

“FUZZY LOGICS: INTRODUCTION AND OVERVIEW ON ITS APPLICATIONS”

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Abstract:

The foundation of fuzzy logic lies in the concept of fuzzy sets, which generalize classical sets by assigning membership degrees to elements. Applications of fuzzy logic are widespread and span fields such as control systems, pattern recognition, artificial intelligence, decision support systems, and optimization. In control systems, fuzzy logic controllers offer a robust and intuitive approach to handling nonlinear and uncertain systems. In this paper we will focus on concept of fuzzy logic and basic applications of fuzzy logics.

Key words: -

fuzzy sets and logics, Applications, membership.

Introduction:

In fuzzy logic, inconsistency is extended to handle degrees of inconsistency, recognizing that contradictory information may exist to varying degrees. The concept of a fuzzy inconsistency degree allows for a more nuanced representation of conflicting information. According to (C. T. LEE & CHANG, 1971)[1] concepts of inconsistency, validity, prime implicit and prime implicate are extended to fuzzy logic and various properties of these notions in the context of fuzzy logic are established. The concept of a fuzzy inconsistency degree allows for a more nuanced representation of conflicting information. Validity in fuzzy logic considers the degree to which a statement is true, acknowledging the fuzzy nature of truth values. This extension is crucial in situations where information is imprecise or incomplete. In fuzzy logic, where truth values are not restricted to binary values, prime implicates are generalized to handle fuzzy implications. A fuzzy prime implicit captures the essential fuzzy conditions necessary for a statement to hold true, considering degrees of membership. (A. Zadeh, 1989)[2] Described the capability to manipulate fuzzy concepts that distinguishes human intelligence from the machine intelligence of current generation computers. (Hellmann) Described the basic notion of fuzzy systems is a fuzzy (sub) set. The membership function, operating in this case on the fuzzy set of interferometric coherence returns a value between 0.0 and 1.0. It is important to point out the distinction between fuzzy logic and probability. Both operate over the same numeric range, and have similar values, 0 representing False (or non-membership), and 1.0 representing True (or full-membership). (Makkar, 2018)[3] Presented the concept of fuzzy logic and its application in different branches. This study represents the use of fuzzy logic approach in chemical science, medical science, agriculture, political science, operations research, in environment science and in household. This paper represents that fuzzy logic approach has mainly three phases: fuzzification, rule or inference and defuzzification. The findings indicated that fuzzy logic is a wide approach rather than a mathematical logic and is applicable in many branches. This paper presented just an overview on fuzzy logic and its applications. But it has a lot of applications that has been discovered and are realized these days. A lot are left that are to be discovered still. The paper reviews fuzzy logic concept and its application in chemical science, in healthcare industry, in agriculture. In political science, in operations research, in household and in environment science. Thus fuzzy logic has become a helping hand not only in mathematics, but in many other branches also. (Bajpai & Kushwah, 2019) [4] the main aim is to survey about the fuzzy logic applications and finding the recent contributions by using the fuzzy theory and their computational ability. In addition, of that the paper includes the taxonomy and the future research directions. Finally, paper provides a proposal of utilizing

the technology in text mining domain as an application for future design and development. The fuzzy logic is an essential part of technology. That offers services not only to the core engineering that is also applicable to solve various real world complexities. The problem solving technique is much transparent and flexible to scale and minimize the requirements according to the application needs. In this context, the paper provides the detailed understanding about the applications and acceptability of the fuzzy based systems in various industries and organizations. In addition, of that paper is also providing the advantages and the disadvantages of the existing fuzzy based data models. For future design and development based on the gained experience a data model is introduced for text mining application where the key aim is to categorize the text according to user sentiments and their orientations according to the product review. In near future the given model is implemented and their performance is simulated. (Sarkar, G.Sahoo, & U.C.Sahoo, 2012) [5] Developed to solve various traffic and transportation planning problems. Emphasis is put on the importance of fuzzy logic systems as universal approximators in solving traffic and transportation problems. This paper presents an analysis of the results achieved using fuzzy logic to model complex traffic and transportation processes. Fuzzy logic could be used successfully to model situations in which people make decisions in an environment that is so complex that it is very hard to develop a mathematical model. Such situations for example often occur in the field of traffic and transportation when studying the work of dispatchers or modeling choice problems. This idea was accepted by a great many researcher and in the past two or three years a large number of papers have appeared in which the fuzzy rule base and/or shape of the membership function are determined using numerical training data. Designing fuzzy logic systems using numerical training data is certainly one of the very important tasks in the area of fuzzy logic systems for transportation engineering as well. Fuzzy logic systems provide two other very important advantages. They can use existing linguistic knowledge very successfully, and they treat uncertainty in an appropriate manner. The basic goal of this paper was to classify and analyze results in the application of fuzzy logic when modeling complex traffic and transportation processes. The results obtained show that fuzzy set theory and fuzzy logic present a promising mathematical approach to model complex traffic and transportation processes that are characterized by subjectivity, ambiguity, uncertainty and imprecision. As already noted, the benefits from the fuzzy logic will be more accurately assessed as the number of successful practical applications of the fuzzy logic in traffic control and transportation planning increases. According to (Florin Popescu & Sorin Pistol, 2021)[6] the indexing of academic performance in various international databases with impact indices at different scales has led to the need for advanced computer models, such as expert systems based on fuzzy logic, proposed in this research, which address the evaluation of teachers even in the face of imprecise information and under conditions of uncertainty. In this research, as a contribution and novelty, a fuzzy logic model was developed in which an algorithm was simulated and implemented in Matlab using the Mandami toolkit, which allows inference of the rules of fuzzy logic and visualization. 3D. The system implementation was done by software in Matlab environment, using systems with fuzzy Mandami logic. The result of this pilot study was to test and validate the proposed model through a graphical interface, giving the results according to minimum criteria and with additional explanations.

Result and Discussion:

Fuzzy logic system requires a stream of processing architecture. This includes Rule base, Fuzzifier, Defuzzifier and Inference engine. Fuzzy logic is a technique to embody human like thinking into a control system. Fuzzy logic is used in the aerospace field for altitude control of spacecraft and satellites. Fuzzy logic can emulate human deductive thinking, that is the process people use to infer conclusions from what they know. Fuzzy logic is implemented using fuzzy rules, which are if-then statements that convey the connection between input variables and output variables in a fuzzy way. Fuzzy logic attempts to solve problems with an open, imprecise spectrum of data and heuristic that makes it possible to obtain an array of accurate conclusions. Defuzzification is used to convert the fuzzy sets obtained by the inference engine into explicit values. Several defuzzification methods are available, and the most suitable method for a particular expert system is used to reduce errors. Because

fuzzy logic resembles human thinking and decision-making, it offers highly efficient solutions to complex problems in all areas of life.

Application of Fuzzy Logic:

This paper assesses a few areas which have seen fuzzy logic being implemented positively. Fuzzy logic has been applied in chemical science. Hayward and Davidson [4] considered numerous examples which made use of fuzzy logic. Almarady's study made use of a fuzzy control system which helped in applying current to anodes connected in series which was done so that a lengthy buried pipeline gets protected and also minimized power requirements to safeguard the pipeline.

Fuzzy logic is being used extensively in the healthcare industry. Biomedicine is looked upon as a branch of science but more than science, it is an art. Because it uses human knowledge, experience and skills to treat and diagnose diseases. Biomedical systems are intrinsically nonlinear, time-varying and have a delay in time. In 1980, in the case of open-heart patients, to regulate the blood pressure of patients a real-time drug distribution method controlled with the help of fuzzy logic has been developed.

The paper "Design and development of Fuzzy Expert System for Integrated Disease management in Finger Millets" identified syndromes as moderately resistant, highly resistant, immune, resistant, highly susceptible and susceptible. The professional system uses defuzzification and fuzzification process which is traditionally done only by experienced farmers or agricultural scholars.

Many models in soil studies are interdisciplinary, requiring mathematical models that are built in the hard sciences and which are then linked with connections and subjective rulebased models used in the less exact or soft sciences. The resulting complex models are often difficult to interpret and may not possibly reflect the soil or soil processes of the real world. In soil science, the fuzzy set theory is prominently used for classification.

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Petroleum production and exploration business prosper with in-depth understanding and knowledge of the subsurface. Technological advancement has aided in providing the industry with a lot of information about the petroleum reservoir; though, a lot of uncertainties are still present as of the nature of the subsurface. The industry has attempted to report this problem in diverse ways; unfortunately, the classical methods have failed to provide proper guidance to management decisions in making use of these reservoirs. The application of fuzzy logic comes across various extents of engineering. Decision-makers solve problems on a day-to-day basis with the aid of quantitative information obtained.

These days, a lot of home-use appliances are being upgraded with the aid of fuzzy logic to save money and time. Fuzzy logic is used in a lot of appliances like an air conditioner, vacuum cleaner, washing machine, etc. Tiryaki and Kazan's dishwasher which made used fuzzy logic and Alhanjouri and Alhaddad's optimized wash time of washing machine using fuzzy logic are the important studies that are based on the fuzzy logic. After which many researchers have worked on this so that they can achieve reduced wash time and the reduced consumption of water and time.

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Conclusion:

Fuzzy logic is a further version of Boolean logic or binary that is two-valued logic. It uses mainly three steps. They are fuzzification, inference system, and defuzzification. It can be easily taught by using fuzzy-fied educational methods. So it is appropriate to use multi-valued fuzzy logic rather than two-valued logic. In general, the employing fuzzy logic may prove to be helpful, for very complex processes, when there does not exist a simple mathematical model. This paper presents a brief outline of fuzzy logic and its applications in different fields. Very less is covered and more are there, which means this paper presents just an overview of fuzzy logic and its applications. But it has a lot of applications that have been discovered and are realized these days. A lot are left that are to be discovered still.

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