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INTUITIONISTIC FUZZY SETS IN CAREER DETERMINATION

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Abstract. Intuitionistic fuzzy set has proven interesting and useful in providing a flexible framework or model to elaborate uncertainty and vagueness involved in decision making. In this paper, we proposed the application of intuitionistic fuzzy sets (IFS) in career determination. Solution is obtained by looking for the smallest distance between each student and each career.

Keywords: Fuzzy sets, Intuitionistic fuzzy sets, Career choice, Career determination.

1. Introduction

The theory of fuzzy sets (FS) introduced by Zadeh [14] has showed meaningful applications in many fields of study. The idea of fuzzy set is welcome because it handles uncertainty and vagueness which Cantorian set could not address. In fuzzy set theory, the membership of an element to a fuzzy set is a single value between zero and one. However in reality, it may not always be true that the degree of non-membership of an element in a fuzzy set is equal to 1 minus the membership degree because there may be some hesitation degree. Therefore, a generalization of fuzzy sets was proposed by Atanassov [1, 2] as intuitionistic fuzzy sets (IFS) which incorporate the degree of hesitation called hesitation margin (and is defined as 1 minus the sum of membership and non-membership degrees respectively). The notion of defining intuitionistic fuzzy set as generalized fuzzy set is quite interesting and useful in many application areas. The knowledge and semantic representation of intuitionistic fuzzy set become more meaningful, resourceful and applicable since it includes the degree of belongingness, degree of non-belongingness and the hesitation margin [3, 4]. Szmidt and Kacprzyk [10] showed that intuitionistic fuzzy sets are pretty useful in situations when description of a problem by a linguistic variable given in terms of a membership function only seems too rough. Due to the flexibility of IFS in handling uncertainty, they are tool for a more human consistent reasoning under imperfectly defined facts and imprecise knowledge [11].

De et al. [6] gave an intuitionistic fuzzy sets approach in medical diagnosis using three steps such as; determination of symptoms, formulation of medical knowledge based on intuitionistic fuzzy relations, and determination of diagnosis on the basis of composition of intuitionistic fuzzy relations. Intuitionistic fuzzy set is a tool in modeling real life problems like sale analysis, new product marketing, financial services, negotiation process, psychological investigations etc. since there is a fair chance of the existence of a non-null hesitation part at each moment of evaluation of an unknown object [8, 10]. Atanassov [4, 5] carried out rigorous research based on the theory and applications of intuitionistic fuzzy sets. Many applications of IFS are carried out using distance measures approach. Distance measure between intuitionistic fuzzy sets is an important concept in fuzzy mathematics because of its wide applications in real world, such as pattern recognition, machine learning, decision making and market prediction. Many distance measures between intuitionistic fuzzy sets have been proposed and researched in recent years [8, 9, 13] and used by Szmidt and Kacprzyk [10, 11] in medical diagnosis.

We show a novel application of intuitionistic fuzzy set in a more challenging area of decision making (i.e. career choice). An example of career determination will be presented, assuming there is a database (i.e. a description of a set of subjects S, and a set of careers C). We will describe the state of students knowing the results of their performance. The problem description uses the concept of IFS that makes it possible to render two important facts. First, values of each subject performance changes for each student. Second, in a career determination database describing career for different students, it should be taken into account that for different students aiming for the same career, values of the same subject performance can be different. We use the normalized Hamming distance method given in [8, 9, 12]

to measure the distance between each student and each career. The smallest obtained value, points out a proper career determination based on academic performance.

2. CONCEPT OF INTUITIONISTIC FUZZY SETS

Definition 1 [14]: Let X be a nonempty set. A fuzzy set A drawn from X is defined as $A = \{\langle x, \mu_A(x)\rangle : x \in X\}$, where $\mu_A(x): X \longrightarrow [0,1]$ is the membership function of the fuzzy set A. Fuzzy set is a collection of objects with graded membership i.e. having degrees of membership.

Definition 2 [4]: Let X be a nonempty set. An intuitionistic fuzzy set A in X is an object having the form $A = \{\langle x, \mu_A(x), \nu_A(x)\rangle : x \in X\}$, where the functions $\mu_A(x), \nu_A(x): X \longrightarrow [0,1]$ define respectively, the degree of membership and degree of non-membership of the element $x \in X$ to the set A, which is a subset of X, and for every element $x \in X$, $0 \leq \mu_A(x) + \nu_A(x) \leq 1$. Furthermore, we have $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ called the intuitionistic fuzzy set index or hesitation margin of x in A. $\pi_A(x)$ is the degree of indeterminacy of $x \in X$ to the IFS A and $\pi_A(x) \in [0,1]$ i.e., $\pi_A(x): X \longrightarrow [0,1]$ and $0 \leq \pi_A \leq 1$ for every $x \in X$. $\pi_A(x)$ expresses the lack of knowledge of whether x belongs to IFS A or not.

For example, let A be an intuitionistic fuzzy set with $\mu_A(x) = 0.5$ and $\nu_A(x) = 0.3 \Rightarrow \pi_A(x) = 1 - (0.5 + 0.3) = 0.2$. It can be interpreted as "the degree that the object x belongs to IFS A is 0.5, the degree that the object x does not belong to IFS A is 0.3 and the degree of hesitancy is 0.2". s

Basic Operations on Intuitionistic Fuzzy Sets [2]

1. [inclusion] $A \subseteq B \leftrightarrow \mu_A(x) \leq \mu_B(x)$ *and* $\nu_A(x) \geq \nu_B(x)$ $i = 1, 2, \ldots, n$ $\forall x \in X$.
2. [equality] $A = B \leftrightarrow \mu_A(x) = \mu_B(x)$ *and* $\nu_A(x) = \nu_B(x)$ $i = 1, 2, \ldots, n$ $\forall x \in X$.
3. [complement] $A^c = \{\langle x, \nu_A(x), \mu_A(x)\rangle : x \in X\}$.
4. [union] $A \cup B = \{\langle x, max\left(\mu_A(x), \mu_B(x)\right), min\ (\nu_A(x), \nu_B(x))\rangle : x \in X\}$.
5. [intersection] $A \cap B = \{\langle x, min\left(\mu_A(x), \mu_B(x)\right), max\ (\nu_A(x), \nu_B(x))\rangle : x \in X\}$.
6. [addition] $A \oplus B = \{\langle x, \mu_A(x) + \mu_B(x) - \mu_A(x)\mu_B(x), \nu_A(x)\nu_B(x)\rangle : x \in X\}$.
7. [multiplication] $A \otimes B = \{\langle x, \mu_A(x)\mu_B(x), \nu_A(x) + \nu_B(x) - \nu_A(x)\nu_B(x)\rangle : x \in X\}$.

Definition 3 [12]: The normalized Hamming distance $d_{n-H}(A, B)$ between two IFSs A and B is defined as $d_{n-H}(A, B) = \frac{1}{2n}\sum_{i=1}^{n}[\,|\mu_A(x_i) - \mu_B(x_i)| + |\nu_A(x_i) - \nu_B(x_i)| + |\pi_A(x_i) - \pi_B(x_i)|\,]$, $X = \{x_1, x_2, \ldots, x_n\}$ for $i = 1, 2, \ldots, n$.

3. Experimental results

The essence of providing adequate information to students for proper career choice cannot be overemphasized. This is paramount because the numerous problems of lack of proper career guide faced by students are of great consequence on their career choice and efficiency. Therefore, it is expedient that students be given sufficient information on career determination or choice to enhance adequate planning, preparation and proficiency. Among the career determining factors such as academic performance, interest, personality make-up etc; the first mentioned seems to be overriding. We use intuitionistic fuzzy sets as tool since it incorporate the membership degree (i.e. the marks of the questions answered by the student), the non-membership degree (i.e. the marks of the questions the student failed) and the hesitation degree (which is the mark allocated to the questions the student do not attempt).

Let $S = \{s_1, s_2, s_3, s_4\}$ be the set of students, $C =$ {medicine, pharmacy, surgery, anatomy} be the set of careers and $Su =$ {English Language, Mathematics, Biology, Physics, Chemistry} be the set of subjects related to the careers. We assume the above students sit for examinations (i.e. over 100 marks total) on the above mentioned subjects to determine their career placements and choices. The table below shows careers and related subjects requirements.

Table 1