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RESULTS ON INTUITIONISTIC FUZZY SOFT MULTI SETS AND IT'S APPLICATION IN INFORMATION SYSTEM

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Abstract – In this paper, we review some operations in intuitionistic fuzzy soft multi set theory in different approach and show that the De Morgan's types of results hold in intuitionistic fuzzy soft multi set theory for these operations in our way. Basic supporting tools in information system are also defined. Application of intuitionistic fuzzy soft multi sets in information system are presented and discussed. Also we show that every intuitionistic fuzzy soft multi set is an intuitionistic fuzzy multi valued information system.

Keywords – *Soft sets, fuzzy soft multi sets, ıntuitionistic fuzzy soft multi sets, information system.*

1 Introduction

Most of the problems in engineering, computer science, medical science, economics, environments etc. have various uncertainties. In 1999, Molodstov [12] initiated the concept of soft set theory as a mathematical tool for dealing with uncertainties. Later on Maji et al.[11] presented some new definitions on soft sets such as subset, union, intersection and complements of soft sets and discussed in details the application of soft set in decision making problem. Based on the analysis of several operations on soft sets introduced in [12], Ali et al. [2] presented some new algebraic operations for soft sets and proved that certain De Morgan's law holds in soft set theory with respect to these new definitions. Combining soft sets [12] with fuzzy sets [15] and intuitionistic fuzzy sets [5], Maji et al. [[9], [10]] defined fuzzy soft sets and intuitionistic fuzzy soft sets, which are rich potential for solving decision making problems. Alkhazaleh and others [[1], [4], [6], [7], [14]] as a generalization of Molodtsov's soft set, presented the definition of a soft multi set and its basic operations such as complement, union, and intersection etc and thereafter Balami and others [[7], [8]] discussed the application of soft multiset and multi-soft set in information

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system. In 2012 Alkhazaleh and Salleh [3] introduced the concept of fuzzy soft multi set theory and studied the application of these sets and recently, Mukherjee and Das [13] introduced the concepts of intuitionistic fuzzy soft multi sets and studied intuitionistic fuzzy soft multi topological spaces in details.

In this paper, we review some new operations in intuitionistic fuzzy soft multi set theory and applications of intuitionistic fuzzy soft multi sets in information system are presented and discussed. Also we show that every intuitionistic fuzzy soft multi set is an intuitionistic fuzzy multi valued information system.

2 Preliminary Notes

In this section, we recall some basic notions in soft set theory, fuzzy soft multi set theory and intuitionistic fuzzy soft multi set theory. Molodstov defined soft set in the following way. Let U be an initial universe and E be a set of parameters. Let P(U) denotes the power set of U and A⊆E.

Definition 2.1. [12] A pair (*F*, *A*) is called a soft set over U, where F is a mapping given by *F: A→ P(U).* In other words, soft set over U is a parameterized family of subsets of the universe U.

Definition 2.2. [3] Let $\{U_i : i\in I\}$ be a collection of universes such that $\bigcap_{i\in I} U_i = \phi$ and let $\{E_{U_i} : i\in I\}$ be a collection of sets of parameters. Let $U=\prod_{i\in I} FS(U_i)$ where $FS(U_i)$ denotes the set of all fuzzy subsets of U_i, $E=\prod_{i\in I} E_{U_i}$ and $A\subseteq E$. A pair (*F*, *A*) is called a fuzzy soft multi set over U, where F is a mapping given by $\mathrm{F}: \mathrm{A}\rightarrow \mathrm{U}$.

Definition 2.3. [3] For any fuzzy soft multi set (F, A), a pair $\left(e_{U_i,j}, F_{e_{U_i,j}}\right)$ is called a U_i – fuzzy soft multiset part $\forall e_{U_i,j}\in a_k$ and $F_{e_{U_i,j}}\subseteq F(A)$ is a fuzzy approximate value set, where $a_k\in A$, $\mathrm{k}\in\{1,2,3,..,\mathrm{m}\}$, $i\in\{1,2,3,..,\mathrm{n}\}$ and $j\in\{1,2,3,..,\mathrm{r}\}$.

Definition 2.4. [13] Let $\{U_i : i\in I\}$ be a collection of universes such that $\bigcap_{i\in I} U_i = \phi$ and let $\{E_i : i\in I\}$ be a collection of sets of parameters. Let $U=\prod_{i\in I} IFS(U_i)$ where $IFS(U_i)$ denotes the set of all intuitionistic fuzzy subsets of U_i, $E=\prod_{i\in I} E_{U_i}$ and $A\subseteq E$. A pair (*F*, *A*) is called an intuitionistic fuzzy soft multi set (briefly, IFSM-set) over U, where F is a mapping given by $F: A\rightarrow U.$

Definition 2.5. [13] The complement of an IFSM-set (F, A) over U is denoted by $(\mathrm{F},\mathrm{A})^{\mathrm{c}}$ and is defined by $(\mathrm{F},\mathrm{A})^{\mathrm{c}}=(\mathrm{F}^{\mathrm{c}},\mathrm{A})$, where $\mathrm{F}^{\mathrm{c}}: A\rightarrow U$ is a mapping given by $\mathrm{F}^{\mathrm{c}}(\alpha)=c\left(\mathrm{F}(\alpha)\right),\ \forall\alpha\in A$, where c is an intuitionistic fuzzy complement.

Definition 2.6. [13] An IFSM-set (F, A) over U is called an absolute IFSM-set, denoted by $(\mathrm{F, A})_U$, if $\left(e_{U_i,j}, F_{e_{U_i,j}}\right) = U_i, \ \forall i.$

Definition 2.7. [13] A null IFSM-set $(\mathrm{F, A})_{\phi}$ over U is an IFSM-set in which all the IFSM-set parts equals ϕ.

Definition 2.8. [13] Union of two IFSM-sets (F, *A*) and (G, *B*) over *U* is an IFSM-set (H, D), where $D = A \cup B$ and $\forall e \in D,$

$$H(e) = \begin{cases} F(e), & if \ \ e \in A - B \\ G(e), & if \ \ e \in B - A \\ \bigcup\left(F(e), G(e)\right), & if \ \ e \in A \cap B, \end{cases}$$

where $\bigcup\left(F(e), G(e)\right) = F_{e_{U_i,j}} \tilde{\cup} G_{e_{U_i,j}} \ \forall i \in \{1,2,3,..,\mathrm{m}\}, \ j \in \{1,2,3,..,\mathrm{n}\}$ with $\tilde{\cup}$ as an intuitionistic fuzzy union and is written as (F, A)$\tilde{\cup}$(G, B)=(H,D).

Definition 2.9. [13] Intersection of two IFSM-sets (F, *A*) and (G, *B*) over *U* is an IFSM-set (H, D) where $D = A \cap B$ and $\forall e \in D,$

$$H(e) = \begin{cases} F(e), & if \ \ e \in A - B \\ G(e), & if \ \ e \in B - A \\ \bigcap\left(F(e), G(e)\right), & if \ \ e \in A \cap B \end{cases}$$

where $\bigcap\left(F(e), G(e)\right) = F_{e_{U_i,j}} \tilde{\cap} G_{e_{U_i,j}}, \forall i \in \{1,2,3,..,\mathrm{n}\}, \ \ j \in \{1,2,3,..,\mathrm{n}\}$ with $\tilde{\cap}$ as an intuitionistic fuzzy intersection and is written as (F, A)$\tilde{\cap}$(G, B)=(H,C).

3 Results on Intuitionistic Fuzzy Soft Multisets

In this section, we review some operation on IFSM-sets in different approach and show that the De Morgan’s types of results hold in intuitionistic fuzzy soft multi set theory for these operations in our way.

Let $\{U_i : i \in I\}$ be a collection of universes such that $\bigcap_{i\in I} U_i = \phi$ and let $\{E_i : i \in I\}$ be a collection of sets of parameters. Let $U = \prod_{i\in I} IFS\left(U_i\right),$ where $IFS\left(U_i\right)$ denotes the set of all intuitionistic fuzzy subsets of U_i, $E = \prod_{i\in I} E_{U_i}$ and $A \subseteq E$.

Definition 3.1. A pair (*F, A*) is called an intuitionistic fuzzy soft multi set (brıefly, IFSM-set)over U, where F is a mapping given by $F: \ A \rightarrow U$, such that $\forall e \in A,$

$$F(e) = \left(\left\{ \frac{u}{\left(\mu_{F(e)}(u), \nu_{F(e)}(u)\right)} : u \in U_i \right\} : i \in I \right).$$

Definition 3.2. For any IFSM-set (F, A), a U_i-intuitionistic fuzzy soft multiset part (briefly, U_i-IFSMS-part) of (*F, A*) over U, is of the form

$$\left\{\frac{u}{\left(\mu_{F(e)}(u),\nu_{F(e)}(u)\right)}:\ u\in U_i,\ e\in A\right\}.$$

Definition 3.3. The union of two IFSM-sets $(\mathrm{F, A})$ and $(\mathrm{G, B})$ over a common universe U is an IFSM-set $(\mathrm{H, C})$, where $\mathrm{C=A\cup B}$ and $\forall \mathrm{e}\in\mathrm{C},\ \mathrm{u}\in\mathrm{U}$

$$\mu_{\mathrm{H(e)}}(\mathrm{u})=\begin{cases}\mu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{A\text{-}B}\\ \mu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{B\text{-}A}\\ \max\left(\mu_{\mathrm{F(e)}}(\mathrm{u}),\mu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in\mathrm{A}\cap\mathrm{B}\end{cases}$$

and

$$\nu_{\mathrm{H(e)}}(\mathrm{u})=\begin{cases}\nu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{A\text{-}B}\\ \nu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{B\text{-}A}\\ \min\left(\nu_{\mathrm{F(e)}}(\mathrm{u}),\nu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in\mathrm{A}\cap\mathrm{B}\end{cases}$$

We write $(F,\ A)\tilde{\cup}(G,\ B)=(H,\ C)$.

Definition 3.4. The intersection of two IFSM-sets $(\mathrm{F, A})$ and $(\mathrm{G, B})$ over a common universe U is an IFSM-set $(\mathrm{H, C})$, where $\mathrm{C=A\cup B}$ and $\forall \mathrm{e}\in\mathrm{C},\ \mathrm{u}\in\mathrm{U}$

$$\mu_{\mathrm{H(e)}}(\mathrm{u})=\begin{cases}\mu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{A\text{-}B}\\ \mu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{B\text{-}A}\\ \min\left(\mu_{\mathrm{F(e)}}(\mathrm{u}),\mu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in\mathrm{A}\cap\mathrm{B}\end{cases}$$

and

$$\nu_{\mathrm{H(e)}}(\mathrm{u})=\begin{cases}\nu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{A\text{-}B}\\ \nu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in\mathrm{B\text{-}A}\\ \max\left(\nu_{\mathrm{F(e)}}(\mathrm{u}),\nu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in\mathrm{A}\cap\mathrm{B}\end{cases}$$

We write $(F,\ A)\tilde{\cap}(G,\ B)=(H,\ C)$.

Definition 3.5. The complement of an IFSM-set *(F, A)* over U is denoted by $(F,A)^c$ and is defined by $(F,A)^c=(F^c,A)$, where

$$F^c(e)=\left(\left\{\frac{u}{\left(\nu_{F(e)}(u),\mu_{F(e)}(u)\right)}:u\in U_i\right\}:i\in I\right),\ \forall e\in A.$$

Proposition 3.6. For two IFSM-sets *(F, A)* and *(G, B)* over U, then we have

1. $\left((F,\ A)\tilde{\cup}(G,\ B)\right)^c\ \tilde{\subseteq}\ (F,\ A)^c\,\tilde{\cup}(G,\ B)^c$
2. $(F,\ A)^c\,\tilde{\cap}(G,\ B)^c\ \tilde{\subseteq}\left((F,\ A)\tilde{\cap}(G,\ B)\right)^c$

Proof. Let $(F,\ A)\tilde{\cup}(G,\ B)=(H,C),$ where $C=A\cup B$ and $\forall e\in C,$

$$\mu_{H(e)}(u)=\begin{cases}\mu_{F(e)}(u), & \text{if } e\in A\text{-}B\\ \mu_{G(e)}(u), & \text{if } e\in B\text{-}A\\ \max\left(\mu_{F(e)}(u),\mu_{G(e)}(u)\right), & \text{if } e\in A\cap B\end{cases}$$

and

$$\nu_{H(e)}(u)=\begin{cases}\nu_{F(e)}(u), & \text{if } e\in A\text{-}B\\ \nu_{G(e)}(u), & \text{if } e\in B\text{-}A\\ \min\left(\nu_{F(e)}(u),\nu_{G(e)}(u)\right), & \text{if } e\in A\cap B\end{cases}$$

Thus $\left((F,\ A)\tilde{\cup}(G,\ B)\right)^c=(H,C)^c=(H^c,C),$ where $C=A\cup B$ and $\forall e\in C,$

$$\mu_{H^c(e)}(u)=\nu_{H(e)}(u)=\begin{cases}\nu_{F(e)}(u), & \text{if } e\in A\text{-}B\\ \nu_{G(e)}(u), & \text{if } e\in B\text{-}A\\ \min\left(\nu_{F(e)}(u),\nu_{G(e)}(u)\right), & \text{if } e\in A\cap B\end{cases}$$

and

$$\nu_{H^c(e)}(u)=\mu_{H(e)}(u)=\begin{cases}\mu_{F(e)}(u), & \text{if } e\in A\text{-}B\\ \mu_{G(e)}(u), & \text{if } e\in B\text{-}A\\ \max\left(\mu_{F(e)}(u),\mu_{G(e)}(u)\right), & \text{if } e\in A\cap B\end{cases}$$

Again, $(F,\ A)^c\,\tilde{\cup}(G,\ B)^c=(F^c,\ A)\tilde{\cup}(G^c,\ B)=\left(K,D\right)$. Where $D=A\cup B$ and $\forall e\in D,$

$$\mu_{K(e)}(\mathrm{u})=\begin{cases}\nu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{A\text{-}B}\\ \nu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{B\text{-}A}\\ \max\left(\nu_{\mathrm{F(e)}}(\mathrm{u}),\nu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in \mathrm{A}\cap\mathrm{B}\end{cases}$$

i.e. $\mu_{H^c(e)}(\mathrm{u})\le \mu_{K(e)}(\mathrm{u})$

and

$$\nu_{K(e)}(\mathrm{u})=\begin{cases}\mu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{A\text{-}B}\\ \mu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{B\text{-}A}\\ \min\left(\mu_{\mathrm{F(e)}}(\mathrm{u}),\mu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in \mathrm{A}\cap\mathrm{B}\end{cases}$$

i.e. $\nu_{H^c(e)}(\mathrm{u})\ge \nu_{K(e)}(\mathrm{u})$.

We see that C=D and $\forall e\in C,\ H^c(e)\subseteq K(e)$. Thus $\left((F,\ A)\tilde{\cup}(G,\ B)\right)^c \tilde{\subseteq} (F,\ A)^c\tilde{\cup}(G,\ B)^c$.

The other can be proved similarly.

Proposition 3.7. If (F,A) and (G,A) are two FSM-sets in $FSMS_A(\mathrm{F},A)$, then we have the following

(i). $\left((\mathrm{F, A})\tilde{\cup}(\mathrm{G, A})\right)^c=(\mathrm{F, A})^{\mathrm{c}}\tilde{\cap}(\mathrm{G, A})^{\mathrm{c}}$

(ii). $\left((\mathrm{F, A})\tilde{\cap}(\mathrm{G, A})\right)^{\mathrm{c}}=(\mathrm{F, A})^{\mathrm{c}}\tilde{\cup}(\mathrm{G, A})^{\mathrm{c}}$

Proof. (i). Let $(F,\ A)\tilde{\cup}(G,\ B)=(H,C)$, where $C=A\cup B$ and $\forall e\in C$,

$$\mu_{\mathrm{H(e)}}(\mathrm{u})=\begin{cases}\mu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{A\text{-}B}\\ \mu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{B\text{-}A}\\ \max\left(\mu_{\mathrm{F(e)}}(\mathrm{u}),\mu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in \mathrm{A}\cap\mathrm{B}\end{cases}$$

$$\nu_{\mathrm{H(e)}}(\mathrm{u})=\begin{cases}\nu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{A\text{-}B}\\ \nu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e}\in \mathrm{B\text{-}A}\\ \min\left(\nu_{\mathrm{F(e)}}(\mathrm{u}),\nu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e}\in \mathrm{A}\cap\mathrm{B}\end{cases}$$

Thus $\left((F,\ A)\tilde{\cup}(G,\ B)\right)^c=(H,C)^c=(H^c,C)$, where $C=A\cup B$ and $\forall e\in C$,

$$\mu_{H^c(e)}(\mathrm{u}) = \nu_{\mathrm{H(e)}}(\mathrm{u}) = \begin{cases} \nu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{A-B} \\ \nu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{B-A} \\ \min\left(\nu_{\mathrm{F(e)}}(\mathrm{u}), \nu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e} \in \mathrm{A} \cap \mathrm{B} \end{cases}$$

$$\nu_{H^c(e)}(\mathrm{u}) = \mu_{\mathrm{H(e)}}(\mathrm{u}) = \begin{cases} \mu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{A-B} \\ \mu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{B-A} \\ \max\left(\mu_{\mathrm{F(e)}}(\mathrm{u}), \mu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e} \in \mathrm{A} \cap \mathrm{B} \end{cases}$$

Also, let $(F, A)^c \tilde{\cap} (G, B)^c = (F^c, A) \tilde{\cap} (G^c, B) = (K, D)$. Where $D = A \cup B$ and $\forall e \in D$,

$$\mu_{K(e)}(\mathrm{u}) = \begin{cases} \nu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{A-B} \\ \nu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{B-A} \\ \min\left(\nu_{\mathrm{F(e)}}(\mathrm{u}), \nu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e} \in \mathrm{A} \cap \mathrm{B} \end{cases}$$

$$= \mu_{H^c(e)}(\mathrm{u}),$$

and

$$\nu_{K(e)}(\mathrm{u}) = \begin{cases} \mu_{\mathrm{F(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{A-B} \\ \mu_{\mathrm{G(e)}}(\mathrm{u}), & \text{if } \mathrm{e} \in \text{B-A} \\ \max\left(\mu_{\mathrm{F(e)}}(\mathrm{u}), \mu_{\mathrm{G(e)}}(\mathrm{u})\right), & \text{if } \mathrm{e} \in \mathrm{A} \cap \mathrm{B} \end{cases}$$

$$= \nu_{H^c(e)}(\mathrm{u}).$$

We see that C=D and $\forall e \in C,\ H^c(e) = K(e)$. Hence the result.

The other can be proved similarly.

Definition 3.8. A IFSM-set (F, A) over U is called an absolute IFSM-set, denoted by $(F, A)_U$, if $\forall e \in A,\ \mu_{F(e)}(u) = 1$ and $\nu_{F(e)}(u) = 0,\ \forall u \in U_i,\ \ i \in I.$

Definition 3.9. A null IFSM-set $(F, A)_U$ over U is an IFSM-set in which $\forall e \in A,\ \mu_{F(e)}(u) = 0$ and $\nu_{F(e)}(u) = 1,\ \forall u \in U_i,\ i \in I.$

Proposition 3.10. If (F, *A*) be any IFSM-set in over U, then

(*i*) $(F, A) \tilde{\cap} (G, B)_\phi = (G, B)_\phi$,

(ii) $(F,A)\tilde{\cap}(H,C)_U=(F,A)$,

(d) $(F,A)\tilde{\cup}(G,B)_\phi=(F,A)$,

(iv) $(F,A)\tilde{\cup}(H,C)_U=(H,C)_U$.

4 An Application of IFSM-set in information system

Definition 4.1. An intuitionistic fuzzy multi-valued information system is a quadruple $Inf_{system}=(X,A,f,V)$ where X is a non empty finite set of objects, A is a non empty finite set of attribute, $V=\underset{a\in A}{\cup}V_a$, where V is the domain (an intuitionistic fuzzy set,) set of attribute, which has multi value and $f:X\times A\to V$ is a total function such that $f(x,a)\in V_a$ for every $(x,a)\in X\times A$.

Proposition 4.2. If (F,A) is an IFSM-set over universe U, then (F,A) is an intuitionistic fuzzy multi-valued information system.

Proof. Let $\{U_i:i\in I\}$ be a collection of universes such that $\bigcap_{i\in I}U_i=\phi$ and let $\{E_i:i\in I\}$ be a collection of sets of parameters. Let $U=\prod_{i\in I}IFS(U_i)$ where $IFS(U_i)$ denotes the set of all intuitionistic fuzzy subsets of U_i, $E=\prod_{i\in I}E_{U_i}$ and $A\subseteq E$. Let (F,A) be an IFSM-set over U and $X=\underset{i\in I}{\cup}U_i$. We define a mapping *f* where $f:X\times A\to V$, defined as

$$f(x,a)=\frac{x}{\left(\mu_{F(a)}(x),\nu_{F(a)}(x)\right)}.$$

Hence $V=\underset{a\in A}{\cup}V_a$ where V_a is the set of all counts of in $F(a)$ and $\cup$ represent the classical set union. Then the intuitionistic fuzzy multi-valued information system (X,A,f,V) represents the IFSM-set (F,A).

Example 4.3. Let us consider there are two universes U_1 *and* U_2. Let $U_1=\{h_1,h_2,h_3\}$ and $U_2=\{c_1,c_2\}$. Let $\{E_{U_1},E_{U_2}\}$ be a collection of sets of decision parameters related to the above universes, where

$E_{U_1}=\{e_{U_1,1}=\text{expensive},\ e_{U_1,2}=\text{wooden}\}$, $E_{U_2}=\{e_{U_2,1}=\text{sporty}, e_{U_2,2}=\text{cheap},\ e_{U_2,3}=\text{2010 model}\}$.

Let $U=\prod_{i=1}^{2}IFS(U_i)$, $E=\prod_{i=1}^{2}E_{U_i}$ and $A=\{e_1=(e_{U_1,1},e_{U_2,1}),\ e_2=(e_{U_1,1},e_{U_2,2}), e_3=(e_{U_1,1},e_{U_2,3})\}$.

Let

$$F(e_1)=\left(\left\{\frac{h_1}{(.2,.7)},\frac{h_2}{(.4,.5)},\frac{h_3}{(0,1)}\right\},\left\{\frac{c_1}{(.8,.1)},\frac{c_2}{(0,1)}\right\}\right),$$
$$F(e_2)=\left(\left\{\frac{h_1}{(0,1)},\frac{h_2}{(.7,.2)},\frac{h_3}{(1,0)}\right\},\left\{\frac{c_1}{(0,1)},\frac{c_2}{(.6,.3)}\right\}\right),$$
$$F(e_3)=\left(\left\{\frac{h_1}{(0,1)},\frac{h_2}{(.8,.1)},\frac{h_3}{(0,1)}\right\},\left\{\frac{c_1}{(0.5,0.3)},\frac{c_2}{(.6,.3)}\right\}\right)$$

Then the IFSM-set (F,A) defined above describes the conditions of some “house” and “car” in a state. Then the quadruple (X,A,f,V) corresponding to the IFSM-set given above is an intuitionistic fuzzy multi-valued information system.

Where $X=\bigcup_{i=1}^{2}U_i$ and A is the set of parameters in the IFSM-set and

$$V_{e_1}=\left\{\frac{h_1}{(.2,.7)},\frac{h_2}{(.4,.5)},\frac{h_3}{(0,1)},\frac{c_1}{(.8,.1)},\frac{c_2}{(0,1)}\right\},$$
$$V_{e_2}=\left\{\frac{h_1}{(0,1)},\frac{h_2}{(.7,.2)},\frac{h_3}{(1,0)},\frac{c_1}{(0,1)},\frac{c_2}{(.6,.3)}\right\},$$
$$V_{e_3}=\left\{\frac{h_1}{(0,1)},\frac{h_2}{(.8,.1)},\frac{h_3}{(0,1)},\frac{c_1}{(0.5,0.3)},\frac{c_2}{(.6,.3)}\right\}$$

For the pair (h_1,e_1) we have $f(h_1,e_1)$ = (0.2, 0.7), for (h_2,e_1), we have $f(h_2,e_1)=$ (0.4, 0.5). Continuing in this way we obtain the values of other pairs. Therefore, according to the result above, it is seen that IFSM-sets are intuitionistic fuzzy soft multi-valued information systems. Nevertheless, it is obvious that intuitionistic fuzzy soft multi-valued information systems are not necessarily IFSM-sets. We can construct an information table representing IFSM-set (F,A) defined above as in Table 1.

Table 1. The information table representing IFSM-set (F,A).

	e_1	e_2	e_3
h_1	(0.2,0.7)	(0,1)	(0,1)
h_2	(0.4,0.5)	(0.7,0.2)	(0.8,0.1)
h_3	(0,1)	(1,0)	(0,1)
c_1	(0,1)	(0,1)	(0.5,0.3)
c_2	(0,1)	(0.6,0.3)	(0.6,0.3)

5 Conclusion

In this paper, we have made an investigation on existing basic notions and results on IFSM-sets. Some new results have been stated in our work. Here we shall present the application of IFSM-set in information system and show that every IFSM-set is an intuitionistic fuzzy multi valued information system.

References

[1]. K. Alhazaymeh, N. Hassan, *Vague soft multiset theory*, Int. J. Pure and Applied Math., 93 (2014) 511-523.

[2]. M.I. Ali, F. Feng, X. Liu, W.K. Min, M. Shabir, *On some new operations in soft set theory* Comp. Math. Appl., 57 (2009) 1547-1553.

[3]. S. Alkhazaleh, A.R. Salleh, *Fuzzy soft multi sets theory*, Abstract and Applied Analysis, Vol. 2012, Article ID 350603, 20 pages, doi: 10.1155/2012/350603, Hindawi Publishing Corporation (2012).

[4]. S. Alkhazaleh, A.R. Salleh, N. Hassan, Soft multi sets theory, Appl. Math. Sci. 5 (2011) 3561– 3573.

[5]. K. Atanassov, *Intuitionistic fuzzy sets*, Fuzzy Sets and Systems, 20 (1986) 87-96.

[6]. K.V. Babitha, S.J. John, *On soft multi sets*, Ann. Fuzzy Math. Inform., 5 (2013) 35-44.

[7]. H.M. Balami, A.M. Ibrahim, *Soft multiset and its application in information system*, International Journal of scientific research and management, 1 (2013) 471-482.

[8]. T. Herawan, M.D. Mustafa, *On multi-soft set construction in information system*, 5th International Conference on Intelligent Computing, Lecture Notes in Computer Science. vol. 5755, Springer, Ulsan, Republic of Korea (2009).

[9]. P.K. Maji, R. Biswas, A.R. Roy, *Fuzzy soft sets*, J. Fuzzy Math. 9 (2001) 589-602.

[10]. P.K. Maji, R. Biswas, A.R. Roy, *Intuitionistic fuzzy soft sets* J. Fuzzy Math. 12 (2001) 677-692.

[11]. P.K. Maji, R. Biswas, A.R. Roy, *Soft set theory*, Comp. Math. Appl. 45 (2003) 555-562.

[12]. D. Molodtsov, *Soft set theory-first results*, Comp. Math. Appl. 37 (1999) 19-31.

[13]. A. Mukherjee, A.K. Das, *Parameterized topological space induced by an intuitionistic fuzzy soft multi topological space*, Ann. Pure and Applied Math. 7 (2014) 7-12.

[14]. D. Tokat, I. Osmanoglu, *Soft multi set and soft multi topology*, Nevsehir Universitesi Fen Bilimleri Enstitusu Dergisi Cilt. 2 (2011) 109-118.

[15]. L.A. Zadeh, *Fuzzy sets*, Inform. Control., 8 (1965) 338-353.