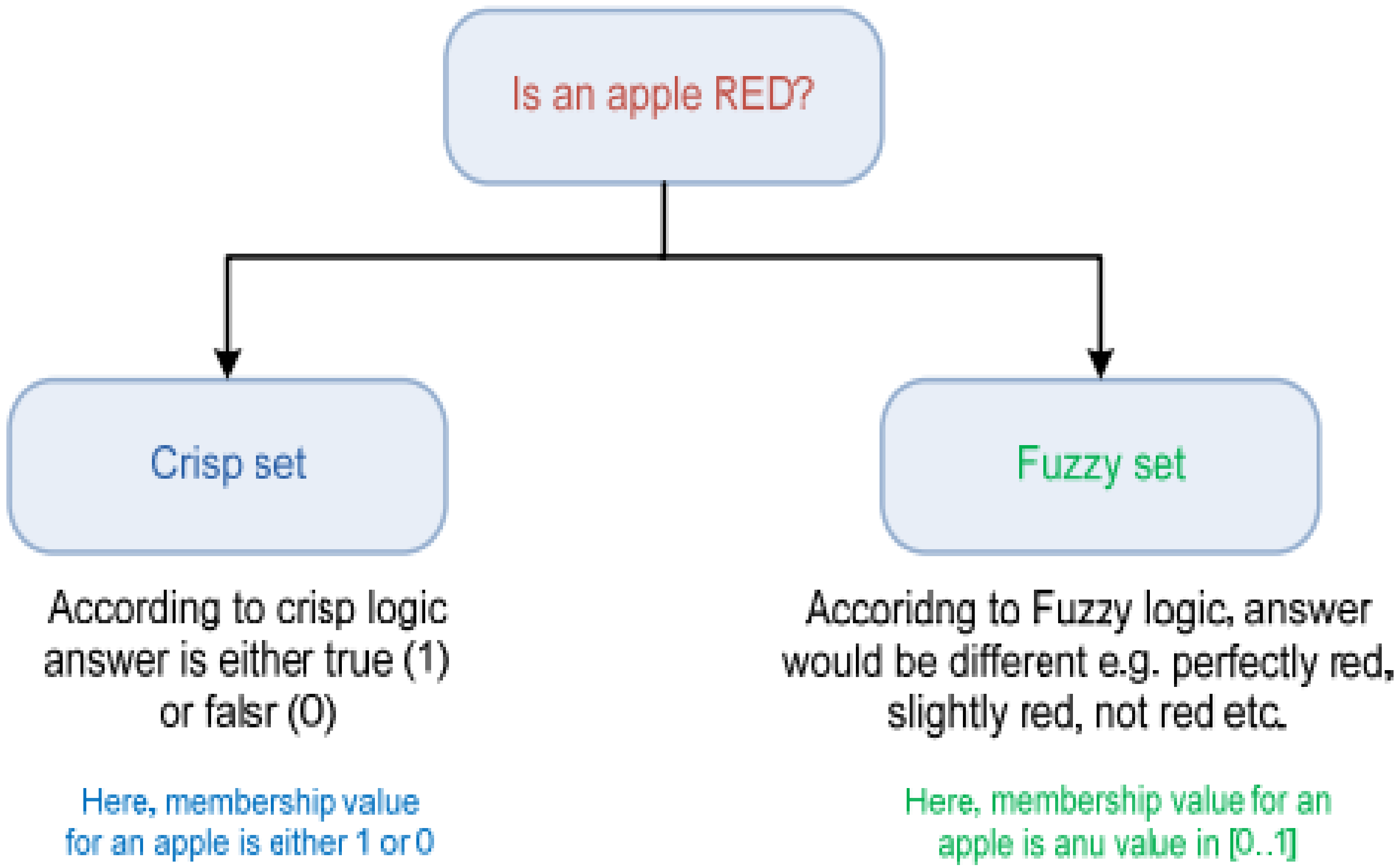






FUZZY OPERATORS

Fuzzy set vs. Crisp Set



MULTIPLE CHOICE QUESTION

6. A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0.

a) True

b) False

c) Sometimes – it can also output intermediate values as well

d) Can't say

7. What is the name of the function in the following statement "A perceptron adds up all the weighted inputs it receives, and if it exceeds a certain value, it outputs a 1, otherwise it just outputs a 0"?

a) Step function

b) Heaviside function

c) Logistic function

d) Perceptron function

8. Having multiple perceptrons can actually solve the XOR problem satisfactorily: this is because each perceptron can partition off a linear part of the space itself, and they can then combine their results.

a) True – this works always, and these multiple perceptrons learn to classify even complex problems

b) False – perceptrons are mathematically incapable of solving linearly inseparable functions, no matter what you do

c) True – perceptrons can do this but are unable to learn to do it – they have to be explicitly hand-coded

d) False – just having a single perceptron is enough

9. The network that involves backward links from output to the input and hidden layers is called __________

a) Self organizing maps

b) Perceptrons

c) Recurrent neural network

d) Multi layered perceptron

10. Which of the following is an application of NN (Neural Network)?

a) Sales forecasting

b) Data validation

c) Risk management

d) All of the mentioned

REFERENCES

- http://www.dma.fi.upm.es/recursos/aplicaciones/logica_borrosa/web/fuzzy_inferencia/fuzzyop_en.htm
- https://cse.iitkgp.ac.in/~dsamanta/courses/archive/sca/Archives/Chapter%201%20Fuzzy%20set.pdf