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Assignment Unit-1.

What is Fuzzy logic ?

The term fuzzy refers to thing that are not clear or are vague.

Fuzzy logic is a form of many valued logic in which the truth values of variable may be any real number between 0 & 1. Instead of just traditional values of true or false.

The fundamental of fuzzy logic is the membership function which defines the degree of membership of an input value to a certain set of category.

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What is membership function in fuzzy logic ?

It determines the degree to which particular input belongs to a fuzzy set.

A membership function assign a value between 0 and 1 each input representing the degree of that input in a fuzzy set.

Membership function for "Cold" temp for temp below 10° C

↳ the membership degree for the temp. below 10° C = 1 (completely Old).

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Que 3. Explain the concept of fuzzy set.

A Fuzzy set is a mathematical concept that extends the idea of classical set by allowing elements to have degree of membership rather than just a simple Yes/No membership. This concept is used to handle situations where boundaries are not clear.

Key Concepts :-

1. Membership functions :- Membership function determine the degree to which a particular input belongs to a fuzzy set. This function made each element to a value blw 0 and 1.

2. Degree of truth :- Instead of just "True" or "False" fuzzy logic use degree of truth ranging from 0 to 1

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Que 4. Describe the role of membership function in fuzzy logic.

A membership function plays a crucial role in quantifying and representing the degree of truth or membership of an element within a fuzzy set.

Role of membership function :-

i) Defining Fuzzy set :- Membership function are used to define fuzzy sets by associating each element of the eleme of the input space with a degree of membership. This allows fuzzy set to capture the nau naunces of real-world concept that are not easily categorized into binary true/false or Yes/No categories.

ii) Quantifying Uncertainity :- Providing a gradual transition b/w membership and non-membership. membership function

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quantify the uncertainty and ambiguity inherent in many real world situations.

iii) Fuzzification :- The process of fuzzification involves conversion crisp input into fuzzy values using membership function.

iv) Decision-making :- In decision making system, membership functions help to evaluate and prioritize inputs by assigning degree of membership, they allow system to weight different factor according to their significance, leading to more nuanced and human-like decision making.

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Que 5. Explain different types of operations on fuzzy sets operations on fuzzy set?

i) Union of fuzzy set :- The Union of two fuzzy sets 'A' and 'B' is a fuzzy set C. Where the membership degree of an element in C is the maximum of its membership degree in A and B

Mathematical expression for any element x :-

$\mu C(x)$ or. $\mu A \cup B(x) =$

$$\max(\mu A(x), \mu B(x))$$

#

$U = \{5, 10, 20, 30\}$

$A = \{(10, 0.2), (20, 0.4), (30, 0.9)\}$

$B = \{(10, 0.4), (20, 0.1), (30, 0.2)\}$

$\mu A \cup B$ or $\mu C(x) = \{(10, 0.4), (20, 0.4), (30, 0.9)\}$

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ii) Intersection of fuzzy set :-

The intersection of two fuzzy sets A and B is a fuzzy set C, where the membership degree of an element in C is the min^m of it's membership degree in A and B.

mathematics representation :-

$$\mu C(x) = \min(\mu A(x), \mu B(x))$$

$A = \{(10, 0.2), (20, 0.4), (30, 0.9)\}$
$B = \{(10, 0.4), (20, 0.1), (30, 0.2)\}$

$C = A \cap B$ is

$$\mu C(x) = \{(10, 0.2), (20, 0.1), (30, 0.2)\}$$

iii) Complement of fuzzy sets :-

The complement of a fuzzy set A is "A" where the membership degree of an element in "A" is 1 minus it's membership degree in A.

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Mathematics expression :-

for any element x
$\mu A^c(x) = 1 - \mu A(x)$

$A = \{(x_1, 0.3), (x_2, 0.7), (x_3, 0.5)\}$

$A^c = \{(x_1, 0.7), (x_2, 0.3), (x_3, 0.5)\}$

i) Scalar Multiplication :-

It involves multipling the membership degree of a fuzzy set by scalar C typically C is a number blw 0 and 1.

Mathemabical Expression :-

For any element x

$\mu A^c(x) = C \cdot \mu A(x)$
where $0 \leq C \leq 1$

ex- for a fuzzy set A

$A = \{(x_1, 0.4), (x_2, 0.8)\}$

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Let $C = 0.5$ then

$A = \{(x, 0.5, 0.4)\}$

5 Fuzzy Addition -

Fuzzy Addition is an operation where the membership degree of an element in the resultant fuzzy set is the sum of its membership degrees in two fuzzy sets, clipped to maximum value of 1.

Mathematics expression -

For any element x

$\mu_{A+B}(x) = \min(\mu_A(x) + \mu_B(x) - 1)$

$A = \{(x_1, 0.2), (x_2, 0.6)\}$

$B = \{(x_1, 0.5), (x_2, 0.3)\}$

the Addl $C = A+B$ would be

$C = \{x_1, \min(0.2 + 0.5), 1)$

$\{(x_2, \min(0.6 + 0.3), 1)\}$

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$= \{(x_1, 0.7), (x_2, 0.9)\}$

6. Fuzzy set subtraction -

Fuzzy set subtraction involves subtracting the membership degree of one fuzzy set from other fuzzy set the result is clipped to a min^m value of 0.

Mathematics expression -

for any element x

$\mu A-B(x) = \max(\mu A(x) - \mu B(x), 0)$

ex-

$A = \{(x_1, 0.7), (x_2, 0.5)\}$

$B = \{(x_1, 0.3), (x_2, 0.6)\}$

$C = \{(x, \max(0.7 - 0.3), 0)$

$(x_2, \max(0.5 - 0.6), 0\}$

$C = \{(x, 0.4), (x_2, 0)\}$