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# Fuzzy Soft Set approach to solve decision making problems

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## Abstract

In this paper, an application of fuzzy soft set for identifying an unknown object from the multi-observer fuzzy data has been discussed. The recognition strategy is based on the multi observer input parameter data set. An algorithm is given in detail to describe the model and it involves the construction of comparison table from the resultant soft set.

**Key words:** Fuzzy Set, Soft Set, Decision Making, Fuzzy-soft-set.

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## INTRODUCTION

Decision making is the process of sufficiently reducing uncertainty and doubt about alternatives to allow a reasonable choice to be made from among them. Based on the values and preferences of the decision maker every decision involves a certain amount of risk.

Molodtsov (1999) initiated a novel concept of soft theory as a new mathematical tool for dealing with uncertainties which is free from all limitations. The soft set introduced by Molodtsov (1999) and Pawlak (1994) is a set associated with a set of parameters and has been applied in several directions.

There are many uncertain problems in practical production and life which needs decisions made with soft sets and fuzzy sets. In the present study an attempt has been made to 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 multi observer decision making problem, where the final identification of the object is based on the set of inputs from different observes who provide the overall object characterization in terms of diverse sets of parameters.

### Preliminaries

#### Definition 2.1

Let U be an initial universe set and E be a set of parameters. Let P(U) denote the power set of U and A $\subset E$.A pair($\lambda$ , P) 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 is a parametrized family of subsets of the universe U. For $\varepsilon \epsilon A$,F($\varepsilon$) may be considered as the set of $\varepsilon -$ approximate elements of the soft set (F, A).

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#### Definition 2.2

If (F,A) and (G,B) be two soft sets then "(F , A) AND (G , B)" denoted by (F , A) ∧(G , B) is defined by (F , A) ∧(G , B) = (H , A ×B) where H($\alpha$, $\beta$) = F($\alpha$) ∩ $G(\beta)$, $\forall(\alpha, \beta) \epsilon A \times B$.

#### Definition 2.3

If (F,A) and (G,B) be two soft sets then "(F , A) OR (G , B)" denoted by (F, A) ∨(G ,B) is defined by (F , A) ∨ $(G , B)$ = $(O, A \times B)$where O($\alpha$ , $\beta$) $\epsilon A \times B$.

#### Definition 2.4

Let $\mathcal{P}(U)$denotes the set of all fuzzy sets of U. Let $A_i \subset$ E.A pair ($F_i$,$A_i$) is called a fuzzy- soft- set over U, where $F_i$ is a mapping given by $F_i : A_i \rightarrow \mathcal{P}(U)$.

#### Definition 2.5

If (F , A) and (G , B) be two fuzzy-soft-sets then "(F , A) AND (G , B)" is a fuzzy-soft-set denoted by (F , A) ∧(G , B) and is defined by (F , A)∧ (G , B) = (H, A×B), where H($\alpha$, $\beta$) = F($\alpha$)$\tilde{\cap}$ G($\beta$), $\forall\alpha \epsilon A$ *and* $\forall\beta \epsilon B$, where $\tilde{\cap}$ is the operation 'fuzzy intersection' of two fuzzy sets.

According to Gorzalzany (1987) andMaji (2007), comparison table is a square table in which the number of row and number of columns are equal, rows and columns both are labelled by the object names$o_1$, $o_2$, …..,$o_n$ of the universe, and the entries are $C_{ij}$, i,j = 1,2…, n, given by $C_{ij}$ = the numbers of parameters for which the membership value of $o_i$ exceeds or qual to the membership value of $o_j$.

Clearly, 0≤ $C_{ij} \leq k$, and $C_{ii}$=k, $\forall i, j$ where, k is the number of parameters present in a fuzzy soft set.

Thus, $C_{ij}$ indicates a numerical measure, which is an integer and $o_i$ dominates $o_j$ in $C_{ij}$ number of parameters out of k parameters.

### 2.1 Fuzzy soft sets in decision making

With reference to Atanassov (1996) and Gau (1996), U = $\{o_1, o_2, \ldots\ldots, o_k\}$be a set of k objects, which may be characterised by a set of parameters $\{A_1, A_2, \ldots\ldots, A_i\}$. The parameter space E may be written as E $\supseteq \{A_1 \cup A_2 \cup \ldots \cup A_i\}$. Let each parameter set $A_i$ represent 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 fuzzy sets.

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

## 3. Algorithm

- Input the fuzzy- soft-sets $(\lambda , P)$ , $(\beta , Q)$, $(\gamma , R)$.
- Input the parameters set P as observed by the observer.
- Compute the corresponding resultant fuzzy-soft-set (S , P) from the fuzzy soft sets $(\lambda , P)$,$(\beta , Q)$, $(\gamma, R)$ and place it in tabular form.
- Construct the comparison-table of the fuzzy-soft-set (S,P) and compute $r_i$ and $t_i$ for $o_i$, $\forall i$.
- Compute the score of $o_i$, $\forall i$.
- If the score$S_k$= $max_i S_i$ then the object $o_k$ will be the favourable decision
- If more than one $S_k$ will have the same value then choose any one of $o_k$ as the favourable decision.

**IV. Application in a decision making problem.**

Let U = $\{o_1, o_2, o_3, o_4, o_5, o_6\}$, be the set of objects having different colours, shapes and material which it is made. The parameter E = {white, orange, blue, red, square, rectangle, circle, cube, cuboid, plastic, wood, steel, clay}. Let P,Q,R denote the three subsets of the parameter E. Let P represents the colour space. P= {white, orange, blue, red}. Let Q represents the shape of the object., Q= {square, rectangle, circle, cube, cuboid}. Let R represents the material from which the object is made. R = {plastic, wood, steel, clay}.

Assuming that the fuzzy-soft-set $(\lambda, P)$ describe the 'objects having color space', the fuzzy-soft-set $(\beta, Q)$ describes the 'object having shape' and the fuzzy-soft-set ($\gamma$, R) describes the 'object having material'. The problem is to identify an unknown object from the multiobserves fuzzy data specified by different observers, in terms of fuzzy soft sets ($\lambda$, P), $(\beta, Q)$, $(\gamma, R)$, as specified earlier. These fuzzy soft sets may be computed as below.

The fuzzy- soft-set $(\lambda, P)$ is defined as $(\lambda, P)$ = {objects having white colour = $\{o_1/.3, o_2/.3, o_3/.4, o_4/.8, o_5/.7, o_6/.9\}$, objects having orange colour = $\{o_1/.4, o_2/.9, o_3/.5, o_4/.2, o_5/.3, o_6/.2\}$,

Object having blue colour = $\{o_1/.6, o_2/.3, o_3/.8, o_4/.4, o_5/.6, o_6/.4\}$,
Object having red colour = $\{o_1/.3, o_2/.3, o_3/.4, o_4/.8, o_5/.7, o_6/.9\}$}.
The fuzzy-soft-set $(\beta, Q)$ is defined as follows
Object having square =$\{o_1/.4, o_2/.8, o_3/.6, o_4/.9, o_5/.2, o_6/.3\}$,
Objects having rectangle= $\{o_1/.2, o_2/.6, o_3/.4, o_4/.8, o_5/.1, o_6/.2\}$,
Objects having circle = $\{o_1/.8, o_2/.3, o_3/.4, o_4/.2, o_5/.9, o_6/.8\}$,
Objects having cube = $\{o_1/.6, o_2/.1, o_3/.1, o_4/.1, o_5/.8, o_6/.6\}$,
Objects having cuboid = $\{o_1/.5, o_2/.7, o_3/.7, o_4/.6, o_5/.7, o_6/.5\}$}
The fuzzy- soft-set ($\gamma$, R) is defined as follows
Object having plastic = $\{o_1/.3, o_2/.6, o_3/.5, o_4/.7, o_5/.6, o_6/.8\}$,
Object having wood =$\{o_1/.4, o_2/.5, o_3/.6, o_4/.6, o_5/.6, o_6/.7\}$,
Object having steel =$\{o_1/.1, o_2/.4, o_3/.3, o_4/.6, o_5/.5, o_6/.7\}$,
Object having clay = $\{o_1/.9, o_2/.5, o_3/.6, o_4/.3, o_5/.4, o_6/.9\}$}.
The tabular representation of the fuzzy-soft-sets ($\lambda$ , P), ($\beta$, $Q$), ($\gamma$, R) are shown in tables 1(a)-(c), respectively.

**Table.1a.**

| U | 'white=$a_1$' | 'Orange= $a_2$' | 'blue=$a_3$' | 'red=$a_3$' |
|---|---|---|---|---|
| $o_1$ | 0.3 | 0.4 | 0.6 | 0.9 |
| $o_2$ | 0.3 | 0.9 | 0.3 | 0.5 |
| $o_3$ | 0.4 | 0.5 | 0.8 | 0.7 |
| $o_4$ | 0.8 | 0.2 | 0.4 | 0.8 |
| $o_5$ | 0.7 | 0.3 | 0.6 | 0.5 |
| $o_6$ | 0.9 | 0.2 | 0.4 | 0.3 |

**Table.1b.**

| U | 'square=$b_1$' | 'Rectangle =$b_2$' | 'circle= $b_3$' | 'Cube= $b_4$' | 'cuboid= $b_5$' |
|---|---|---|---|---|---|
| $o_1$ | 0.4 | 0.2 | 0.8 | 0.6 | 0.5 |
| $o_2$ | 0.8 | 0.6 | 0.3 | 0.1 | 0.7 |
| $o_3$ | 0.6 | 0.4 | 0.4 | 0.1 | 0.7 |
| $o_4$ | 0.9 | 0.8 | 0.2 | 0.1 | 0.4 |
| $o_5$ | 0.2 | 0.1 | 0.9 | 0.8 | 0.7 |
| $o_6$ | 0.3 | 0.2 | 0.8 | 0.6 | 0.5 |

**Table.1c.**

| U | 'Plastic=$c_1$' | 'wood=$c_2$' | 'steel=$c_3$' | 'clay=$c_4$' |
|---|---|---|---|---|
| $o_1$ | 0.3 | 0.4 | 0.1 | 0.9 |
| $o_2$ | 0.6 | 0.5 | 0.4 | 0.5 |
| $o_3$ | 0.5 | 0.6 | 0.3 | 0.6 |
| $o_4$ | 0.7 | 0.6 | 0.6 | 0.3 |
| $o_5$ | 0.6 | 0.6 | 0.5 | 0.4 |
| $o_6$ | 0.8 | 0.7 | 0.7 | 0.9 |

Considering the two fuzzy-soft-sets $(\lambda, P)$ and $(\beta, Q)$ if we perform "$(\lambda, P)$ AND $(\beta, Q)$" then we will have 4 × 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 fuzzy-soft set for the parameters R = $\{e_{11}, e_{15}, e_{21}, e_{24}, e_{33}, e_{44}, e_{45}\}$, then the resultant-fuzzy-soft-set for the fuzzy-soft-sets $(\lambda, P)$ and $(\beta, Q)$ is $(\mu, S)$, say.

So, after performing the "$(\lambda, P)$ AND $(\beta, Q)$" for some parameters the tabular representation of the resultant-fuzzy-soft-set $(\mu, S)$ will take the form as,

**Table.2.**

| U | '$e_{11}$' | '$e_{15}$' | '$e_{21}$' | '$e_{24}$' | '$e_{33}$' | '$e_{44}$' | '$e_{45}$' |
|---|---|---|---|---|---|---|---|
| $o_1$ | 0.3 | 0.3 | 0.4 | 0.4 | 0.6 | 0.6 | 0.5 |
| $o_2$ | 0.3 | 0.3 | 0.8 | 0.1 | 0.3 | 0.1 | 0.5 |
| $o_3$ | 0.4 | 0.4 | 0.5 | 0.1 | 0.4 | 0.1 | 0.7 |
| $o_4$ | 0.8 | 0.4 | 0.2 | 0.1 | 0.2 | 0.1 | 0.4 |
| $o_5$ | 0.2 | 0.7 | 0.2 | 0.3 | 0.6 | 0.5 | 0.5 |
| $o_6$ | 0.3 | 0.5 | 0.2 | 0.2 | 0.4 | 0.3 | 0.3 |

Let us now see how the algorithm may be used to solve our original problem. Consider the fuzzy-soft-sets $(\lambda, P)$, $(\beta, Q)$ and $(\gamma, R)$ as defined above. Suppose that P = $\{e_{11} \wedge c_1, e_{15} \wedge c_3, e_{21} \wedge c_2, e_{24} \wedge c_4, e_{33} \wedge c_3, e_{44} \wedge c_3, e_{45} \wedge c_4\}$, be the set of 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 resultant-fuzzy-soft-set $(s, P)$ will be as

**Table.3.**

| U | '$e_{11} \wedge c_1$' | '$e_{15} \wedge c_3$' | '$e_{21} \wedge c_2$' | '$e_{24} \wedge c_4$' | '$e_{33} \wedge c_3$' | '$e_{44} \wedge c_3$' | '$e_{45} \wedge c_4$' |
|---|---|---|---|---|---|---|---|
| $o_1$ | 0.3 | 0.1 | 0.4 | 0.4 | 0.1 | 0.1 | 0.5 |
| $o_2$ | 0.3 | 0.3 | 0.5 | 0.1 | 0.3 | 0.1 | 0.5 |
| $o_3$ | 0.4 | 0.3 | 0.5 | 0.1 | 0.3 | 0.1 | 0.6 |
| $o_4$ | 0.7 | 0.4 | 0.2 | 0.1 | 0.2 | 0.1 | 0.3 |
| $o_5$ | 0.2 | 0.5 | 0.2 | 0.3 | 0.5 | 0.5 | 0.4 |
| $o_6$ | 0.3 | 0.5 | 0.2 | 0.2 | 0.4 | 0.3 | 0.3 |

The comparison-table of the above resultant-fuzzy-soft-set is as below.

**Table.4.**

| U | Row-sum($r_i$) | Column-sum($t_i$) | Score($S_i$) |
|---|---|---|---|
| $o_1$ | 25 | 30 | -5 |
| $o_2$ | 29 | 31 | -2 |
| $o_3$ | 31 | 26 | 5 |
| $o_4$ | 24 | 33 | -9 |
| $o_5$ | 30 | 22 | 8 |
| $o_6$ | 29 | 26 | 3 |

From the above score table, it is clear that the maximum score is 8 scored by $o_5$. Therefore the decision will be in favour of selecting the object.

## CONCLUSION

In this paper, an application of fuzzy soft set theory in object recognition problem is given. This model will helpful for the decision maker to recognize the favourable object from the diverse sets of parameters. The final decision is based on the maximum score computed from the comparison table. So, it gives the better result and it will be highly satisfied by the decision maker.

## REFERENCES

Molodtsov, D.1999. Soft set theory-first results, *Comput. Math*. Appl. 37, 19–31. https://doi.org/10.1016/S0898-1221(99)00056-5

Pawlak, Z.1994. *Hard set and soft sets*, ICS Research Report, Institute of Computer Science, Poland. https://doi.org/10.1007/978-1-4471-3238-7_15