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A new approach for decision making using intuitionistic fuzzy sets

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Abstract
A new approach named as Intuitionistic fuzzy Max-min average composition method for decision making is proposed to study the disease diagnosis based on the test results. Sanchez's approach for decision making is studied and the concept is modified by the application of Fuzzy Set theory. Through a survey the composite relations between the patients, symptoms and diseases are discussed. The proposed method is compared with max-min composition method.

Keywords: Fuzzy sets, Intuitionistic fuzzy relations (IFR), Intuitionistic Fuzzy Max-min average composition method, Membership function, Non-membership funtion.

1. Introduction
In the present paper it study the Sanchez's (1976, 1977) [6, 7] method using the notion of IFS theory, the degrees of membership and non-membership are a single value between 0 and 1. However, in reality, it may not always be certain that the sum of the degrees is just 1 Atanassov, (1995) [1] and Biswas (1997) [3]. Fuzzy set theory has a number of properties that make it suitable for decision making. There are two popular techniques for decision making using Sanchez's approach. One is the method that uses the max-min composition rule. The other is the method that uses the distance measure between fuzzy sets for Decision making.
Intuitionistic fuzzy sets [IFSs] as a generalization of fuzzy sets, it was introduced by Zadeh, (1965) [10] and K. Atanassov (1989, 1995) [1, 2] which contains three functions namely, membership non membership and hesitancy. The hesitancy plays an important role in determining medical diagnosis. For example, in decision making problems, in the case of medical diagnosis [8, 9], sales analysis, Enterprise planning, Network Security analysis Sales and marketing services, etc. there is a fair chance of the existence of a non-null hesitation part at each moment of evaluation of an unknown object In this paper Intuitionistic fuzzy sets is used as a tool for reasoning in the presence of imperfect facts and precise knowledge. In max-min composite relation method Supriya Kumar *et al* (2001) [8] Edward Samuel and M. Balamurugan (2012) [4, 5] an attempt is made to provide a formal model of the process to identify the diseases of the patients based on the four main types of diseases. The techniques summarize the simulation results to compare the outcomes of the diagnosis techniques by using IFS theory and implement it in the form of field recommendation system. This is the system by which the doctors use his knowledge to infer the diseases from the symptoms, based on his test results.

2. Preliminaries
The basic definitions of Intuitionistic fuzzy set theory that are useful for subsequent discussions are given.
Definition 2.1. A set E be fixed. An IFS A in E is an object having the form
A= $\{\langle x, \mu_A(x), \nu_A(x)\rangle | x \in E\}$, Where the functions $\mu_A : E \to [0,1]$ and $\nu_A : E \to [0,1]$ define the degree of membership and degree of non-membership respectively of the element $x \in E$ to the set A, which is a subset of E, and for every $x \in E$, $0 \le \mu_A(x) + \nu_A(x) \le 1$.

The amount $\pi_A(x) = 1 - (\mu_A(x) + v_A(x))$ is called the hesitation part, which may cater to either membership value or non-membership value or both.

Definition 2.2. If A and B are two Intuitionistic fuzzy sets of the set E, then

$A \subset B$ *iff* $\forall x \in E, [\mu_A(x) \leq \mu_B(x)$ and $v_A(x) \geq v_B(x)]$,

$A \subset B$ iff $B \subset A$,

A=B iff $\forall x \in E, [\mu_A(x) = \mu B(x)$ and $v_A(x) = v_B(x)]$,

$\bar{A} = \{\langle x, v_A(x), \mu_A(x)\rangle | x \in E\}$,

$A \cap B = \{\langle x, \min(\mu_A(x), \mu_B(x)\rangle, \max(v_A(x), v_B(x))\rangle | x \in E\}$,

$A\, U\, B = \{\langle x, \max(\mu_A(x), \mu_B(x)\rangle, \min(v_A(x), v_B(x))\rangle | x \in E\}$,

Clearly every fuzzy set has the form $\{\langle x, \mu_A(x), \mu_{A^c}(x)\rangle | x \in E\}$,

Definition 2.3. Let X and Y be two sets. An Intuitionistic fuzzy relation (IFR) R from X to Y is an IFS of $X \times Y$ characterized by the membership function μ_R and non-membership function v_R. An IFR R from X to Y will be denoted by $R(X \to Y)$.

Definition 2.4. If A is AN IF of X, the max-min- composition of the relation $R(X \to Y)$ with A is an IFS B of Y denoted by $B = R \circ A$, and is defined by the membership function

$\mu_{R \circ A}(y) = \bigvee_x [\mu_A(x) \wedge \mu_R(x, y)]$ and the non-membership function

$v_{R \circ A}(y) = \bigwedge_x [v_A(x) \vee v_R(x, y)]\ \forall y \in Y$ (Where $\vee$ = max, $\wedge$ = min).

Definition 2.5. Let $Q(X \to Y)$ and $R(Y \to Z)$ be two IFRs. The max-min-max composition $R \circ Q$ is the Intuitionistic fuzzy relation from X to Z, described by the membership function

$\mu_{R \circ Q}(x, z) = \bigvee_y [\mu_Q(x, y) \wedge \mu_R(y, z)]$ and the non-membership function

$v_{R \circ Q}(x, z) = \bigwedge_y [v_Q(x, y) \vee v_R(y, z)]\ \forall (x, z) \in X \times Z$ *and* $\forall y \in Y$.

Definition 2.6. Let $Q(X \to Y)$ and $R(Y \to Z)$ be two IFRs. The max-min-average composition $R \circ Q$ is the Intuitionistic fuzzy relation from X to Z, described by the membership function

$$\mu_T(p_i, d) = \bigvee_y \left\{ \frac{1}{2} [\mu_Q(p_i, s) + \mu_R(s, d)] \right\}$$

The non-membership function is

$$v_T(p_i, d) = \bigwedge_y \left\{ \frac{1}{2} [v_Q(p_i, s) + v_R(s, d)] \right\} \quad \forall pi \in p \text{ and } d \in D$$

and the hesitation function is

$$\pi_T(p_i, d) = \bigwedge_y \left\{ \frac{1}{2} [\pi_Q(p_i, s) + \pi_R(s, d)] \right\}$$

3. Max-min Average Composition Method for Decision Making

In this section an application of Intuitionistic Fuzzy set theory using Max-min average composite relation method for decision making is presented.

In a given set of system, let P={x_1, x_2,….,x_n} be the set of patients and S= {y_1, y_2,….,y_n} be the set of symptoms and D ={z_1, z_2,….,z_n} be the set of diseases. Using composition relation in mathematical Analysis, the Intuitionistic Fuzzy relation R from the set of symptoms to the set of diseases D is formed. This relation reveals the degree of association and the degree of non-association between the symptoms and diseases.

The proposed method is based on the following three steps.

(i) Determination of symptoms

(ii) Formulation of Intuitionistic Fuzzy relation

(iii) Classification of opportunities on the basis of composition of Intuitionistic Fuzzy relations 65 ^{0}C

An Intuitionistic Fuzzy relation Q is given from the set of patients X to the set of symptoms Y and another Fuzzy relation R is given from the set of symptoms Y to the set of diagnoses Z. the composite function T from the Intuitionistic Fuzzy relation R and Q.

3.1 Algorithm

Step 1: Form the Intuitionistic Fuzzy relation $Q(P \to S)$

Step 2: Take the Intuitionistic fuzzy relation $R\ (S \to D)$ (hypothetical)

Step 3: Find the composition function $T = R \circ Q$ describes the state of patients P in terms of the selection as an IFR from P(patients) to D(diseases) given by the membership, the non-membership and the hesitation function is

$$\mu_T(p_i, d) = \vee_y \left\{ \frac{1}{2} [\mu_Q(p_i, s) + \mu_R(s, d)] \right\} \quad v_T(p_i, d) = \wedge_y \left\{ \frac{1}{2} [v_Q(p_i, s) + v_R(s, d)] \right\}$$

$\forall pi \in p \text{ and } d \in D$

$$\pi_T(p_i, d) = \wedge_y \left\{ \frac{1}{2} [\pi_Q(p_i, s) + \pi_R(s, d)] \right\}$$

Step 4: Calculate ST= μ_T - V_T

Step 5: Calculate ST= μ_T - min $\{V_T, \pi_T\}$ using step-3.

3.2 Case Study

The test results of four patients Amity, John, Peter, and Ram are considered for the case study. In the discrimination analysis, the symptoms are ranked according to the grades of each diseases by a particular symptoms and is represented in the form of a matrix called a frequency distribution matrix m={aij} where aij is the Intuitionistic Fuzzy value of the patients X with diseases Z and symptoms Yto the total number of patients with diseases.

Let X={ Amity, John, Peter, Ram} be set of four patients, Y= { temperature, headache, stomach pain, cough} be the set of symptoms and Z= {Viral Fever, Malaria, Typhoid, Stomach Problem} be the set of diseases

Table 1: Determination of symptoms by using Intuitionistic fuzzy relation $Q(P \to S)$ in entries as per the survey are in the form of IFS (μ_A, v_A)

Q	Temperature	Head ache	Stomach Pain	cough
Amity	(0.8, 0.1,)	(0.6, 0.1)	(0.2, 0.8)	(0.6, 0.1)
John	(0.0, 0.8)	(0.4, 0.4)	(0.6, 0.1)	(0.1, 0.7)
Peter	(0.8, 0.1)	(0.8, 0.1)	(0.0, 0.6)	(0.2, 0.7)
Ram	(0.6, 0.1)	(0.5, 0.4)	(0.3, 0.4)	(0.7, 0.2)

Table 2: Intuitionistic fuzzy relation $R\ (S \to D)$ gives collections of an approximate description of the patient- symptoms in the hospital in the form of IFS (μ_A, v_A)

R	Viral Fever	Malaria	Typhoid	Stomach Problem
Temperature	(0.7,0.0)	(0.7, 0)	(0.3, 0.3)	(0.1, 0.7)
Head ache	(0.3, 0.5)	(0.2, 0.6)	(0.6, 0.1)	(0.2, 0.4)
Stomach Pain	(0.1, 0.7)	(0.1, 0.9)	(0.2, 0.7)	(0.8, 0.0)
cough	(0.4, 0.3)	(0.7, 0.0)	(0.2, 0.6)	(0.2, 0.7)

Table 3: Represents the Determination of diseases by using the max-min average composition $T = R \circ Q$.

T	Viral Fever	Malaria	Typhoid	Stomach Problem
Amity	(0.75, 0.05)	(0.75, 0.05)	(0.6, 0.1)	(0.5, 0.25)
John	(0.35, 0.4)	(0.4, 0.35)	(0.5, 0.25)	(0.7, 0.05)
Peter	(0.6, 0.05)	(0.75, 0.05)	(0.7, 0.1)	(0.50, 0.25)
Ram	(0.55, 0.05)	(0.7, 0.05)	(0.55, 0.2)	(0.55, 0.2)

Table 4: The difference between membership and non-membership values S_T= μ_T - V_T using Table-3

S_T	Viral Fever	Malaria	Typhoid	Stomach Problem
Amity	0.70	0.70	0.50	0.25
John	0.0	0.05	0.25	0.65
Peter	0.55	0.70	0.60	0.15
Ram	0.50	0.65	0.35	0.35

Table 5: Reduces the row wise repetitions by using the relations $S_T = \mu_T$ - Min (V_T, π_T) using Table-3.

S_T	Viral Fever	Malaria	Typhoid	Stomach Problem
Amity	0.70	0.75	0.50	0.25
John	0.10	0.15	0.25	0.65
Peter	0.55	0.70	0.60	0.15
Ram	0.50	0.65	0.35	0.35

4. Conclusion

Clearly the max-min average composition method and max min composition method Edward Samuel and M. Balamurugan (2012) [4, 5] gives the same result of the patients and the diseases. From Table 4 and Table 5, it is seen that the max value of Amity, Peter and Ram is 0.75,0.70 and0.65, the doctors agrees that Amity, Peter and Ram are suffer from malaria whereas the max value of John is 0.65, he is affected by the Stomach Problem. As a result, our approach makes it possible to introduce weights for all symptoms and reduces the confusion about the possibility of two diseases in a patient and also it is an efficient tool for decision making problem.

References

1. Atanassov K. More on Intuitionistic fuzzy sets, Fuzzy Sets and Systems. 1989; 33:37-46.
2. Atanassov K. Remarks on the Intuitionistic fuzzy sets - III, Fuzzy Sets and Systems. 1995; 75:401-402.
3. Biswas R. On fuzzy sets and Intuitionistic fuzzy sets, NIFS. 1997; 3:3-11.
4. Edward Samuel, A. and M. Balamurugan, Fuzzy Max-Min Composition Technique in Medical Diagnosis, Applied Mathematical Sciences. 2012; 6(35):1741-1746.
5. Edward Samuel A, Balamurugan M. An application of fuzzy logic in medical diagnosis, Advances in Fuzzy Sets and Systems. 2012; 12:59-67.
6. Sanchez E. Resolution of composition fuzzy relation equations, Inform Control. 1976; 30:38-48.
7. Sanchez E. Solutions in composite fuzzy relation equation. Application to medical diagnosis in Brouwerian Logic, in: M.M. Gupta., G.N. Saridis., B.R. Gaines., (Eds.), Fuzzy Automata and Decision Process, Elsevier, North-Holland, 1977.
8. Supriya Kumar De, Ranjit Biswas, Akhil Ranjan Roy, An application of Intuitionistic fuzzy sets in medical diagnosis, Fuzzy Sets and Systems. 2001; 117:209-213.
9. Szmidt E, Kacprzyk J. Intuitionistic fuzzy sets in group decision making, NIFS. 1996; 2:1-14.
10. Zadeh LA. Fuzzy sets, Inform. and Control. 1965; 8:338-353.