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Assignment No : 01 (SCOA)

Problem Statement :

Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.

Objective :

- Provide an understanding of the basic mathematical elements of fuzzy sets.
- Understand and analyse concepts of fuzzy set.
- To use fuzzy set operations to implement current computing techniques used in fuzzy computing.

Software and Hardware Requirement :

1. 32/64 bit PC
2. CPP compiler

Theory :

Fuzzy Logic: Fuzzy logic is an organized method for dealing with imprecise data. It is a multivalued logic that allows intermediate values to be defined between conventional solutions. In classical set theory, the membership of elements in a set is assessed in binary terms according to a bivalent condition — an element either belongs or does not belong to the set. By contrast, fuzzy set theory permits the gradual assessment of the membership of elements in a set; this is described with the aid of a membership function valued in the real unit interval [0, 1].

Bivalent Set Theory can be somewhat limiting if we wish to describe a 'humanistic' problem mathematically. For example, Fig 1 below illustrates bivalent sets to characterize the temperature of a room.The most obvious limiting feature of bivalent sets that can be seen clearly from the diagram is that they are mutually exclusive - it is not possible to have membership of more than one set. Clearly, it is not accurate to define a transition from a quantity such as 'warm' to 'hot' by the application of one degree Fahrenheit of heat. In the real world a smooth (unnoticeable) drift from warm to hot would occur.

Fuzzy Sets:

If "X is collection of objects" (named universe of discourse) "denoted generically by x, then a fuzzy set Ã={(µĀ(x))| x Є X}

Where: µĀ(x)= X →[0,1] is called membership function or degree of membership(also, degree of compatibility or degree of truth) of x in A"

If the interval of real numbers [0,1] is replaced by discrete set {0,1}, then fuzzy set A becomes classic or crisp set.

Example:

A set X in which each element y has a grade of membership µX(y) in the range 0 to 1, i.e. set membership may be partial.

e.g. if cold is a fuzzy set, exact temperature values might be mapped to the fuzzy set as follows:

15 degrees → 0.2 (slightly cold)

10 degrees → 0.5 (quite cold)

Fuzzy Cartesian product

The totally ordered set I = [0, 1] is a distributive but not complemented lattice under the operations of infimum ∧ and supremum ∨. On L = I x I we define a partial order ✹, in terms of the partial order on I, as follows:

(i) (r1, r2) ✹(s1, s2) iff r1✹s1, r2✹ s2, whenever s1 0 and s2 0,

(ii) (0, 0) = (s1, s2) whenever s1 = 0 or s2 = 0,

For every (r1, r2), (s1, s2) ϵ L. The Cartesian product L=IxI is then a distributive but not complemented vector lattice. The operations of minimum and maximum in L are given respectively by (r1, r2) ∧ (s1, s2) = (r1 ∧ s1, r2∧ s2) And (r1, r2) ∨ (s1, s2) = (r1 ∨ s1, r2∨ s2)

For every (r1, r2),(s1, s2) ϵ L where the equality holds in the last relation when ri 0 si. When we speak of an L-fuzzy subset we mean that the associated membership function takes its values from the lattice L = I x I An L-fuzzy subset of X is thus a function from X to L [4]. The notation {(x, A(x)): x ϵ X} or, simply, {(x, r)}, where r = A(x), will be used to denote a fuzzy subset A of X. Similarly, an L-fuzzy subset of X, a fuzzy subset of X × Y and an L-fuzzy subset of X × Y will be denoted

respectively by {(x, (r1, r2))}, {((x, y), r)} and {((x, y), (r1, r2))}. To each fuzzy subset {(x, r1)} of X and fuzzy subset {(y, r2)} of Y here corresponds an L-fuzzy subset {((x, y), (r1, r2))} of X × Y. Throughout this paper the notation (x, r)
є A; where A є Ix, will mean that A(x) = r. Definition. The fuzzy Cartesian product of two ordinary sets X and Y, symbolically , is the collection of all L-fuzzy subsets of X × Y. That is,

Conclusion :

The concepts of union, intersection and complement are implemented using fuzzy sets which helped to understand the differences and similarities between fuzzy set and classical set theories. It provides the basic mathematical foundations to use the fuzzy set operations. With the use of fuzzy logic principles max min composition of fuzzy set is calculated which describes the relationship between two or more fuzzy sets.