International Archive of Applied Sciences and Technology
Int. Arch. App. Sci. Technol; Vol 9 [4] December 2018 : 138-141
© 2018 Society of Education, India
[ISO9001: 2008 Certified Organization]
www.soeagra.com/iaast.html

IAAST
ONLINE ISSN 2277- 1565
PRINT ISSN 0976 - 4828

CODEN: IAASCA REVIEW ARTICLE

DOI: .10.15515/iaast.0976-4828.9.4.138141

Role of Intuitionistic Fuzzy Logic in Diagnosis of Diseases

Shubhnesh Kumar Goyal
Associate Professor, D.S.(P.G.) College, Aligarh U.P.

ABSTRACT
This paper provides a planned way to diagnose clinical diseases on the basis of general symptoms. The method of intuitionistic medical diagnosis involves intuitionistic fuzzy relations. In this work Sanchez's approach for medical diagnosis is studied and the concept is generalized by the application of IFS theory.
Key Words :*Medical diagnosis, Sanchez's approach, intuitionistic fuzzy sets.*

Received 22/09/2018 Revised 10/11/2018 Accepted 01/12/2018

Citation of this article
Shubhnesh Kumar Goyal. Role of Intuitionistic Fuzzy Logic in Diagnosis of Diseases. Int. Arch. App. Sci. Technol; Vol 9 [4] December 2018. 138-141.

INTRODUCTION

Medical diagnosis is the process of determining which disease or condition explains a person's symptoms and signs. It is most often referred to as diagnosis with the medical context being implicit. The information required for diagnosis is typically collected from a history and physical examination of the person seeking medical care [1-3]. Out of several generalizations of fuzzy set theory for various objectives, the notion introduced by Atanassov in defining intuitionistic fuzzy sets (IFSs) is interesting and useful. Fuzzy sets are IFSs but the converse is not necessarily true. In fact, there are situations where IFS theory is more appropriate to deal.IFS theory has been applied in different areas,viz.,logic programming, decision making problems etc. In the present paper we studied Sanchez's method of medical diagnosis using the notion of IFS theory [4-6]. The method of intuitionistic medical diagnosis involves intuitionistic fuzzy relations.

PRELIMINARIES

First of all we will introduce some basic definitions which are used in our next section.

Definition2.1. Let a set E be fixed. An intuitionistic fuzzy set or IFSA in E is an object having the form

$A = \{(x, \mu_A(x), v_A(x)) \mid x \in E\}$

where the function sμ_A:E[0,1]andυ_A:E [0,1] define the degree of membership and degree of non-membership respectively of the element x∈E to the set A,which is a subset of E,and for every x∈E , $0 \leq \mu_A(x) + \upsilon_A(x) \leq 1$.

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

Definition2.2. If A and B are two IFSs of the set E, then

$A \subset B$ iff $\forall x \in E; [\mu_A(x) \leq \mu_B(x)$ and $\upsilon_A(x) \geq \upsilon_B(x)]$

$A \supset B$ if f $B \subset A$

$A = B$ iff $\forall x \in E; [\mu_A(x) = \mu_B(x)$ and $\upsilon_A(x)= \upsilon_B(x)]$

$\bar{A}=\{(x , \upsilon_A(x) , \mu_A(x)) \mid x \in E$

$A \cap B = \{(x , \min(\mu_A(x), \mu_B(x)), \max(\upsilon_A(x),\upsilon_B(x))) \mid x \in E\}$

$A \cup B = \{(x, \max(\mu_A(x), \mu_B(x)), \min(\upsilon_A(x), \upsilon_B(x))) \mid x \in E$

Obviously every fuzzy set has the form

$\{(x, \mu_A(x), \upsilon_A(x)) \mid x \in E\}$

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

Definition 2.4: If A is an IFS of X, the max–min–max composition of the IFR $R(X \to Y)$ with A is an IFS B of Y denoted by $B = R^\circ A$; and is defined by the membership function

$\mu_{R0A}(y) = \vee[\mu_A(x) \wedge \mu_R(x,y)]$

and the non-membership function

$\upsilon_{R0A}(y) = \wedge[\upsilon_A(x) \vee \upsilon_R(x,y)]\ \forall y \in Y$

(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 defined by the membership function

$\mu_{RoQ}(x,z) = \vee[\mu_Q(x,y) \wedge \mu_R(y,z)]$

and the non-membership function

$\upsilon_{R0Q}(x,z) = \wedge[\upsilon_Q(x,y) \vee \upsilon_R(y,z)]\ \forall\ (x,z) \in XxZ$ and $\forall\ y \in Y$

Medical diagnosis

In this section we present an application of intuitionistic fuzzy set theory in Sanchez's approach for medical diagnosis. In a given pathology, suppose S=is a set of symptoms, D a set of diagnoses, and P a set of patients.

Analogous to Sanchez's notion of" Medical Knowledge" we define "Intuitionistic Medical Knowledge" as an intuitionistic fuzzy relation R from the set of symptoms S to the set of diagnoses D(i.e.,onSxD) which reveals the degree of association and the degree of non-association between symptoms and diagnosis. Now let us discuss intuitionistic fuzzy medical diagnosis.

Now let us discuss intuitionistic fuzzy medical diagnosis. The methodology involves mainly the following three jobs:

1. Determination of symptoms.
2. Formulation of medical knowledge basedon intuitionistic fuzzy relations.
3. Determination of diagnosis on the basis of composition of intuitionistic fuzzy relations.

Let A be an IFS of the set S;and R be an IFR from S to D. Then max-min-max composition of IFS A with the IFRR$(S \to D)$ denotes by B=A0R signifies the state of the patient in terms of diagnosis as an IFS B of D with the membership function given by

$\mu_B(D) = \vee[\mu_A(s) \wedge \mu_R(s,d)]$

and the non-membership function

$\upsilon_B(d) = \wedge[\upsilon_A(s) \vee \upsilon_R(s,d)]\ \forall\ d \in D$

If the state of agiven patient P is described in terms of an IFSAof S,then P is assumed to be assigned diagnosis in terms of IFS B of D, through an IFR R of "Intuitionistic Medical Knowledge" from S to D which is assumed to be given by a doctor who is able to translate his own perception of the intuitionism involved in degrees of association and non-association respectively between symptoms and diagnosis. For a given R and Q; the relation T = R o Q can be computed. From the knowledge of Q and T; one may compute an improved version of the IFRR for which the following holds good:

$S_R = \mu_R - \upsilon_R.\pi_R$ is greatest and the equality T = R o Q is retained.

Obviously, this improved version of R will be a more significant IFR translating the higher degrees of association and lower degrees of non-association of symptoms as well as lower degrees of hesitation to the diagnosis, an approach to "Intuitionistic Medical Knowledge". In case, the doctor is not satisfied with the results, Ri s modified. A computer-based diagnostic system can be used for this purpose. To see the application of the method let us make a hypothetical case study below:

Case study

Suppose there are five patients Amit, Babul, Chaman and Deepak in hospital of Delhi. Their symptoms are loose motion, temperature, cough, cold, itching and body pain. Clearly, P= { Amit, Babul, Chaman, Deepak} and the set of symptoms

S = { loose motion, temperature, cough, itching, body pain }.

The Intuitionistic fuzzy relation $Q(P \to S)$is given in hypothetical form as –

Q	Loose Motion	Temperature	Cough	Itching	Body Pain
Amit	(0.8,0.1)	(0.6,0.1)	(0.2,0.8)	(0.6,0.1)	(0.1,0.6)
Babul	(0.0,0.8)	(0.4,0.4)	(0.6,0.1)	(0.1,0.7)	(0.1,0.8)
Chaman	(0.8,0.1)	(0.8,0.1)	(0.0,0.6)	(0.2,0.7)	(0.0,0.5)
Deepak	(0.6,0.1)	(0.5,0.4)	(0.3,0.4)	(0.7,0.2)	(0.3,0.4)

Let the set of diagnosis be D = { Malaria, Typhoid, Viral Fever, Dengue, Cold } Then The Intuitionistic fuzzy relation R(S→D)is given in hypothetical form as –

R	Malaria	Typhoid	Viral Fever	Dengue	Cold
Loose Motion	(0.4,0.0)	(0.7,0.0)	(0.3,0.3)	(0.1,0.7)	(0.1,0.8)
Temperature	(0.3,0.5)	(0.2,0.6)	(0.6,0.1)	(0.2,0.4)	(0.0,0.8)
Cough	(0.1,0.7)	(0.0,0.9)	(0.2,0.7)	(0.8,0.0)	(0.2,0.8)
Itching	(0.4,0.3)	(0.7,0.0)	(0.2,0.6)	(0.2,0.7)	(0.2,0.8)
Body Pain	(0.1,0.7)	(0.1,0.8)	(0.1,0.9)	(0.2,0.7)	(0.8,0.1)

Therfore the composition T= RoQ will be given by -

T	Malaria	Typhoid	Viral Fever	Dengue	Cold
Amit	(0.4,0.1)	(0.7,0.1)	(0.6,0.1)	(0.2,0.4)	(0.2,0.6)
Babul	(0.3,0.5)	(0.2,0.6)	(0.4,0.4)	(0.6,0.1)	(0.1,0.7)
Chaman	(0.4,0.1)	(0.7,0.1)	(0.6,0.1)	(0.2,0.4)	(0.2,0.5)
Deepak	(0.4,0.1)	(0.7,0.1)	(0.5,0.3)	(0.3,0.4)	(0.3,0.4)

Let us calculate $S_T = \mu_T - U_T\ .\pi_T$ corresponding to this data

S_T	Malaria	Typhoid	Viral Fever	Dengue	Cold
Amit	0.35	0.68	0.57	0.04	0.08
Babul	0.20	0.08	0.32	0.57	0.04
Chaman	0.35	0.68	0.57	0.04	0.05
Deepak	0.32	0.68	0.44	0.18	0.18

It is obvious that if the doctor agrees, then Amit, Chaman and Deepak suffers from Malaria whereas Babul suffers from Dengue.

CONCLUSION

In this paper, Sanchez's approach for medical diagnosis is studied and the concept is generalized by the application of IFS theory. As a consequence, a study of Sanchez's approach for medical diagnosis has been made with a generalized notion (i.e., IFS theory). The non- membership functions have more important roles here in comparison to the membership function corresponding to the complement of fuzzy sets because of the fact that in decision making problems, particularly in case of medical diagnosis, there is a fair chance of the existence of an on-zero hesitation part at each moment of evaluation of any unknown object.

REFERENCES

1. De S.K.,R.Biswas,Roy.A.R.(2001). An application of fuzzy sets in medical diagnosis, Fuzzy Sets and System; 209-213.
2. K. Atanassov, (1986). Intuitionistic fuzzy sets, Fuzzy Sets and Systems 20, 87–96.
3. K.Atanassov, (1989). More on intuitionistic fuzzy sets,FuzzySets and Systems 33,37– 46.
4. K. Atanassov, (1995). Remarks on the intuitionistic fuzzy sets – III, Fuzzy Sets and Systems 75, 401–402.
5. R. Biswas, (1997). Intuitionistic fuzzy relations, Bull. Sous. Ens. Flous. Appl. (BUSEFAL) 70(1997)22–29.
6. R.Biswas, (1997). On fuzzy sets and intuitionistic fuzzy sets,NIFS 3, 3–11.
7. Bustince,P.Burillo,(1996). Vague sets are intuitionistic fuzzy sets, Fuzzy Sets and Systems 79, 403– 405.
8. D.Doubois,H.Prade, (1980). Fuzzy Sets and Systems:Theory and Application, Academic Press, New York.
9. W.L.Gau,D.J.Buehrer,(1993). Vague sets, IEEETrans. Systems Man Cybernet. 23 (2);)610 – 619.

10. A. Kaufmann, (1975). An Introduction to the Theory of Fuzzy Subsets,vol.1,Academic Press,NewYork.
11. E. Szmidt, J. Kacprzyk, (1996). Intuitionistic fuzzy sets in group decision making,NIFS2(1)1–14.
12. L.A. Zadeh, (1965). Fuzzy sets, Inform. and Control 8, 338–353.