Intuitionistic Neutrosophic Soft Set

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Abstract. In this paper we study the concept of intuitionistic neutrosophic set of Bhowmik and Pal. We have introduced this concept in soft sets and defined intuitionistic neutrosophic soft set. Some definitions and operations have been introduced on intuitionistic neutrosophic soft set. Some properties of this concept have been established.

Keywords: Soft sets, Neutrosophic set,Intuitionistic neutrosophic set, Intuitionistic neutrosophic soft set.

1. Introduction

In wide varities of real problems like , engineering problems, social, economic, computer science, medical science…etc. The data associated are often uncertain or imprecise, all real data are not necessarily crisp, precise, and deterministic because of their fuzzy nature. Most of these problem were solved by different theories, firstly by fuzzy set theory provided by Lotfi , Zadeh [1] ,Later several researches present a number of results using different direction of fuzzy set such as : interval fuzzy set [13], intuitionistic fuzzy set by Atanassov[2], all these are successful to some extent in dealing with the problems arising due to the vagueness present in the real world ,but there are also cases where these theories failed to give satisfactory results, possibly due to indeterminate and inconsistent information which exist in belif system, then in 1995, Smarandache [3] intiated the theory of neutrosophic as new mathematical tool for handling problems involving imprecise, indeterminacy,and inconsistent data. Later on authors like Bhowmik and Pal [7] have further studied the intuitionistic neutrosophic set and presented various properties of it. In 1999 Molodtsov [4] introduced the concept of soft set which was completely a new approche for dealing with vagueness and uncertainties ,this concept can be seen free from the inadequacy of parameterization tool. After Molodtsovs'work, there have been many researches in combining fuzzy set with soft set, which incorporates the beneficial properties of both fuzzy set and soft set techniques (see [12] [6] [8]). Recently , by the concept of neutrosophic set and soft set, first time, Maji [11] introduced neutrosophic soft set, established its application in decision making, and thus opened a new direction, new path of thinking to engineers, mathematicians, computer scientists and many others in various tests. This paper is an attempt to combine the concepts: intuitionistic neutrosophic set and soft set together by introducing a new concept called intuitionistic neutrosophic sof set, thus we introduce its operations namely equal ,subset, union ,and intersection, We also   present an application of intuitionistic neutrosophic soft set in decision making problem.

The organization of this paper is as follow : in section 2, we briefly present some basic definitions and preliminary results are given which will be used in the rest of the paper. In section 3, Intuitionistic neutrosophic soft set. In section 4 an application of intuitionistic neutrosophic soft set in a decision making problem. Conclusions are there in the concluding section 5.

2. Preliminaries

Throughout this paper, let U be a universal set and E be the set of all possible parameters under

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consideration with respect to U, usually, parameters are attributes , characteristics, or properties of objects in U. We now recall some basic notions of neutrosophic set , intuitionistic neutrosophic set and soft set .

Definition 2.1 (see[3]). Let U be an universe of discourse then the neutrosophic set A is an object having the form A = {< x: $T_{A(x)}, I_{A(x)}, F_{A(x)}$ >,x ∈ U}, where the functions T,I,F : U→]⁻0,1⁺[define respectively the degree of membership , the degree of indeterminacy, and the degree of non-membership of the element x ∈ X to the set A with the condition.

$$^-0 \le T_{A(x)} + I_{A(x)} + F_{A(x)} \le 3^+.$$

From philosophical point of view, the neutrosophic set takes the value from real standard or non-standard subsets of]⁻0,1⁺[.so instead of]⁻0,1⁺[we need to take the interval [0,1] for technical applications, because]⁻0,1⁺[will be difficult to apply in the real applications such as in scientific and engineering problems.

Definition 2.2 (see [3]). A neutrosophic set A is contained in another neutrosophic set B i.e. A ⊆ B if ∀x ∈ U, $T_A(x) \le T_B(x)$, $I_A(x) \le I_B(x)$, $F_A(x) \ge F_B(x)$.

A complete account of the operations and application of neutrsophic set can be seen in [3] [10].

Definition 2.3(see[7]). intuitionistic neutrosophic set

An element x of U is called significant with respect to neutrsophic set A of U if the degree of truth-membership or falsity-membership or indeterminancy-membership value, i.e.,$T_{A(x)}$ or $F_{A(x)}$or $I_{A(x)} \le 0.5$. Otherwise, we call it insignificant. Also, for neutrosophic set the truth-membership, indeterminacy-membership and falsity-membership all can not be significant. We define an intuitionistic neutrosophic set by A = {< x: $T_{A(x)}, I_{A(x)}, F_{A(x)}$ >,x ∈ U},where

min { $T_{A(x)}, F_{A(x)}$ } ≤ 0.5,

min { $T_{A(x)}, I_{A(x)}$ } ≤ 0.5,

min { $F_{A(x)}, I_{A(x)}$ } ≤ 0.5, for all x ∈ U,

with the condition $0 \le T_{A(x)} + I_{A(x)} + F_{A(x)} \le 2$.

As an illustration ,let us consider the following example.

Example2.4. Assume that the universe of discourse U={x_1, x_2, x_3},where x_1 characterizes the capability, x_2 characterizes the trustworthiness and x_3 indicates the prices of the objects. It may be further assumed that the values of x_1, x_2 and x_3 are in [0,1] and they are obtained from some questionnaires of some experts. The experts may impose their opinion in three components viz. the degree of goodness, the degree of indeterminacy and that of poorness to explain the characteristics of the objects. Suppose A is an intuitionistic neutrosophic set (IN S) of U, such that, A = {< x_1,0.3,0.5,0.4 >,< x_2,0.4,0.2,0.6 >,< x_3,0.7,0.3,0.5 >}, where the degree of goodness of capability is 0.3, degree of indeterminacy of capability is 0.5 and degree of falsity of capability is 0.4 etc.

Definition 2.5 (see[4]). Let U be an initial universe set and E be a set of parameters. Let P(U) denotes the power set of U. Consider a nonempty set A, A ⊂ E. A pair (F, A) is called a soft set over U, where F is a mapping given by F : A → P(U).

As an illustration ,let us consider the following example.

Example 2.6. Suppose that U is the set of houses under consideration, say U = {h_1, h_2, . . ., h_5}. Let E be the set of some attributes of such houses, say E = {e_1, e_2, . . ., e_8}, where e_1, e_2, . . ., e_8 stand for the attributes "expensive", "beautiful", "wooden", "cheap", "modern", and "in bad repair", respectively.

In this case, to define a soft set means to point out expensive houses, beautiful houses, and so on. For example, the soft set (F, A) that describes the "attractiveness of the houses" in the opinion of a buyer, say Thomas, may be defined like this:

A={e_1, e_2, e_3, e_4, e_5};

F(e_1) = {h_2, h_3, h_5}, F(e_2) = {h_2, h_4}, F(e_3) = {h_1}, F(e_4) = U, F(e_5) = {h_3, h_5}.

For more details on the algebra and operations on intuitionistic neutrosophic set and soft set, the reader may refer to [5,6,8,9,12].

3. Intuitionistic Neutrosophic Soft Set

In this section ,we will initiate the study on hybrid structure involving both intuitionstic neutrosophic set and soft set theory.