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ANALYTICAL STUDIES OF THE APPLICATION ASPECTS OF FUZZY INTUITIONISTIC AND FUZZY TYPE 2 SET

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Abstract

The main aim of this paper is to introduce the definition of intuitionistic fuzzy set and operations on it that will prove fruitful to conclude to a solution on problems of real life and how fuzzy logic and Graphics Processing unit can be used together to solve different domain problems for faster responses. Various comprehensive survey of Type-2 fuzzy set and the intuitionistic fuzzy set theories have been described here. IFS is nothing but a simple extension of the fuzzy set defined in the domain of discourse. Graphics Processing Unit (GPU) has been used to enhance the speed of execution. The intuitionistic fuzzy set is utilized as a proper element for representing the degree of hesitation concerning both the non-membership and membership degrees of an element of a set. Recent trends show how GPU is used for various computational applications that are run parallel to reduce overall execution time. Both the fuzzy domains seek application in tackling of the situation of vagueness with their respective characteristic feature sets to the fields concerned to different engineering domains of interdisciplines. This paper highlights the overview of the two eminent fuzzy categories like Fuzzy type 2 and intuitionistic fuzzy theory along with their application on greater scale.

Keywords: *Intuitionistic, discourse, Type-2 Fuzzy, Ituitionistic fuzzy, CPU, GPU.*

INTRODUCTION

K.T. Atanassov introduced Intuitionistic Fuzzy Set which has become helpful in solving many practical problems. The IFS theory found its application in various arenas such as medical diagnosis, logic and decision-making programming.

The membership function $\mu_A(x)$ of a fuzzy set A is a function μ_A:x-> [0,1]. So, every element in X has a membership degree, $\mu_A(x)$ belongs to [0,1]. A is completely determined by the set of tuples: A= {(x, $\mu_A(x)$ x ∈X}.

There is a huge advancement in parallel computing that uses GPUs which have multicore architecture. This architecture upholds parallel computing, an essential factor for processing in graphics. They utilize more transistors for logical and arithmetic operations compared to flow control and caching of general CPU. They weigh much better performance than CPU in terms of core numbers and thus increase in computational power . The use of GPU's computational power has become easy with the development of CUDA software development kit in 2007 by NVIDIA. The operation of GPU device is from coprocessor to host.

Set theory is the important tool to represent any collection in some ordered form. Set is formaly defined to be the collection of elements which never occur in duplicate. This implies that the {1,2,3,4,5} defines a set but the collection {1,3,5,2,3}is not a set. The presentation of set occur in two different ways.(i) set builder form and (b) Roster form .In the fisrt type of representation , the set elements occur in the summarized and gist format. The main advantage of this procedure is the compactness in presentation. Secondly , all the individual elements of the set need not be exposed for its manipulation. In the second case of set presentation, ie, in the roster format , all the set elements will be displayed directly. This set can be written in the set builder form as {n:n is an integer}.The set may be presented in different format also. The formal set theory is also known as the classical set theory. The formal definition of such set theory is not supposed to represent the real world objects or discourses minutely.The vaugueness, uncertainity and inexactness present in the nature cannot be tracked by the simple crisp set due to its failure in tracking the uncertain behavior and more inclination to the representation of the discrete and instantaneous values .Such problem of presenting the uncertain world can easily be overcome by the concepts of the fuzzy set concept. Fuzzy set theory is different from the crisp set theory in presenting the information coped with the unreliable and uncertain behaviousr of the nature. The behaviour of vagueness and uncertainty has been exposed in such presentation of the set. The crisp set is behaving within the exact boundaries without showing any trace of uncertainty related to the location of boundaries of discourse on the other hand the fuzzy set theory is confined within the boundary behaving ambiguously in the uncertain way. The classical set theory implies the assessment of binary terms corroborating bivalent condition .The fuzzy set theory implies the gradual assessment of memberships presenting the vagueness to the greatest possible extent. The total space dealing with the object presentation may therefore consists of three distinct regions.

The first one comprising of elements which are the members following the criterians of the membership. Second part of the space representing the member data and the third type of space representing the elements lying between such two distinct boundaries and presenting both the members and nonmemebers partially which is termed as the hesitation set and is the overlapping between the members and nonmembers portion of the entire space. The instutinistic fuzzy set extends the concept of membership ,nonmembership alongwith the part lying in hesitation which presents the vagueness and certaininty both together.

FUZZY TYPE2

The type1 fuzzy set fails to tackle the problem with large comllesities. Due to presence of the complexities in the system , the uncertainty value attached to the system has become much larger and remain beyond control. In order to overcome such problem where the complexity is too large and associated uncertainties are also intractable. The membership function of the Fuzzy typwe 2 is three imensionsal in nature and is therefore capable of providing the additional degrees of freedom which is fit for making the model of uncertainties. The very concept of fuzzy type -2 has been introduced.The detailed analysis of such concept has been presented in the section Introduction to Fuzzy Set.

INTUITIONISTIC FUZZY SETS

Intuitionistic Fuzzy set is a fuzzy set which is defined in the domain of discourse if each fuzzy set is a four-tuple having hesitation degree, non-hesitation degree and membership degree. The hesitation degree can be a part of either non- membership or membership degree or both . The below given example illustrates the facts:

Suppose the domain of discourse is a set of people in the group of age 18 years and above. The membership degree, hesitation degree and non-hesitation degree of the IFS can be represented below as follows:

If young age group of people between 18-45 years be represented by membership degrees, old age group 50 years and above be represented by non-membership degree then people in age group between 45-50 years can be considered either young or old or both. The people in the age group of 45-50 years can be on the hesitation group.

INTRODUCTION TO THE FUZZY SET

The fuzzy set A defined as a non-empty set of four tuple elements in a domain of discourse S ($A \subseteq S$) is

$$A = \{ (e, \mu_F(e), \pi_F(e), \nu_F(e)) \mid e \in S\}, \forall e \in S---(1)$$

where the notation, μ_F, π_F and ν_F denotes membership function : $S \rightarrow [0,1]$ ν_F , and non-membership function: $S \rightarrow [0,1]$ ν_F , hesitation function π_F: $S \rightarrow [0,1]$

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respectively. $\mu_F(e)$, $\pi_F(e)$ and $\nu_F(e)$ quantify the membership degree, hesitation degree and non-membership degree of $e \in S$ respectively to the IFS F. We can represent, μ_G, π_G and ν_G pictorially Fig 1.

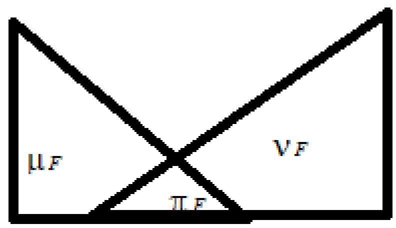

Fig 1. Pictorial representation of μ_G, π_G and ν_G

For every $e \in S$, $\mu_F(e) + \pi_F(e) + \nu_F(e) = 1$ and $0 \leq \mu_F(e), \pi_F(e), \upsilon_F(e) \leq 1$. For instance, if we know the degrees of $\mu_F(e)$ and $\nu_F(e)$, we can calculate the degree of $\pi_F(e)$, that is,

$$\pi_F = 1 - \mu_F(e) - \upsilon_F(e), \ (e \in S) - - - (2)$$

INTUITIONISTIC FUZZY MULTISET

Let X be a nonempty set. An Intuitionistic Fuzzy Multiset[10] A denoted by IFMS drawn from X is characterized by two functions: 'count membership' of A(CM_A) and 'count non membership' of A(CN_A) given respectively by $CM_A : X \to Q$ and $CN_A : X \to Q$ where Q is the set of all crisp multisets drawn from the unit interval [0, 1] such that for each $x \in X$, the membership sequence is defined as a decreasingly ordered sequence of elements in CMA(x) which is denoted by $(\mu^1_{A(x)}, \mu^2_{A(x)}, \ldots, \mu^P_{A(x)})$ where $(\mu^1_{A(x)} \geq \mu^2_{A(x)} \geq, \ldots \geq, \mu^P_{A(x)}$ and the corresponding non membership sequence will be denoted by $(\nu^1_{A(x)}, \nu^2_{A(x)}, \ldots, \nu^P_{A(x)})$ such that $0 \leq \mu^i_{A(x)} + \nu^i_{A(x)} \leq 1$ for every $x \in X$ and $i = 1, 2, \ldots, p$.

An IFMS A is denoted by

$$A = \{< x : \mu^1_{A(x)}, \mu^2_{A(x)}, \ldots, \mu^P_{A(x)}, \nu^1_{A(x)}, \nu^2_{A(x)}, \ldots, \nu^P_{A(x)} >: x \in X\} - - - (3)$$

GRAPHICS PROCESSING UNIT

The main hardware drafted for high parallel applications is the GPU. The speedy increase in capability and programmability in GPU has helped the research arena to solve various complex and computationally demanding problems to GPU. Usually, GPU was used for rendering graphics coprocessor to host the PC. Now GPU technology has increased to computation of various rendering graphics application. It is clearly visible now that many non-graphics applications can be performed on GPUs. So GPGPU is utilized as GPU computation of general-purpose applications. NVIDIA invented GPU.

One kind of solution to control GPU is NVIDIA's CUDA. Compute Unified Device Architecture (CUDA) does not need the support graphics API to have a data-parallel computing environment. Multiple kernels can run concurrently on a single GPU in CUDA. CUDA uses C programming language and each kernel is referred as grid. A group of blocks is called grid. Each block runs the same kernel without other blocks interference. Block consist of thread, smallest divisible unit of GPU. CUDA permits multiple kernels; programs to execute sequentially on single GPU. The fig 2 shows the of CUDA processing design

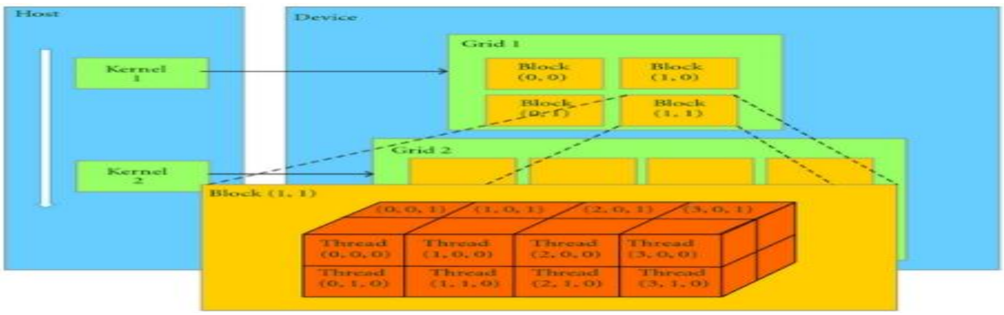

Fig 2. Design architecture of CUDA processing

Computing in GPU uses CPU together with GPU to fasten applications on general purpose engineering and scientific applications.The host is the CPU and the device is the GPU. Thousands of very fast, more efficient cores are present in GPU for parallel performance. Large number of dedicated ALUs are present more in GPUs than CPUs. GPU execute parallel portion of the code while CPU execute serial portion of the code. GPU's processing unit contain local memory that shrinks fetch time and enhances local memory.

The computing efficiency of GPU lies in the principle of parallel processing. Parallel execution of the large number of ALU operations renders the GPU with much high and efficient processing capability. The pictorial comparison of CPU and GPU architecture has been represented in the fig 3.

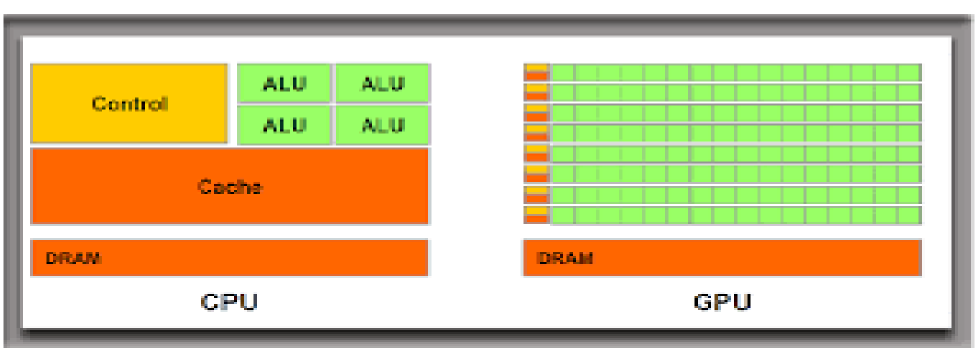

Fig 3.   Pictorial Comaprison of CPU and GPU Architecture

FUZZY LOGIC SYSTEM

It is the capability of the Fuzzy logic System (FLS) to play with both linguistic knowledge and data concurrently. Nonlinear universal function approximation and a linear combination of fuzzy basis function has helped to state FLS in terms of mathematics. The term fuzzy implies vagueness ie, the term may tell whether the value is true or false in case of the boolean value interpretation.The concept of fuzzy logic system is to develop the system based on the fuzzy concept rather than being on the crisp set concept.The membership values are obtained from the fuzzy rule sets which works on the input data. Development of fuzzy basis function is highly productive as its basis function can be obtained from either surjective or objective knowledge or both of them which can be given into the structure of IF-THEN order. Both the above knowledge can be expressed in the manner of mathematics. The two main types of problem that can be resolved by the FLS are:

- Subjective Knowledge: This knowledge upholds information on linguistics which in many cases is impractical to predict the value using formulas of mathematics, the knowledge which may prove productive in detecting the movement of a submarine or any other large slowly moving objects etc. to name a few.
- Objective Knowledge: This knowledge is used in model of mathematics. For example, equations for motion of spacecraft, submarine, models of mathematics etc. to name a few.

FLS is nothing but a non-linear mapping from an input vector to scalar output. It is a method which uses fuzzy set to simulate fuzzy decision making of a person. A small collection of simple rules and small fuzzy sets helps solving a situation. Computers which work on fuzzy logic system works much faster, finishes the job very speedily and much better in many cases than normal computer which utilizes the crisp set. The following example illustrates the difference between fuzzy and crisp logic.

Suppose someone wants to describe the class of cars having the property of being expensive by considering BMW, Roll Royce, Mercedes, Ferrari, Fiat, Honda and Renault. Some cars like Ferrari and Rolls Royce are definitely expensive and some like Fiat and Renault are not expensive in comparison and do not belong to the set. Using a fuzzy set, the fuzzy set of expensive cars can be described as:

{(Ferrari,1), (Rolls Royce,1), (Mercedes,0.8), (BWM,0.7), (Honda,0.4)}. Obviously, Ferrari and Rolls Royce have membership value of 1 whereas BMW, which is less expensive, has a membership value of 0.7 and Honda 0.4. The membership value signify the extent of expensiveness of the car. The prices of cars of different makes can vary over certain range confined to the scale 0 - 1. The low value of the membership on the unit scale implies less price and high value n the scale implies high price.

The Fuzzy set is quite similar to the super set of the Boolean logic with extra membership functions in between "true" and "false". As the name suggests, it is logic with the underlying mode of reasoning which are approximate rather than exact. The importance of fuzzy logic drives from the fact that most mode of human reasoning and especially common-sense reasoning are approximate in nature.

The concept of fuzzy set is the realization of crisp sets: Classical Sets are called Crisp Sets. Crisp set can be considered as a special case of fuzzy set with the degree of membership as 0 or 1. Let A be a crisp set defined over universe U. For any element x in X, either x is a member of A or not. In fuzzy set, the property is more generalized. One example analysis outcome has been presented in the fig 4.It has been seen that the outcome of two different fuzzy aspects has been counted up in two distinct way.

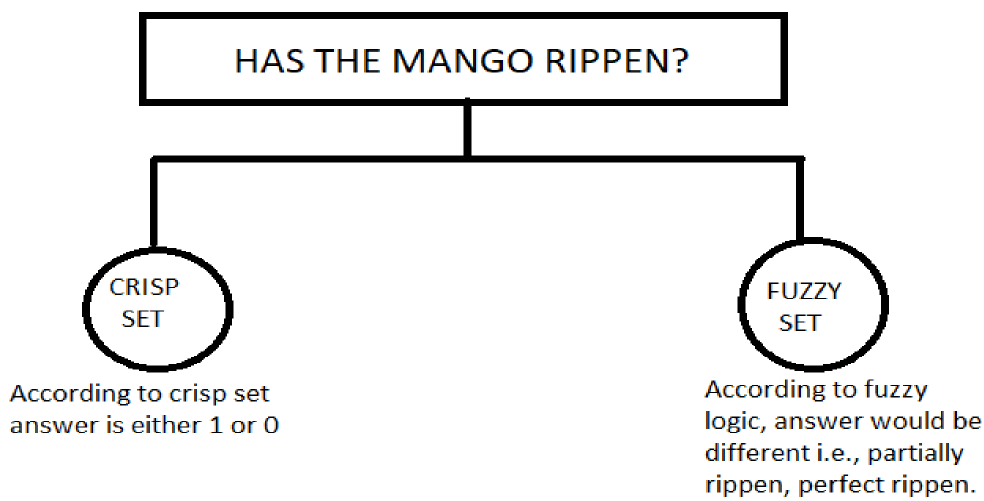

Fig 4. Instance of Crisp and Fuzzy set outcome

For any crisp set A, it is possible to define a characteristic function or membership function which can either of the values 0 or 1 in classical set. For fuzzy set, the characteristic function can take any values between zero and one. As the value of the items are lying on the range 0 to 1, so it may assume any value expressed in fraction. In the example illustrated in fig- , the color values corresponding to different ripening stages of the mango have been mapped on to the scale from 0 to 1.As for example the scale may be mapped with green color on 0 and red color on 1 as it is explanatory that the green and red colour individually corresponds to the scale value 0 and 1 respectively. Any intermediate color between the green and red must lie on the scale and accordingly pick up the concerned fractioanal value. Like for the mango color reddish green , the value may corresponds to 0.5 or 0.6 as the intermediately picked up values.

Another example that upholds the difference between the two is the same path in which an air conditioner is controlled by a computer. Computer having crisp logic contains a sensor that calculates the temperature, after which this number is transferred to the computer having some prebuilt logic rules under which operation takes place. FLS has three major components:

- Fuzzifier: Takes values as input (in this example temperature) and convert them into sets on fuzzy.
- Logic Control Center: Using rules, initiated by fuzzy sets and turn out fuzzy set at its output.
- Defuzzifier: Takes the output on fuzzy sets and convert them back to values which upholds what kind of activity will occur or resolution can be concluded. The air conditioner we are talking about is directed by two simple rules (in practical it is obviously directed by more than two rules), that utilizes two input sets on fuzzy i.e., hot and cold. The resolution we are taking about with two output sets on fuzzy are high and off which narrates the fixture for the air conditioner.

TYPE-2 FUZZY SYSTEMS

We all know that the construction of Type-1 fuzzy systems and Type-2 fuzzy systems are same but the difference lies in their membership. Thus, the only distinction is now some or all fuzzy sets participated in the directive are of Type-2. The Type-1 fuzzy systems utilize Type-1 fuzzy sets for defuzzification to get a value which in some order a crisp (Type-0) representation of the combined output. We have to elongate the Type-1 defuzzification method for the output case of Type-2. The construction of Type-2 fuzzy logic system is shown below.
The membership grade of Type -2 can be a subset of [0,1] primary membership. The probabilities of primary membership can be defined by secondary membership. FLS of Type-2 can now be explained by consequent or antecedent sets of Type-2. The application of Type-2 fuzzy system proves beneficial when there are situations that cannot predict the exact membership grade particularly when the data trained is disturbed by noise.

- Fuzzifier: The mapping of a numeric vector $a=(a_1\ldots a_t)^p \in A_1*A_2*\ldots\ldots\ldots*A_t\equiv A$ into a fuzzy set X'_a of Type-2 in this purpose is called fuzzifier. Singleton fuzzifier of Type-2 is utilized in a single on fuzzification, the input set has non zero membership at a single point.
- Rules: The construction of Type-2 and Type-1 fuzzy logic system is identical, but in the Type-2 FLS consequents and antecedents is represented by Type-2 fuzzy sets.
- Type Reducer: The conversion of the generated Type-1 fuzzy set output (by type reducer) in a numerical value through the running defuzzifier for the case of our FLS we utilized sets(cos) type reductions. The fuzzy set of Type-1 is also called interval set.
- Defuzzifier: The type reducer gives us a set on interval B cos, for defuzzification we utilized the average of bl and br, so the defuzzified output of a singleton interval of Type-2 FLS is B(a)= $(b_{(1+br)})/2$. The fuzzy type 2 fuzzy logic system with the entire internal working of different interrelated components have been displayed in the fig 5.

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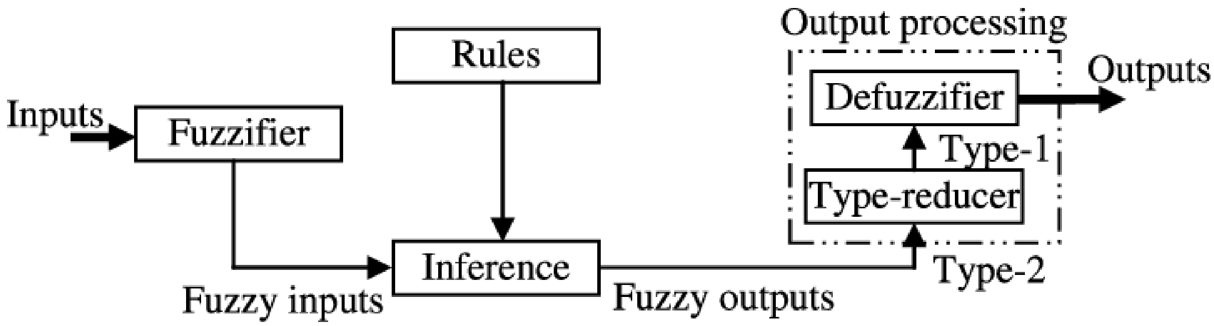

Fig 5. Construction of Type-2 Fuzzy Logic System

APPLICATION OF THE FUZZY SYSTEM

Fuzzy system is one of the primalmathematical tool used for decision control or inference mechanism.The fuzzy logic has been successfully applied in many diversified fields in solution of myriad real life problems in the fields like aero space, defence, electronics, business, manjufacturing , transportation , securities,marine and industrial sectors. The detailed overviews of the application areas of the two distinct type fuzzy set theories have been presented in the next two sections respectively.

APPLICATION OF INTUITIONISTIC FUZZY SET

Let us divide the weather into three categories: cold, warm and hot. Suppose ‘hot’ is a non-membership function, ‘cold’ is a membership function and ‘warm’ is a hesitation function. Here, the degree of warm may cater to either degree of cold or degree of hot or both. Suppose the weather is definitely cold at and below 20ºC, and it is hot at and beyond 30ºC and it is warm in between and coldness decreases and hotness increases with increase in level. We can represent the weather ‘cold’, ‘warm’, and ‘hot’ pictorially. The diagrammatic representation of the relation has been shown in the fig 6.

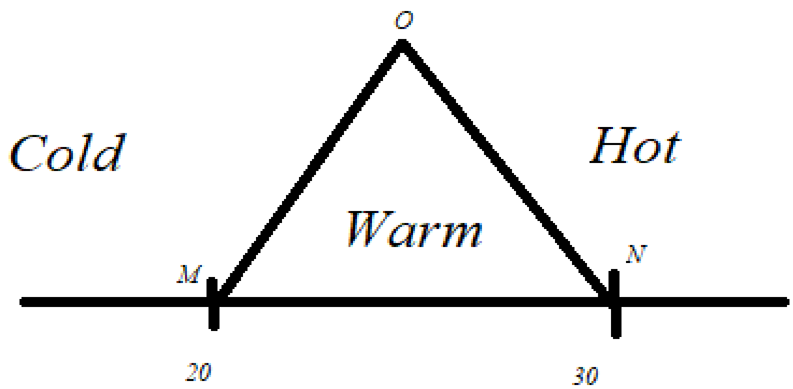

Fig 6. The hesitation function of the intuitionistic fuzzy set

Suppose S be set for various values of the weather, the intuitionistic fuzzy set be F defined on the set

S. Let the membership grade of weather 'cold' at e be $\mu F(e)$ where $e = x°C$. x denotes a

value of number. For example, $x°C = 20°C$. Similarly, we can denote $\pi F(e)$ as the grade on hesitation

For example, S = **{**20°C, 26°C, 32°C**}** and

$F\{ < \mu F(20^oC), \pi F(20^oC), \upsilon F(20^oC) > < \mu F(26^oC), \pi F(26^oC), \upsilon F(26^oC) > < \mu$
$F(30^oC), \pi F(30^oC), \upsilon F(30^oC) > \}$

There is no warm or hot at and below 20°C, but there exists only cold.

Hence, $\upsilon F(20^oC)=0, \pi F(20^oC)=0, \mu F(20^oC)=1$ i.e., (1, 0, 0)

At 26°C(at the point O), $\upsilon F(26^oC)=0, \pi F(26^oC)=1, \mu F(26^oC)=0$i.e., (0, 1, 0 There is no cold or warm but there exists hot at and above 32°C.

Hence,$\upsilon F(30^oC)=1, \pi F(30^oC)=0, \mu F(30^oC)=0$, i.e., (0, 0, 1)

$\therefore F = \{1,0,0,\ 0,1,0,\ 0,0,1\}$

Warm decreases and hot increases in between O and N, i.e., $1>\pi>0$ and $0<\upsilon<1$ The nature of variation of the membership functions are contradictory. Cold decreases and warm increases in between M and O, i.e., $1>\mu>0$ and $0<\pi<1$

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MEDICAL DIAGNOSIS THROUGH INTUITIONISTIC FUZZY MULTISETS (IFMS) THEORY

Human reasoning involves the use of certain types of variables that can be expressed as a fuzzy set. This is the basic concept for linguistic variable, variable whose values are words rather than numbers. Sometimes there are many situations like decision making problems (such as analysis of Sales, Medical diagnosis, Marketing etc.) where description of linguistic variable by membership function is always not adequate. There is a possibility of existence of non-full complement. Both membership and non-membership of an element of a set can be represented by IFMS. Sometimes there are circumstances where each element has various membership values. IFMS is more apt there. IFMS is used as tool for reasoning such circumstances here. The following small case study shows the application of intuitionistic fuzzy set theory.

Let Q= $\{Q_1,Q_2,Q_3,Q_4\}$ be a set of patients, A= {Viral Fever, Tuberculosis, Typhoid, Throat disease} be set of diseases and P= {Temperature, Cough, Throat Pain, Headache, Body Pain}

be a set of symptoms.In this context generally a question arises, whether by taking one time inspection can we arrive at a point whether a particular person has a particular disease or not? It may sometimes display symptoms of different diseases also. The question arises how can we come to a proper conclusion? One solution is to examine the patient at different time intervals (it can be three or four times a day). We have taken some symptoms of each disease given in A for analysis purpose.

For the cause we have taken three different specimens for three different times in a day.

The details of the example are given below: The membership functions evaluations are shown as the triplet in resect of the different cases of diseases in table 1. The triplet signifies the values of the three different samples based on the symptomatic factors stated alongside .

TABLE 1 The membership function representation of symptoms vs diseases.

	Viral Fever	Tuberculosis	Typhoid	Throat Disease
Temperature	(0.8,0.1,0.1)	(0.2,0.7,0.1)	(0.5,0.3,0.2)	(0.1,0.7,0.2)
Cough	(0,2,0.7,0.1)	(0.9,0,0.1)	(0.3,0.5,0.2)	(0.3,0.6,0.1)
Throat Pain	(0.3,0.5,0.2)	(0.7,0.2,0.1)	(0.2,0.7,0.1)	(0.8,0.1,0.1)
Headache	(0.5,0.3,0.2)	(0.6,0.3,0.1)	(0.2,0.6,0.2)	(0.1,0.8,0.1)
Body Pain	(0.5,0.4,0.1)	(0.7,0.2,0.1)	(0.4,0.4,0.2)	(0.1,0.8,0.1)

Proper diagnosis of each patient is our main aim. Here Euclidean distance function is used.

Suppose we collect the sample at three different times of a day; 7AM, 2 PM and 8 PM. The distance function calculate the distance of each patient Q_j from the set of symptoms P_j for each diagnosis d_k : k=1,2,3,4.The detailed outcome has been represented in table 3.

First set constitute the membership values obtained at 7AM, 2PM, and 8PM respectively.

The non-membership and hesitation margin is represented by second and third sets.The membership functions for patients vs symptoms have been shown in the table 2.

TABLE 2. Member ship functions of patients vs symptoms

	Temperature	Cough	Throat Pain	Headache	Body pain
Q_1	(0.6,0.7,0.5) (0.2,0.1,0.4) (0.2,0.2,0.1)	(0.4,0.3,0.4) (0.3,0.6,0.4) (0.3,0.1,0.2)	(0.1,0.2,0) (0.7,0.7,0.8) (0.2,0.1,0.2)	(0.5,0.6,0.7) (0.4,0.3,0.2) (0.1,0.1,0.1)	(0.2,0.3,0.4) (0.6,0.4,0.4) (0.2,0.3,0.2)
Q_2	(0.4,0.3,0.5) (0.5,0.4,0.4) (0.1,0.3,0.1)	(0.7,0.6,0.8) (0.2,0.2,0.1) (0.1,0.2,0.1)	(0.6,0.5,0.4) (0.3,0.3,0.4) (0.1,0.2,0.2)	(0.3,0.6,0.2) (0.7,0.3,0.7) (0,0.1,0.1)	(0.8,0.7,0.5) (0.1,0.2,0.3) (0.1,0.1,0.2)
Q_3	(0.1,0.2,0.1) (0.7,0.6,0.9) (0.2,0.2,0.0)	(0.3,0.2,0.1) (0.6,0,0.7) (0.1,0.8,0.2)	(0.3,0.2,0.1) (0.6,0,0.7) (0.1,0.8,0.2)	(0.3,0.2,0.2) (0.6,0.7,0.6) (0.1,0.1,0.2)	(0.4,0.3,0.2) (0.4,0.7,0.7) (0.2,0,0.1)
Q_4	(0.5,0.4,0.5) (0.4,0.4,0.3) (0.1,0.2,0.2)	(0.4,0.3,0.4) (0.5,0.3,0.5) (0.1,0.4,0.1)	(0.4,0.3,0.4) (0.5,0.3,0.5) (0.1,0.4,0.1)	(0.5,0.6,0.3) (0.4,0.3,0.6) (0.1,0.1,0.1)	(0.4,0.5,0.4) (0.6,0.4,0.3) (0,0.1,0.3)

TABLE 3. Eucledean distance measure between patients and diseases.

	Viral Fever	Tuberculosis	Typhoid	Throat Disease
Q_1	0.49	0.96	0.45	1.04
Q_2	0.79	0.50	0.64	0.90
Q_3	0.98	0.89	0.85	0.49
Q_4	0.51	0.89	0.36	0.93

From the above chart the lowest distance point we get the proper diagnosis. The estimated eucledean distances for the respective cases vouches for considerable evidence for the disease to be diagnosed . Patient Q_1 suffers from Typhoid, Patient Q_2 suffers from Tuberculosis, Patient Q_3 suffers from Throat disease and Patient Q_4 suffers from Typhoid.

APPLICATION OF TYPE-2 FUZZY LOGIC IN VARIOUS SECTORS

Successful application of Type-2 fuzzy logic system has been presented here. Type-2 fuzzy logic is utilized to handle high level of uncertainty in practical world to overcome complex situations. The applications presented here signifies the superiority of Type-2 Fuzzy Set over Type-1 Fuzzy Set. The divergence of applications content in this context varies from social science to medicine, which uphold the value of Type-2 Fuzzy Logic for this purpose of situations.

Naim, Syibrah and Hagras Hani(2013) proposed a new modelling framework of neural network in the interval Type-2 radial basis function (IT2-RBF-NN) is put forward. The similarity in function of radial basis networks on neural (RBFNN) to a class of Type-1 fuzzy logic systems (T1-FLS) to put forward a new interval similar mechanism of Type-2, it is preferably displayed that the similarity in type (between RBF and FLS) of the new mechanism constructed is conserved in the purpose of the IT2 system. A well-developed estimation in computation is explained as a output of the automatic and systematic development of IT2 data on linguistics and the FOU.

Melin, Patricia, Mendoza Olivia and Castillo Oscar(2010) based on the concept of generalized Type-2 Fuzzy Logic and morphological gradient put forward the idea of edge detection system. Type-2 Fuzzy logic is implemented by alpha planes for edge detection. Heights and approximation process are used for defuzzification.

Rickard, T. John, Aisbett Janet and Gibbon Greg(2007) approaches the concept of Centroids very useful in Type-2 and Type-1 logic systems on fuzzy as a method of defuzzification and type reduction. However, when membership functions (MF) have singleton spikes problem arises in computation.

Multi-criteria Group Discussion Making (MCGDM) is an essential tool for decision making put forward by Naim, Syibrah and Hagras Hani(2013) based on the idea of Type-2 Fuzzy Logic. It is a tool that decides a unique agreement from various users and decision makers by calculating secret judgement among them. To deal with the hesitancy and linguistic uncertainties of MCGDM various fuzzy logic-based concepts have been utilized.

Type-2 Fuzzy control of robotic arm in sliding mode utilizing ellipsoidal membership function was put forward by Kayacan, Erdal, Saeys Wouter, Kayacan Erkan, Ramon Herman and Kaynak Okyay. It has already been claimed that Type- 2 Fuzzy Set is better than its counterpart Type-1 Fuzzy Set-in noisy atmosphere. The effectiveness of Type-2 Fuzzy Set to reduce noise capabilities has been clearly stated in the novel ellipsoidal membership function and Type-2 fuzzy logic systems recently put forward.

CONCLUSION

A concise and precise review of Type-2 Fuzzy logic system which finds various applications in modern arena as narrated above is presented here. Many of the prototypical review of the most recent application of Type-2 fuzzy set was displayed here. The Fuzzy Logic is achieving fame because of its wonderful ability to solve various uncertainties in various arenas. It also helps us to get object knowledge and get the succeeding outcome with the help of preceding knowledge.

This paper has highlighted the elongated interpretation of intuitionistic fuzzy set following a comprehensive description and a diagrammatic imagination for overcoming practical situations. The versatile fields of application of the institutionistic fuzzy system has been illucidated with the comparative study with the fuzzy type -1 based system. The challenging direction in the analysis of weather forecasting using the fuzzy system has been discussed. The challenging aspects of the fuzzy type 2 and its beneficial aspects over the fuzzy type -1 application has been studied through a problem. The outcome of the solution shows the potential efficiency of the fuzzy type -2 systems over the fuzzy-1 system elaborately and that of the instuitionistic fuzzy theory. The indepth exploration of the fuzzy systems in view of their various principles and application aspects have been illucidated in promising attitudes to shed light on many unexplored areas of research.

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