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Theorem analysis for application of fuzzy set in real life

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Abstract - Fuzzy logic has its uses, but other new AI methods like machine learning and deep learning may be better suited to tackling challenging, complex, and large data tasks. Once upon a time, it was believed that the three most important AI programmes were the Genetic Algorithm, the Neural Network, and the Fuzzy Logic. While it's true that each of these methods has had its moment in the sun, it now appears that the time has arrived for machine learning based on Neural Networks. Given that fuzzy logic has features like interpretability and universal approximation, the issue of whether or not it will play a crucial role in the current uptick in interest in artificial intelligence emerges. (AI). yes, but how exactly? When it comes to making choices, why doesn't automated technology make more use of imprecise logic?

Keywords - Neural network, Fuzzy logic, and artificial intelligence

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INTRODUCTION

The field of artificial intelligence encompasses fuzzy logic as a theoretical framework. The applications of fuzzy logic of type 1 and type 2, whether in control systems or in other domains, have been developed and expanded throughout the last several decades. However, owing to the limitations of the capabilities of fuzzy logic, tough, complicated, and big data jobs may be addressed more effectively by applying other recent AI approaches such as machine learning and deep learning. It was previously thought that the Genetic Algorithm, Neural Network, and Fuzzy Logic were the three most essential algorithms of artificial intelligence. While each of these algorithms has had its day in the spotlight, it seems that the time has come for Neural Network-based machine learning. Since fuzzy logic possesses properties such as interpretability and universal approximation, the question that arises is whether or not it will play an essential part in the recent surge of interest in artificial intelligence (AI). and how exactly? Why are there so few uses of fuzzy logic in the processes that autonomous vehicles use to make decisions?

(a) The Vehicle Sector: Some of the most impressive applications of artificial intelligence in the automobile industry are automatic automobiles and racing motorcycles. They are equipped with all of the complicated capabilities that may be found in a single device, such as automated lane changing while driving, braking, collision avoidance between two cars, navigation, and so on. The data mapping function of AI is used in this situation. This function saves data on the path of the vehicle from which it will travel through as well as data regarding its surroundings, such as information regarding traffic, the kind of road, street lights, and so on. It also runs an algorithm in the backend that assesses and recognises any changes in the operating state of the vehicle, such as changes in speed or surrounds, and makes any necessary adjustments to the route as a result so that activities may continue without interruption.

(b) The Healthcare Industry: The medical and pharmaceutical industries need to find ways to cope with the unreliability of patient data, sporadic reports, haziness in drugs and medications, a patient's mental and physical state while being tested, and other issues that are comparable to these problems. Fuzzy logic (FL), which functions in a way that is similar to that of human brains and is driven by approximate facts, is capable of addressing the challenges that have been presented. The system first removes any unnecessary information from a massive database, then summarises what's left, and finally provides users with brief responses. The process of using a model to design and develop an accurate representation of a biological system is

notoriously difficult, which is one of the reasons why its application to the decision-making process in the healthcare industry is seeing explosive development. The FL requires researchers, medical experts, and technology developers to study uncomplicated in addition to cutting-edge potential answers. Because human knowledge and experience cannot be characterised by using precise mathematical models, it is possible to utilise it as a versatile tool for modelling, managing, and regulating processes. [Citation needed] As a result of this, the authors are motivated to conduct research on the underlying FL framework and investigate the application areas that it serves in this industry. In the field of healthcare, the decision-making process that is based on ranking, classification, data mining, feature selection, pattern recognition, and optimization has been the focus of descriptive research that has been conducted to investigate and concentrate on this process. This research has been undertaken to investigate and focus on this process. It has also been explored how FL-based approaches may be employed while dealing with fundamental and discriminative algorithms, with the goal of reducing the amount of uncertainty that is present in the process.

(c) The Use of AI on Smart Phones

When building a fuzzy logic system, the first stage in the process is to start with a set of attribute values for each input and another set for each output. This is the beginning of the process. An accurate output is achieved by subjecting the membership functions to a set of criteria, which, when taken together, provide the desired effect. First, let's take a look at a straightforward illustration of process control, and then we'll talk about fuzzy logic.

- Google Assistant

For illustration's sake, let's say that we need to contact someone while we're driving a vehicle.

Voice commands are an option for doing this. We can talk on the phone while concurrently navigating to our destination using Google Maps.

- Intelligent Camera • Smart selfie-and Super-Resolution Zoom camera • Google Maps using AI to predict traffic • Digital Wallet

(d) AI in Social Networking • LINKEDIN • FACEBOOK FACIAL RECOGNITION

- INSTAGRAM
- YOUTUBE
- AI in online shopping Intelligent Camera • Smart selfie-and Super-Resolution Zoom camera • Google Maps using AI to predict traffic

(f) The applications of artificial intelligence in finance and banking include: the trade and share market claim management smart banking research and market intelligence

The contemporary climate for doing business is marked by intense rivalry as a result of the growing globalisation and variety of the marketplace. As a consequence of this, businesses have begun to recognise the necessity of designing and putting into action marketing strategies that are based on the client in order to increase customer loyalty and optimise lifetime earnings. As a direct result of this, fuzzy logic has been included into many marketing models in order to provide answers for various customer-specific marketing and commercial difficulties. In their explanation, Hernández and Hidalgo state that fuzzy logic is founded on the study of human actions. For example, fuzzy logic attempts to simulate the way that humans think by analysing situations and coming to conclusions based on ambiguous or inaccurate values rather than depending on concrete truths or outright lies. Fuzzy logic is a method to computing that originates from the mathematical study of multivalued logic. This technique processes all potential truth values via the same variable. Scott defines fuzzy logic as an approach. The use of true values ranging from 0 to 1 in fuzzy logic, on the other hand, denotes that the algorithm can provide solutions based on data ranges rather than on a single discrete data point. This is in contrast to the requirements of classical logic, which stipulates that statements must either be completely true or completely false. In this scenario, fuzzy logic may be used in data interpretation for the purpose of providing informative results that have relative or subjective meanings. Because of the many ways in which individuals take in and make sense of the information they are exposed to, assertions of absolute falsity or truth are very uncommon in real-world contexts. For instance, the same piece of marketing material may be interpreted in a variety of ways by various clients, resulting in a variety of choices and intents. As a result, the use of fuzzy logic in marketing enables marketeers to make judgements based on diverse data ranges gleaned from a variety of clients and partners. The notion of "fuzzy marketing" was developed as a result of applying the concepts of fuzzy logic to various

marketing decision-making processes. It is used to reflect how individuals think and act by estimating the results of their prior information and experiences. It does this by looking at people's past knowledge and experiences. In this particular instance, the fuzzy logic used in marketing determines that the truth coefficients are located somewhere on the spectrum ranging from 0 to 1. This argues that consumer behaviours and consumption of marketing information cannot be viewed as merely being black and white (i.e., true/false binary absolutes), but rather need to be understood from'shades of grey' viewpoints. Customers are not predicable or specified in any way; rather, by definition, they are fuzzy. For instance, just because a consumer purchased a certain product this week does not always guarantee that they would purchase the same thing again the next week. Therefore, fuzzy logic advocates considering consumers as individuals and genuine persons, as opposed to addressing them collectively within a certain sector using signal data. As a consequence, this strategy makes it possible to create promotional messages that emotionally engage the target audience and enhance the likelihood of good actions and results. In order to further illustrate the connection between these ideas, marketing and fuzzy logic, a systematic bibliometric literature review (LRSB) consisting of 96 sources was carried out. The goal of this review was to assist marketers in their efforts to achieve competitiveness in an environment that is characterised by uncertainty.

A market development strategy is a marketing tactic that businesses use to expose current goods or services to new markets. This may be accomplished via the use of a market development strategy. When a company has reached maturity in its existing market, it is imperative for it to investigate new markets for a continuing product in order to boost sales, which is vital for ensuring both organisational performance and stability. The product that is being sold has not changed, but in order to aid the expansion of the company, it is being advertised to new consumers. A corporation could, for instance, decide to advertise a product in new geographical areas or build routes for exporting the items to foreign markets. Both of these options are available to the company. A market development plan is an essential marketing tool because it enables businesses to access a bigger audience of prospective clients. This is particularly important in the more worldwide corporate environment that exists in the present day. It may also be used to promote brand recognition, create organisational resilience, generate more leads and sales, and support long-term company growth and financial success in addition to being utilised to acquire new consumers. These are just some of the many applications of this technology. However, in order to assure the success of the market growth strategy, firms need to perform market research in order to discover development prospects, design a marketing plan, and allocate adequate resources.

Design and structure of fuzzy logic system:

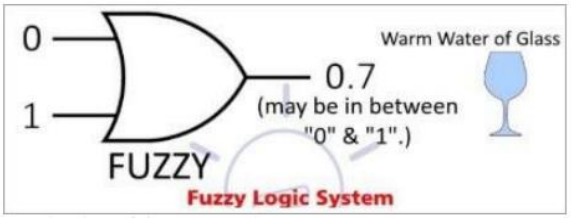
Four main components

(1) The fuzzification interface : transforms input crisp values into fuzzy values

(2) The knowledge base : contains a knowledge of the application domain and the goals.

(3) The decision-making logic :performs inference for fuzzy control actions

(4) The defuzzification interface Type 2 Fuzzy System



The operations of the automatic and semi-automatic home appliances such as refrigerators, air-conditioners, washing machine, dishwasher, microwave oven, vacuum cleaners, etc.

- Different environmental conditions like heater operations, air-purifiers, etc.
- Operations of the automobiles like four-wheeler cars and racing bikes and cars.
- Operations of electronic goods like digital cameras, still cameras, smart television, photocopy machine, printing machine, etc. Advantages:
- The mathematical perception of the inputs along with the graphical notation makes the analysis easier for obtaining meaningful output.
- We can modify the artificial fuzzy logic according to our requirements by adding or deleting rules which make its function flexible.
- It also synthesis the inputs having the error, distorted and ambiguous data.
- It provisions a significant solution to a complex input problem which is similar to the quality of humans to provide sensible reasoning and decision making for complex issues.

Robotics In Artificial Intelligence Robots are the artificially intelligent machines that behave as intelligent humans in the realworld. The basic objective of any kind of robot is to minimize the human efforts to perform a given task repeatedly based on the given set of properties on which they have been skilled and programmed. Through the support of strong AI, the robots are designed to perform one specified task repeatedly and accurately and these are used for business purposes to perform the heavy task in an industrial area also known as industrial robots.

Then let's discuss and explain the application in information Information Retrieval

The vast majority of the tools that we have traditionally used for formal modelling, reasoning, and computation are characterised by their crispness, determinism, and precision. Real-life circumstances are seldom clear-cut and predetermined, and it is impossible to provide an accurate description of them. It is frequently the case that in order to provide a comprehensive description of a genuine system, one would need far more specific data than a human person could possibly be expected to simultaneously perceive, analyse, and comprehend. This finding resulted in the expansion of the notion of crisp sets in order to represent imprecise data, which may result in an increase in the modelling capacity of crisp sets.

L.A. Zadeh is the one who came up with the idea of a "fuzzy set" after making the initial step in this direction ([11]). The introduction of fuzzy sets was motivated by the desire to provide graded membership to components rather than binary membership, which was the original plan. Pawlak ([13]), who invented the concept of Rough Sets and it is an effective tool to capture indiscernibility of objects, is responsible for another method of capturing impreciseness. This method is thanks to Pawlak's work. According to Pawlak's formulation of rough set theory, the primary assumption of this school of thought is that the amount of information that humans possess about the universe is directly proportional to their level of expertise in the subject of object classification. It is common knowledge that classifications of a universe and equivalence relations established on it are two different names for the same thing. Therefore, for mathematical reasons, Pawlak believed equivalence relations to be a viable option for defining rough sets. A pair of crisp sets, which are collectively referred to as the lower and upper approximations of the set, are used to represent a rough set. Lower approximation of a rough set contains those components of the universe that, based on the information that is now available, may be categorically identified as belonging to the rough set. The upper approximation, on the other hand, is made up of the items that, according to the information that is now available, have a chance of being included in the set. Over the course of the previous several years, the initial notion of rough sets, which was presented by Pawlak, has been developed further in a variety of various ways. One example of such an enhancement would be to loosen the restrictions that the fundamental relationships must be equivalence relations. For the sake of accuracy, this is accomplished by removing the requirement that the basis relations either be symmetric or transitive (or both) ([67]). These kinds of connections are far more common in real life.

L.A. Zadeh is the one who came up with the idea of a "fuzzy set" after making the initial step in this direction ([110]). The introduction of fuzzy sets was motivated by the desire to provide graded membership to components rather than binary membership, which was the original plan. Pawlak ([39]), who invented the concept of Rough Sets and it is an effective tool to capture indiscernibility of objects, is responsible for another method of capturing impreciseness. This method is thanks to Pawlak's work. According to Pawlak's formulation of rough set theory, the primary assumption of this school of thought is that the amount of information that humans possess about the universe is directly proportional to their level of expertise in the subject of object classification. It is common knowledge that classifications of a universe and equivalence relations established on it are two different names for the same thing. Therefore, for mathematical reasons, Pawlak believed equivalence relations to be a viable option for defining rough sets. A pair of crisp sets, which are collectively referred to as the lower and upper approximations of the set, are used to represent a rough set. Lower approximation of a rough set contains those components of the universe that, based on the information that is now available, may be categorically identified as belonging to the rough set. The upper approximation, on the other hand, is made up of the items that, according to the information that is now available, have a chance of being included in the set. Over the course of the previous several years, the initial notion of rough sets, which was presented by Pawlak, has been developed further in a variety of various ways. One example of such an enhancement would be to loosen the restrictions that the fundamental relationships must be equivalence relations. For the sake of accuracy, this is accomplished by removing the requirement that the basis relations either be symmetric or transitive (or both) ([67]). These kinds of connections are far more common in real life.

Fuzzy Similarity Relation

First, we define a fuzzy set and a fuzzy relation. A universal set, U, is what we have in mind.

Definition:

Let assume that "A" is the fuzzy set ([110]), A over the universal set U is featured by its relativeness and membership function Fa defined as

$\Rightarrow Fa: U \rightarrow [0,1],$

This function is linked with every $x \in U$ *which is a real number* $Fa(x)g$

etting into the interval $[0,1]$*, known as the membership value o*

Definition-: Binary connection with some fuzziness If we define R over U as a fuzzy set, then R over U is a fuzzy set defined over U*U.

Throughout with the discussion of this chapter, R(x,y) is representing the mean value of the function $\mu_{R(x,y)}$.

Definition-: Allow R to represent a fuzzy binary association over U. To be fuzzy reflexive, R must have R(x, x) = 1 for every x $\in U$.

Fuzzy reflexive binary relations seem to be more broad than regular reflexive binary relations because they allow for x $\neq y, R(x, y) = a, a \in [0,1]$*in the situation of*

Former whereas R(x,y)=0 or 1 in the next case to be any real number.

2nd R meets both of these conditions, we may call it fuzzy symmetric iff.

$R(x,y) = R(y,x)$ *for all* x, y *belongs to universal set* U.

3rd R needs to be fuzzy max-min transitive iff

$$R(x,z) \geq \max_{y \in U} \min\{R(x,y), R(y,z)\}, \forall x, z \in U$$

in the above equation fuzzy transitive = fuzzy max − min transiive.

Therefore, a max-min transitive relation will always be a transitive relation, since this follows from the previous statement.

For, if $R(x,y) = R(y,z) = 1$, *then* $R(x,z) \geq \max_{y} \min\{R(x,y), R(y,z) = 1$

That implies $R(x,z) = 1$.

In the same vein, a fuzzy symmetric relation always represents a symmetric relation. Because of this, if R is symmetric, then R(x, y) =1 is the same as R(y, x) =1, and R(x, y) =R(y, x) holds true for all possible combinations of x and y belong to Universal set U.

Comparability Determined Using a Fuzzy Reflexive Binary Relationship

Consider the relation R to be a fuzzy reflexive binary over U.

Definition:

For

any $a \in$ $[0,1]$, *the* $a -$ *cut of* R, *presented by* Ra, *is a subset of* $U *$ U, *given by* $Ra = \{(x,y): R(x,y) \geq a\}$.

Definition:

For any $x, y \in U$, *we can assume that* x *is a* $-$ *fuzzy similar to* y *ans can represent* $xR_a y$ *iff* $R(x,y) \geq b$.

The following two sets are defined by us as being connected with any x ∈ U.

$R_a(x)$ *is known the a* $-$ *fuzzy similarity class of variable* x *w.r.t.* R, *that* Constitute the set of each and every element of U, which stands similar to the x. on the opposite side $R_a^{-1}(x)$ *incomprises of those an element of* U *to which* x *is denoted as*

$a -$ *fuzzy similar. If* r *is not in the form of fuzzy symmetric then* $R_a(x)$ And $R_a^{-1}(x)$ *are not same, otherwise they will be identical.*

CONCLUSION

Fuzzy logic has its uses, but other new AI methods like machine learning and deep learning may be better suited to tackling challenging, complex, and large data tasks. Once upon a time, it was believed that the three most important AI programmes were the Genetic Algorithm, the Neural Network, and the Fuzzy Logic. While it's true that each of these methods has had its moment in the sun, it now appears that the time has arrived for machine learning based on Neural Networks. Given that fuzzy logic has features like interpretability and universal approximation, the issue of whether or not it will play a crucial role in the current uptick in interest in artificial intelligence emerges. (AI). yes, but how exactly? When it comes to making choices, why doesn't automated technology make more use of imprecise logic?

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