Literature review on fuzzy logic

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Abstract:

In every field, Mathematics plays a vital role, serving as the cornerstone of knowledge. Mathematics is often regarded as the quintessence of all arts and the science of all sciences. Its terms and functions permeate numerous branches across various domains. This paper delves into the realm of Fuzzy Logic, a significant concept within mathematics that has gained prominence not only in theoretical mathematics but also in practical applications across diverse sectors such as medicine, engineering etc. Here, we explore its applications and approaches within each field. This paper posits that the fuzzy logic approach comprises primarily three phases: rule or inference, fuzzification, and defuzzification. It underscores that fuzzy logic is a broad methodology rather than a strict mathematical framework, applicable across multiple domains.

Keywords:

Fuzzy Logic, Application of fuzzy logic.

1. Introduction:

The term "fuzzy" denotes situations that are ambiguous and lack clarity. In our daily lives, we often encounter situations where determining the absolute truth or falsehood is challenging, as conditions may vary. Fuzzy Logic provides a valuable framework for dealing with such uncertainties, offering assessments of situations encountered. Fuzzy Logic represents a form of multi-valued logic where the truth values of variables can range between 0 and 1, rather than being confined to the binary values of true or false. This concept emerged in response to scenarios where the dichotomy of true or false was deemed overly restrictive, allowing for the expression of partial truths. It serves as a tool to handle imprecise or uncertain information, providing a mathematical apparatus for representing vagueness and uncertainty in decision-making processes. While Boolean logic adheres strictly to the values of 0 and 1, fuzzy logic introduces intermediate values, allowing for significance assessments of truth. This expanded scope enables the consideration of concepts such as low, high, and medium, along with their variations. Hence, fuzzy logic extends beyond the confines of Boolean logic, accommodating a broader spectrum of possibilities. The term "fuzzy" denotes ambiguity or lack of clarity. Fuzzy logic accommodates propositions that may be partially true or false, reflecting the concept of partial truth. Degrees of truth are represented through membership functions, which assign values within the unit interval [0, 1]. This range encompasses the false value (0), the true value (1), and intermediate values representing partial truths. One of the principal advantages of fuzzy logic lies in its resemblance to human reasoning, employing linguistic variables to mitigate complexity. We see the application of fuzzy logic serve as the cornerstones of fuzzy mathematics, an extension of conventional mathematics. Fuzzy logic finds application across diverse fields, beyond its roots in Mathematics. This paper reviews select areas where fuzzy logic has been effectively applied. Fuzzy logic has found utility in chemical science, as evidenced by studies exploring its application in diverse contexts such as chemical process control and pH regulation in wastewater treatment. These studies demonstrate the efficacy of fuzzy logic in optimizing chemical processes and minimizing resource consumption. Also in Healthcare Industry Fuzzy logic has been leveraged in the healthcare industry to address the complexities of biomedical systems and clinical decision-making. Applications range from real-time drug delivery systems to decision support systems for diagnosis and treatment planning, highlighting its value in enhancing healthcare outcomes. We see in the field of Agriculture, Fuzzy logic has emerged as a valuable tool in agriculture, facilitating tasks such as pest management, disease diagnosis, and soil analysis. Expert systems employing fuzzy logic enable farmers to make informed decisions based on complex environmental factors,

thereby optimizing crop yields and resource utilization. We see in the Political Science also the Fuzzy logic offers a novel approach to political decision-making, particularly in candidate selection and election result prediction. By accommodating the inherent uncertainties and complexities of electoral processes, fuzzy logic aids in devising more significance decision support systems for political actors. Here in Mathematics we see in Operations Research, Fuzzy logic contributes to operations research by providing solutions to optimization problems in diverse domains such as transportation, traffic management, and production planning. Its ability to handle imprecise data and complex decision scenarios makes it a valuable tool for optimizing resource allocation and process efficiency.

We see in daily life the application of fuzzy logic like in Household, Fuzzy logic is increasingly integrated into household appliances to enhance functionality and efficiency. From washing machines to air conditioners, fuzzy logic enables appliances to adapt to varying environmental conditions and user preferences, resulting in improved performance and energy savings. Now we see in the Environmental Science, Fuzzy logic finds application in environmental science for tasks such as flood prediction, climate modeling, and ecological risk assessment. Its ability to handle uncertain data and nonlinear relationships makes it well-suited for addressing complex environmental challenges.

2. Conclusion:

Fuzzy logic, as an extension of traditional two-valued logic, offers a versatile framework for modeling and decision-making in uncertain environments. Its application extends beyond mathematics to encompass a wide array of disciplines, where it serves as a powerful tool for addressing complex and ambiguous problems. This paper provides a glimpse into the diverse applications of fuzzy logic across fields such as chemical science, healthcare, agriculture, political science, operations research, household, and environmental science. While this review offers a comprehensive overview, it merely scratches the surface of fuzzy logic's potential applications, leaving ample room for further exploration and innovation. Fuzzy logic stands as a testament to the adaptability and efficacy of mathematical concepts in addressing real-world challenges across diverse domains.

3. References:

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