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FUZZY LOGIC FOR UTILIZATION IN INTELLIGENCE CYCLE AND IN GENERATION OF ALTERNATIVES

Animesh Kumar Sharma

Lecturer (Maths), Raipur Institute of Technology, Raipur (C.G)
Email: animatte.sharma@gmail.com

ABSTRACT

In this paper I summarize an application of Fuzzy logic in intelligence cycle, also some concept about utilization in intelligence cycle and in generation of alternatives.

Keywords: Intelligence Warfare, Fuzzy Logic, Decision Analysis, Utilization in IC

INTRODUCTION

The concept of Fuzzy Logic (FL) was conceived at the beginning of the 70s by Lotfi Zadeh, a professor at the University of California at Berkley, and presented not as a control methodology, but as a way of processing data by allowing partial set membership rather than crisp set membership or non-membership. This approach to set theory was not applied to control systems until the 70's due to insufficient small-computer capability prior to that time. Professor Zadeh reasoned that people do not require precise, numerical information input, and yet they are capable of highly adaptive control. If feedback controllers could be programmed to accept noisy, imprecise input, they would be much more effective and perhaps easier to implement.

What Is Fuzzy Logic?

In this context, FL is a problem-solving control system methodology that lends itself to implementation in systems ranging from simple, small, embedded micro-controllers to large, networked, multi-channel PC or workstation-based data acquisition and control systems. It can be implemented in hardware, software, or a combination of both. FL provides a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information. FL's approach to control problems mimics how a person would make decisions, only much faster.[]

Because of the nature of intelligence predictions and decision analysis, fuzzy logic can be utilized in nearly every step of the intelligence cycle and create options for planners and decision makers. Additionally, offensive intelligence warfare can benefit from fuzzy logic by efficiently applying the least amount of force necessary to achieve the desired results. For these reasons, intelligence strategists can use fuzzy logic systems to aid in management and decision analysis. First invented as a representation method and calculus for unsure or indistinct concepts, fuzzy logic is fundamentally a multi-valued logic that permits more

human-like analysis and calculations in computers by creating subcategories between concepts such as “true/false”, “hot/cold” etc. The idea for fuzzy logic is steeped in history, though Lofti Zadeh, U.C. Berkley professor, is accredited with its discovery and development in 1965.[2] Over a thousand years before Zadeh, however, philosophers such as Plato had posited the Law of Excluded Middle, yet later proposed a third area where notions of “true” and “false” coexist.[3] Parmenides propositioned the earliest version of this rule around 400 B.C. and affirmed amidst controversy that statements could be concurrently true and false.[4] This middle ground or grey area is where most of human thought and decision resides. While idealists deal with absolutes, most of the decisions humans make are arrived at through compromise, considering simultaneously multiple inputs and relying on experience and perception.

A useful allegory for considering the middle ground comes from the ancient philosophical problem of Theseus' ship. Greek legend holds that Theseus slew the Minotaur and returned to Greece with the youth of Athens. On their return, the Greeks decided to preserve Theseus' ship in perpetuity. The ship was moored and vigilantly maintained. Over the years, rotting ropes, timbers, and sails were gradually replaced with new ones. Plutarch records it thus:

"The ship wherein Theseus and the youth of Athens returned had thirty oars, and was preserved by the Athenians down even to the time of Demetrius Phalereus [~ 350–280 B.C.], for they took away the old planks as they decayed, putting in new and stronger timber in their place, insomuch that this ship became a standing example among the philosophers, for the logical question of things that grow; one side holding that the ship remained the same, and the other contending that it was not the same." [5]

The inquiry has now been debated for more than 2000 years: was the ship still Theseus' ship? Fuzzy logic theorists would answer “yes and no,” and be perfectly content with that concept. Most mathematicians would shudder at the thought of a conflicting answer; in conventional logic, the answer must be true or false (usually represented as 1 and 0, respectively), but not both, severely limiting the application of conventional mathematical equations.

Fuzzy Logic as a Tool

Fuzzy logic academicians, conversely, assign a value between 0 and 1 (such as .5 or .23) to a statement, allowing the statement to occupy a region between true and false. This variance allows for greater application in many problems that would be difficult or impossible to solve using traditional methods. Fuzzy logic has been successfully applied in areas of air-conditioning, traffic control, handwriting recognition, automatic television picture control, and, most famously, in controlling the subway in Sendai, Japan.. The Applications appear to be limitless and challenge conventional thought and modern computer programming, although it is the primary system employed in artificial intelligence. Because intelligence warfare decision making involves incorporating information from a wide spectrum of sources, fuzzy logic is an ideal tool in providing information on demand, offering suggestions, and providing alerts.

Application in Decision Analysis

Fuzzy logic (Zadeh, 1965), (Cox, 1999) allows natural language statements to be expressed and manipulated using mathematical formalism. It allows us to deal with the inherent imprecision in everyday life by using the technique of inexact (approximate) reasoning. In

decision making processes, we are often faced with facts and relationships which have varying degrees of truth and falsehood, and this has to be taken into account in designing systems for decision support. Fuzzy logic has been applied in rule-based systems, where rules fire with strengths ranging from “none at all” to “full”. The combined effect of these rules gives rise to assertions having a proportional strength. One example of fuzzy DSS available commercially is the Fuzzy Decision Maker (McNeill & Thro,1994) which uses a fuzzy inferencing mechanism (O'Hagan & O'Hagan, 1993). Given a decision making problem, with its goals, constraints and alternatives, it asks the user to rank the importance of the goals and constraints using verbal terms ranging from most to least. It then asks for the verbal specification of how well the various alternatives satisfy each of the goals. The decision result is given as a graphical display of a relative "value" in a scale of 0 to 100 for each of the alternatives. Two application examples of the Fuzzy Decision Maker are described in (McNeill & Thro,1994); One of them is a decision process involving the analysis of an existing transport system with a view to deciding how it should evolve in the future to become a better system. It uses goals such as "reduction in air pollution" and "increased use of public transport"; Examples of constraints are " socioeconomic and land use pattern of area" and "cost of construction and maintenance". Among the alternatives to choose from are, "car pooling", "telecommuting" etc. and combinations of these. Because, in some cases, requests and requirements for information have become institutionalized, a baseline of data has been acquired and a fuzzy logic system could easily identify and alert intelligence officers to changes within a certain subset, such as nuclear forces in China. Once the request for information has been levied, the acquisition and processing of data and intelligence is often overwhelming to the technician, who must sift like a gold miner for the important data. [6]

Fuzzy applications that “learn” from the user and “adapt” to individual working styles can help to identify potential nuggets to the collector/processor. Additionally, language and voice recognition are among tasks that fuzzy logic has been shown to excel in and this function can assist in voice intercept collection. Fuzzy logic systems in networking can also balance the workload among collectors, regulating how much data “sits” in the inbox.

Stage of Analysis and Production Stage

During the analysis and production stage, raw intelligence is converted into finished intelligence. Because the preparation of intelligence includes data that is regularly fragmentary and often contradictory, conventional computer systems have been inept at automating the tasks, leaving the bulk of the work for the human analyst. Fuzzy logic systems are an ideal match for this often vague and seemingly contradictory environment. Aided by unconventional fuzzy logic programs, analysts can use fuzzy logic systems to more easily see the relationships between disparate data and become more efficient.[7]

Finally, dissemination of the finished product could become better automated, in addition to providing the report to the originator of the product, network fuzzy systems could monitor the type of reports other analysts and consumers read, and “suggest” that they read other relative reports from various sources previously untapped.

When considering the application of force against a foe, fuzzy logic can aid the decision makers by providing a non-linear forum for exploring actions and their outcomes. In conventional decision analysis, the user utilizes a decision tree, with forks and branches,

presenting the user with defined options and structured outcomes, usually with a degree of probability attached to each future.[8]

This is a good, time-tested model for predicting and measuring success in a known environment. Unfortunately, international relations are rarely stable and are dependent on a multitude of variables. Similarly, intelligence warfare is often described as an ongoing process of offensive, exploitation, and defensive information functions, with "overlapping … degrees of intensity moving from daily unstructured attacks to focused net warfare of increasing intensity until militaries engage in C2W."[9] These "degrees of intensity" are not easily measured by conventional means; therefore, fuzzy logic appears to be a more appropriate model in this application. Further, the appropriate equilibrium of force determined by fuzzy logic systems can be easily controlled and automated to minimize collateral damage and maximize the benefit of intelligence and conventional operations.

CONCLUSION

For long , decision theory and analysis have been supported for the prevailing logic system ,fuzzy logic can supply additional lay figures for in taking and grappling with data to access to a linear outcome. Faster and more précised outcome can be obtained by coordinating computer logic systems closer to the natural process of human thinking.

Letting the intake of rational and measured inputs into a system such as, definitely yes, probably no and definitely no ,will assist in better explanation of intelligence situation .This way ,better explanations of intelligence situations which is supported by fuzzy logic system facilitate the decision and analytical process throughout the total intelligence method and decision analysis.

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