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An Application of Similarity Measure of Fuzzy Soft Set Based on Distance

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Abstract : *The concept of soft set is one of the recent topics developed for dealing with the uncertainties present in most of our real life situations. In this paper, we have applied the notion of similarity between two fuzzy soft sets based on distance, to obtain the solution of a medical problem in an imprecise environment.*
Keywords - *Soft set, Fuzzy soft set, Similarity measure*

I. Introduction

In many complicated problems arising in the fields of engineering, social science,economics,medical science etc involving uncertainties, classical methods are found to be inadequate in recent times.Molodtsov[1] has shown that each of the above topics has some inherent difficulties due to the inadequacy of their parameterization tools. Then he initiated a different concept called soft set theory as a new mathematical tool for dealing with uncertainties.In recent times, researchers have contributed a lot towards fuzzification of soft set theory.Maji et al[2] introduced the concept of fuzzy soft set and some properties regarding fuzzy soft union,intersection,complement of a fuzzy soft set etc.

Similarity measure have extensive application in pattern recognition,region extraction,coding theory,image processing and in many other areas.Similarity of two fuzzy soft has been studied by Majumder and Samantha in[3] and D.K.Sut applied similarity of fuzzy soft sets in decision making problem in [5].In this paper, we are using the notion of similarity of fuzzy soft sets initiated by Majumder and Samantha in [3] and applied it in medical diagnosis.

II. Preliminaries

In this section, we first recall the basic definitions related to fuzzy soft sets which would be used in the sequel.

2.1.Soft set [1]

Suppose that U is an initial universe set and E is a set of parameters, let P(U) denotes the power set of U.A pair (F,E) is called a soft set over U where F is a mapping given by $F: E \rightarrow P(U)$ .Clearly, a soft set is a mapping from parameters to P(U),and it is not a set, but a parameterized family of subsets of the Universe.

2.2. Fuzzy soft set [2]

Let U be an initial Universe set and E be the set of parameters. Let $A \subset E$.A pair (F,A) is called fuzzy soft set over U where F is a mapping given by $F: A \rightarrow I^U$,where I^U denotes the collection of all fuzzy subsets of U.

2.3.Fuzzy soft class[5]

Let U be an initial Universe set and E be the set of attributes. Then the pair (U,E) denotes the collection of all fuzzy soft sets on U with attributes from E and is called a fuzzy soft class.

2.4.Fuzzy soft sub set[2]

For two fuzzy soft sets (F,A) and (G,B) over a common universe U, we have $(F,A) \subseteq (G,B)$ if $A \subset B$ and $\forall e \in A$, F(e) is a fuzzy subset of G(e).

i.e., (F,A) is a fuzzy soft sub set of (G,B).

2.5.Fuzzy soft complement set[2]

The complement of fuzzy soft set (F,A) denoted by $(F,A)^c$ is defined by

$$(F,A)^c = (F^C, \sim A), \text{where } F^c: \sim A \rightarrow I^U \text{ is a mapping given by}$$
$$F^c(e) = \text{fuzzy complement of } F(\sim e)$$

$=[F(e)]^c \quad \forall e \in A.$

2.6.Fuzzy soft Absolute set[2]

A fuzzy soft set (F,A) over U is said to be absolute fuzzy soft set with respect to the parameter set A denoted by $\tilde{A}$ if F(e)=U, $\forall e \in A$.

2.7.Fuzzy soft Null set[2]

A fuzzy soft set (F,A) over U is said to be null fuzzy soft set with respect to the parameter set A, denoted by $\tilde{\Phi}$ if F(e)=Φ, $\forall e \in A$.

2.8.Union of fuzzy soft sets[2]

Union of two fuzzy soft sets (F,A) and (G,B) in a soft class (U,E) is a fuzzy soft set (H,C) where C= $A \cup B$ and

$$\forall e \in C, H(e) = \begin{cases} F(e) & \text{if } e \in A\text{-}B \\ G(e) & \text{if } e \in B\text{-}A \\ F(e) \cup G(e) & \text{if } e \in A \cap B \end{cases}$$

And is written as $(F,A)\tilde{\cup}(G,B) = (H,C)$

2.9.Intersection of fuzzy soft sets[2]

Intersection of two fuzzy soft sets (F,A) and (G,B) in a soft class (U,E) is a fuzzy soft set (H,C) where C= $A \cap B$ and
$\forall e \in C, H(e) = F(e)$ or G(e)

And is written as $(F,A)\tilde{\cap}(G,B) = (H,C)$

Ahmad and Kharal [4] pointed out that generally F(e) and G(e) may not be identical. More over in order to avoid the degenerate case, he proposed that $A \cap B$ must be non-empty and thus revised the above definition as follows

2.10.Intersection of fuzzy soft sets Redefined[4]

Let (F,A) and (G,B) be two fuzzy soft sets in a soft class (U,E) with $A \cap B \neq \phi$
Then Intersection of two fuzzy soft sets (F,A) and (G,B) in the fuzzy soft class (U,E) is a fuzzy soft set (H,C) where C= $A \cap B$ and
$\forall e \in C, H(e) = F(e) \cap G(e)$

2.11.Similarity of fuzzy soft sets based on Distance measure[3]

We know that if A and B are two fuzzy sets and the distance between them is d,then the similarity between them can be defined as

$$S = \frac{1}{1+d}.$$

Again a fuzzy soft set is a collection of its e-approximations which are nothing but fuzzy sets.Here we take the distance between A and B is $d_\infty(A,B) = \max_i |a_i - b_i|$,where $A=(a_1,a_2,a_3,\ldots a_n)$ and $B=(b_1,b_2,b_3,\ldots.. b_n)$ are the two fuzzy sets. Then the similarity between them will be $T(A,B) = \dfrac{1}{1+d_\infty(A,B)}$.

Now let $(F,E)=\{F(e_i), i=1,2,3,\ldots..n\}$ and
$(G,E)=\{G(e_i), i=1,2,3,\ldots..n\}$ be two fuzzy soft sets where $F(e_i)$ is the e_i approximations of (F,E)

And G(e_i) is the e_i approximations of (G,E).Let $T_i(F,G) = \frac{1}{1+d_\infty{}^i}$, where $d_\infty{}^i$ is the distance between the e –approximations of F(e_i) and G(e_i) .Then the similarity measure between (F,E) and (G,E) will be denoted by T(F,G) and is defined by $T(F,G) = \max_i T_i(F,G)$.

III. Application of similarity measure of fuzzy soft set in medical diagnosis

We would say the fuzzy soft sets (F,A) and (G,B) in the fuzzy soft class (U,E) to be significantly similar if M((F,E),(G,E))>0.7.

Suppose that there are three patients p_1,p_2,p_3 in a hospital with symptoms temperature, Headache,vomiting,joint pain, cough and stomach problem. Let the universal set contain only three elements 'severe'(s),'mild'(m) and 'no'(n).ie U={s,m,n}.Here the set of parameters E is the set of certain approximations determined by the Hospital. Let E={e_1,e_2,e_3,e_4,e_5,e_6} where e_1 =temperature, e_2 =headache,e_3=vomiting, e_4 =joint pain,e_5 =cough ,e_6 =stomach problem.
We construct the fuzzy soft set (F,E) for malaria fever, from medical knowledge as given in Table1.

Table1: Fuzzy soft set (F,E) for malaria fever.

(F,E)	e_1	e_2	e_3	e_4	e_5	e_6
s	1	0.4	1	1	0.2	0
m	0.6	0.4	0.7	0.5	0.6	0.4
n	0.1	0.6	0.3	0	1	1

Similarly, we construct the fuzzy soft sets for the three patients under consideration as given in Table2,3 and 4.

Table2: Fuzzy soft set (P_1,E)for the first patient.

(P_1,E)	e_1	e_2	e_3	e_4	e_5	e_6
s	0.8	0.3	0.1	0.8	0.1	0
m	0.2	0.7	0.2	0.1	0.4	0.2
n	0.1	0.2	1	0	0.6	0.5

Table3: Fuzzy soft set (P_2,E)for the second patient.

(P_2,E)	e_1	e_2	e_3	e_4	e_5	e_6
s	0.8	0.3	0.6	0.6	0.6	0.4
m	0.2	0.2	0.3	0.1	0.2	0.1
n	0.1	0.5	0.1	0.3	0.6	0.6

Table4: Fuzzy soft set (P_3,E)for the third patient.

(P_3,E)	e_1	e_2	e_3	e_4	e_5	e_6
s	0.1	0.5	0.2	0.3	0.6	0.5
m	0.2	0.4	0.5	0.7	0.2	0.3
n	0.6	0.2	0.6	0.2	0.1	0.2

Table5: Distances between them.

	d_∞^1	d_∞^2	d_∞^3	d_∞^4	d_∞^5	d_∞^6
P_1	0.4	0.4	0.9	0.4	0.4	0.5
P_2	0.4	0.2	0.4	0.4	0.4	0.4
P_3	0.9	0.4	0.8	0.7	0.9	0.8

Table6: Similarity between them.

	T_1	T_2	T_3	T_4	T_5	T_6	minimum
P_1	0.71	0.71	0.53	0.71	0.71	0.67	0.53
P_2	0.71	0.83	0.71	0.71	0.71	0.71	**0.71**
P_3	0.53	0.71	0.56	0.59	0.53	0.56	0.53

In view of our work,we can conclude that from Table 6 second patient is suffering from malaria.

IV. Conclusion

We have applied the similarity of fuzzy soft sets in medical diagnosis based on distance measure.As far as future direction are concerned, we hoped that our finding would help enhancing this study on fuzzy soft sets.

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