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A Generalized Intuitionistic Fuzzy Soft Set Theoretic Approach to Decision Making Problems

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Abstract

The problem of decision making under imprecise environments are widely spread in real life decision situations. We present a method of object recognition from imprecise multi observer data, which extends the work of Roy and Maji [J. Compu. Appl. Math. 203(2007) 412-418] to generalized intuitionistic fuzzy soft set theory. The method involves the construction of a comparison table from a generalized intuitionistic fuzzy soft set in a parametric sense for decision making.

Key Words: generalized intuitionistic fuzzy soft sets, resultant generalized intuitionistic fuzzy soft sets, Comparison

1. Introduction

The theories such as probability theory [1], fuzzy set theory [2, 3], intuitionistic fuzzy set theory [4, 5], vague set theory [6] and rough set theory [7], which can be considered as mathematical tools for dealing with uncertainties, have their inherent difficulties (see [8]). The reason for these difficulties is possibly the inadequacy of parameterization tool of the theories. Molodtsov [8] introduced soft sets as a mathematical tool for dealing with uncertainties which is free from the above-mentioned difficulties. Since the soft set theory offers mathematical tool for dealing with uncertain, fuzzy and not clearly defined objects, it has a rich potential for applications to problems in real life situation. The concept and basic properties of soft set theory are presented in [8, 9]. He also showed how soft set theory is free from the parameterization inadequacy syndrome of fuzzy set theory, rough set theory, probability theory and game theory. However, several assertions presented by Maji et al. [9] are not true in general [10].

Maji et al. [12] presented the concept of fuzzy soft sets which is based on a combination of the fuzzy sets and soft set models. Roy and Maji [13] provided its properties and an application in decision making under imprecise environment. Kong et al. [14] argued that the Roy-Maji method [13] was incorrect and presented a revised algorithm. Zou and Xiao [15] used soft sets and fuzzy soft sets to develop the data analysis approaches under incomplete environment, respectively. Xu et al. [16] introduced the notion of vague soft sets which is an extension to soft sets and is based on a combination of vague sets and soft set models. Majumdar and Samanta [17] further generalized the concept of fuzzy soft sets, in the other words, a degree is attached with the parameterization of fuzzy sets while defining a fuzzy soft set. Maji and his coworker [18, 19, 20] introduced the notion of intuitionistic fuzzy soft set theory which is based on a combination of the intuitionistic fuzzy sets and soft set models and studied the properties of intuitionistic fuzzy soft sets. Park et al [21] presented the concept of the generalized intuitionistic fuzzy soft sets by combining the generalized intuitionistic fuzzy sets [22] and soft set models.

In this paper, we present some results on an application of generalized intuitionistic fuzzy soft sets in decision making problem. The problem of object recognition has received paramount importance in recent times. The recognition problem may be viewed as a multiobserver decision making problem, which the final identification of the object is based on the set of inputs from different observers who provide the overall object characterization in terms of diverse sets of parameters. A generalized intuitionistic fuzzy soft set theoretic approach to solution of the above decision making problem is presented. This paper is arranged into four sections. The intent of the Section 2 is to deal with the basic concept of generalized intuitionistic fuzzy soft sets and some relevant definition to solve a decision making problem. A numerical example of object recognition problem in generalized intuitionistic fuzzy soft environment is used to illustrate the feasibility of the proposed method in Section 3. Finally, conclusions are offered in Section 4.

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2. Generalized intuitionistic fuzzy soft sets in decision making

In this section we present generalized intuitionistic fuzzy soft set and some results of it. Most of them may be found in [21].

Let $U = \{h_1, h_2, \ldots, h_n\}$ be the set of n objects, which may be characterized by a set of parameters $\{A_1, A_2, \ldots, A_i\}$. The parameter space E may be written as $E \supseteq A_1 \cup A_2 \cup \cdots \cup A_i$. Let each parameter set A_i represents the ith class of parameters and the elements of A_i represents a specific property set. Here we assume that these property sets may be viewed as generalized intuitionistic fuzzy sets.

In view of above we may now define a generalized intuitionistic fuzzy soft set $\langle F_i, A_i\rangle$ which characterizes a set of objects having the parameter set A_i.

Definition 2.1. Let $\mathcal{GIF}(U)$ denotes the set of all generalized intuitionistic fuzzy sets of U. Let $A_i \subseteq E$. A pair $\langle F_i, A_i\rangle$ is a generalized intuitionistic fuzzy soft set over U, where F_i is a mapping given by $F_i : A_i \to \mathcal{GIF}(U)$.

In other words, a generalized intuitionistic fuzzy soft set is a parameterized family of generalized intuitionistic fuzzy subsets of U and thus its universe is the set of all generalized intuitionistic fuzzy sets of U, i.e., $\mathcal{GIF}(U)$. A generalized intuitionistic fuzzy soft set is also a special case of a soft set because it is still a mapping from parameters to $\mathcal{GIF}(U)$.

Definition 2.2. Let $\langle F, A\rangle$ and $\langle G, B\rangle$ be two generalized intuitionistic fuzzy soft sets over U. Then $\langle F, A\rangle$ is said to be a generalized intuitionistic fuzzy soft subset of $\langle G, B\rangle$ if

(1) $A \subseteq B$;

(2) for any $\varepsilon \in A$, $F(\varepsilon)$ is a generalized fuzzy subset of $G(\varepsilon)$, that is, for all $x \in U$ and $\varepsilon \in A$, $\mu_{F(\varepsilon)}(x) \leq \mu_{G(\varepsilon)}(x)$ and $\gamma_{F(\varepsilon)}(x) \geq \gamma_{G(\varepsilon)}(x)$.

This relationship is denoted by $\langle F, A\rangle \sqsubseteq \langle G, B\rangle$. Similarly, $\langle F, A\rangle$ is said to be a generalized intuitionistic fuzzy soft superset of $\langle G, B\rangle$, if $\langle G, B\rangle$ is called a generalized intuitionistic fuzzy soft subset of $\langle F, A\rangle$. We denote it by $\langle F, A\rangle \sqsupseteq \langle G, B\rangle$.

In view of above discussions, we present an example below.

Example 2.3. Consider two generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$ and $\langle G, B\rangle$ over the same universal set U, where $U = \{h_1, h_2, h_3, h_4, h_5\}$ is the set of five houses, $A = \{\text{blackish}, \text{reddish}, \text{green}\}$ and $B = \{\text{blackish}, \text{reddish}, \text{green}, \text{large}\}$ are the sets of parameters, and

$$\begin{aligned}
F(\text{blackish}) &= \{\langle h_1, 0.9, 0.2\rangle, \langle h_2, 0.7, 0.3\rangle, \\
&\quad \langle h_3, 0.5, 0.4\rangle, \langle h_4, 0.6, 0.5\rangle, \langle h_5, 0.6, 0.4\rangle\}; \\
F(\text{reddish}) &= \{\langle h_1, 0.8, 0.2\rangle, \langle h_2, 0.7, 0.2\rangle, \\
&\quad \langle h_3, 0.7, 0.4\rangle, \langle h_4, 0.8, 0.3\rangle, \langle h_5, 0.5, 0.4\rangle\}; \\
F(\text{green}) &= \{\langle h_1, 0.6, 0.2\rangle, \langle h_2, 0.5, 0.3\rangle, \\
&\quad \langle h_3, 0.4, 0.5\rangle, \langle h_4, 0.7, 0.5\rangle, \langle h_5, 0.6, 0.4\rangle\}; \\
G(\text{blackish}) &= \{\langle h_1, 0.4, 0.6\rangle, \langle h_2, 0.9, 0.3\rangle, \\
&\quad \langle h_3, 0.7, 0.4\rangle, \langle h_4, 0.8, 0.3\rangle, \langle h_5, 0.8, 0.4\rangle\}; \\
G(\text{reddish}) &= \{\langle h_1, 0.9, 0.2\rangle, \langle h_2, 0.8, 0.3\rangle, \\
&\quad \langle h_3, 0.7, 0.4\rangle, \langle h_4, 0.6, 0.5\rangle, \langle h_5, 0.7, 0.4\rangle\}; \\
G(\text{green}) &= \{\langle h_1, 0.6, 0.2\rangle, \langle h_2, 0.5, 0.3\rangle, \\
&\quad \langle h_3, 0.4, 0.5\rangle, \langle h_4, 0.7, 0.5\rangle, \langle h_5, 0.6, 0.4\rangle\}; \\
G(\text{large}) &= \{\langle h_1, 0.4, 0.6\rangle, \langle h_2, 0.9, 0.3\rangle, \\
&\quad \langle h_3, 0.7, 0.4\rangle, \langle h_4, 0.8, 0.3\rangle, \langle h_5, 0.8, 0.4\rangle\}.
\end{aligned}$$

Clearly, $\langle F, A\rangle \sqsubseteq \langle G, B\rangle$.

Definition 2.4. Let $\langle F, A\rangle$ and $\langle G, B\rangle$ be two generalized intuitionistic fuzzy soft sets over a universe U. Then "$\langle F, A\rangle$ and $\langle G, B\rangle$" is a generalized intuitionistic fuzzy soft set, denoted by $\langle F, A\rangle \wedge \langle G, B\rangle$, is defined by $\langle F, A\rangle \wedge \langle G, B\rangle = \langle H, A \times B\rangle$, where $H(\alpha, \beta) = F(\alpha) \cap G(\beta)$ for any $(\alpha, \beta) \in A \times B$, that is, $H(\alpha, \beta)(x) = \langle \min\{\mu_{F(\alpha)}(x), \mu_{G(\beta)}(x)\}, \max\{\gamma_{F(\alpha)}(x), \gamma_{G(\beta)}(x)\}\rangle$, for all $(\alpha, \beta) \in A \times B$ and $x \in U$.

Definition 2.5. Let $\langle F, A\rangle$ and $\langle G, B\rangle$ be two generalized intuitionistic fuzzy soft sets over a universe U. Then "$\langle F, A\rangle$ or $\langle G, B\rangle$" is a generalized intuitionistic fuzzy soft set, denoted by $\langle F, A\rangle \vee \langle G, B\rangle$, is defined by $\langle F, A\rangle \vee \langle G, B\rangle = \langle O, A \times B\rangle$, where $O(\alpha, \beta) = F(\alpha) \cup G(\beta)$ for any $(\alpha, \beta) \in A \times B$, that is, $O(\alpha, \beta)(x) = \langle \max\{\mu_{F(\alpha)}(x), \mu_{G(\beta)}(x)\}, \min\{\gamma_{F(\alpha)}(x), \gamma_{G(\beta)}(x)\}\rangle$, for all $(\alpha, \beta) \in A \times B$ and $x \in U$.

2.1 Comparison Table

The Comparison Table of generalized intuitionistic fuzzy soft set $\langle F, A\rangle$ is a square table in which number of rows and number of columns are equal, rows and columns are labeled by the object names $h_1, h_2, \ldots, h_n$ of the universe set U, and the entries c_{ij} $(i, j = 1, 2, \ldots, n)$ is the number of parameters satisfying

$$\mu_{ik} \geq \mu_{jk} \text{ and } \gamma_{ik} \leq \gamma_{jk},$$

where μ_{ik} and μ_{ik} are, respectively, the membership values of h_i and h_j in $F(e_k)$ for all k, and γ_{jk} and γ_{jk} are, respectively, the non-membership values of h_i and h_j in $F(e_k)$ for any k, where k is the number of parameters presented in a generalized intuitionistic fuzzy soft set.

Clearly, $0 \leq c_{ij} \leq k$ for any i, j, where k is the number of parameters in A. Thus, c_{ij} indicates a numerical measure which h_i dominates h_j in c_{ij} number of parameters out of k parameters.

2.2 Row sum, column sum and score of an object

- The row sum r_i of an object h_i is calculated by

$$r_i = \sum_{j=1}^{n} c_{ij}.$$

Clearly, r_i indicates the total number of parameters in which h_i dominates all the members of U.

- The column sum t_j of an object h_j is calculated by

$$t_j = \sum_{i=1}^{n} c_{ij}.$$

The integers t_j indicates the total number of parameters in which h_j is dominates by all the numbers of U.

- The score s_i of an object h_i is calculated by

$$s_i = r_i - t_i.$$

2.3 Algorithm

The problem here is to choose an object from the set of given objects with respect to a set of choice parameters P. We now present an algorithm for identification of an object, based on multiobservers input data characterized by color, size and surface texture features.

1. Input the generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$, $\langle G, B\rangle$ and $\langle H, C\rangle$.
2. Input the parameter set P as observed by the observers.
3. Compute the corresponding resultant generalized intuitionistic fuzzy soft set $\langle S, P\rangle$ from the generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$, $\langle G, B\rangle$ and $\langle H, C\rangle$, and place it in tabular form.
4. Construct the Comparison Table of the generalized intuitionistic fuzzy soft set $\langle H, C\rangle$ and compute row sum r_i and column sum t_i of h_i for all i.
5. Compute the score of h_i for all i.
6. The decision is s_k if $s_k = \max_i s_i$.
7. If k has more than one value then any one of h_k may be chosen.

3. An application in a decision making problem

In this section, we present an application of generalized intuitionistic fuzzy soft set in a decision making problem.

Consider the problem of selecting the most suitable object from the set of objects with respect to a set of choice parameters. Let $U = \{h_1, h_2, h_3, h_4, h_5, h_6\}$ be the set of objects having different colors, sizes and surface texture features. Let $E = \{\text{blackish, dark brown, yellowish, reddish, small, very small, average, large, very large, course, moderately course, fine, extra fine}\}$ be the set of parameters. Let A, B and C be three subsets of E such that $A = \{\text{blackish, dark brown, reddish, yellowish}\}$ represents the color space, $B = \{\text{small, very small, average, large, very large}\}$ represents the size of the object, and $C = \{\text{course, moderately course, fine, extra fine}\}$ represents the surface texture granularity.

Assuming that the generalized intuitionistic fuzzy soft set $\langle F, A\rangle$ describes the 'objects having color space', the generalized intuitionistic fuzzy soft set $\langle G, B\rangle$ describes the 'objects having size' and the generalized intuitionistic fuzzy soft set $\langle H, C\rangle$ describes the 'texture feature of the objects surface'. The problem is identify an unknown object from multiobservers generalized intuitionistic fuzzy data, specified by different observers, in terms of generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$, $\langle G, B\rangle$ and $\langle H, C\rangle$.

The generalized intuitionistic fuzzy soft set $\langle F, A\rangle$ is defined as $\langle F, A\rangle = \{\text{objects having blackish color} = \{\langle h_1, 0.4, 0.7\rangle, \langle h_2, 0.3, 0.7\rangle, \langle h_3, 0.4, 0.5\rangle, \langle h_4, 0.8, 0.3\rangle, \langle h_5, 0.7, 0.4\rangle, \langle h_6, 0.9, 0.3\rangle\}, \text{objects having dark brown color} = \{\langle h_1, 0.4, 0.7\rangle, \langle h_2, 0.9, 0.3\rangle, \langle h_3, 0.5, 0.4\rangle, \langle h_4, 0.2, 0.7\rangle, \langle h_5, 0.3, 0.6\rangle, \langle h_6, 0.2, 0.8\rangle\}, \text{objects having yellowish color} = \{\langle h_1, 0.6, 0.3\rangle, \langle h_2, 0.3, 0.8\rangle, \langle h_3, 0.8, 0.4\rangle, \langle h_4, 0.4, 0.5\rangle, \langle h_5, 0.6, 0.4\rangle, \langle h_6, 0.4, 0.6\rangle\}, \text{objects having reddish color} = \{\langle h_1, 0.9, 0.2\rangle, \langle h_2, 0.5, 0.6\rangle, \langle h_3, 0.7, 0.4\rangle, \langle h_4, 0.8, 0.3\rangle, \langle h_5, 0.5, 0.4\rangle, \langle h_6, 0.3, 0.8\rangle\}\}$.

The generalized intuitionistic fuzzy soft set $\langle G, B\rangle$ is defined as $\langle G, B\rangle = \{\text{objects having large size} = \{\langle h_1, 0.4, 0.8\rangle, \langle h_2, 0.8, 0.3\rangle, \langle h_3, 0.6, 0.4\rangle, \langle h_4, 0.9, 0.2\rangle, \langle h_5, 0.2, 0.9\rangle, \langle h_6, 0.3, 0.7\rangle\}, \text{objects having very large size} = \{\langle h_1, 0.2, 0.9\rangle, \langle h_2, 0.6, 0.3\rangle, \langle h_3, 0.4, 0.5\rangle, \langle h_4, 0.8, 0.3\rangle, \langle h_5, 0.1, 0.9\rangle, \langle h_6, 0.2, 0.9\rangle\}, \text{objects having small size} = \{\langle h_1, 0.9, 0.2\rangle, \langle h_2, 0.3, 0.7\rangle, \langle h_3, 0.4, 0.5\rangle, \langle h_4, 0.2, 0.8\rangle, \langle h_5, 0.9, 0.2\rangle, \langle h_6, 0.8, 0.3\rangle\}, \text{objects having very small size} = \{\langle h_1, 0.6, 0.5\rangle, \langle h_2, 0.1, 0.8\rangle, \langle h_3, 0.1, 0.8\rangle, \langle h_4, 0.1, 0.9\rangle, \langle h_5, 0.8, 0.3\rangle, \langle h_6, 0.6, 0.4\rangle\}, \text{objects having average size} = \{\langle h_1, 0.5, 0.6\rangle, \langle h_2, 0.5, 0.7\rangle, \langle h_3, 0.7, 0.4\rangle, \langle h_4, 0.7, 0.5\rangle, \langle h_5, 0.6, 0.4\rangle, \langle h_6, 0.5, 0.4\rangle\}\}$.

The generalized intuitionistic fuzzy soft set $\langle H, C\rangle$ is defined as $\langle H, C\rangle = \{\text{objects having course texture} = \{\langle h_1, 0.3, 0.8\rangle, \langle h_2, 0.6, 0.3\rangle, \langle h_3, 0.5, 0.4\rangle, \langle h_4, 0.7, 0.5\rangle,$

$\langle h_5, 0.6, 0.4\rangle, \langle h_6, 0.8, 0.3\rangle\}$, objects having moderately course texture color $= \{\langle h_1, 0.4, 0.6\rangle, \langle h_2, 0.5, 0.5\rangle, \langle h_3, 0.6, 0.4\rangle, \langle h_4, 0.6, 0.5\rangle, \langle h_5, 0.6, 0.4\rangle, \langle h_6, 0.7, 0.4\rangle\}$, objects havingfine texture $= \{\langle h_1, 0.1, 0.8\rangle, \langle h_2, 0.4, 0.7\rangle, \langle h_3, 0.3, 0.7\rangle, \langle h_4, 0.6, 0.5\rangle, \langle h_5, 0.5, 0.4\rangle, \langle h_6, 0.7, 0.4\rangle\}$, objects having extra fine texture $= \{\langle h_1, 0.9, 0.2\rangle, \langle h_2, 0.5, 0.5\rangle, \langle h_3, 0.6, 0.4\rangle, \langle h_4, 0.3, 0.7\rangle, \langle h_5, 0.4, 0.6\rangle, \langle h_6, 0.9, 0.2\rangle\}\}$.

The tabular representation of generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$, $\langle G, B\rangle$ and $\langle H, C\rangle$ are shown in Tables 1-3.

Table 1: Tabular representation of the generalized intuitionistic fuzzy soft set $\langle F, A\rangle$

U	blackish (a_1)	dark brown (a_2)	yellowish (a_3)	reddish (a_4)
h_1	$\langle 0.4, 0.7\rangle$	$\langle 0.4, 0.7\rangle$	$\langle 0.6, 0.3\rangle$	$\langle 0.9, 0.2\rangle$
h_2	$\langle 0.3, 0.7\rangle$	$\langle 0.9, 0.3\rangle$	$\langle 0.3, 0.8\rangle$	$\langle 0.5, 0.6\rangle$
h_3	$\langle 0.4, 0.5\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.8, 0.4\rangle$	$\langle 0.7, 0.4\rangle$
h_4	$\langle 0.8, 0.3\rangle$	$\langle 0.2, 0.7\rangle$	$\langle 0.4, 0.5\rangle$	$\langle 0.8, 0.3\rangle$
h_5	$\langle 0.7, 0.4\rangle$	$\langle 0.3, 0.6\rangle$	$\langle 0.6, 0.4\rangle$	$\langle 0.5, 0.4\rangle$
h_6	$\langle 0.9, 0.3\rangle$	$\langle 0.2, 0.8\rangle$	$\langle 0.4, 0.6\rangle$	$\langle 0.3, 0.8\rangle$

Table 2: Tabular representation of the generalized intuitionistic fuzzy soft set $\langle G, B\rangle$

U	large (b_1)	very large (b_2)	small (b_3)	very small (b_4)	average (b_5)
h_1	$\langle 0.4, 0.8\rangle$	$\langle 0.2, 0.9\rangle$	$\langle 0.9, 0.2\rangle$	$\langle 0.6, 0.5\rangle$	$\langle 0.5, 0.6\rangle$
h_2	$\langle 0.8, 0.3\rangle$	$\langle 0.6, 0.3\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.1, 0.8\rangle$	$\langle 0.5, 0.7\rangle$
h_3	$\langle 0.6, 0.4\rangle$	$\langle 0.4, 0.5\rangle$	$\langle 0.4, 0.5\rangle$	$\langle 0.1, 0.8\rangle$	$\langle 0.7, 0.4\rangle$
h_4	$\langle 0.9, 0.2\rangle$	$\langle 0.8, 0.3\rangle$	$\langle 0.2, 0.8\rangle$	$\langle 0.1, 0.9\rangle$	$\langle 0.7, 0.5\rangle$
h_5	$\langle 0.2, 0.9\rangle$	$\langle 0.1, 0.9\rangle$	$\langle 0.9, 0.2\rangle$	$\langle 0.8, 0.3\rangle$	$\langle 0.6, 0.4\rangle$
h_6	$\langle 0.3, 0.7\rangle$	$\langle 0.2, 0.9\rangle$	$\langle 0.8, 0.3\rangle$	$\langle 0.6, 0.4\rangle$	$\langle 0.5, 0.4\rangle$

Table 3: Tabular representation of the generalized intuitionistic fuzzy soft set $\langle H, C\rangle$

U	course (c_1)	moderately course (c_2)	fine (c_3)	extra fine (c_4)
h_1	$\langle 0.3, 0.8\rangle$	$\langle 0.4, 0.6\rangle$	$\langle 0.1, 0.8\rangle$	$\langle 0.9, 0.2\rangle$
h_2	$\langle 0.6, 0.3\rangle$	$\langle 0.5, 0.5\rangle$	$\langle 0.4, 0.7\rangle$	$\langle 0.5, 0.5\rangle$
h_3	$\langle 0.5, 0.4\rangle$	$\langle 0.6, 0.4\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.6, 0.4\rangle$
h_4	$\langle 0.7, 0.5\rangle$	$\langle 0.6, 0.5\rangle$	$\langle 0.6, 0.5\rangle$	$\langle 0.3, 0.7\rangle$
h_5	$\langle 0.6, 0.4\rangle$	$\langle 0.6, 0.4\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.4, 0.6\rangle$
h_6	$\langle 0.8, 0.3\rangle$	$\langle 0.7, 0.4\rangle$	$\langle 0.7, 0.4\rangle$	$\langle 0.9, 0.2\rangle$

After performing some operations (like "and", "or" etc.) on the generalized intuitionistic fuzzy soft sets for some particular parameters of A and B, we obtain another generalized intuitionistic fuzzy soft set. The newly obtained generalized intuitionistic fuzzy soft set is termed as resultant generalized intuitionistic fuzzy soft set of $\langle F, A\rangle$ and $\langle G, B\rangle$.

Considering the above two generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$ and $\langle G, B\rangle$ if we perform "$\langle F, A\rangle$ and $\langle G, B\rangle$" then we will have $4 \times 5 = 20$ parameters of the form e_{ij}, where $e_{ij} = a_i \wedge b_j$, for all $i = 1, 2, 3, 4$ and $j = 1, 2, 3, 4, 5$. If we require the generalized intuitionistic fuzzy soft set for the parameters $R = \{e_{11}, e_{15}, e_{21}, e_{33}, e_{44}\}$, then the resultant generalized intuitionistic fuzzy soft set for generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$ and $\langle G, B\rangle$ will be $\langle K, R\rangle$, say.

So, after performing the "$\langle F, A\rangle$ and $\langle G, B\rangle$" for some parameters the tabular representation of the resultant generalized intuitionistic fuzzy soft set $\langle K, R\rangle$ will take the form as

Table 4: Tabular representation of the resultant generalized intuitionistic fuzzy soft set $\langle K, R\rangle$

U	e_{11}	e_{15}	e_{21}	e_{33}	e_{44}
h_1	$\langle 0.4, 0.8\rangle$	$\langle 0.4, 0.7\rangle$	$\langle 0.4, 0.8\rangle$	$\langle 0.6, 0.3\rangle$	$\langle 0.6, 0.5\rangle$
h_2	$\langle 0.3, 0.7\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.8, 0.3\rangle$	$\langle 0.3, 0.8\rangle$	$\langle 0.1, 0.8\rangle$
h_3	$\langle 0.4, 0.5\rangle$	$\langle 0.4, 0.5\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.4, 0.5\rangle$	$\langle 0.1, 0.8\rangle$
h_4	$\langle 0.8, 0.3\rangle$	$\langle 0.7, 0.5\rangle$	$\langle 0.2, 0.7\rangle$	$\langle 0.2, 0.8\rangle$	$\langle 0.1, 0.9\rangle$
h_5	$\langle 0.2, 0.9\rangle$	$\langle 0.6, 0.4\rangle$	$\langle 0.2, 0.9\rangle$	$\langle 0.6, 0.4\rangle$	$\langle 0.5, 0.4\rangle$
h_6	$\langle 0.3, 0.7\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.2, 0.8\rangle$	$\langle 0.4, 0.6\rangle$	$\langle 0.3, 0.8\rangle$

Let us now see how the algorithm may be used to solve original problem. Consider the generalized intuitionistic fuzzy soft sets $\langle F, A\rangle$, $\langle G, B\rangle$ and $\langle H, C\rangle$ as defined above. Suppose that $P = \{e_{11} \wedge c_1, e_{15} \wedge c_3, e_{21} \wedge c_2, e_{33} \wedge c_3, e_{44} \wedge c_3\}$, be the set of choice parameters of an observer. On the basis of this parameter we have to take the decision from the availability set U. The tabular representation of generalized intuitionistic fuzzy soft set $\langle S, P\rangle$ will be as

Table 5: Tabular representation of the resultant generalized intuitionistic fuzzy soft set $\langle S, P\rangle$

U	$e_{11} \wedge c_1$	$e_{15} \wedge c_3$	$e_{21} \wedge c_2$	$e_{33} \wedge c_3$	$e_{44} \wedge c_3$
h_1	$\langle 0.3, 0.8\rangle$	$\langle 0.1, 0.8\rangle$	$\langle 0.4, 0.8\rangle$	$\langle 0.1, 0.8\rangle$	$\langle 0.1, 0.8\rangle$
h_2	$\langle 0.3, 0.7\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.5, 0.5\rangle$	$\langle 0.3, 0.8\rangle$	$\langle 0.1, 0.8\rangle$
h_3	$\langle 0.4, 0.5\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.1, 0.8\rangle$
h_4	$\langle 0.7, 0.5\rangle$	$\langle 0.6, 0.5\rangle$	$\langle 0.2, 0.7\rangle$	$\langle 0.2, 0.8\rangle$	$\langle 0.1, 0.9\rangle$
h_5	$\langle 0.2, 0.9\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.2, 0.9\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.5, 0.4\rangle$
h_6	$\langle 0.3, 0.7\rangle$	$\langle 0.5, 0.4\rangle$	$\langle 0.2, 0.8\rangle$	$\langle 0.4, 0.6\rangle$	$\langle 0.3, 0.8\rangle$

The Comparison Table of the above resultant generalized intuitionistic fuzzy soft set is as below.

Table 6: Comparison Table of the resultant generalized intuitionistic fuzzy soft set $\langle S, P\rangle$

	h_1	h_2	h_3	h_4	h_5	h_6
h_1	5	1	1	1	2	1
h_2	5	5	2	3	2	2
h_3	5	5	5	3	2	2
h_4	3	2	2	5	3	3
h_5	3	3	3	2	5	3
h_6	4	4	3	2	3	5

Next we compute the row sum (r_i), column sum (t_i), and the sore (s_i) for each h_i as shown below.

Table 7: The row sum, column sum and score of h_i

	row sum (r_i)	column sum (t_i)	score(s_i)
h_1	11	25	-14
h_2	19	20	-1
h_3	22	16	6
h_4	18	16	2
h_5	19	17	2
h_6	21	16	5

From the above score table, it is clear that the maximum score is 6, scored by h_3 and the decision is in favour of selecting h_3.

4. Conclusions

Though the soft set theory, proposed by Molodtsov, has been regarded as an effective mathematical tool for dealing with uncertainty, it is difficult to be used to present the uncertainties of problem parameters. So some extensions of soft set theory such as fuzzy soft set theory, intuitionistic fuzzy soft set theory, interval-valued fuzzy soft set theory and vague soft set theory are proposed to handle these types of problem parameters. In this paper, we give an application of generalized intuitionistic fuzzy soft theory in object recognition problem. The recognition strategy is based on multiobserver input parameter data set. The algorithm involves the construction of Comparison Table from the resultant generalized intuitionistic fuzzy soft set and the final decision is taken based on the maximum score computed from the Comparison Table (Tables 6 and 7).

To extend our work, further research could be done to study the issues on the parameterization reduction of the generalized intuitionistic fuzzy soft sets, and to explore the applications of using the generalized intuitionistic fuzzy soft set approach to solve real world problems such as decision making, forecasting and data analysis.

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