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Analysis of Ambiguity, Vagueness, Fuzziness, Uncertainty, Possibility and Probability in the Natural Language Semantics with Fuzzy Logic

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Abstract
Understanding the esotericism of human instinct in their daily life conversation is not enough then a mystery now. This is a bundle of ambiguity, vagueness, fuzziness, uncertainty, possibility and probability as a wrap that humans have built around themselves. With the advancement in artificial Intelligence, natural language processing is more capable now to work with real world and performing intelligent analysises. The real world has interactions between natural and artificial intelligent systems. Despite all it, humans retained their superiority over artificial intelligent systems. The fuzzy Logic can play an important computational role in understanding this intelligence gap in clear dimensions. Logical Semantics, Distributional Semantics and Probabilistic Logic are focused on their intention for better natural language semantic representations. But no single semantic representation fulfills all requirements needed for a satisfactory representation. The objective of the present work has two folds. The first one focused on the understanding of fuzzy logic in two dimensions as an intelligence computational technique and another as mathematical modeling of natural language semantics. The second fold illustrates this intelligence gap with real world examples of natural language processing applications such as Google and Microsoft Translator.

Keywords: *Computational Natural Language Semantics, Mathematical Fuzzy Logic, Google Translator, Microsoft Translator.*

1. Introduction

The foundation of intelligent system is rooted on logical system. The fuzzy logic is logical, mathematics of fuzzy set, relational and epistemic [1]. Thus, it is now much more than a logical system. Although, it was disputed with its birth, but after more than five decades, it is in isolationframe from all controversy. According to father of fuzzy logic Lotfi A. Zadeh report on 25 February, 2008and on March 4, 2013 about impact of fuzzy logic in terms of numbers of research publications and patents records on theory or applications of fuzzy logic [Table 1], the achievement in its journey of fifty years shows its unsurpassed utility for anyone and everywhere with excellent flexibility with real world applications [2].

Table 1 The Achievement in Its Journey of Fifty Years

Report Date	Numbers of Research Publications		Numbers of Patents	
	INSPEC database	Math-Sci-Net database	USA	JAPAN
25 Feb, 2008	53,000	15,000	1500	4800
13 March, 2013	89,365	22,657	16,898	7149

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Here, the growths in contributions of fuzzy logic applications achievement were almost in ratio of 1:1000000 for decades 1965-175:2005-2015 but this ratio further in downfall in current decade and very similar to its start decade. Therefore, it creates an attention in researchers' community to review and reanalysis this part on various detentions [3]. The natural language used in communication and way of viewing the real world of human are closely related and complement to each other. Therefore, both require the appropriate understanding of their structure and more mathematical, well formulated semantics with malization of natural language having applications. The A. Zadeh also urged in favor of novelformal system with higher capturing ability for semantics of natural languages in a better way and enables it to build various kinds of applications. **[L. A. Zadeh, 2004]** [4]. As our study is organize in two folds.The first one focused on understanding of fuzzy logic on two dimensions as an intelligence computational technique and another as tool for mathematical modeling of natural language semantics. The second fold illustrates this intelligence gap in between natural intelligence and artificial intelligence for communication with real world examples of natural language processing applications such as Google and Microsoft Translator as a most popular and used language translator applications worldwide [5].

2. Fuzzy Logic as an Intelligence Computational Technique

The artificial intelligent system has now both capabilities to investigate the contemporary phenomenon within its real-life context while the boundaries between phenomenon and context are clearly evidentialand are not clearly evidential **U.S. Tiwari T. Siddiqu, 2008; C.D. Manning and H. Schutze]** [6]. The intelligent system inherits the methods of information technology and mathematics that includes the mathematical axioms, postulates and proofs with quantification, comparison, measurement. This inheritance is foundation of simulation, implementation and experimentation over large data as text, speech or images and more. The computational intelligence or soft computing is new emerging methods that include different techniques and technologies of soft sciences [7]. The basic foundation of this computing rooted on biological systems responsesin social system like conversation or natural language processing. It includes the human cognition, perception and reasoning. The fuzzy logic has now become the fruitful tool for reasoning, inference and control systems. The fuzzy logic based intelligent systems are closely mimic of natural decision-making system that provides the precise solution of problems from real life domain. The fuzzy models are ease in adaption and free from abstraction. It is also important that fuzzy has consideration of sub-symbolic information rather than symbolic and non-symbolic from real world that providing the context to used model and its acceptably better solutions with remarkable reduction in computational complexity **[L. A. Zadeh, 1965, 1975]** [8-9]. The Fuzzy Logic and other computational intelligence techniques are more suited in filling the gap in engineering design with mathematical methods. The hard core mathematics is behind the other techniques for this purpose but fuzzy logic is quite different in this respect.The fuzzy logic with vague boundaries capable to analyzed and understand ambiguity, vagueness, fizziness, uncertainty, possibility and probability all one at single platform of the real world problems**[R. R. Yager and L. A. Zadeh, 2012]** [10-11]. It is not easy here to briefing all aspects of fuzzy logic as an intelligence computing tool. Finally, we conclude the fuzzy logic contribution in next few paragraphs. It has featuresof linguisticvariables for natural language processing purpose and fuzzy based if–then rules.These features play a vital role in the conception and design of applications products and much more. It is based on the use of information comparison that is achieved with fuzzygranulation. The other feature generalization is with very high potential in Fuzzy logic

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compared tobivalent logic that ensures it's dealing with imprecision, uncertainty, incompleteness, partiality, possibility and probability. The precisiation and cointension is another advantage of fuzzy logic use. It has important roles inanalyzing the fuzzy logic uses in nontraditional way.The nontraditional fuzzy logic deals with two hands of precision, left hand as value-precision and right hand as meaning-precision. The meaning may vary from one to another many times so broadly meaning-precision may either human- oriented precision or machine-oriented precision. It has high power of cointensive precision that provides the better models of real-world problems with the use of fuzzy logic. The natural language computation with this precision facility makes it precisiated natural language. As we know that much of human knowledge is expressed with natural language and this representation based on bivalent logic.This bivalent logic based such phenomena in natural language make it imprecise. This imprecise perception reflects the bounded ability of human brain and as well as in natural language-perception. This makes vote infavor of rejection of bivalent logic. The natural language computation and fuzzy logic based precisiated natural language both are now closely tied to formalisms that consists the propositions and predicates having meaning in generalized constraints form [**L. A. Zadeh, 1999, 2000, 2002, 2004, 2005]** [12-13]. The entire brain task performs by human need no measurements and computations, only perception perform such mental task. This conceptual approachbecomes the root of computationaltheory of fuzzy logic based perceptions in formalism.Hence, the possibility theory is considered as a sub-branch of fuzzy logic.The possibility theory is quite different from probability theory. The possibility theory can be said as perception of possibility formalization while probability theory based on perception of likehood or similarities in a complementary format. We use the possibility theory in knowledge representation, natural language semantics; decision making and computing with imprecise probabilities. At last, our purpose of Fuzzy logic as a modeling language, it deals with logic forapproximate reasoning and imprecision. The fuzzy logic is more suitable modeling language that works with partially or not well defined objects of modeling.A fuzzy modeling language works whenever; the result of imprecisiation is a partially or not precisely defined object of modeling [14].

3. Fuzzy Logic in Modeling of Natural Language Semantics

This can be viewed as natural language and fuzzy logic and language modeling with precisiated fuzzy language [15].

3.1. Natural Language and Fuzzy Logic

As we know wide range of human knowledge is represented with natural language and communication and reasoning both rooted on used natural language also. Therefore, it is necessarily important mechanize the natural language in various dimensions for automated decision making and machine intelligence. Natural languages are imprecise because almost everything is a degree in a natural language.Theimprecision of natural languages and imprecision of perceptionsboth are complement to each other like the two faces of a coin in the context of modeling of natural language. Actually, the perceptions are intrinsically imprecise and reflecting the ability of human sensory organs like brain that store the information and resolve the problemsin a very limited scope. **[V. Novak, 2005]** [16-18]. But the philosophy of languages and the literatures of linguistics both are ignore the importance of this the issue of imprecision because of this bivalent logic availability during that time duration. This gap between imprecision of natural languages and precision of bivalent logic is in the background of use of fuzzy logic in natural language processing for finding the appropriate semantics after probability logic and probabilistic logic. The fuzzy logic application to natural language starts

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with quantitative fuzzy system and fuzzy logic based theoretic interpretation of such linguistic boundaries.The concept of precisiation was introduced in 1978. The computational approach of representation of meaning takes tis shape with test score semantic, concept of fuzzy quantifiers and generalized constraints **[L. A. Zadeh, 1971, 1972, 1982, 1983,1986]** [19-20]. This generalized constraint conceptbecomes the basis of developing of granular computing. The granular computing creates a platform for formalisms of computing the words of natural languages and natural language computation. Now the imprecisenatural languagebecomes the precisiated natural language with generalized theory of uncertainty **[L. A. Zadeh, 1997, 1999, 2004, 2006] & [R. Carnap, 1947; P. Materna,1998]** [21-23]. From above description, we conclude that knowledge, semantics and constraints are naturally related to each other in many dimensions to get the better natural language processing outcomes which are ignored in philosophy and linguistics theory of natural languages.

3.2. Language Modeling with Precisiated Fuzzy Language

The science, engineering and technology deal with models of reality instead of reality whenever the subject of large measure and optimization is necessary. Mathematically we can say that if S is a system of real world, then M(S) represent the model of that system S. Here, a mathematical language is used to specify this M(S). This mathematical language has capability to measure the closeness of both the system S and model of system M(S) with input to model and its output, and relationship between these input and output for the model of reality. This measure is called coin tension of M(S). Primarily, the bivalent logic is used to developed such modeling languages. The bivalent logic-based modeling languages have less power of coin tension than the fuzzy logic-based modeling languages having higher power of coin tension. This is because the bivalent based modeling languages use the smaller number of parameter than fuzzy logic. Thus, the bivalent logic can view as a special case of fuzzy logic and it is consider as generalized fuzzy logic [24]. Hence it may use in all systems which requires the computation with imprecise probability and constraints.For the more clarification, if a system S is perfect system than it has no imprecision, uncertainty, incompleteness, partiality in truth or false, possibility and probability. We can achieve the higher level of cointension with the fuzzy logic-based modeling language.

4. Observational Analysis with Real Life Applications

The Fuzzy logic is extremely useful for research, inovation and development in all branches of engineering, sciences, social, political, economics,management, medical, space. It may very usefull in computer software development that make real world as digital world [25]. It is equaly important in study of cognitive science, psychology and various analysis. The real-life applications as per our considerations are concern with machine translation. There are most commonly worldwide used translators are Google Translate, Microsoft Translate, Reverso Translation Dictionary, Naver Papago Translator, SayHi Translator, Dictionary Linguee, TheaterEars, TripLingo and many more. The recent invoations, improvements and performance of deep neural networks integrate machine translation into our daily lives. The smartphones and such applications show their urgency and important from its root. Despite of all, the machine translation applications are irregular in their perfection. They regularly return err full translations, which can lead the deleterious results such as wrong decision, data losses, and failure in perdition, economic loss and political conflicts. Here, some translators are used to justify the quaries to applications to understand the performance of NLP systems affected poorly with natural language input text with ambiguity, vagueness and uncertainty. How the performance of translators can be empowered with fuzzy logic is also discussed here. The Google translator and

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Microsoft translator both are used in two approaches:

Approach1: The translation of translation from FIRST language to SECOND language and in reverse.

Approach2: The two or more sentences of different meaning have not the same translation [26].

The Approach1 concern with translation of a sentence in FIRST language to SECOND language, then translated sentence in SECOND language is translate in to FIRST language. The outcome has not the same meaning. This phenomenon is appearing in translation between English and Spanish language:

- **Input1** (In English): there is a slight difference between warm and hot
- **Output1**(In Spanish):esunaligeradiferencia entre caliente y caliente

If we reverse the translation now from Spanish to English language then result is not the same

- **Input2** (In Spanish): esunaligeradiferencia entre caliente y caliente
- **Output2** (In English): is a slight difference between hot and hot

Here, OUTPUT2 is not the same as INPUT1

Again, we see in next example

- **Input3**(In English): Washington voted Washington to power
- **Output3**(In Spanish): Washington votó a Washington al poder
- **Input4** (In Spanish): Washington votó a Washington al poder
- **output4** (In English): Washington voted to power

The outcome OUTPUT4 is not similar to INPUT3.

The idea of Approach2 deals with basic concept that two or more sentences of different meaning have not the same translation. For this purpose, two or more sentences constructed by either replacing one words or phrase from a sentence or removing one words or phrase from that sentence.To examine this, translation in between English and Hindi language is considered or any languages specified in Google translate or Microsoft translates, the result is as specified. What a coincident with Microsoft translator, it almost reflects the same result. This incorrectness in translation is due to lack of most wanderful performance of human brain, reasoning with common sense not only with world knowledge, domain knowledge and constraints. In above, there are errorfull interpretations of various words like some, few, huge, least, most, more, little etc. This makes a gap between the expected processing of natural language outcome and and actual outcome.

Conclusion

This article focused on nontraditional perspective view of fuzzy logic that reflects the existence of higher power of precisiation and having ability to frame the cointensive model of natural language processing. We also described some concept of mathematical fuzzy logic for ambiguity, vagueness, uncertainty possibility and probability at little bit having ability for construction of precisiated natural language. This makes it most successful technology for control, reasoning and inference systems. Finally, it is most resembling with human decision-making system. There is anincredible interest of researchers in domain of fuzzy logic for various analyses, application development for humanity and have to be researched and developed. We have multiple natural language translators' applications that help to computers to translate a sentence but cannot perform the proofreading of that translation. Therefore, we can say that a computer can inherently work on computation and memory but on the other hand, human uses the computation, memory and common sense efficiently. Fuzzy logic is an answer of all to better responses involving common sense reasoning of a system that is need of human beings.

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