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Application of Intuitionistic Fuzzy Set With n-Parameters in Medical Diagnosis

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Abstract- In this paper, we first introduce intuitionistic fuzzy sets [IFS] with n-parameters. This method of approach is different and singular in certain aspects. In this n-parameters method the relationship between membership values and hesitancy values and hesitancy values and non-membership values are studied to diagnosis the cause of diseases. The symptoms are checked once and even if there is slight variations in the symptoms the doctor can diagnosis the disease accurately, but this is not studied in other existing methods.

Keywords- Intuitionistic fuzzy sets (IFS), fuzzy logic (FL), n-parameters medical diagnosis

I. INTRODUCTION

An intuitionistic fuzzy set (Atanassov IFS presented in 1986) has been used.There are three functions in this fuzzy sets namely, membership, non membership and hesitancy. Here hesitancy plays a vital role in determining the diseases. The distance between membership values and hesitancy values has n-parameters. Similarly, the distance between non membership values and hesitancy also has n-parameters. There are reasons for considering the distance between these values as n parameters. One or two causes alone cannot help to identify the diseases because there could be so many reasons that would have caused the diseases. To diagnose the disease to the patients, these n-parameters will be valuable to the doctors.By studying the metabolism of a patient it cannot be clearly confirmed about the cause of a disease sometimes, all treatment will end up in failure. In some cases, after studying the symptoms completely if the treatment is given the patient is cured successfully. Many research scholars have studied role of membership, non-membership and hesitancy values. But the significant role of hesitancy values ignored in those approaches. Here the n-parameters method is used to diagnosis the disease accurately.

II. PRELIMINARIES

A. Definition

Let a set E be fixed. An Intuitionistic fuzzy set or IFS A in E is an object having the form A = {< x,μ_A (x),ν_A (x) > /x$\in$E}where the functions

μ_A: E → [0, 1] and ν_A :E → [0, 1] define the degree of membershipand degree of non-membership of the element x$\in$E to the set A,Which is a subset of E, and for every x$\in$E,0≤ $\mu_A(x)+\nu_A(x) \leq 1$. The amount ΠA (x) = 1 − (μ_A (x) + ν_A (x)) is called the hesitation part, which may cater toeither membership value or non-membership value or both.

B. Definition

If A is an IFS of X, then the max-min composition of the IFR R (X → Y) with A is an IFS B of Y denoted by B = RoA, and is defined by the membership function. $\mu_{RoA}(y) = \vee_x[\mu_A(x) \wedge \mu_R(x, y)]$ and the non-membership function given by $\nu_{RoA}(y) = \wedge_x[\nu_A(x) \vee \nu_R(x, y)]$ ∀ y ∈Y (Here ∨= max, ∧= min)

C. Definition

Let X be a non empty set, A set of ($\pi_{i=2}^{n} q_i, \pi_{i=2}^{n} q_i'$).Level generated by an IFS A, where $\pi_{i=2}^{n} q_i, \pi_{i=2}^{n} q_i' \in [0,1]$ are membership values, such that$0 \leq \pi_{i=2}^{n} q_i + \pi_{i=2}^{n} q_i' \leq 1$is defined as:

$$J^{(A)}_{\pi_{i=2}^{n} q_i} < \pi_{i=2}^{n} q_i' = \{< x, \mu_A(x) + \pi_{i=2}^{n} q_i \times q_1, \pi_{i=2}^{n} q_i' \times \nu_A(x) > / x \in A\}$$

D. Definition

Let R be an IFR(C → F) and construct an IFR Q from the set of stakeholders S to the set of criteria C. Clearly, the composition T of IFRS R and Q(T = RoQ) describes the state of the stakeholder in terms of the factors as an IFR from S to F given by the membership function $\mu_T(s_i, f_j) = \vee_{c\in C} [\mu_Q(s_i, c) \wedge \mu_R(c, f)]$c∈C And the non-membership function given by $\nu_T(s_i, f_j) = \wedge_{c\in C} [\nu_Q(si, c) \vee \nu_R(c, f)]$ ∀s_i∈S and f∈F. For a given R and Q, the relation T = RoQ can be computed.

III. MEDICAL DIAGNOSIS

Suppose that S is a set of symptoms, D is a set of diagnosis and P is a set of patients. Let M_1 be an IFR,M_1 (P → S) and M_2 from the set of patients to the set of symptoms s, i.e., M_2 (S → D) then

$K_1 = \max\{\min\{\mu_A(x), \nu_A(x) \backslash x \in E\}\}$

$$K_2 = q_1 = \frac{\mu_A(x) \times \nu_A(x)}{2(\mu_A(x) + \nu_A(x))}$$

$$K_3 = \pi_{i=2}^{n} q_i = \frac{q_{n-1} \times \mu_A(x)}{2(q_{n-1} + \mu_A(x))}$$

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$K_4= \pi_{i=2}^{n} q_i' = \frac{q_{n-1}' \times \nu_A(x)}{2(q_{n-1}' + \nu_A(x))}$

$K_5= J^{(A)}_{\pi_{i=2}^{n} q_i < \pi_{i=2}^{n} q_i'} = \{< \mu_A(x) + \pi_{i=2}^{n} q_i \times q_1, \pi_{i=2}^{n} q_i' \times \nu_A(x) >\}$

$K_6=$

$H^{(A)}_{\pi_{i=2}^{n} q_i > \pi_{i=2}^{n} q_i'} = \{< \mu_A(x) \times \pi_{i=2}^{n} q_i, \nu_A(x) + \pi_{i=2}^{n} q_i' \times q_1 >\}$

$K_7= G^{(A)}_{\pi_{i=2}^{n} q_i = \pi_{i=2}^{n} q_i'}$ $K_8=$

$\min\{ \mu_A(x), q_n, \ldots\ldots, q_2, q_1, q_2', q_3', \ldots q_n', \nu_A(x) >\}$

IV. ALGORITHM

Compute K_1=PoD in Table1and Table2 and the resultant in Table3.

Table 3 values are applied in K_2, K_3 and $K_4$and the results are given in Table 4.

Table 4 values are applied in K_5,K_6 and K_7 and the results are named as Table 5.

Table 5 values are applied in K_8, and the result is given in Table 6.

Finally, select the minimum values from each row of Table 6, and then conclude that the patient p_i is suffering from the disease d_r

V. CASE STUDY

Let there be four patients P = {Ram, Sri, Wilson, Marina} and the setof symptoms
S = {temperature, headache, stomach-pain, cough, chest-pain}.The set of Diagnosis

Table 1: Using step2, we get

	Ram	Sri	Wilson	Marina
Viral fever	(.5,.017,.071,.025,.2)	(.7,.034,.077,.027,.2)	(.5,.034,.077,.027,.2)	(.5,.017,.71,.25,.2)
Malaria	(.5,.017,.071,.025,.2)	(.8,.02,.044,.015,.1)	(.5,.07,.071,.025,.2)	(.6,.033,.075,.027,.2)
Typhoid	(.8,.02,0.44,.15,.1)	(.6,.033,.075,.027,.2)	(.8,.02,.044,.015,.1)	(.5,.017,.71,.25,.2)
Stomach Problem	(.4,.028,.066,.024,.2)	(.4,.028,.066,.24,.2)	(.3,.025,.06,.023,.2)	(.4,.035,.085,.033,.3)
Chest Problem	(.3,.025,.06,.023,.2)	(.4,.028,.066,.024,.2)	(.3,.025,.06,.023,.2)	(.7,.034,.077,.27,.2)

D = {Viral Fever, Malaria, Typhoid, Stomach Problem,Chest-Problem}.

Now, select the minimum values from each row of Table6, it is obvious that,if the doctor agrees then Ram, Wilson, and Marina suffer from viral fever where as Sri faces stomach problem.

IFS WITH n-PARAMETERS IN MEDICAL DIAGNOSIS

Table 2: IFR M_1 (P → S)

	Temperature	Headache	Stomach pain	Cough	Chest-pain
Ram	(0.4,0.2)	(0.5,0.2)	(0.8,0.1)	(0.2,0.6)	(0.8,0.1)
Sri	(0.8,0.1)	(0.8,0.2)	(0.8,0.1)	(0.4,0.3)	(0.6,0.2)
Wilson	(0.2,0.2)	(0.5,0.3)	(0.9,0.0)	(0.2,0.7)	(0.8,0.1)
Marina	(0.4,0.4)	(0.7,0.1)	(0.9,0.1)	(0.8,0.1)	(0.4,0.3)

Table 3: IFR M_2 (S → D)

	Viral Fever	Malaria	Typhoid	Stomach Problem	Chest Problem
Temperature	(0.7,0.2)	(0.8,0.1)	(0.6,0.3)	(0.4,0.3)	(0.2,0.6)
Headache	(0.5,0.2)	(0.6,0.1)	(0.5,0.2)	(0.3,0.3)	(0.1,0.8)
Stomach pain	(0.4,0.3)	(0.5,0.2)	(0.2,0.2)	(0.1,0.3)	(0.2,0.2)
Cough	(0.1,0.5)	(0.1,0.6)	(0.3,0.2)	(0.2,0.4)	(0.7,0.2)
Chest-pain	(0.5,0.2)	(0.4,0.2)	(0.8,0.0)	(0.2,0.2)	(0.3,0.4)

Table 4: Using step1, we get

	Viral fever	Malaria	Typhoid	Stomach Problem	Chest Problem
Ram	(0.5012,0.005)	(0.5012,0.005)	(0.016,0.1006)	(0.0112,02015)	(0.0075,0.2006)
Sri	(0.0238,0.2020)	(0.016,0.1006)	(0.0198,0.2020)	(0.0112,0.2015)	(0.0112,0.2015)
Wilson	(0.5012,0.005)	(0.5012,0.0057)	(0.016,0.1006)	(0.0075,0.2015)	(0.0075,0.2015)
Marina	(0.5012,0.005)	(0.0198,0.2020)	(0.5012,0.005)	(0.014,0.3028)	(0.0238,0.2020)

Table 5: Using step4, we get

	Viral fever	Malaria	Typhoid	Stomach Problem	Chest Problem
Ram	0.005	0.0056	0.016	0.0112	0.0075
Sri	0.0238	0.016	0.0198	0.0112	0.01122
Wilson	0.005	0.0057	0.016	0.0075	0.0075
Marina	0.005	0.0198	0.0056	0.014	0.0238

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Table-6

	Viral Fever	Malaria	Typhoid	Stomach Problem	Chest Problem
Ram	(0.5,0.2)	(0.5,0.2)	(0.8,0.1)	(0.4,0.2)	(0.3, 0.2)
Sri	(0.7,0.2)	(0.8,0.1)	(0.6,0.2)	(0.4,0.2)	(0.4,0.2)
Wilson	(0.5,0.2)	(0.5,0.2)	(0.8,0.1)	(0.3,0.2)	(0.3,0.2)
Marina	(0.5,0.2)	(0.6,0.1)	(0.5,0.2)	(0.4,0.3)	(0.7,0.2)

VI. CONCLUSION

An intuitionistic fuzzy set [IFS] with n-parameters approach is different and singular in certain aspects. In n-parameters approach the relationship between membership values and hesitancy values, hesitancy values and non-membership values are studied, to diagnosis the cause of the disease. The symptoms are checked once and even if there is slight variations in the symptoms the doctor can diagnoses the disease accurately, but this is not studied in other existing methods.

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