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Finding and Taxonomy a New Fuzzy Soft Points

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Abstract: In this study, we reformulate some definitions in view of the mathematical analysis concepts about the combination between the soft sets and fuzzy sets. We get a new four different fuzzy soft points produced via. the combination between the three different types of the fuzzy points and the different three types of soft points with illustrative examples

Key words: Taxonomy, fuzzy soft points, analysis, combination, illustrative examples, reformulate

INTRODUCTION

Bayramov (2013) was introduced the concept of fuzzy set in his paper of 1965, since, different problems in real live contains different types of uncertainty. Atanassov (1986) and Aygunoglu *et al*. (2014) introduced the concept of intuitionistic fuzzy sets which have many applications in several fields of real world as in reliability theory (Borgohain and Gohain, 2014). By Molodtsov (1999) introduced the concept of a soft set and started to develpe the basic of the corresponding theory as a new procedure to modeling uncertainties as a general mathematical tool for dealing with uncertain objects. Borgohain and Gohain (2014) given some new definitions on soft sets and they studied the application of soft set theory in the problems of decision making. Maji *et al*. (2001) they combined fuzzy sets and soft sets via. the study of soft set on a family of fuzzy sets and they called these sets a fuzzy soft sets in other words it is a soft set defined on the family of fuzzy sets . They presented some properties and relations for these fuzzy soft sets. Many researchers have applied this concept in different problems. Roy and Samanta (2012) gave the definition of fuzzy soft topology over the initial universe set. Further studied as by Kandil *et al*. (2014, 2015, 2017) and AL-Sweedi (2017) etc. The fuzzy soft sets takes a wide area of applications in engineering, economic, control systems, decision making, etc.

In our study we reformulate some definitions in view of the mathematical analysis concepts this impose that the definitions must be becomes more precise and simple. For the combination between the soft sets and fuzzy sets to find a fuzzy set such that its membership function is a combination of the fuzzy function with the soft function, say f is a function from (X) to I = [0, 1] and F is a function from E to (X) where X is a universal set, E is the set of parameters of the universal set X . We classify the families that contains these sets which are represent the combination of soft familes with fuzzy families to introduce a fuzzy families which depends on them. Zadeh (1975) introduced four families of soft sets denoted by $S_1(X)$-$S_4(X)$ with some basic notions (Subrie and Musleh, 2018). Three different soft points mentioned by Al-Swidi and Al-Fathly (2017) which are related with the fourth soft family $S_4(X)$, redefined a type of fuzzy point and produced two new other types of fuzzy points. It appears in our study a new different fuzzy soft points, produced via the combination between the three different types of the fuzzy points which produced by Subrie and Musleh (2018) with the different three types o f soft points mentioned by Al-Swidi and Al-Fathly (2017) and we get a new four fuzzy soft points with illustrative examples.

MATERIALS AND METHODS

Preliminaries: In this study some definitions which are concern our study throughout this study are presented.

Definition 2.1; Zadeh (1975): A fuzzy set A of a non-empty set X is characterized by a membership function $\mu A:X\rightarrow I$ whose value $\mu A(x)$ represents the degree of membership or grade of x in A for $x\in X$.

Definition 2.2; Maji *et al*. (2001, 2003): Let, U be an initial universe set and E be a set of parameters. Let, P(U) denotes the set of all fuzzy sets of U. Let, $A\subset E$ A pair (F, A) is called a fuzzy soft set over U where F is a mapping given by $F: A\rightarrow p(U)$.

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Definition 2.3; Molodtsov (1999): Let, U be an initial universe set and E be a set of parameters. Let P(U) denotes the power set of U and A⊂E, 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 a soft set over U be a parameterized family of subsets of the universe U. For ε∈A, F(ε) may be considered as the set of ϵ-approximate elements of the soft set (F, A).

RESULTS AND DISCUSSION

Fuzzy soft points: In this study we reformulate the definition of fuzzy soft set presented by Maji *et al*. (2001) and some definitions with illustrative examples a new four fuzzy soft points are introduced via. the combination between three types of the fuzzy points (Subrie and Musleh, 2018) with three the types of soft points (Al-Swidi and Al-Fathly, 2017).

Definition(1)[3.1]: Let f:X→I be a function and I^X be the collection of all fuzzy sets and E be parameters of elements of X. The fuzzy soft set denoted by F_A where F_f:A→I^X, F:A→P(x).

$$f\tilde{\tilde{A}}F_A = F_{f^A} = \{(a, F_f(a)), \forall a \in A, F_f(a) \in I^x\}$$

$$F_f(a) = \{(x, f_{F_{(a)}}(x); x \in X)\}$$

That is:

$$F_{f^A} = \{(a, (x, f_{F(a)}(x))), \forall a \in A, x \in X\}$$

$$A \subseteq E \; f_{F(a)}(x) = \begin{cases} f(x) & \text{if } x \in F(a) \\ 0 & \text{if } x \notin F(a) \end{cases}$$

$$\tilde{\tilde{\phi}} = \tilde{\tilde{0}} = \{(a, \tilde{0}), \forall a \in A\} \text{ the null fuzzy soft set}$$

$$\tilde{\tilde{X}} = \tilde{\tilde{1}} = \{(a, \tilde{1}), \forall a \in A\} \text{ the absolute fuzzy soft set}$$

$$\tilde{0} = \{(x, 0) : \forall x \in X\}$$

$$\tilde{1} = \{(x, 1) : \forall x \in X\}$$

Example 1; Let f: X→I:

$$f(x_1) = 0.2 \qquad X = \{x_1, x_2, x_3, x_4, x_5\}$$
$$f(x_2) = 0.9 \qquad E = \{e_1, e_2, e_3, e_4\}$$
$$f(x_3) = 0.4$$
$$f(x_4) = 0.5$$
$$f(x_5) = 0.8$$

And F: E→P(x):

$$\left.\begin{array}{l} F(e_1) = \{x_2, x_4\} \\ F(e_2) = X \\ F(e_3) = \phi \\ F(e_4) = \{x_1, x_3, x_5\} \end{array}\right\} F_A = \left\{\begin{array}{l} (e_1, F(e_1)), (e_2, F(e_2)), \\ (e_3, F(e_3)), (e_4, F(e_4)) \end{array}\right\}$$

Is a soft set:

$$f\{x_2, x_4\} = f_{F(e_1)} = \left\{\begin{array}{l} (x_1, 0), (x_2, 0.9), (x_3, 0), \\ (x_4, 0.5), (x_5, 0) \end{array}\right\}$$

$$f_{F(e_2)} = \{(x, 1), \forall x \in X\}$$

$$f_{F(e_3)} = \{(x, 0), \forall x \in X\}$$

$$f_{F(e_4)} = \{(x_1, 0.2), (x_2, 0), (x_3, 0.4), (x_5, 0.8)\}$$

Thus:

$$_f\tilde{\tilde{A}}_{FA} = \left\{\begin{array}{l} (e_1, f_{F(e_1)}), (e_2, f_{F(e_2)}), \\ (e_3, f_{F(e_3)}), (e_4, f_{F(e_4)}) \end{array}\right\} \text{ fuzzy soft set}$$

Definition (3.2) : Let X be an initial universe set, E be a set of parameters of elements of the set X and I = [0, 1]. The soft fuzzy set $\tilde{A}$ with membership foF where f is a mapping from P(x) to I and F is a mapping from E to P(x). That is: $\tilde{A}$ = {(a,(foF)(a)), a∈E} and foF:E→I.

Example (2): Let X = {x_1, x_2, x_3}, E = {e_1, e_2}:

$$F(e_1) = \{x_1, x_2\}, F(e_2) = \{x_3\}$$
$$f(\{x_1\}) = 0.1, f(\{x_2\}) = 0.2, f(\{x_3\}) = 0.14$$
$$f(\{x_1, x_2\}) = 0.11, f(\{x_1, x_3\}) = 0.12$$
$$f(\{x_2, x_3\}) = 0.13, f(X) = 1, f(\phi) = 0$$

Then:

$$(f\,oF)(e_1) = f(F(e_1)) = f(\{x_1, x_2\}) = 0.11$$
$$(f\,oF)(e_2) = f(F(e_2)) = f(\{x_3\}) = 0.14$$

Thus:

$$\tilde{A} = \{(e_1, 0.11), (e_2, 0.14)\}$$

Definition (3.3): Let F_e^x be a soft point and p_a^x be a fuzzy point, then from the combination of the soft point of type F_e^x with fuzzy point of type p_a^x we get fuzzy soft point of type:

$$F^e_{p^x_a} \ni F^e_{p^x_a}(\varepsilon) = \begin{cases} P^x_\alpha & \text{if } \varepsilon = e \\ \tilde{\theta} & \text{if } \varepsilon \neq e \end{cases}$$

example 3. The combination of the soft point of type F^X with fuzzy point of type P_α^x for some x∈E and 0<α<1, we get the fuzzy soft point of type $F_{P_\alpha^x}$ that is:

$$F_{P_\alpha^x} = \{(e, P_a^x), e \in E\}$$

example 5(i). Note that soft point F^y of fuzzy point of type P_α^x with x≠y we get that:

$$f_{F(e)}(z) = \begin{cases} f(z) \text{ if } z \in F(e) \\ 0 \quad \text{if } z \notin F(e) \end{cases}$$

Put F(e) = {y} ∀x∈X, so, we get f (z) = 0:

$$\forall z \in F(e) \rightarrow f_{F(e)}(z) = 0 \forall z \in X$$

Hence, $F_{P_\alpha^x} = \tilde{o}$ example 5(ii). The combination of the soft point of type F_e with fuzzy point of type P_α^x for some x∈X, e ∈E and 0<α<1 where:

$$F_e(y) = \begin{cases} F(e) \neq \varnothing \ \text{ if } y = e \\ \phi \qquad\quad \text{ if } y \neq e \end{cases}$$

Then, we get the following:

- if x∈F(e) and through it will be a fuzzy soft point of type $F_{P_\alpha^x}^e$
- if x∉F(e) then $F_{P_\alpha^x} = \tilde{\tilde{o}}$

So, through these two conditions we get a point of type:

$$e_{F_{P_\alpha^x}} = \begin{cases} F_{P_\alpha^x}^e \text{if } x \in F(e) \\ \tilde{\tilde{O}} \text{if } x \notin F(e) \end{cases}$$

example 6. The combination of the soft point type of F_e^x for some x∈X, e∈E with fuzzy point of type p_α, 0<α<1; Then, through it will be a fuzzy soft point of type $F_{P_\alpha^x}^e$ because F(e) = {x}, so, we have $f_{F(e)}(x)$ = f(x) = a and $f_{F(e)}(y)$ = 0∀y≠x example 7.

The combination of the soft point of type F^x, for some x∈X with fuzzy point of type p_α for 0<α< 1. then through it will be a fuzzy soft point of type $F_{P_\alpha^x}$ such that ∀e∈E∃y∈X$f_{F(e)} = P_\alpha^x$ example 8.

The combination of the soft point of type F_e, for some e∈E with fuzzy point of type p_α, 0<α<1 , then, it will a fuzzy soft point with a equation $F_{P_\alpha^{x(e)}}^e$, that is:

$$F_{P_\alpha^{x(e)}}^e(\in) = \begin{cases} P_a^{F(e)} \ \text{if} \in = e \\ \tilde{O} \ \ \text{if} \in \neq e \end{cases}$$

Where:

$$P_a^{F(e)}(x) = \begin{cases} a \ \text{ if } x \in F(e) \\ 0 \ \text{ if } x \notin F(e) \end{cases}$$

Example 3: Let:

$$X = \{x_1\ x_2\ x_3\ x_4, x_5\}$$
$$E = \{e_1, e_2, e_3, e_4\}$$

And:

$$F_{e_1}^{x_1} = \{(e_1, \{x_1\}), (e_2, \varnothing), (e_3, \varnothing), (e_4, \varnothing)\}$$
$$P_{0.2}^{x_1} = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0), (x_5, 0)\}$$

The membership function of fuzzy soft point $F_{P_\alpha^{x_1}}^{e_1}$:

$$f_{F(e_1)} = f_{\{x_1\}} = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0), (x_5, 0)\} = P_{0.2}^{x_1}$$
$$f_{F(e_2)} = f_\varnothing = \tilde{o}$$
$$f_{F(e_3)} = f_{F(e_4)} = f_\varnothing = \tilde{o}$$
$$F_{P_\alpha^{x_1}}^{e_1} = \{(e_1, P_{0.2}^{x_1}, (e_2, \tilde{o}), (e_3, \tilde{o}), (e_4, \tilde{o})\}$$

Note: Let, F_e^x be the soft point and P_α^y be a fuzzy point if x≠y, then, the fuzzy soft point $F_{P_\alpha^y}^x = \tilde{o}$ because $f_{F(e)} = \tilde{o} \forall e \in$ shown in example below.

Example 4: Let, X = {x_1, x_2, x_3, x_4, x_5}, E = {e_1, e_2, e_3, e_4} and:

$$F_{e_1}^{x_1} = \{(e_1, \{x_1\}), (e_2, \varnothing), (e_3, \varnothing), (e_4, \varnothing)\}$$
$$P_{0.2}^{x_2} = \{(x_1, 0), (x_2, 0.2), (x_3, 0), (x_4, 0), (x_5, 0)\}$$
$$f_{F(e_1)} = f_{F(e_2)} = f_{F(e_3)} = f_{F(e_4)} = \tilde{o}$$

Thus:

$$F_{P_\alpha^{x_2}}^{e_1} = \tilde{\tilde{o}}$$

Example 5: Let, $F_{x_1} = \{(e, \{x_1\}), e \in E\}$:

$$P_{0.2}^{x_1} = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0), (x_5, 0)\}$$
$$f_{F(e_1)} = f_{\{x_1\}} = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0), (x_5, 0)\}$$
$$f_{F(e_2)} = f_{\{x_1\}} = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0), (x_5, 0)\} = P_{0.2}^{x_1}$$
$$f_{F(e_3)} = f_{F(e_4)} = f_{\{x_1\}} = P_{0.2}^{x_1}$$
$$= \{(e, P_\alpha^{x_1}); e \in E\} = F_{P_\alpha}^{x_1}$$

$$P_{0.2}^{x_2} = \{(x_1, 0), (x_2, 0.2), (x_3, 0), (x_4, 0), (x_5, 0)\}$$
$$f_{\{x_1\}} = f_{F(e_1)} = ,\ldots, = f_{F(e_4)} = \{(e_1, 0), (e_2, 0), (e_3, 0), (e_4, 0)\}$$
$$f_{\{x_1\}}(y) = \begin{cases} f(y) \ \text{ if } y \in \{x_1\} \\ 0 \quad \text{if } y \notin \{x_1\} \end{cases} = 0 \ \forall x \in X$$

Example 6: $X = \{x_1, x_2, x_3, x_4\}$, $E = \{e_1, e_2, e_3\}$ let:

$$F_{e_1} = \{(e_1, B), (e_2, \varnothing), (e_3, \varnothing)\}$$
$$P_{0.2}^{x_1} = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0)\}$$

If $B = \{x_1, x_3\}$ then:

$$f_{F(e_1)} = f\{x_1, x_3\} = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0)\} =$$
$$P_{0.2}^{x_1}\ f_{F(e_2)} = f_{F(e_3)} = f_{\varnothing} = \tilde{o}$$

Thus:

$$F_{P_{0.2}^{x_1}}^{e_1} = \{(e_1, P_{0.2}^{x_1}), (e_2, \tilde{o}), (e_3, \tilde{o})\}$$

If $B = \{x_2, x_3, x_4\}$:

$$f_{F(e_1)} = f_B = \{(x_1, 0), (x_2, 0), (x_3, 0), (x_4, 0)\}$$
$$f_{F(e_2)} = f_{F(e_3)} = f_{\varnothing} = \tilde{o}$$

Thus:

$$F_{P_{0.2}^{x}} = \tilde{\tilde{o}}$$

Example 7: $X = \{x_1, x_2, x_3, x_4\}$, $E = \{e_1, e_2, e_3\}$ and:

$$P_{0.2} = \{(x_1, 0.2), (x_2, 0.2), (x_3, 0.2), (x_4, 0.2)\}$$
$$= \{(x, 0.2), \forall x \in X\}$$

$$F_{e_1}^{x_1} = \{(e_1, \{x_1\}), (e_2, \varnothing), (e_3, \varnothing)\}$$
$$f_{F(e_1)}(y) = f\{x_1\}(y) = \begin{cases} f(y) & \text{if } y \in \{x_1\} \\ 0 & \text{if } y \notin \{x_1\} \end{cases}$$
$$f_{F(e_1)} = \{(x_1, 0.2), (x_2, 0), (x_3, 0)\}$$
$$f_{F(e_2)} = f_{F(e_3)} = f_{\varnothing} = \tilde{o}$$

Thus:

$$F_{P_{\alpha}^{x_1}}^{e_1} = \{(e_1, P_{0.2}^{x_1}), (e_2, \tilde{o}), (e_3, \tilde{o})\}$$

If:

$$F_{e_2}^{x_3} = \{(e_1, \varnothing), (e_2, \{x_3\}), (e_3, \varnothing)\}$$
$$f_{F(e_1)} = f_{\varnothing} = \tilde{\tilde{o}}$$

$$f_{F(e_2)} = f_{\{x_3\}} \to f_{\{x_3\}}(y) = \begin{cases} f(x_3) & \text{if } y = x_3 \\ 0 & \text{if } y \neq x_3 \end{cases}$$
$$f_{F(e_2)} = \{(x_1, 0), (x_2, 0), (x_3, 0.2)\} \to \text{The fuzzy soft point } F_{P_{\alpha}^{x_3}}^{e_2}$$

Example 8: Let, $X = \{x_1, x_2, x_3, x_4\}$, $E = \{e_1, e_2, e_3\}$:

$$F^{x_1} = \{(e_1, \{x_1\}), (e_2, \{x_1\}), (e_3, \{x_1\})\}$$
$$P_{\alpha} = \{(x_1, \alpha), (x_2, \alpha), (x_3, \alpha)\}$$

Then, the membership function of P_{α} is:

$$f(x) = \alpha \quad \forall x \in X \quad 0<\alpha<1$$
$$f_{F(e_1)} = f_{\{x_1\}}(y) = \begin{cases} \alpha & \text{if } y = x_1 \\ 0 & \text{if } y \neq x_1 \end{cases}$$

$$f_{F(e_1)} = f_{\{x_1\}} = \{(x_1, \alpha), (x_2, 0), (x_3, 0), (x_4, 0)\}$$
$$f_{F(e_2)} = f_{\{x_1\}} = \{(x_1, \alpha), (x_2, 0), (x_3, 0), (x_4, 0)\}$$
$$f_{F(e_3)} = f_{\{x_1\}} = P_{\alpha}^{x_1}$$

Thus:

$$f_{F(e_1)} = f_{F(e_2)} = f_{F(e_3)} = P_{\alpha}^{x_1}$$
$$F_{P_{\alpha}^{x_1}} = \{(e_1, P_{\alpha}^{x_1}), (e_2, P_{\alpha}^{x_1}), (e_3, P_{\alpha}^{x_1})\}$$

Example 9: Let $X = \{x_1, x_2, x_3, x_4\}$:

$$E = \{e_1, e_2, e_3\}$$
$$P_{\alpha} = \{(x, \alpha); x \in X\}$$

If:

$$F_{e_1} = \{(e_1, \{x_1, x_2\}), (e_2, \varnothing), (e_3, \varnothing)\}$$
$$f_{F(e_1)} = f_{\{x_1, x_2\}} = \{(x_1, \alpha), (x_2, \alpha), (x_3, 0), (x_4, 0)\} = P_{\alpha}^{F(e_1)}$$
$$f_{F(e_2)} = f_{F(e_3)} = f_{\varnothing} = \tilde{o}$$

Thus:

$$F_{P_{\alpha}^{F(e_1)}}^{e_1} = \{(e_1, P_{\alpha}^{F(e_1)}), (e_2, \tilde{o}), (e_3, \tilde{o})\}$$

$$F_{e_1} = \{(e_1, \{x_2, x_3\}), (e_2, \varnothing), (e_3, \varnothing)\}$$
$$f_{F(e_1)} = f_{(x_2, x_3)} = (x_1, 0), (x_2, \alpha), (x_3, \alpha) =$$
$$P_{\alpha}^{F}(e_1) f_F(e_2) = f_F(e_3) = f\varnothing = \tilde{o}$$

Thus:

$$F_{(P_{\alpha}^{F}(e_1))}^{(e_1)} = (e_1, P_{\alpha}^{F}(e_1)), (e_2, \tilde{o}), (e_3, \tilde{o})$$

Example 10: If A is a proper sub set of the universe set X, through the following example we notice that let:

$$X = \{x_1, x_2, x_3, x_4\}$$
$$E = \{e_1, e_2, e_3\}$$
$$A = \{x_1, x_2, x_3\}$$

Let:

$$F_{e_1}^{x_1} = \{(e_1,\{x_1\}),(e_2,\varnothing),(e_3,\varnothing)\}$$
$$P_\alpha^{\{x_1,x_2\}} = \{(x_1,\alpha),(x_2,\alpha),(x_3,0)\}$$
$$f_{F(e_1)} = \{(x_1,\alpha),(x_2,0),(x_3,0)\} = P_\alpha^{x_1}$$
$$f_{F(e_2)} = f_{F(e_3)} = f_\varnothing = \tilde{0}$$
$$F_{P_\alpha^{x_1}}^{e_1} = \{(e_1, P_\alpha^{x_1}), (e_2, \tilde{0}), (e_3, \tilde{0})\}$$

$$F_{e_1}^{x} \to P_\alpha^{A} \text{ if } x \notin A \to F_{P_\alpha} \text{ fuzzy soft point}$$
$$\to F_{e_1}^{x_2} = \{(e_1,\{x_2\}),(e_2,\varnothing),(e_3,\varnothing)\}$$
$$P_\alpha^{\{x_1,x_3\}} = \{(x_1,\alpha),(x_2,0),(x_3,\alpha)\}$$
$$f_{F(e_1)} = f_{\{x_2\}} = \{(x_1,0),(x_2,0),(x_3,0)\} = \tilde{0}$$
$$f_{F(e_1)} = f_{F(e_3)} = \tilde{0}$$

$$F_e^x \to P_\alpha^A \begin{cases} \text{if } x \in A \to F_{P_\alpha^x}^e \\ \text{if } x \notin A \to \text{The combinatin } \tilde{\tilde{0}} \end{cases}$$

$$F_{x_1} = \{(e_1,\{x_1\}),(e_2,\{x_1\}),(e_3,\{x_1\})\}$$
$$P_\alpha^{\{x_1,x_2\}} = \{(x_1,\alpha).(x_2,0),(x_3,0)\}$$

$$f_{F(e_1)} = f_{\{x_1\}} = \{(x_1,\alpha),(x_2,0),(x_3,0)\} = P_\alpha^{x_1}$$
$$f_{F(e_2)} = f_{\{x_1\}} = \{(x_1,\alpha),(x_2,0),(x_3,0)\} = P_\alpha^{x_1}$$
$$f_{F(e_3)} = f_{\{x_1\}} = \{(x_1,\alpha),(x_2,0),(x_3,0)\} = P_\alpha^{x_1}$$
$$F_{P_\alpha^{x_1}} = \{(e_1, P_\alpha^{x_1}), (e_2, P_\alpha^{x_1}), (e_3, P_\alpha^{x_1})\}$$

For:

$$P_\alpha^{\{x_2,x_3\}} = \{(x_1, 0), (x_2, \alpha), (x_3, \alpha)\}$$
$$f_{F(e_1)} = f_{F(e_2)} = f_{F(e_3)} = f_{\{x_1\}} = \{(x_1, 0), (x_2, 0), (x_3, 0)\} = \tilde{0}$$

Thus, the combination is $= \tilde{\tilde{0}}$:

$$F_{e_1} = \{(e_1, \{x_1\})\}$$

If $A = F(e_1) = \{x_1\}$ then the combination is the fuzzy soft point P_α^e $F(e) \cap A = \phi \to$ the compination is $\tilde{\tilde{0}}$.

CONCLUSION

In this study we produced some new definitions and a new four different types of fuzzy soft points via. the combination between the three different fuzzy points presented by Borgohain and Gohain (2014) with three different soft points mentioned by AL-Sweedi (2017) with illustrative examples.

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