ON EFFECTIVENESS OF VARIOUS MODELS OF UNCERTAINTY OVER OPTIMIZATION/CLASSIFICATION PROBLEMS

The Abstract Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of

DOCTOR OF PHILOSOPHY

In

MATHEMATICS

By:

POONAM TARIQ

Under the Supervision of:

Dr. MUSHEER AHMAD

Co-Supervision of:

Dr. ANWAR SHAHZAD SIDDIQUI

Department of Applied Sciences and Humanities
Faculty of Engineering and Technology
Jamia Millia Islamia
A Central University by an Act of Parliament
New Delhi-110025 (India)
October 2009

ABSTRACT

Professor L. Zedah of the University of California introduced that vagueness is an aspect of uncertainty that is different from randomness. He proposed a mathematical way of vagueness of the natural human language. He called his approach “Fuzzy Logic”.

The objective of fuzzy logic is to make computers “think” like humans and remove the barrier between the user and the utilization of Computer Capabilities fully.

one may conclude the all things admit degrees in their description, these degrees are not random but rather deterministic based on several factors such as the nature of the situation, experience etc. This idea is the essence of so-called fuzzy sets as opposed to classical or crisp sets.

In classical or crisp set or not, a person is either good or bad; temp. is either hot or cold. In classical set theory mathematical back ground for computer logic has been utilized. In fuzzy set theory, degree of belongingness to a set are introduced, a person can be 80% in the “good” set and 40% in the “bag” set. Thus fuzzy set theory is the mathematical background that is needed to capture the way people think.

Randomness and fuzziness are two different aspects of uncertainty. With the passage of time or an increase in information can classify the uncertainty of randomness.

In the present work, an effort will be made to establish the mathematical foundation of fuzzy logic concept based on linguistic variables and finite universal set as a logical extension of conventional two values set theory having infinite universal set.

In optimization/classification problems, one comes across may kind of vagueness because of ill-defined classes or non-availability of exact data. This vagueness is an aspect of uncertainly that is different from randomness. Computers

do not ‘understand’ vague human concepts; data has to be presented to a computer in simple binary logic. Most of human data, however, is not binary. In fact all things admit degree in their description; these degrees are not random but rather deterministic based on factors.

The crisp set is defined in such a way as to dichotomize the individuals in some given universe of discourse into two groups; members (those that certainly belong in the set) and nonmembers (those that certainly do not). A sharp, unambiguous distinction exists between the members and nonmembers of the set. However, many classification concepts we commonly employ and express in natural language describe sets that do not exhibit this characteristic. Examples are the set of tall people, expensive cars, highly contagious diseases, close driving distances, modest profits, numbers much greater than one, or sunny days. We perceive these sets as having imprecise boundaries that facilitate gradual transitions from membership to non membership and vice versa.

A fuzzy set can be defined mathematically by assigning to each possible individual in the universe of discourse a value representing its grade of membership in the fuzzy set. This grade corresponds to the degree to which that individual is similar or compatible with the concept represented by the fuzzy set. Thus, individuals may belong in the fuzzy set to greater or lesser degree as indicated by a larger or smaller membership grade. As already mentioned, these membership grades are very often represented by real-member values ranging in the closed interval between 0 to 1.

The utility of fuzzy set theory in handling uncertainty, arising from deficiencies of information available from a situation in pattern recognition problems has been proposed by many researchers. Controversy has surrounded the concept of fuzziness since its inception. Some maintains that probability theory can handle any kind of uncertainty; other think that fuzziness is probability in disguise or that probability is the only sensible way to describe any kind of uncertainty. This theory provides an approximate, yet effective and more flexible means of classifying the patterns, which are too complex or have too ill-defined features to be handled by Classical approaches.

Recent researchers are based on integrating of the merits of these two technologies, to provide more intelligent systems (in terms of parallelism, Fault tolerance, adaptively and Uncertainty management) to handle real-time classification problems. These modern techniques have been successfully applied to many real time problems yet much is still desired on the theoretical aspect and a solid mathematical foundation of these techniques is yet to be worked out. The goal of present work would be to proof mathematically the effectiveness of these mathematical modal free approaches over classical techniques.

Admittedly, a formal theory over fuzzy mathematics is just a notational abbreviation of classical reasoning about the class of all models. Nonetheless, the axiomatic method is the general paradigm of mathematics. The appropriate choice of the language of the formal theory screens off irrelevant features of the models. An axiomatic system is thus not only the means of generalization over all models, but rather an abstraction to their constitutive features. The need for axiomatization of further areas of fuzzy mathematics besides fuzzy logic is beyond doubt. Axiomatization has always aided the development of mathematical theories. There have been many -- more or less successful – attempts to formalize or even axiomatize some areas of fuzzy mathematics. However, these axiomatic are usually designed ad hoc: some concepts in a classical theory are turned fuzzy, however their selection is based on non-systematic intuitions or intended applications; seldom is fuzzified all that could be.