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Application of higher order fuzzy sets

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***Abstract*— As far as we are aware with the theory of fuzzy sets, and their applications in the fields of Engineering, Medical sciences, Computer science, and Management, the researchers start working on their applications to daily life problems. It is well known fact the importance of fuzzy set theory could not neglect in daily life problems. In this present paper my aim is to discuss some applications of higher fuzzy set theory in daily life problems.**

***Index Terms*—Fuzzy sets, researches, Zadeh.**

I. INTRODUCTION

Fuzzy set theory plays an important role in many areas of Communication, management, computer, medical, and Quantum Mechanics. Since the inception of the theory of Fuzzy Groups by Rosenfeld, a huge number of works have been reported in this area. Theory of fuzzy relations has been playing a great and significant role in different areas in Computer Science, in Management Science, in Medical Science, in Banking and Finance, in Social Sciences, and in many more areas. Consequently it is expected that the work reported in this paper will add an element of support to the existing theory of fuzzy algebra and to the theory of mathematical relations.

Precision assumes that the parameters of a model represent exactly either our perception of the phenomenon modeled or the features of the real system that has been modeled. Generally precision indicates that the model is unequivocal, that is, it contains no ambiguities. By crisp we mean yes-or-no type rather than more-or-less type. In conventional dual logic, for instance, a statement can be true or false-and definitely nothing in between. Vagueness, imprecision and uncertainty have so far been modelled by classical set-theoretic approach. According to this approach, borderline elements can be either put into the set or should be kept outside it. Hence it becomes inadequate for applying to humanistic type of problems. Zadeh [1], in 1965 initiated the notion of fuzzy set theory as a modification of the ordinary set theory, which turned out to be of far reaching implications. Vague notions can be modeled using this theory.

A fuzzy set is a class of objects in which the transition form membership to non-membership is gradual rather than abrupt. Such a class is characterized by a membership function which assigns to an element a grade or degree of membership between 0 and 1. For a beginner on fuzzy set theory, the work in [3], [7], [8], [9], [16], [18], [20] etc. are good enough to start with.

If we look at the developmental history of mathematical systems or structures, we see that a mathematical system is, in general, suggested by situations which, while they are different, have some basic features in common so that the emergence of a mathematical system is essentially the result of a process of unification and abstraction. A mathematical system, thus, lays bare the structurally essential relations between otherwise distinct entities. So, it may be accepted that the results of the study of a mathematical system will be valid for each of those otherwise different situations which provided motivation and inspiration for the same. Such a study also provided an economy of effort and leads to a better and fuller understanding of the motivation situations.

Even without considering the motivation situations inherent in cybernetics and general systems prevailing in the emerging man- machine civilization, if we just consider everyday language, we see that we are concerned with statements which are often distinguished as interrogative, imperative, exclamatory or declarative. In classical mathematical systems, we deal with only those statements which are declarative in nature and which may be either true or false. Fuzzy mathematical systems, whose foundation was laid by Zadeh [1] in his classic papers on the theory of fuzzy subsets and the theory of possibility deal with situations of interrogative, imperative, exclamatory and also declarative statements. So, even in an intuitive sense, fuzzy set theory is a generalization of classical set theory, which has been algebraically established in several of the above- mentioned sources. As a result, one of the most important motivations and one of the main aims of most of the research in fuzzy set theory, is to furnish mathematical models which are able to describe systems or classes of systems which elude traditional analysis. They are being attempted in two different, non-contradictory approaches—using well-known mathematics, interpreting them in a different way and trying to build a new methodology of the modeling of reality in its complexity or by making abstractions which are weaker than the usual ones and based ultimately on a conceptual point of view even if not on a formal one.

Different authors from time to time have made a number of generalizations of fuzzy set theory of Zadeh [1] with different objectives ([2], [4], [5], [6], [10], [14], [17], [19]). Of these, the notion of intuitionistic fuzzy set theory (IFS theory) introduced by Atanassov [2] is of interest to us. All fuzzy sets can be viewed as intuitionistic fuzzy sets, but the converse is not true

II. HIGHER ORDER FUZZY SETS

Different authors ([2], [4], [5], [6], [10], [14], [17], [19]) from time to time have made a number of generalizations of fuzzy set theory of Zadeh

[1]. While fuzzy sets are applicable to many application domains, higher order fuzzy sets may not, because of their specialization in character by birth.

In parallel there are few more potential mathematical models for soft computing which are rough set theory of Pawlak [15], Soft set theory of Molodtsov [11-13], etc. Since the inception of this very popular model of rough set theory by Pawlak in 1982, many authors have studied the application of rough set theory for extracting reducts and cores in Information Systems. This has become a very interesting problem to the Scientists and engineers specially those working in the areas of DBMS, Knowledge Engineering, Decision Sciences, Management Sciences, etc. to name a few only out of many. There are a number of works recently done on hybridization of fuzzy sets and rough sets too.

Application of higher order fuzzy sets makes the solution-procedure more complex, but if the complexity on computation-time, computation-volume or memory-space are not the matter of concern then a better results could be sometimes achieved.

The most popular generalizations ([2], [4], [5], [6], [10], [14], [17], [19]) of fuzzy sets are iv- fuzzy sets, L- fuzzy sets, intuitionistic fuzzy sets (IFS), vague sets, iv-IFS, type-II fuzzy sets, etc. Of these, the notion of intuitionistic.
fuzzy set theory (IFS theory) introduced by Atanassov [2] is of interest to us for our work reported in this thesis. Recently Gau and Buehrer reported in IEEE [5] the theory of vague sets. *But vague sets and intuitionistic fuzzy sets are same concepts as clearly justified by Bustince and Burillo in [2]. Consequently, in this paper the two terminologies 'vague set' and 'intuitionistic fuzzy set' have been used with same meaning and objectives.*

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