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# *NEW FORM OF SOFT SETS AND ITS PROPERTIES*

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**Abstract:** *Molodtsov* introduced the concept of soft set theory as a general mathematical tool for dealing with uncertainty. Many researchers have studied this theory and developed several models to solve decision-making and medical diagnostic problems, but most of these models deal only one set of parameters. This causes problems for users, especially with those who use questionnaires in their work and studies. Also *Alkhazaleh and Salleh*, also introduced the concept of soft-expert sets. This structure can be considered as a generalization of soft-sets in which experts and their opinions have been added to make decision analysis easier to handle. In our model, is more generalization of soft- set and soft-expert set, the collection of more specific information about object sets using mappings. This concept is more powerful for information tables, since collection of the information is very particular to define by mapping and also this model is approaches to rough set theory and information system.
**Keywords:** Soft sets, soft expert sets and swarm sets.

## 1. Introduction

Most of the problems in engineering, medicine, economics, environment, etc. are related to various uncertainties. Molodtsov [1] initiated the concept of soft-set theory as a mathematical tool for dealing with uncertainty. After the work of Molodtsov, some operations and applications of the soft-set were introduced by Chen et al. [2] and Maji et al. [3, 4]. Alkhazaleh et al. [5] introduced the concept of soft-multi set as a generalization of soft-set. They also defined the concepts of possible fuzzy soft-sets and fuzzy parameterized interval valued fuzzy soft-sets in [6, 7] and gave their application to decision making and medical diagnosis. Alkhazaleh and Salleh [9] introduced the concept of soft-expert sets. Many researchers have studied this theory and developed several models to solve decision-making and medical diagnostic problems, but most of these models deal only with one set of parameters, and if we want to take the number of attributes and sets of parameters, perform some operations such as union, intersection, and so on. This causes problems among users, especially with those who use questionnaires in their work and studies. In our model the user can know the set of parameters in one model without any intervention. Even after any operation on our model the user can know the number of attributes and sets of parameters. So in this paper we introduce the concept of swarm set deals with associate parameters in each of its attributes of objects, which will be more

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effective and useful. We also introduced basic operations namely, complement, union and intersection. Finally, we give an application on real estate problem to illustrate the concept is discussed.

## 2. Preliminaries: Basic Definitions Revisited

In this section, we recall some basic notions in soft set theory. Molodtsov [1] defined soft set in the following way. Let $U$ be an initial universe set and let $E$ be a set of parameters.

Let $P(U)$ denote the power set of $U$ and $A \subseteq E$.

**Definition 2.1:** A pair $(F, A)$ is called a soft set over $U$, where $F$ is a mapping defined by $F : A \to P(U)$. In other words, a soft set over $U$ is a parameterized family of subsets of the universe $U$. For $\epsilon \in A, F(\epsilon)$ may be considered as the set of $\epsilon$-approximate elements of the soft set $(F, A)$.

**Definition 2.2:** For two soft sets $(F, A)$ and $(G, B)$ over a common universe $U$, we say that $(F, A)$ is a soft subset of $(G, B)$ if

$(i)$ $A \subset B$ and

$(ii)$ $\forall\ \epsilon\ \in A$, $F(\epsilon)$ and $G(\epsilon)$ are identical approximations.

Write $(F, A)\widetilde{\subset}(G, B)$. $(F, A)$ is said to be a soft super set of $(G, B)$, if $(G, B)$ is a soft subset of $(F, A)$. Denoted by $(F, A)\widetilde{\supset}(G, B)$.

**Definition 2.3:** For two soft sets $(F, A)$ and $(G, B)$ over a common universe $U$ are said to be soft equal if $(F, A)$ is a soft subset of $(G, B)$ and $(G, B)$ is a soft subset of $(F, A)$.

**Definition 2.4:** Let $E = \{e_1, e_2, ..., e_n\}$ be a set of parameters. The NOT set of $E$ denoted by $\neg E$ and is defined by $\neg E = \{\neg e_1, \neg e_2, ..., \neg e_n\}$ where $\neg e_i = not\ e_i$, $\forall\ i$.

**Definition 2.5:** The complement of a soft set $(F, A)$ is denoted by $(F, A)^C$ and is defined by $(F, A)^C = (F^C, \neg A)$, where $F^C : \neg A \to P(U)$ is a mapping given by $F^C(\alpha) = U - F(\neg\alpha)$, $\forall\ \alpha \in \neg A$.

**Definition 2.6:** *A soft set* $(F, A)$ over $U$ *is said to be a* $NULL$ *soft set* denoted by $\phi$ if for all $\epsilon \in A, F(\epsilon) = \phi$(null set).

**Definition 2.7:** A soft set $(F, A)$ over $U$ is said to be an *absolute* soft set denoted by $\widetilde{A}$ if for all $\epsilon \in A, F(\epsilon) = U$.

**Definition 2.8:** If $(F, A)$ and $(G, B)$ are two soft sets, then $(F, A)\ AND\ (G, B)$ denoted by $(F, A) \wedge (G, B)$ is defined by $(F, A) \wedge (G, B) = (H, A \times B)$, where $H(\alpha, \beta) = F(\alpha) \cap F(\beta)$, for all $(\alpha, \beta) \in A \times B$.

**Definition 2.9:** *If* $(F, A)$ and $(G, B)$ *are two soft sets*, then $(F, A)\ OR\ (G, B)$ *denoted by* $(F, A) \vee (G, B)$ is defined by $(F, A) \vee (G, B) = (O, A \times B)$, where $O(\alpha, \beta) = F(\alpha) \cup F(\beta)$, for all $(\alpha, \beta) \in A \times B$.

**Definition 2.10:** The union of two soft sets $(F, A)$ and $(G, B)$ over a common universe $U$ is the soft set $(H, C)$, where $C = A \cup B$ and $\forall\ e \in C$,

$$H(e) = \begin{cases} F(e), & \text{if } e \in A - B \\ G(e), & \text{if } e \in B - A \\ F(e) \cup G(e), & \text{if } e \in A \cap B \end{cases} \tag{1}$$

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

**Definition 2.11:** The intersection $(H, C)$ of two soft sets $(F, A)$ and $(G, B)$ over a common universe $U$, denoted $(F, A) \cap (G, B)$, is defined as $C = A \cap B$, and $H(e) = F(e) \cap G(e)$ for all $e \in C$

**Definition 2.12:** The extended intersection of two soft sets $(F, A)$ and $(G, B)$ over a common universe $U$ is the soft set $(H, C)$, where $C = A \cup B$ and $\forall\ e \in C$,

$$H(e) = \begin{cases} F(e), & \text{if } e \in A - B \\ G(e), & \text{if } e \in B - A \\ F(e) \cap G(e), & \text{if } e \in A \cap B \end{cases} \tag{2}$$

## 3. Swarm Sets

Let $U$ be the set of objects, $A$ be a finite set of attributes in which each attribute is a word or sentence and $V$ is a collection of all associated parameter set with each attribute, such that $V = \bigcup V_a,\ \forall\ a \in A$.

For example, consider the attribute set $A = \{gender, age\}$, then the associate parameter set of an attribute gender is $V_{gender} = \{male, female\}$ and age is $V_{age} = \{young, adult, old\}$. The collection of all associate parameter set is $V = \bigcup_{a \in A} V_a = V_{gender} \cup V_{age} = \{male, female, young, adult, old\}$.

**Definition 3.1:** The function $f_A$ is called *swarm map* defined by $f_A : V \to P(U)$, where $P(U)$ denotes power set of object set $U$ and $V = \bigcup_{a \in A} V_a$.

In other words, a swarm map $f_A$ is associate parameters of each of its attributes of objects.

**Definition 3.2:** A pair $(f_A, V)$ is called *swarm set* over the swarm map $f_A : V \to P(U)$, where $P(U)$ denotes power set of $U$ and $V = \bigcup_{a \in A} V_a$.

**Example 3.3:** Consider $U = \{u_1, u_2, u_3\}$ is the set of objects and $A = \{colour, shape, size, category\}$ is the set of attributes.

The associate parameters set of an attribute colour is $V_{colour} = \{orange, yellow, red\}$, shape is $V_{shape} = \{round, long\}$, size is $V_{size} = \{small, medium\}$ and category is $V_{category} = \{apple, banana, orange\}$.

Tabular representation of swarm set is in Table 1.

Table 1:

| Objects | Attributes | | | |
|---|---|---|---|---|
| U | colour | shape | size | category |
| $u_1$ | red | round | medium | apple |
| $u_2$ | yellow | long | medium | banana |
| $u_3$ | orange | round | small | orange |

The collection of all associate parameter set is $V = V_{colour} \cup V_{shape} \cup V_{size} \cup V_{category} = \{orange, yellow, red, round, long, small, medium, apple, banana, orange\}$.

The swarm map $f_A : V \to P(U)$ is defined by, $f_A(orange) = \{u_3\}$ or $f_{colour}(orange) = \{u_3\}$, $f_{colour}(yellow) = \{u_2\}$, $f_{colour}(red) = \{u_1\}$, $f_{shape}(round) = \{u_1, u_3\}$, $f_{shape}(long) = \{u_2\}$, $f_{size}(small) = \{u_3\}$,

$f_{size}(medium) = \{u_1, u_2\}$, $f_{category}(apple) = \{u_1\}$, $f_{category}(banana) = \{u_2\}$, $f_{category}(orange) = \{u_3\}$.

Then the swarm set is $(f_A, V) = \{(u_1, \{red, round, medium, apple\})$, $(u_2, \{yellow, long, medium, banana\}), (u_3, \{orange, round, small, orange\})$.

**4. Complete and Incomplete Swarm sets**

In this section, we introduce the complete and incomplete swarm sets with examples.

**Definition 4.1:** The swarm set $(f_A, V)$ is called complete swarm set if $\bigcup_{a\in A}(f_A(e_a)) = U$, otherwise incomplete swarm set.

**Example 4.2:** Example 3.3 is complete swarm set.

**Example 4.3:** Consider $U = \{h_1, h_2, h_3, h_4, h_5, h_6\}$ *is set of objects and* $A = \{Type, Price\} = \{T, P\}$ is set attributes. The associate parameters set of an attribute, Type is $V_T = \{muddy, wooden\} = \{e_{t1}, e_{t2}\}$ and Price is $V_P = \{low, high\} = \{e_{p1}, e_{p2}\}$. The collection of all associate parameter set is $V = V_T \cup V_P = \{muddy, wooden, low, high\} = \{e_{t1}, e_{t2}, e_{p1}, e_{p2}\}$.

The swarm map $f_A : V \to P(U)$ is defined by

$f_A(e_{t1}) = \{h_1, h_3\}$, $f_A(e_{t2}) = \{h_2, h_6\}$,
$f_A(e_{p1}) = \{h_2, h_3\}$, $f_A(e_{p2}) = \{h_1, h_5, h_6\}$.

Then the swarm set is $(f_A, V) = \{(h_1, \{e_{t1}, e_{p2}\}), (h_2, \{e_{t2}, e_{p1}\}), (h_3, \{e_{t1}, e_{p1}\}), (h_4, \{\phi, \phi\}), (h_5, \{\phi, e_{p2}\}), (h_6, \{e_{t2}, e_{p2}\})\}$.

Therefore $(f_A, V)$ is not a complete swarm set. Since $f_A(e_{t1}) \cup f_A(e_{t2}) = \{h_1, h_3\} \cup \{h_2, h_6\} = \{h_1, h_2, h_3, h_6\} \neq U$. Thus, $(f_A, V)$ is incomplete swarm set.

Note that in this paper only complete swarm sets are used.

**5. Operations of Swarm Sets.**

In this section, give definitions of its basic operations with examples.

Let $(f_A, V)$ and $(f_B, V)$ *are two swarm sets over common object set* $U$ and $A$, $B$ are sets of attributes. The associate parameters set $V_A = \bigcup_{a\in A} V_a$ and the associate parameters set $V_B = \bigcup_{b\in B} V_b$ respectively. The collection of all associate parameter set is $V = (\cup_{a\in A} V_a) \bigcup (\cup_{b\in B} V_b)$.

**Definition 5.1: Swarm subset:** The swarm set $(f_A, V)$ is subset of swarm set $(f_B, V)$ if

*i)* $A \subset B$
*ii)* $f_A(e_\alpha) \subset f_B(e_\alpha)$ , $\forall\ e_\alpha \in V$

where $f_A(e_\alpha)$ and $f_B(e_\alpha)$ are identical approximation, write $(f_A, V)\tilde{\subset}(f_B, V)$, i.e $(f_A, V)$ is swarm subset of $(f_B, V)$. Also $(f_A, V)$ is said to be swarm super set of $(f_B, V)$, if $(f_B, V)$ is swarm subset of $(f_A, V)$. Denote it by $(f_A, V)\tilde{\supset}(f_B, V)$.

**Definition 5.2: Equality of two swarm sets :** Swarm sets $(f_A, V)$ and $(f_B, V)$ are said to be equal if $(f_A, V)$ is swarm subset of $(f_B, V)$ and $(f_B, V)$ is swarm subset of $(f_A, V)$.

**Example 5.3:** Consider $(f_A, V)$ and $(f_B, V)$ are two swarm sets over common object set $U = \{h_1, h_2, h_3, h_4, h_5, h_6\}$ and $A = \{T, P\}$, $B = \{T, F, P, C\}$ are sets of attributes.

The associate parameter set of an attribute $A$ is $V_T = \{muddy, wooden,$

$RCC\} = \{e_{t1}, e_{t2}, e_{t3}\}$ and $V_P = \{low, high, very\ high\} = \{e_{p1}, e_{p2}, e_{p3}\}$.

The associate parameter set of an attribute $B$ is $V_T = \{muddy, wooden, RCC\} = \{e_{t1}, e_{t2}, e_{t3}\}$, $V_F = \{east, west, north, south\} = \{e_{f1}, e_{f2}, e_{f3}, e_{f4}\}$, $V_P = \{low, high, very\ high\} = \{e_{p1}, e_{p2}, e_{p3}\}$ and $V_C = \{bad, good\} = \{e_{c1}, e_{c2}\}$.

The collection of all associate parameter set is $V = \{V_T \cup V_P\} \cup \{V_T \cup V_F \cup V_P \cup V_C\} = \{V_T \cup V_P \cup V_F \cup V_C\} = \{muddy, wooden, RCC, low, high, very\ high, east, west, north, south, bad, good\} = \{e_{t1}, e_{t2}, e_{t3}, e_{p1}, e_{p2}, e_{p3}, e_{f1}, e_{f2}, e_{f3}, e_{f4}, e_{c1}, e_{c2}\}$.

The swarm map $f_A : V \to P(U)$ is defined by
$f_A(e_{t1}) = \{h_2, h_3\}$, $f_A(e_{t2}) = \{h_1, h_4\}$, $f_A(e_{t3}) = \{h_5, h_6\}$,
$f_A(e_{p1}) = \{h_2, h_4, h_5\}$, $f_A(e_{p2}) = \{h_3\}$, $f_A(e_{p3}) = \{h_1, h_6\}$,

Then the swarm set is $(f_A, V) = \{(h_1, \{e_{t2}, e_{p3}\}), (h_2, \{e_{t1}, e_{p1}\}), (h_3, \{e_{t1}, e_{p2}\}), (h_4, \{e_{t2}, e_{p1}\}), (h_5, \{e_{t3}, e_{p1}\}), (h_6, \{e_{t3}, e_{p3}\})\}$.

The swarm map $f_B : V \to P(U)$ is defined by
$f_B(e_{t1}) = \{h_2, h_3\}$, $f_B(e_{t2}) = \{h_1, h_4\}$, $f_B(e_{t3}) = \{h_5, h_6\}$,
$f_B(e_{f1}) = \{h_2, h_3, h_5, h_6\}$, $f_B(e_{f2}) = \{\phi\}$, $f_B(e_{f3}) = \{h_1, h_4\}$,
$f_B(e_{f4}) = \{\phi\}$, $f_B(e_{p1}) = \{h_2, h_4, h_5\}$, $f_B(e_{p2}) = \{h_3\}$,
$f_B(e_{p3}) = \{h_1, h_6\}$, $f_B(e_{c1}) = \{h_1, h_2, h_4, h_5\}$, $f_B(e_{c2}) = \{h_3, h_6\}$.

Then the swarm set is $(f_B, V) = \{(h_1, \{e_{t2}, e_{f3}, e_{p3}, e_{c1}\}), (h_2, \{e_{t1}, e_{f1}, e_{p1}, e_{c1}\}), (h_3, \{e_{t1}, e_{f1}, e_{p2}, e_{c2}\}), (h_4, \{e_{t2}, e_{f3}, e_{p1}, e_{c1}\}), (h_5, \{e_{t3}, e_{f1}, e_{p1}, e_{c1}\}), (h_6, \{e_{t3}, e_{f1}, e_{p3}, e_{c2}\})\}$. Therefore, $(f_A, V) \tilde{\subset} (f_B, V)$.

**Definition 5.4: NOT set of attribute and NOT associate parameters set:** Let $A = \{P, Q, R\}$ *be the set of attributes.* The associate parameter set of an attribute $P$ is $V_P = \{e_{p1}, e_{p2}\}$, $Q$ is $V_Q = \{e_{q1}, e_{q2}\}$ and $R$ is $V_R = \{e_{r1}, e_{r2}\}$.

The collection of all associate parameter set is $V = V_P \cup V_Q \cup V_R = \{e_{p1}, e_{p2}, e_{q1}, e_{q2}, e_{r1}, e_{r2}\}$.

The NOT set of attribute and NOT associate parameters *set are denoted by* $\neg A$ and $\neg V$ *respectively and defined by* $\neg A = \{\neg P, \neg Q, \neg R\}$ and $\neg V = (\neg V_P) \cup (\neg V_Q) \cup (\neg V_R) = \{\neg e_{p1}, \neg e_{p2}, \neg e_{q1}, \neg e_{q2}, \neg e_{r1}, \neg e_{r2}\}$.
That is $\neg e_{pi} = not\ e_{pi}, \neg e_{qi} = not\ e_{qi}, \neg e_{ri} = not\ e_{ri}, \forall i$.

**Example 5.5:** Consider $A = \{Type, Condition\} = \{T, C\}$ is set of attributes and The associate parameter set of an attribute, Type is $V_T = \{muddy, wooden, RCC\} = \{e_{t1}, e_{t2}, e_{t3}\}$, Condition is $V_C = \{bad, good\} = \{e_{c1}, e_{c2}\}$.

The collection of all associate parameter set is $V = (V_T) \cup (V_C) = \{muddy, wooden, RCC, bad, good\} = \{e_{t1}, e_{t2}, e_{t3}, e_{c1}, e_{c2}\}$.

NOT set of an attribute $\neg A = \{\neg T, \neg C\}$ and NOT associate parameters set of an attribute, Type is $\neg V_T = \{not\ muddy, not\ wooden, not\ RCC\} = \{\neg e_{t1}, \neg e_{t2}, \neg e_{t3}\}$, Condition is $\neg V_C = \{not\ bad, not\ good\} = \{\neg e_{c1}, \neg e_{c2}\}$.

Therefore the collection of all NOT associate parameters set is $\neg V = \{(\neg V_T) \cup (\neg V_C)\} = \{not\ muddy, not\ wooden, not\ RCC, not\ bad, not\ good\} = \{\neg e_{t1}, \neg e_{t2}, \neg e_{t3}, \neg e_{c1}, \neg e_{c2}\}$.

**Proposition 5.6:** Let $(f_A, V)$ and $(f_B, V)$ are two swarm sets over common object set $U$ and $A$, $B$ are sets of attributes. The associate parameters sets are $V_A = \bigcup_{a \in A} V_a$ and $V_B = \bigcup_{b \in B} V_b$ *respectively and the collection of all associate parameter set is* $V = (\cup_{a \in A} V_a) \bigcup (\cup_{b \in B} V_b)$. Then
*i)* $\neg(\neg(A)) = A$

$ii)$ $\neg(A \cup B) = (\neg A \cup \neg B)$
$iii)$ $\neg(A \cap B) = (\neg A \cap \neg B)$

**Definition 5.7: Complement of swarm set :** A *complement of swarm set* $(f_A, V)$ *is denoted by* $(f_A, V)^C$ and is defined by $(f_A, V)^C = (f^C_{\neg A}, \neg V)$.

The *complement of swarm map* $f^C_{\neg A} : \neg V \to P(U)$ is defined by $f^C_{\neg A}(\neg e_a) = U - f_A(e_a)$, $\forall\ a \in V_A$. Clearly, $[(f_A, V)^C]^C = (f_A, V)$.

**Example 5.8:** Consider $U = \{h_1, h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{10}\}$ and $A = \{Type, Face, Price, Durable, Condition\} = \{T, F, P, D, C\}$ .

The collection of all associate parameter set is $V = \{muddy, wooden,$ $RCC, east, west, north, south, low, high, very\ high, less, more, most, bad, good\} = \{e_{t1}, e_{t2}, e_{t3}, e_{f1}, e_{f2}, e_{f3}, e_{f4}, e_{p1}, e_{p2}, e_{p3}, e_{d1}, e_{d2}, e_{d3}, e_{c1}, e_{c2}\}$.

The complement of swarm map $f^C_{\neg A} : \neg V \to P(U)$ is defined by
$f^C_{\neg A}(\neg e_{t1}) = U - f_A(e_{t1}) = U - \{h_2, h_4, h_9\} = \{h_1, h_3, h_5, h_6, h_7, h_8, h_{10}\}$,
i. e. $f^C_{\neg A}(not\ muddy\ type\ houses) = \{h_1, h_3, h_5, h_6, h_7, h_8, h_{10}\}$, Similarly
$f^C_{\neg A}(\neg e_{t2}) = f^C_{\neg A}(not\ wooden\ type\ houses) = \{h_2, h_3, h_4, h_6, h_9, h_{10}\}$,
$f^C_{\neg A}(\neg e_{t3}) = f^C_{\neg A}(not\ RCC\ type\ houses) = \{h_1, h_2, h_4, h_5, h_7, h_8, h_9\}$,
$f^C_{\neg A}(\neg e_{f1}) = f^C_{\neg A}(not\ east\ face\ houses) = \{h_1, h_5, h_9, h_{10}\}$,
$f^C_{\neg A}(\neg e_{f2}) = f^C_{\neg A}(not\ west\ face\ houses) = U$,
$f^C_{\neg A}(\neg e_{f3}) = f^C_{\neg A}(not\ north\ face\ houses) = \{h_2, h_3, h_4, h_6, h_7, h_8\}$,
$f^C_{\neg A}(\neg e_{f4}) = f^C_{\neg A}(not\ south\ face\ houses) = U$,
$f^C_{\neg A}(\neg e_{p1}) = f^C_{\neg A}(not\ low\ price\ houses) = \{h_1, h_3, h_5, h_6, h_7, h_8, h_{10}\}$,
$f^C_{\neg A}(\neg e_{p2}) = f^C_{\neg A}(not\ high\ price\ houses) = \{h_2, h_3, h_4, h_6, h_9, h_{10}\}$,
$f^C_{\neg A}(\neg e_{p3}) = f^C_{\neg A}(not\ very\ high\ price\ houses) = \{h_1, h_2, h_4, h_5, h_7, h_8, h_9\}$,
$f^C_{\neg A}(\neg e_{d1}) = f^C_{\neg A}(not\ less\ durable\ houses) = \{h_1, h_2, h_3, h_5, h_6, h_7, h_8, h_{10}\}$,
$f^C_{\neg A}(\neg e_{d2}) = f^C_{\neg A}(not\ more\ durable\ houses) = \{h_1, h_3, h_4, h_6, h_9\}$,
$f^C_{\neg A}(\neg e_{d3}) = f^C_{\neg A}(not\ most\ durable\ houses) = \{h_2, h_4, h_5, h_7, h_8, h_9, h_{10}\}$,
$f^C_{\neg A}(\neg e_{c1}) = f^C_{\neg A}(not\ bad\ condition\ houses) = \{h_1, h_3, h_6, h_9, h_{10}\}$,
$f^C_{\neg A}(\neg e_{c2}) = f^C_{\neg A}(not\ good\ condition\ houses) = \{h_2, h_4, h_5, h_7, h_8\}$,

**Definition 5.9: Null swarm set:** A *swarm set* $(f_A, V)$ *is said to be Null swarm set denoted by* $\phi$, if $\forall\ e_a \in V_A$, $f_A(e_a) = \phi$ *(null-set).*

**Example 5.10:** *Let* $U = \{u_1, u_2, u_3, u_4, u_5\}$ be the set of objects and $A = \{P, Q, R\}$ be the set attributes. The associate parameters sets of an attribute $P$ is $V_P = \{e_{p1}, e_{p2}, e_{p3}\}$, $Q$ is $V_Q = \{e_{q1}, e_{q2}\}$ and $R$ is $V_R = \{e_{r1}, e_{r2}, e_{r3}\}$.

The collection of all associate parameter set is $V = V_P \cup V_Q \cup V_R = \{e_{p1}, e_{p2}, e_{p3}, e_{q1}, e_{q2}, e_{r1}, e_{r2}, e_{r3}\}$.

The swarm map $f_A : V \to P(U)$ is defined by
$f_A(e_{p1}) = \{\phi\}$, $f_A(e_{p2}) = \{\phi\}$, $f_A(e_{p3}) = \{\phi\}$,
$f_A(e_{q1}) = \{\phi\}$, $f_A(e_{q2}) = \{\phi\}$, $f_A(e_{r1}) = \{\phi\}$,
$f_A(e_{r2}) = \{\phi\}$, $f_A(e_{r3}) = \{\phi\}$.

Then the swarm set is $(f_A, V) = \{(u_1, \{\phi\}), (u_2, \{\phi\}), (u_3, \{\phi\}), (u_4, \{\phi\}),$ $(u_5, \{\phi\})$. Therefore $(f_A, V)$ is NULL swarm set.

## 6. Union and Intersecton of two swarm sets

In this section, give definitions of union and intersecton of two swarm sets with examples.

Let $(f_A, V)$ and $(f_B, V)$ are two swarm sets over common object set $U$ and

$A$, $B$ are sets of attributes. The associate parameters sets are $V_A = \bigcup_{a\in A} V_a$ and $V_B = \bigcup_{b\in B} V_b$ respectively. The collection of all associate parameter set is $V = (\cup_{a\in A}V_a)\bigcup(\cup_{b\in B}V_b)$.

**Definition 6.1 :** The *union* of $(f_A, V)$ and $(f_B, V)$ *denoted by* $(f_A, V)\cup(f_B, V)$ *and is defined by* $(f_A, V)\cup(f_B, V) = (f_{A\cup B}, V)$.

The swarm map $f_{A\cup B} : V \to P(U)$ is defined by

$$f_{A\cup B}(e_\alpha) = \begin{cases} f_A(e_\alpha), & \text{if } e_\alpha \in A - B \\ f_B(e_\alpha), & \text{if } e_\alpha \in B - A \\ f_A(e_\alpha)\cup f_B(e_\alpha), & \text{if } e_\alpha \in A\cap B \end{cases} \tag{3}$$

**Example 6.2:** Consider $U = \{h_1, h_2, h_3, h_4, h_5, h_6\}$ is set of objects and $A = \{Type, Price, Durable\} = \{T, P, D\}$, $B = \{Type, Durable, Condition\} = \{T, D, C\}$ are sets of attributes.

The associate parameter set of an attribute $A$ of Type is $V_T = \{muddy, wooden\} = \{e_{t1}, e_{t2}\}$, Price is $V_P = \{low, high\} = \{e_{p1}, e_{p2}\}$ and Condition is $V_C = \{bad, good\} = \{e_{c1}, e_{c2}\}$. Also The associate parameter set of an attribute $B$ of Type is $V_T = \{muddy, wooden\} = \{e_{t1}, e_{t2}\}$, Durable is $V_D = \{less, more\} = \{e_{d1}, e_{d2}\}$ and Condition is $V_C = \{bad, good\} = \{e_{c1}, e_{c2}\}$.

Therefore the collection of all associated parameters set is $V = \{V_T \cup V_P \cup V_D\}\cup\{V_T\cup V_D\cup V_C\} = V_T\cup V_P\cup V_D\cup V_C = \{muddy, wooden, low, high, less, more, bad, good\} = \{e_{t1}, e_{t2}, e_{p1}, e_{p2}, e_{d1}, e_{d2}, e_{c1}, e_{c2}\}$.

The swarm map $f_A : V \to P(U)$ is defined by
$f_A(e_{t1}) = \{h_2, h_3\}$, $f_A(e_{t2}) = \{h_1, h_4, h_5, h_6\}$,
$f_A(e_{p1}) = \{h_1, h_3, h_5\}$, $f_A(e_{p2}) = \{h_2, h_4, h_6\}$.
$f_A(e_{d1}) = \{h_2, h_4, h_6\}$, $f_A(e_{d2}) = \{h_1, h_3, h_5\}$.

Then the swarm set is $(f_A, V) = \{(h_1, \{e_{t2}, e_{p1}, e_{d2}\}), (h_2, \{e_{t1}, e_{p2}, e_{d1}\}), (h_3, \{e_{t1}, e_{p1}, e_{d2}\}), (h_4, \{e_{t2}, e_{p2}, e_{d1}\}), (h_5, \{e_{t2}, e_{p1}, e_{d2}\}), (h_6, \{e_{t2}, e_{p2}, e_{d1}\})\}$.

The swarm map $f_B : V \to P(U)$ is defined by
$f_B(e_{t1}) = \{h_1, h_2, h_3, h_4\}$, $f_B(e_{t2}) = \{h_5, h_6\}$,
$f_B(e_{d1}) = \{h_1, h_5, h_6\}$, $f_B(e_{d2}) = \{h_2, h_3, h_4\}$,
$f_B(e_{c1}) = \{h_1, h_4, h_6\}$, $f_B(e_{c2}) = \{h_2, h_3, h_5\}$.

The swarm set is $(f_B, V) = \{(h_1, \{e_{t1}, e_{d1}, e_{c1}\}), (h_2, \{e_{t1}, e_{d2}, e_{c2}\}), (h_3, \{e_{t1}, e_{d2}, e_{c2}\}), (h_4, \{e_{t1}, e_{d2}, e_{c1}\}), (h_5, \{e_{t2}, e_{d1}, e_{c2}\}), (h_6, \{e_{t2}, e_{d1}, e_{c1}\})\}$.

Here $(f_A, V)$ and $(f_B, V)$ *are two swarm sets over a common object set* $U$ and $A$, $B$ *are sets of attributes.* The collection of all associated parameters set $V = \{e_{t1}, e_{t2}, e_{p1}, e_{p2}, e_{d1}, e_{d2}, e_{c1}, e_{c2}\}$.

If $A - B = \{T, P, D\} - \{T, D, C\} = P$, then the swarm map $f_{A\cup B} : V \to P(U)$ *defined by* $[f_{A\cup B}(e_\alpha)] = f_A(e_\alpha)$, $\forall\ e_\alpha \in A - B$, such that $f_{A\cup B}(e_{p1}) = f_A(e_{p1}) = \{h_1, h_3, h_5\}$, $f_{A\cup B}(e_{p2}) = f_A(e_{p2}) = \{h_2, h_4, h_6\}$

If $B - A = \{T, D, C\} - \{T, P, D\} = C$, then the swarm map $f_{A\cup B} : V \to P(U)$ *defined by* $[f_{A\cup B}(e_\alpha)] = f_B(e_\alpha)$, $\forall\ e_\alpha \in B - A$, such that $f_{A\cup B}(e_{c1}) = f_B(e_{c1}) = \{h_1, h_4, h_6\}$, $f_{A\cup B}(e_{c2}) = f_B(e_{c2}) = \{h_2, h_3, h_5\}$

If $A\cap B = \{T, P, D\}\cap\{T, D, C\} = \{T, D\}$, then the swarm map $f_{A\cup B} : V \to P(U)$ *defined by* $[f_{A\cup B}(e_\alpha)] = f_A(e_\alpha)\cup f_B(e_\alpha)$ , $\forall\ e_\alpha \in A\cap B$.
$f_{A\cup B}(e_{t1}) = f_A(e_{t1})\cup f_B(e_{t1}) = \{h_2, h_3\}\cup\{h_1, h_2, h_3, h_4\} = \{h_1, h_2, h_3, h_4\}$

$f_{A\cup B}(e_{t2}) = f_A(e_{t2}) \cup f_B(e_{t2}) = \{h_1, h_4, h_5, h_6\} \cup \{h_5, h_6\} = \{h_1, h_4, h_5, h_6\}$
$f_{A\cup B}(e_{d1}) = f_A(e_{d1}) \cup f_B(e_{d1}) = \{h_2, h_4, h_6\} \cup \{h_1, h_5, h_6\} = \{h_1, h_2, h_4, h_5, h_6\}$
$f_{A\cup B}(e_{d2}) = f_A(e_{d2}) \cup f_B(e_{d2}) = \{h_1, h_3, h_5\} \cup \{h_2, h_3, h_4\} = \{h_1, h_2, h_3, h_4, h_5\}$

**Definition 6.3:** The *intersection* of $(f_A, V)$ and $(f_B, V)$ *denoted by* $(f_A, V) \cap (f_B, V)$ *and is defined by* $(f_A, V) \cap (f_B, V) = (f_{A\cap B}, V)$.

The swarm map $f_{A\cap B} : V \to P(U)$ is defined by

$$f_{A\cap B}(e_\alpha) = \begin{cases} f_A(e_\alpha), & \text{if } e_\alpha \in A - B \\ f_B(e_\alpha), & \text{if } e_\alpha \in B - A \\ f_A(e_\alpha) \cap f_B(e_\alpha), & \text{if } e_\alpha \in A \cap B \end{cases} \tag{4}$$

**Example 6.4:** By Exmple 6.2, $(f_A, V)$ and $(f_B, V)$ *are two swarm sets over common object set* $U$ and $A$, $B$ *are sets of attributes*. The collection of all associate parameters set is $V = \{e_{t1}, e_{t2}, e_{p1}, e_{p2}, e_{d1}, e_{d2}, e_{c1}, e_{c2}\}$

If $A - B = \{T, P, D\} - \{T, D, C\} = P$, then the swarm map $f_{A\cap B} : V \to P(U)$ is defined by $f_{A\cap B}(e_\alpha) = f_A(e_\alpha)$, $\forall\ e_\alpha \in A - B$, such that
$f_{A\cap B}(e_{p1}) = f_A(e_{p1}) = \{h_1, h_3, h_5\}$, $\quad f_{A\cap B}(e_{p2}) = f_A(e_{p2}) = \{h_2, h_4, h_6\}$

If $B - A = \{T, D, C\} - \{T, P, D\} = C$, then the swarm map $f_{A\cap B} : V \to P(U)$ *defined by* $[f_{A\cap B}(e_\alpha)] = f_B(e_\alpha)$, $\forall\ e_\alpha \in B - A$, such that
$f_{A\cap B}(e_{c1}) = f_B(e_{c1}) = \{h_1, h_4, h_6\}$, $\quad f_{A\cap B}(e_{c2}) = f_B(e_{c2}) = \{h_2, h_3, h_5\}$

If $A \cap B = \{T, P, D\} \cap \{T, D, C\} = \{T, D\}$, then the swarm map $f_{A\cap B} : V \to P(U)$ *defined by* $[f_{A\cap B}(e_\alpha)] = f_A(e_\alpha) \cap f_B(e_\alpha)$ , $\forall\ e_\alpha \in A \cap B$
$[f_{A\cap B}(e_{t1})] = [f_A(e_{t1})] \cap [f_B(e_{t1})] = [\{h_2, h_3\}] \cap [\{h_1, h_2, h_3, h_4\}] = [\{h_2, h_3\}]$
$f_{A\cap B}(e_{t2}) = f_A(e_{t2}) \cap f_B(e_{t2}) = \{h_1, h_4, h_5, h_6\} \cap \{h_5, h_6\} = \{h_5, h_6\}$
$f_{A\cap B}(e_{d1}) = f_A(e_{d1}) \cap f_B(e_{d1}) = \{h_2, h_4, h_6\} \cap \{h_1, h_5, h_6\} = \{h_6\}$
$f_{A\cap B}(e_{d2}) = f_A(e_{d2}) \cap f_B(e_{d2}) = \{h_1, h_3, h_5\} \cap \{h_2, h_3, h_4\} = \{h_3\}$

**Proposition 6.5:** If $(f_A, V)$ *is a swarm set in the objects set* $U$, $A$ *is set of attributes and the associate parameters set* $V_A = \bigcup_{a\in A}$. The collection of all associate parameter set is $V = (\cup_{a\in A} V_a)$, then

*i)* $\quad (f_A, V) \cup (f_A, V) = (f_A, V)$
*ii)* $\quad (f_A, V) \cap (f_A, V) = (f_A, V)$

**Proposition 6.6:** If $(f_A, V)$ , $(f_B, V)$ , $(f_C, V)$ are three swarm sets over common objects set $U$ and $A$, $B$, $C$ are sets of attributes. The associate parameters sets are $V_A = \bigcup_{a\in A} V_a$, $V_B = \bigcup_{b\in B} V_b$ and $V_C = \bigcup_{c\in C} V_c$. The collection of all associate parameter set is $V = (\cup_{a\in A} V_a) \bigcup (\cup_{b\in B} V_b) \bigcup (\cup_{c\in C} V_c)$, *then*

*i)* $\quad [(f_A, V) \cup (f_B, V)] \cup (f_C, V) = (f_A, V) \cup [(f_B, V) \cup (f_C, V)]$
*ii)* $\quad [(f_A, V) \cap (f_B, V)] \cap (f_C, V) = (f_A, V) \cap [(f_B, V) \cap (f_C, V)]$

## 7. Application of Swarm Set

In this section, we present an application on real estate problem to illustrate the concept is discussed. The problem we consider is as below.

In a town there are fifteen houses are in sale, meanwhile six customers came to purchase the house of their own requirements. Now by using swarm set it is possible for customers to select their own requirements for the house. Here three customers are officers, two customers of business persons and one customer is retired person. The customers requirements are as follows:

Customers $X_1, X_2$ and $X_3$ are officers, their requirements are near by office, near by school, RCC type, medium dimension, east face, good location, good road and good water facility etc.

Customers $X_4$ and $X_5$ are business persons, their requirements are near by market, near bus stand, RCC type, well dimension, north face, good location, good road and good water facility etc.

Customer $X_6$ is retired person, his requirements are outside the city, small dimension, east face, less price, RCC type, good location, good road and good water facility etc.

Consider $U = \{h_1, h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{10}, h_{11}, h_{12}, h_{13}, h_{14}, h_{15}\}$ is object set of fifteen houses and $A = \{Type, Dimension, Face, Condition, Location, Price, School, Office, Road, Water, Bus\ stand, Market, City\} = \{T, D, F, Co, L, P, S, O, R, W, B, M, Ci\}$ is set of attributes.

The associate parameter set of an attribute, Type is $V_T = \{wooden,\ RCC\} = \{e_{t1}, e_{t2}\}$, $e_{t1}$ stands for wooden type and $e_{t2}$ stands for RCC type. Similarly, $V_D = \{20 \times 30,\ 30 \times 40,\ 40 \times 60\} = \{e_{d1}, e_{d2}, e_{d3}\}$, $e_{d1}$ stands for 20×30 dimension, $e_{d2}$ stands for 30×40 dimension and $e_{d3}$ stands for 40×60 dimension.
$V_F = \{east,\ north\} = \{e_{f1}, e_{f2}\}$, $e_{f1}$ stands for east face and $e_{f2}$ stands for north face.
$V_{Co} = \{bad,\ good\} = \{e_{co1}, e_{co2}\}$, $e_{co1}$ stands for bad condition and $e_{co2}$ stands for good condition.
$V_L = \{bad,\ good\} = \{e_{l1}, e_{l2}\}$, $e_{l1}$ stands for bad location and $e_{l2}$ stands for good location.
$V_P = \{25\ lakh\ , between\ 25\ to\ 55\ lakh\ , more\ than\ 55\ lakh\} = \{e_{p1}, e_{p2}, e_{p3}\}$, $e_{p1}$ stands for less price i.e less than 25 lakh, $e_{p2}$ stands for costly price i.e between 25 to 55 lakh and $e_{p3}$ stands for every costly price i.e more than 55 lakh.
$V_S = \{near,\ long,\ very\ long\} = \{e_{s1}, e_{s2}, e_{s3}\}$, $e_{s1}$ stands for near by school i.e within 4 kms, $e_{s2}$ stands for long distance to school i.e between 4 to 10 kms and $e_{s3}$ stands for very long distance i.e above 10 kms to schools.
$V_O = \{near,\ long,\ very\ long\} = \{e_{o1}, e_{o2}, e_{o3}\}$, $e_{o1}$ stands for near by office i.e within 4 kms, $e_{o2}$ stands for long distance to office i.e between 4 to 10 kms and $e_{o3}$ stands for very long distance i.e above 10 kms to offices.
$V_R = \{bad,\ good,\ very\ good\} = \{e_{r1}, e_{r2}, e_{r3}\}$, $e_{r1}$ stands for bad road, $e_{r2}$ stands good road and $e_{r3}$ stands for very good road.
$V_W = \{bad,\ good,\ very\ good\} = \{e_{w1}, e_{w2}, e_{w3}\}$, $e_{w1}$ stands for bad water facility, $e_{w2}$ stands good water facility and $e_{w3}$ stands for very good for water facility.
$V_B = \{near,\ long,\ very\ long\} = \{e_{b1}, e_{b2}, e_{b3}\}$, $e_{b1}$ stands for near to bus stand i.e within 4 kms, $e_{b2}$ stands for long distance to bus stand i.e between 4 to 10 kms, $e_{b3}$ stands for very long distance i.e above 10 kms to bus stand.
$V_M = \{near,\ long,\ very\ long\} = \{e_{m1}, e_{m2}, e_{m3}\}$, $e_{m1}$ stands for near to market i.e within 4 kms, $e_{m2}$ stands for long distance to market i.e between 4 to 10 kms, $e_{m3}$ stands for very long distance i.e above 10 kms to market.
$V_{Ci} = \{inside,\ outside\} = \{e_{ci1}, e_{ci2}\}$, $e_{ci1}$ stands for inside the city and $e_{ci2}$ stands for outside the city.

Therefore the collection of all associated parameters set $V = V_T \cup V_D \cup V_F \cup$

$V_{Co} \cup V_L \cup V_P \cup V_S \cup V_O \cup V_R \cup V_W \cup V_B \cup V_M \cup V_{Ci} = \{e_{t1}, e_{t2}, e_{d1}, e_{d2}, e_{d3}, e_{f1}, e_{f2}, e_{co1}, e_{co2}, e_{l1}, e_{l2}, e_{p1}, e_{p2}, e_{p3}, e_{s1}, e_{s2}, e_{s3}, e_{o1}, e_{o2}, e_{o3}, e_{r1}, e_{r2}, e_{r3}, e_{w1}, e_{w2}, e_{w3}, e_{b1}, e_{b2}, e_{b3}, e_{m1}, e_{m2}, e_{m3}, e_{ci1}, e_{ci2}\}$.

The swarm map $f_A : V \to P(U)$ is defined by
$f_A(wooden) = f_A(e_{t1}) = \{h_1, h_{10}, h_{15}\}$,
$f_A(RCC) = f_A(e_{t2}) = \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\}$,
$f_A(20 \times 30) = f_A(e_{d1}) = \{h_1, h_{10}, h_{15}\}$,
$f_A(30 \times 40) = f_A(e_{d2}) = \{h_3, h_4, h_5, h_7, h_8, h_9, h_{12}, h_{13}\}$,
$f_A(40 \times 60) = f_A(e_{d3}) = \{h_2, h_6, h_{11}, h_{14}\}$,
$f_A((east) = f_A(e_{f1}) = \{h_3, h_4, h_6, h_7, h_{10}, h_{12}, h_{13}, h_{14}\}$,
$f_A(north) = f_A(e_{f2}) = \{h_1, h_2, h_5, h_8, h_9, h_{11}, h_{15}\}$,
$f_A(bad) = f_A(e_{co1}) = \{h_{10}, h_{15}\}$,
$f_A(good) = f_A(e_{co2}) = \{h_1, h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\}$,
$f_A(bad) = f_A(e_{l1}) = \{h_1, h_{10}\}$,
$f_A(good) = f_A(e_{l2}) = \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}, h_{15}\}$,
$f_A(less) = f_A(e_{p1}) = \{h_1, h_{10}, h_{15}\}$,
$f_A(coslty) = f_A(e_{p2}) = \{h_3, h_4, h_5, h_7, h_8, h_9, h_{12}, h_{13}\}$,
$f_A(very\ coslty) = f_A(e_{p3}) = \{h_2, h_6, h_{11}, h_{14}\}$,
$f_A(near) = f_A(e_{s1}) = \{h_3, h_5, h_7, h_8, h_9, h_{12}\}$,
$f_A(long) = f_A(e_{s2}) = \{h_2, h_6, h_{11}, h_{14}\}$,
$f_A(very\ long) = f_A(e_{s3}) = \{h_1, h_4, h_{10}, h_{13}, h_{15}\}$,
$f_A(near) = f_A(e_{o1}) = \{h_3, h_5, h_7, h_8, h_9, h_{12}\}$,
$f_A(long) = f_A(e_{o2}) = \{h_2, h_6, h_{11}, h_{14}\}$,
$f_A(very\ long) = f_A(e_{o3}) = \{h_1, h_4, h_{10}, h_{13}, h_{15}\}$,
$f_A(bad) = f_A(e_{r1}) = \{h_1, h_{10}, h_{13}, h_{15}\}$,
$f_A(good) = f_A(e_{r2}) = \{h_4, h_5, h_8, h_9, h_{11}\}$,
$f_A(very\ good) = f_A(e_{r3}) = \{h_2, h_3, h_6, h_7, h_{12}, h_{14}\}$,
$f_A(bad) = f_A(e_{w1}) = \{h_1, h_{10}, h_{13}, h_{15}\}$,
$f_A(good) = f_A(e_{w2}) = \{h_4, h_5, h_{11}\}$,
$f_A(very\ good) = f_A(e_{w3}) = \{h_2, h_3, h_6, h_7, h_8, h_9, h_{12}, h_{14}\}$,
$f_A(near) = f_A(e_{b1}) = \{h_2, h_6, h_{11}, h_{14}\}$,
$f_A(long) = f_A(e_{b2}) = \{h_3, h_7, h_9, h_{12}, h_{15}\}$,
$f_A(very\ long) = f_A(e_{b3}) = \{h_1, h_4, h_5, h_8, h_{10}, h_{13}\}$,
$f_A(near) = f_A(e_{m1}) = \{h_2, h_6, h_{11}, h_{14}\}$,
$f_A(long) = f_A(e_{m2}) = \{h_3, h_5, h_7, h_8, h_9, h_{12}, h_{15}\}$,
$f_A(very\ long) = f_A(e_{m3}) = \{h_1, h_4, h_{10}, h_{13}\}$,
$f_A(inside) = f_A(e_{ci1}) = \{h_2, h_3, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{14}\}$,
$f_A(outside) = f_A(e_{ci2}) = \{h_1, h_4, h_{10}, h_{13}, h_{15}\}$,

Then the swarm set is $(f_A, V) = \{(h_1$ , { wooden type, $20 \times 30$ dimension, north face, good condition, bad location, less price, very long distance to school, very long distance to office, bad road, bad water facility, very long distance to bus stand, very long distance to market, outside the city }),
($h_2$, { RCC type, $40 \times 60$ dimension, north face, good condition, good location, every costly price, long distance to school, long distance to office, very good road, very good water facility, near by bus stand, near by market, inside the city }),

($h_3$, { RCC type, $30 \times 40$ dimension, east face, good condition, good location, costly price, near by school, near by office, very good road, very good water facility, long distance to bus stand, long distance to market, inside the city }),
($h_4$, { RCC type, $30 \times 40$ dimension, east face, good condition, good location, costly price, very long distance to school, very long distance to office, good road, good water facility, very long distance to bus stand, very distance long to the market, outside the city }),
($h_5$, { RCC type, $30 \times 40$ dimension, north face, good condition, good location, costly price, near by school, near by office, very good road, very good water facility, very long distance to bus stand, long distance to market, inside the city }),
($h_6$, { RCC type, $40 \times 60$ dimension, east face, good condition, good location, every costly price, long distance to school, long distance to office, very good road, very good water facility, near by bus stand, near by market, inside the city }),
($h_7$, { RCC type, $30 \times 40$ dimension, east face, good condition, good location, costly price, near by school, near by office, very good road, very good water facility, long distance to bus stand, long distance to market, inside the city }),
($h_8$, { RCC type, $30 \times 40$ dimension, north face, good condition, good location, costly price, near by school, near by office, good road, very good water facility, very long distance to bus stand, long distance to market, inside the city }),
($h_9$, { RCC type, $30 \times 40$ dimension, north face, good condition, good location, costly price, near by school, near by office, good road, very good water facility, long distance to bus stand, long distance to market, inside the city }),
($h_{10}$, { wooden type, $20 \times 30$ dimension, east face, bad condition, bad location, less price, very long distance to school, very long distance to office, bad road, bad water facility, very long distance to bus stand, very distance long to market, outside the city }),
($h_{11}$, { RCC type, $40 \times 60$ dimension, north face, good condition, good location, every costly price, long distance to school, long distance to office, good road, good water facility, near by bus stand, near by market, inside the city }),
($h_{12}$, { RCC type, $30 \times 40$ dimension, east face, good condition, good location, costly price, near by school, near by office, very good road, very good water facility, long distance to bus stand, long distance to market, inside the city }),
($h_{13}$, { RCC type, $30 \times 40$ dimension, east face, good condition, good location, costly price, very long distance to school, very long distance to office, bad road, bad water facility, very long distance to bus stand, very long distance to market, outside the city }),
($h_{14}$, { RCC type, $40 \times 60$ dimension, east face, good condition, good location, every costly price, long distance to school, long distance to office, very good road, very good water facility, near by bus stand, near by market, inside the city }),
($h_{15}$, { wooden type, $20 \times 30$ dimension, north face, bad condition, good location, less price, very long distance to school, very long distance to office, bad road, bad water facility, long distance to bus stand, long distance to market, outside the city }).

Tabular representation of swarm set is in Table 2.

Table 2:

| Ob. | Attributes | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U | T | D | F | Co | L | P | S | O | R | W | B | M | Ci |
| $h_1$ | $e_{t1}$ | $e_{d1}$ | $e_{f2}$ | $e_{co2}$ | $e_{l1}$ | $e_{p1}$ | $e_{s3}$ | $e_{o3}$ | $e_{r1}$ | $e_{w1}$ | $e_{b3}$ | $e_{m3}$ | $e_{ci2}$ |
| $h_2$ | $e_{t2}$ | $e_{d3}$ | $e_{f2}$ | $e_{co2}$ | $e_{l2}$ | $e_{p3}$ | $e_{s2}$ | $e_{o2}$ | $e_{r3}$ | $e_{w3}$ | $e_{b1}$ | $e_{m1}$ | $e_{ci1}$ |
| $h_3$ | $e_{t2}$ | $e_{d2}$ | $e_{f1}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s1}$ | $e_{o1}$ | $e_{r3}$ | $e_{w3}$ | $e_{b2}$ | $e_{m2}$ | $e_{ci1}$ |
| $h_4$ | $e_{t2}$ | $e_{d2}$ | $e_{f1}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s3}$ | $e_{o3}$ | $e_{r2}$ | $e_{w2}$ | $e_{b3}$ | $e_{m3}$ | $e_{ci2}$ |
| $h_5$ | $e_{t2}$ | $e_{d2}$ | $e_{f2}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s1}$ | $e_{o1}$ | $e_{r2}$ | $e_{w2}$ | $e_{b3}$ | $e_{m2}$ | $e_{ci1}$ |
| $h_6$ | $e_{t2}$ | $e_{d3}$ | $e_{f1}$ | $e_{co2}$ | $e_{l2}$ | $e_{p3}$ | $e_{s2}$ | $e_{o2}$ | $e_{r3}$ | $e_{w3}$ | $e_{b1}$ | $e_{m1}$ | $e_{ci1}$ |
| $h_7$ | $e_{t2}$ | $e_{d2}$ | $e_{f1}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s1}$ | $e_{o1}$ | $e_{r3}$ | $e_{w3}$ | $e_{b2}$ | $e_{m2}$ | $e_{ci1}$ |
| $h_8$ | $e_{t2}$ | $e_{d2}$ | $e_{f2}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s1}$ | $e_{o1}$ | $e_{r2}$ | $e_{w3}$ | $e_{b3}$ | $e_{m2}$ | $e_{ci1}$ |
| $h_9$ | $e_{t2}$ | $e_{d2}$ | $e_{f2}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s1}$ | $e_{o1}$ | $e_{r2}$ | $e_{w3}$ | $e_{b2}$ | $e_{m2}$ | $e_{ci1}$ |
| $h_{10}$ | $e_{t1}$ | $e_{d1}$ | $e_{f1}$ | $e_{co1}$ | $e_{l1}$ | $e_{p1}$ | $e_{s3}$ | $e_{o3}$ | $e_{r1}$ | $e_{w1}$ | $e_{b3}$ | $e_{m3}$ | $e_{ci2}$ |
| $h_{11}$ | $e_{t2}$ | $e_{d3}$ | $e_{f2}$ | $e_{co2}$ | $e_{l2}$ | $e_{p3}$ | $e_{s2}$ | $e_{o2}$ | $e_{r2}$ | $e_{w2}$ | $e_{b1}$ | $e_{m1}$ | $e_{ci1}$ |
| $h_{12}$ | $e_{t2}$ | $e_{d2}$ | $e_{f1}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s1}$ | $e_{o1}$ | $e_{r3}$ | $e_{w3}$ | $e_{b2}$ | $e_{m2}$ | $e_{ci1}$ |
| $h_{13}$ | $e_{t2}$ | $e_{d2}$ | $e_{f1}$ | $e_{co2}$ | $e_{l2}$ | $e_{p2}$ | $e_{s3}$ | $e_{o3}$ | $e_{r1}$ | $e_{w1}$ | $e_{b3}$ | $e_{m3}$ | $e_{ci2}$ |
| $h_{14}$ | $e_{t2}$ | $e_{d3}$ | $e_{f1}$ | $e_{co2}$ | $e_{l2}$ | $e_{p3}$ | $e_{s2}$ | $e_{o2}$ | $e_{r3}$ | $e_{w3}$ | $e_{b1}$ | $e_{m1}$ | $e_{ci1}$ |
| $h_{15}$ | $e_{t1}$ | $e_{d1}$ | $e_{f2}$ | $e_{co1}$ | $e_{l2}$ | $e_{p1}$ | $e_{s3}$ | $e_{o3}$ | $e_{r1}$ | $e_{w1}$ | $e_{b2}$ | $e_{m2}$ | $e_{ci2}$ |

Find the requirements of customers by using the formula

$$Requirement = \bigcap\{f_A(parameter)\}_{customer\ requirement}$$
$$= \bigcap_{\alpha\in A}\{f_A(\alpha), \alpha \in \text{requirement parameter }\}$$

$$\text{Officers requirement} = \bigcap\{f_A(parameters)\}_{requirements}$$
$$= \bigcap_{\alpha\in A}\{f_A(\alpha), \alpha \in requirements\ parameters\}$$

$= \cap$ (near by office) $\cap$ (near by school) $\cap$ (medium dimension) $\cap$ (granite type) $\cap$ (east facing) $\cap$ (wide road) $\cap$ (sufficient water facility)

$= \cap f_A(e_{o1}) \cap f_A(e_{s1}) \cap f_A(e_{d2}) \cap f_A(e_{t2}) \cap f_A(e_{f1}) \cap f_A(e_{r3}) \cap f_A(e_{w3})$

$= \cap\{h_3, h_5, h_7, h_8, h_9, h_{12}\} \cap \{h_3, h_5, h_7, h_8, h_9, h_{12}\} \cap \{h_3, h_5, h_7, h_8, h_9, h_{12}\}$
$\cap\{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\} \cap \{h_3, h_4, h_5, h_7, h_8, h_9, h_{12}, h_{13}\}$
$\cap\{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\} \cap \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11},$
$h_{12}, h_{13}, h_{14}\} = \{h_3, h_5, h_7, h_8, h_9, h_{12}\}$

Officers customers can select their own house which meets their requirements by using swarm set, because each house information is available. Here $h_3, h_5, h_7, h_8, h_9$ and $h_{12}$ houses are suitable for officers $X_1, X_2$ and $X_3$. So in this concept the customers $X_1, X_2$ and $X_3$ can select any one of the house in the list $\{h_3, h_5, h_7, h_8, h_9, h_{12}\}$.

$$\text{Business Pepole requirement} = \bigcap\{f_A(parameters)\}_{requirements}$$
$$= \bigcap_{\alpha\in A}\{f_A(\alpha), \alpha \in requirements\ parameters\}$$

$= \cap$ (near by market) $\cap$ (near by bus stand) $\cap$ (wide dimension) $\cap$ (granite type) $\cap$ (north facing) $\cap$ (wide road) $\cap$ (sufficient water facility)

$= \cap f_A(e_{m1}) \cap f_A(e_{b1}) \cap f_A(e_{d3}) \cap f_A(e_{t2}) \cap f_A(e_{f2}) \cap f_A(e_{r3}) \cap f_A(e_{w3})$

$= \cap\{h_2, h_6, h_{11}, h_{14}\} \cap \{h_2, h_6, h_{11}, h_{14}\} \cap \{h_2, h_6, h_{11}, h_{14}\} \cap \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\} \cap \{h_1, h_2, h_6, h_{10}, h_{11}, h_{14}, h_{15}\} \cap \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\} \cap \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\}$
$= \{h_2, h_6, h_{11}, h_{14}\}$

Business Pepole can select their own house which meets their requirements by using swarm set. Here $h_2, h_6, h_{11}$ and $h_{14}$ houses are suitable for business customers $X_4$ and $X_5$. So in this concept the customers $X_4$ and $X_5$ can select any one of the house in the list $\{h_2, h_6, h_{11}, h_{14}\}$.

Retired person requirement $= \bigcap\{f_A(parameters)\}_{requirements}$
$= \bigcap_{\alpha \in A} \{f_A(\alpha), \alpha \in requirements\ parameters\}$
$=$ ∩ (outside city) ∩ (small dimension) ∩ (east facing) ∩ (less price) ∩ (wide road) ∩ (sufficient water facility)
$= \cap f_A(e_{ci2}) \cap f_A(e_{d1}) \cap f_A(e_{f1}) \cap f_A(e_{p1}) \cap f_A(e_{co2}) \cap f_A(e_{r3}) \cap f_A(e_{w3})$
$= \cap\{h_1, h_4, h_{10}, h_{13}\} \cap \{h_1, h_4, h_{10}, h_{13}, h_{15}\} \cap \{h_3, h_4, h_5, h_7, h_8, h_9, h_{12}, h_{13}\} \cap \{h_1, h_4, h_{10}, h_{13}, h_{15}\} \cap \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\} \cap \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\} \cap \{h_2, h_3, h_4, h_5, h_6, h_7, h_8, h_9, h_{11}, h_{12}, h_{13}, h_{14}\}$
$= \{h_4, h_{13}\}$

Retired person can select own house which meets his requirements by using swarm set. Here $h_4$ and $h_{13}$ houses are suitable for retired person $X_6$. So in this concept the customer $X_6$ can select any one of the house in the list $\{h_4, h_{13}\}$.

**Conclusion**

This paper introduced a new concept of swarm sets that can be used to give a more detailed description of an object or situation, including a collection of parameters associated with each attribute of the object. Several operations on swarm set and established their important properties have been studied. This concept provides a new dimension of information system representation with a set-based structure. This concept is more generalization of soft set and soft expert set, also collection of more particular information about the objects by using swarm mapping. In our model is more power full for the information table and also information system, since collection of the information is very particular to define by mapping. Swarm set is extende to rough set theory and approaches to information system.

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