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A REVIEW ON FUZZY SET THEORY AND ITS OPERATIONS

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ABSTRACT

In science, FUZZY sets will be sets whose components have degrees of enrollment. ... In FUZZY set hypothesis, established bivalent sets are generally called fresh sets. The FUZZY set hypothesis can be utilized as a part of an extensive variety of spaces in which data is fragmented or loose, for example, bioinformatics. In this paper an endeavor has been made to depict the diverse idea of FUZZY rationale in an exact way.

Key words- Fuzzy set, bioinformatics, fuzzy operations.

INTRODUCTION

In arithmetic, FUZZY sets will be sets whose components have degrees of enrollment. FUZZY sets were presented by Lotfi A. Zadeh[1] and Dieter Klaua[2] in 1965 as an augmentation of the established idea of set. In the meantime, Salii (1965) characterized a more broad sort of structure called a L-connection, which he considered in a conceptual mathematical setting. FUZZY relations, which are utilized now in various territories, for example, phonetics (De Cock, Bodenhofer and Kerre 2000) basic leadership (Kuzmin 1982) and bunching (Bezdek 1978), are extraordinary instances of L-relations when L is the unit interim [0, 1]. [1]

In established set hypothesis, the participation of components in a set is evaluated in twofold terms as indicated by a bivalent condition — a component either has a place or does not have a place with the set. By differentiate, FUZZY set hypothesis allows the steady appraisal of the enrollment of components in a set; this is portrayed with the guide of a participation work esteemed in the genuine unit interim [0, 1]. FUZZY sets sum up established sets, since the pointer elements of traditional sets are exceptional instances of the enrollment elements of FUZZY sets, if the last just take esteems 0 or 1.[3] In FUZZY set hypothesis, traditional bivalent sets are normally called fresh sets. The FUZZY set hypothesis can be utilized as a part of an extensive variety of spaces in which data is inadequate or loose, for example, bioinformatics.[2]

Fuzzy Set : Fuzzy logic set Theory was formalized by professor LoftiZadeh at the University of California in 1965. What Zadeh proposed is particularly an outlook change that initially picked up acknowledgment in the Far East and its fruits application has guaranted its reception around the globe.

FUZZY LOGIC:

Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean **logic** on which the modern computer is based. The idea of **fuzzy logic** was first advanced by Dr. LotfiZadeh of the University of California at Berkeley in the 1960s.What is membership function:

a. Fuzzy rationale :

As an expansion of the instance of multi-esteemed rationale, valuations ( ) of propositional factors ( ) into an arrangement of participation degrees ( ) can be thought of as enrollment capacities mapping predicates into FUZZY sets (or all the more formally, into a requested arrangement of FUZZY sets, called a FUZZY connection). With these valuations, numerous esteemed rationale can be stretched out to consider FUZZY premises from which reviewed conclusions might be drawn.[3]
This expansion is now and again called "FUZZY rationale in the tight sense" instead of "FUZZY rationale in the more extensive sense," which began in the designing fields of mechanized control and information building, and which envelops numerous points including FUZZY sets and "approximated reasoning."

Modern uses of FUZZY sets with regards to "FUZZY rationale in the more extensive sense" can be found at FUZZY rationale. [4]
b.FUZZY Number :

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A FUZZY number is a curved, standardized FUZZY set whose enrollment work is at any rate segmentally consistent and has the practical incentive no less than one component.

This can be compared to the funfair diversion "figure your weight," where somebody surmises the challenger's weight, with nearer surmises being more right, and where the guesser "wins" on the off chance that he or she surmises sufficiently close to the hopeful's weight, with the real weight being totally right (mapping to 1 by the participation work). [5]

c. FUZZY interval:

A FUZZY interim is a questionable set with a mean interim whose components have the participation work esteem . As in FUZZY numbers, the participation work must be arched, standardized, at any rate segmentally continuous.[6]

d. FUZZY categories:

The utilization of set participation as a key segments of class hypothesis can be summed up to FUZZY sets. This approach which started in 1968 not long after the presentation of FUZZY set theory[10] prompted the improvement of "Goguen classifications" in the 21st century.[11] [12] In these classifications, instead of utilizing two esteemed set enrollment, more broad interims are utilized, and might be cross sections as in L-FUZZY sets.[7]

e. FUZZY connection equation :

The FUZZY connection condition is a condition of the shape A • R = B, where An and B are FUZZY sets, R is a FUZZY connection, and A • R remains for the structure of A with R. [8]

Properties of Fuzzy Sets:As the FUZZY set hypothesis is an augmentation of the established set hypothesis, fresh sets are particular instances of the FUZZY sets. Therefore, the current properties of the established sets must be expanded and some new properties are presented. Among the broadened properties of the traditional sets are the meanings of vacancy, correspondence, consideration and cardinality. So as to consider the more extensive extent of the FUZZY sets, the meanings of convexity, bolster, α-cut, piece, width, tallness and standardization have been presented. A FUZZY set is thought to be unfilled if the participation degrees of all the elements of the universe are equivalent to zero.. [9] proposed a system in which this study presented the implementation of two fully automatic liver and tumors segmentation techniques and their comparative assessment. The described adaptive initialization method enabled fully automatic liver surface segmentation with both GVF active contour and graph-cut techniques, demonstrating the feasibility of two different approaches. The comparative assessment showed that the graph-cut method provided superior results in terms of accuracy and did not present the described main limitations related to the GVF method. The proposed image processing method will improve computerized CT-based 3-D visualizations enabling noninvasive diagnosis of hepatic tumors. The described imaging approach might be valuable also for monitoring of postoperative outcomes through CT-volumetric assessments. Processing time is an important feature for any computer-aided diagnosis system, especially in the intra-operative phase.

Operations on Fuzzy Sets The operations of supplement, convergence and union of the established set hypothesis can likewise be summed up for the FUZZY sets. For these operations, a few definitions with various ramifications exist. This segment just exhibits the most well-known administrators from the Zadeh's unique recommendation [131]. Encourage administrators can be found in Appendix A. The supplement of a FUZZY set is 1 short the participation degrees of the components of the universe. This definition regards the thought of solid refutation [41].grees of all the elementsof the universe areequal to zero.Fuzzy Sets

FUZZY Set Theory was formalized by Professor LoftiZadeh at the University of California in 1965. What Zadeh proposed is particularly an outlook change that initially picked up acknowledgment in the Far East and its fruitful application has guaranteed its reception around the globe.

A worldview is an arrangement of principles and directions which characterizes limits and instructs us to be effective in tackling issues inside these limits. For instance the utilization of transistors rather than vacuum tubes is an outlook change - moreover the advancement of Fuzzy Set Theory from traditional bivalent set hypothesis is an outlook change.

Bivalent Set Theory can be to some degree constraining in the event that we wish to depict a "humanistic" issue scientifically. For instance, Fig 1 underneath represents

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bivalent sets to describe the temperature of a room.(10)

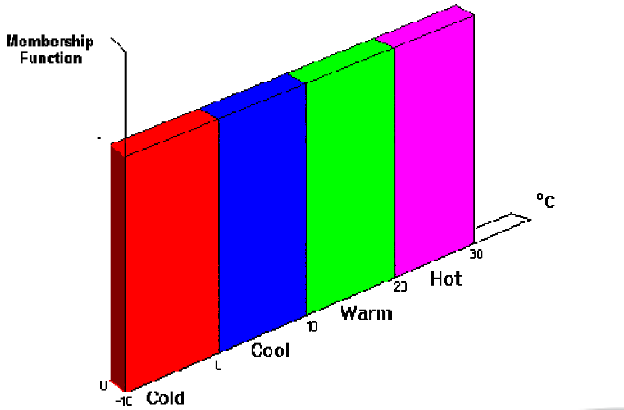


Fig. 1 : Bivalent Sets to Characterize the Temp. of a room.

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 (opinion would widely vary as to whether 50 degrees Fahrenheit is 'cold' or 'cool' hence the expert knowledge we need to define our system is mathematically at odds with the humanistic world). Clearly, it is not accurate to define a transiton 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.

This natural phenomenon can be described more accurately by Fuzzy Set Theory. Fig.2 below shows how fuzzy sets quantifying the same information can describe this natural drift.(11)

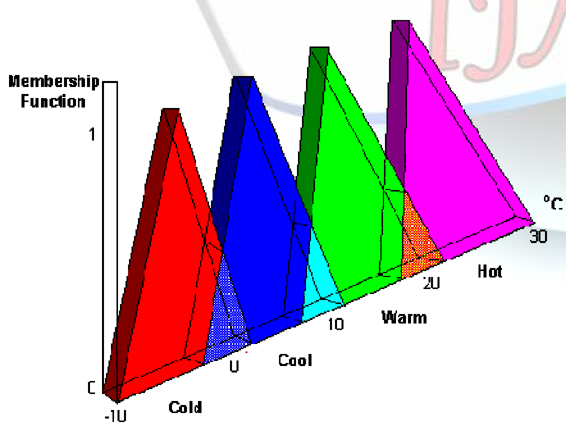


Fig. 2 - Fuzzy Sets to characterize the Temp. of a room.

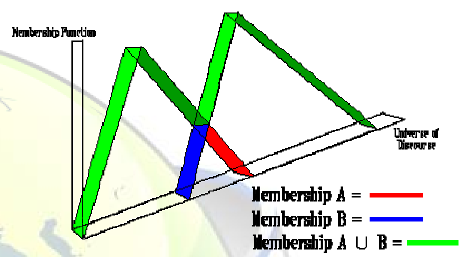
The whole concept can be illustrated with this example. Let's talk about people and "youthness". In this case the set S (the universe of discourse) is the set of people. A fuzzy subset YOUNG is also defined, which answers the question "to what degree is person x young?" To each person in the universe of discourse, we have to assign a degree of membership in the fuzzy subset YOUNG. The easiest way to do this is with a membership function based on the person's age.[12]

Fuzzy Set Operations:

Union:

The membership function of the Union of two fuzzy sets A and B with membership functions μ_A and μ_B respectively is defined as the maximum of the two individual membership functions. This is called the *maximum* criterion.

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

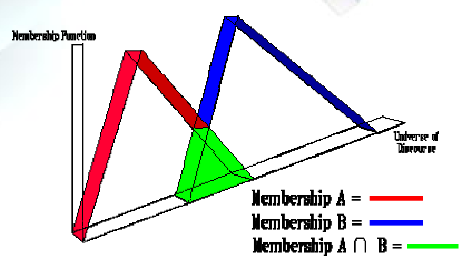


The Union operation in Fuzzy set theory is the equivalent of the **OR** operation in Boolean algebra.

Intersection:

The membership function of the Intersection of two fuzzy sets A and B with membership functions μ_A and μ_B respectively is defined as the minimum of the two individual membership functions. This is called the *minimum* criterion.

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



The Intersection operation in Fuzzy set theory is the equivalent of the **AND** operation in Boolean algebra.

Complement:

The membership function of the Complement of a Fuzzy set A with membership function μ_A is defined as the negation of the specified membership function. This is caleed the *negation* criterion.

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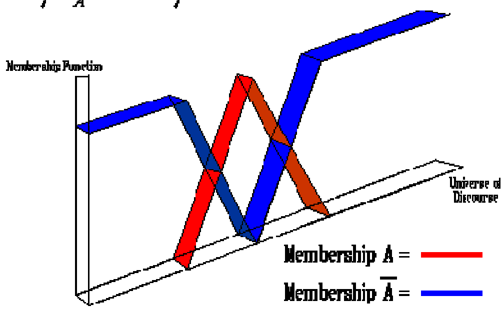
$$\mu_{\overline{A}} = 1 - \mu_A$$



The Complement operation in Fuzzy set theory is the equivalent of the **NOT** operation in Boolean algebra.
The following rules which are common in classical set theory also apply to Fuzzy set theory.

De Morgans law:

$$\overline{(A \cap B)} = \overline{A} \cap \overline{B}$$

$$, \overline{(A \cup B)} = \overline{A} \cap \overline{B}$$

Associativity:

$$(A \cap B) \cap C - A \cap (B \cap C)$$

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

Commutativity:

$$A \cap B = B \cap A \text{ , } A \cup B = B \cup A$$

Distributivity:

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

$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$ [13]

Glossary:

- Universe of Discourse

  The Universe of Discourse is the range of all possible values for an input to a fuzzy system.

- Fuzzy Set

  A Fuzzy Set is any set that allows its members to have different grades of membership (membership function) in the interval [0,1].

- Support

  The Support of a fuzzy set F is the crisp set of all points in the Universe of Discourse U such that the membership function of F is non-zero.

- Crossover point

  The Crossover point of a fuzzy set is the element in U at which its membership function is 0.5.

- Fuzzy Singleton

  A Fuzzy singleton is a fuzzy set whose support is a single point in U with a membership function of one.[14]

Fuzzy propositions: The classification of fuzzy propositions are statements which are either true or false.IN FUZZY logic, the truth or falsity of fuzzy propositions is assigned different degrees i.e, the truth and falsity are expressed by numbers in [0 1]

The fuzzy propositions of simple nature can be classified in to the following four types.

a) Unconditional and unqualified propositions.
b) Conditional and unqualified propositions.
c) Unconditional and qualified propositional.
d) Conditional and qualified proportional.

Applications of fuzzy LOGIC sets:

Fuzzy logic allows for the inclusion of vague human assessments in computing problems. ... New computing methods based on **fuzzy** logic can be used in the development of intelligent systems for decision making, identification, pattern recognition, optimization, and control.

Anti – Lock Break System(ABS) Temperature Controller Some Examples Fuzzy Logic provides a more efficient and resourceful way to solve Control Systems.[15]

1.FUZZY LOGIC IN CONTROL SYSTEMS

Using this we can define the fuzzy set. Low, Medium, and High Humidity can be defined by: Cold, Cool, Warm, and Hot A temperature control system has four settings Change the speed of a heater fan, based off the room temperature and humidity. The problem

2.**TEMPERATURE CONTROLLER**

Fuzzy logic washing machines are gaining popularity. These machines offer the advantages of performance, productivity, simplicity, productivity, and less cost. Sensors continually monitor varying conditions inside the machine and accordingly adjust operations for the best wash results. As there is no standard for fuzzy logic, different machines perform in different manners.

3.**Fuzzy Logic in a Washing Machine**

The machine rebalances washing load to ensure correct spinning. Else, it reduces spinning speed if an imbalance is detected. Even distribution of washing load reduces spinning noise. Neuro fuzzy logic incorporates optical sensors to sense the dirt in water and a fabric sensor to detect the type of fabric and accordingly adjust wash cycle . The fuzzy logic checks for the extent of dirt and grease, the amount of soap and water to add, direction of spin, and so on.

Trainable fuzzy systems for idle speed control, shift scheduling method for automatic transmission, intelligent highway systems, traffic control, improving efficiency of automatic transmissions.

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Automotive Altitude control of spacecraft, satellite altitude control, flow and mixture regulation in aircraft deiceing vehicles.

4. Aerospace :

Control of pH, drying, chemical distillation processes, polymer extrusion production, a coke oven gas cooling plant

5. Chemical Industry:

Decision-making support systems, personnel evaluation in a large company.

6. Business :

Control of automatic exposure in video cameras, humidity in a clean room, air conditioning systems, washing machine timing, microwave ovens, vacuum cleaners.

7.Electronics:Underwater target recognition, automatic target recognition of thermal infrared images, naval decision support aids, control of a hypervelocity interceptor, fuzzy set modeling of NATO decision making.

5..**Medical diagnostic support system**, control of arterial pressure during anesthesia, multivariable control of anesthesia, modeling of neuropathological findings in Alzheimer's patients, radiology diagnoses, fuzzy inference diagnosis of diabetes and prostate cancer.

 Autopilot for ships, optimal route selection, control of autonomous underwater vehicles, ship steering. Marine Optimization of cheese production. Manufacturing Fuzzy Logic Applications

Decision systems for securities trading. Securities Fuzzy control for flexible-link manipulators, robot arm control. Robotics Sinter plant control, decision making in metal forming. Mining and Metal Processing Fuzzy Logic Applications

8.Automatic underground train operation, train schedule control, railway acceleration, braking, and stopping Transportation Adaptive filter for nonlinear channel equalization control of broadband noise Signal Processing and Telecommunications Fuzzy Logic Applications.[16]

CONCLUSION:

In this paper we have reviewed the litearature and discussed the pros and cons as welas application of the fuzzy set in different area of science and engineering .

The next work we can consider an application oriented approach in any real time process.

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