International Journal of Pure and Applied Mathematics
Volume 120 No. 8 2018, 129-135
ISSN: 1314-3395 (on-line version)
url: http://www.acadpubl.eu/hub/
Special Issue

http://www.acadpubl.eu/hub/

Intuitionistic Fuzzy Sets in Medical Diagnosis

A.Edward Samuel and S.Rajakumar
Ramanujan Research Centre,
P.G. & Research Department of Mathematics,
Government Arts College (Autonomous), Kumbakonam,
Tamil Nadu, India.
aedward74_thrc@yahoo.co.in
tplrajkumar@gmail.com

October 19, 2018

Abstract

In this paper, we propose a new approach for medical diagnosis with the symptoms of disease using intuitionistic fuzzy sets with score function.

AMS Subject Classification:03B52, 92C50, 91B06, 03E72, 03B80

Key words and Phrases
Intuitionistic fuzzy sets, score function, medical diagnosis.

1 Introduction

The field of medicine is one of the best areas of application of fuzzy set theory. In the discrimination analysis, the symptoms are ranked according to the grade of discrimination of each disease by a particular symptom. In real world, we frequently deal with vague or imprecise information. Information available is sometimes vague, sometimes inexact or sometimes insufficient. Out of several higher order fuzzy sets, intuitionistic fuzzy sets[1,2] have been found to be highly useful to deal with vagueness. There are situations where

due to insuffiency in the information available, the evaluation of membership values is not possible up to our satisfaction.Due to the some reason, evaluation of non-membership values is not always possible and consequently there remains a part indeterministic on which hesitation survives.
Certainly fuzzy set theory is not appropriate to deal with such problem, rather intuitionistic fuzzy set theory is more suitable.Out of several generalizations of fuzzy set theory for various objectives ,the notion introduced by Atanassov[1] in defining intuitionistic fuzzy sets is interesting and useful.Fuzzy sets are intuitionistic fuzzy sets but the converse is not necessarily true[1].In fact, there are situations where intuitionistic fuzzy set theory is more appropriate to deal with [3].Besides, it has been cultured in [4] that vague sets [6] are nothing but intuitionistic fuzzy sets.
In the present paper we study Sanchez's method for medical diagnosis using the notion of intuitionistic fuzzy set theory.The method of intuitionistic medical diagnosis involves intuitionistic fuzzy relations as defined in section 3.

2 Preliminaries

We give here some basic definitions, which are used in our next section.

Definition 1. Let a set E be fixed. An intuitionistic fuzzy set(IFS) A in E is an object having the form, $A = \{\langle x, \mu_A(x), \gamma_A(x)\rangle / x \in E\}$ where the function $\mu_A : E \to [0,1]$ and $\gamma_A : E \to [0,1]$ define the degree of membership and degree of non-membership resepectively of the element $x \in E$ to the set A. which is a subset of E and for every $x \in E$, $0 \leq \mu_A(x) + \gamma_A(x) \leq 1$. The amount $\pi_A(x) = 1 - (\mu_A(x) + \gamma_A(x))$ is called the hesitation part which may cater to either membership value or non-membership value or both.

Definition 2. Let $Q(x \to y)$ and $R(y \to z)$be two intuitionistic fuzzy relations.The max-min composition $(R \circ Q)$ is the intuitionistic fuzzy relation from $x \to z$,defined by the membership function $\mu_{R\circ Q}(x,z) = \bigvee_y(\mu_Q(x,y) \bigwedge \mu_R(y,z))$ and the non-membership

function $\gamma_{R\circ Q}(x,z) = \bigwedge_y(\gamma_Q(x,y) \bigvee \gamma_R(y,z))\ \forall(x,z) \in (X*Z)\forall y \in Y$

3 Methodology

Definition 3. Let be an intuitionistic fuzzy number.Then the score function is defined as $S(A) = 1 - min(\mu_A, \gamma_A) + (\mu_A\gamma_A/2)$

4 Medical diagnosis

Suppose S is a set of symptoms,D is a set of diseases and P is a set of patients.Let Q be the intuitionistic fuzzy relation from the set of patients to the set of symptoms i.e.,$Q(P \to S)$and R be the intuitionistic fuzzy relation from the set of symptoms to the set of diseases i.e., $R(S \to D)$

4.1 Algorithm

Step 1
$Q(P \to S)$ and $R(S \to D)$ are applied in Table 1 and Table 2. We get the results is named Table 3 (i.e.,compute $T = (R \circ Q)$)
Step 2
Applying complement(i.e., $A^c = (\mu_A, 1 - \gamma_A)$in Table 3 and the result is named Table 4
Step 3
The Table 4 values are applied in score function $1 - min(\mu_A, \gamma_A) + (\mu_A\gamma_A/2)$ and the result is named Table 5
Step 4
Finally we select the minimum value from (Table 5)each row and then we conclude $P_i(i = 1, 2, 3, 4)$ is suffering from the diseases $D_j(j = 1, 2, 3, 4, 5)$

4.2 Case Study[5]

Let there be four patients $P = \{Ram, Mari, Sugu, Somu\}$and the set of symptoms $S = \{Temperature, Headache, Stomachpain, Cough, Chestpain\}$ and the set of Diseases $D = \{Viralfever, Malaria, Typhoid, Stomachproblem, Chestproblem\}$

Table 1: IFR ($Q(P \to S)$)

Q	Temperature	Headache	Stomach pain	Cough	Chestpain
Ram	(0.8, 0.1)	(0.6, 0.1)	(0.2, 0.8)	(0.6, 0.1)	(0.1, 0.6)
Mari	(0.0, 0.8)	(0.4, 0.4)	(0.6, 0.1)	(0.1, 0.7)	(0.1, 0.8)
Sugu	(0.8, 0.1)	(0.8, 0.1)	(0.0, 0.6)	(0.2, 0.7)	(0.0, 0.5)
Somu	(0.6, 0.1)	(0.5, 0.4)	(0.3, 0.4)	(0.7, 0.2)	(0.3, 0.4)

Table 2: IFR ($S \to D$)

R	Viral fever	Malaria	Typhoid	Stomach problem	Chest problem
Temperature	(0.4, 0.0)	(0.7, 0.0)	(0.3, 0.3)	(0.1, 0.7)	(0.1, 0.8)
Headache	(0.3, 0.5)	(0.2, 0.6)	(0.6, 0.1)	(0.2, 0.4)	(0.0, 0.8)
Stomach pain	(0.1, 0.7)	(0.0, 0.9)	(0.2, 0.7)	(0.8, 0.0)	(0.2, 0.8)
Cough	(0.4, 0.3)	(0.7, 0.0)	(0.2, 0.6)	(0.2, 0.7)	(0.2, 0.8)
Chestpain	(0.1, 0.7)	(0.1, 0.8)	(0.1, 0.9)	(0.2, 0.7)	(0.8, 0.1)

Table 3: Using Step1 (i.e.,compute $T = (R \circ Q)$)

T	Viral fever	Malaria	Typhoid	Stomach problem	Chest problem
Ram	(0.4, 0.1)	(0.7, 0.1)	(0.6, 0.1)	(0.2, 0.4)	(0.2, 0.6)
Mari	(0.3, 0.5)	(0.2, 0.6)	(0.4, 0.4)	(0.6, 0.1)	(0.1, 0.7)
Sugu	(0.4, 0.1)	(0.7, 0.1)	(0.6, 0.1)	(0.2, 0.4)	(0.2, 0.5)
Somu	(0.4, 0.1)	(0.7, 0.1)	(0.5, 0.3)	(0.3, 0.4)	(0.3, 0.4)

Table 4: Using Step2

T	Viral fever	Malaria	Typhoid	Stomach problem	Chest problem
Ram	(0.4, 0.9)	(0.7, 0.9)	(0.6, 0.9)	(0.2, 0.6)	(0.2, 0.4)
Mari	(0.3, 0.5)	(0.2, 0.4)	(0.4, 0.6)	(0.6, 0.9)	(0.1, 0.3)
Sugu	(0.4, 0.9)	(0.7, 0.9)	(0.6, 0.9)	(0.2, 0.6)	(0.2, 0.5)
Somu	(0.4, 0.9)	(0.7, 0.9)	(0.5, 0.7)	(0.3, 0.6)	(0.3, 0.6)

Table 5: Using Step3 and Step4

T	Viral fever	Malaria	Typhoid	Stomach problem	Chest problem
Ram	0.780	**0.615**	0.670	0.860	0.840
Mari	0.775	0.840	0.720	**0.670**	0.915
Sugu	0.780	**0.615**	0.670	0.860	0.850
Somu	0.780	**0.615**	0.675	0.860	0.790

From Table 5, We see that the minimum value of Ram, Sugu and somu is 0.615 and therefore they suffer from Malaria. Where as the minimum value of Mari is 0.670 and therefore she faces Stomach problem.

5 Conclusion

In this paper, a new technique to diagnose the symptom of the disease using intuitionistic fuzzy set is proposed and it is successful and effective to solve many problems faced by patients.

References

[1] Atanassov, K, Intuitionistic Fuzzy Sets, Fuzzy Sets and Systems, 20(1986), 87-96.

[2] Atanassov, K, New operations defined over Intuitionistic Fuzzy Sets, Fuzzy Sets and Systems,61(1994), 137-142.

[3] Biswas, R, On Fuzzy Sets and Intuitionistic Fuzzy Sets, NIFS, 3(1997), 3-11.

[4] Bustince, H.and Burillo,P, Vague Sets are Intuitionistic Fuzzy Sets, Fuzzy Sets and Systems,79(1996), 403-405.

[5] Edward samuel,A and Balamurugan,M, Fuzzy max-min composition technique in medical Diagnosis, Applied mathematical sciences,6(35),1741-1746(2012)

[6] Gau,W.L, Buehrer, D.J, Vague Sets, IEEE Trans. Systems Man Cybernet, 23(2), (1993),610-614.