

Decision making using fuzzy soft set inference system

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Introduction

Related Work

fpfs-sets to fps-sets

Fuzzy Inference System

Fuzzy Soft Set Inference System

Strengths and Weaknesses

A 5000 feet view

- ▶ Using existing tools in fuzzy set theory to solve problems expressed in terms of soft sets.
- ▶ Allowing multiple choices to be made by comparative analysis.
- ▶ conversion between hybrid fuzzy-soft sets.

Methodology

- ▶ Simulations on Python 2.7 using NumPy.
- ▶ IPython/Jupyter Notebooks.
- ▶ Math :)

Dealing with uncertainty

- ▶ theory of probability
- ▶ interval mathematics
- ▶ theory of fuzzy sets

Soft Sets

- ▶ Proposed by Molodtsov in 1999 [7]
- ▶ A generalization of fuzzy set theory which was given by Zadeh.
- ▶ Aims to solve complicated economic, environmental, and social problems.

Soft Sets - Definition

Definition

The *soft set* is a parametrized family of subsets of the set U . Every set $F(e)$, $e \in E$, from this family may be considered as the set of e -elements of the soft set (F, E) . [7]

Soft Sets - Example

Example

A soft set (F, E) describes the attractiveness of the houses.

U - set of houses under consideration.

E - set of parameters.

$E = \{\text{expensive, beautiful, wooden, good-surroundings}\}$.

$F(e)$ - gives the set of houses that have attribute e

Soft Set Matrix [4]

Matrix Form

(F, E)	<i>expensive</i>	<i>wooden</i>	<i>beautiful</i>	<i>good – surroundings</i>
o_1	1	1	1	1
o_2	1	1	0	0
o_3	1	1	1	1
o_4	1	1	0	1
o_5	1	1	1	0
o_6	1	1	0	0

Hybrid soft and fuzzy sets

- ▶ Fuzzy Soft Set [8]
- ▶ Fuzzy Parameterized Soft Set [3]
- ▶ Fuzzy Parameterized Fuzzy Soft Set [3]

Related Work

- ▶ Fuzzy Soft Set to crisp Soft Set : α -cut [6]
- ▶ Decision making
 - ▶ Aggregation (FS-, FPS-, FPFS-sets) [5] [3]
 - ▶ By Comparison Table [1]
 - ▶ By Fuzzy-Soft Relations [2]

Proposed Work

- ▶ Defuzzification of fuzzy parameterized fuzzy soft-sets
- ▶ Solving decision making problems with Fuzzy Soft Set Inference Systems

Defuzzification of fuzzy parameterized fuzzy soft-sets

(F, E) is fuzzy parametrized fuzzy soft set describing houses.

(F, E)	<i>expensive</i>	<i>wooden</i>	<i>beautiful</i>	<i>good – surroundings</i>
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

E	<i>expensive</i>	<i>wooden</i>	<i>beautiful</i>	<i>good – surroundings</i>
<i>membership</i>	0.15	0.3	0.4	0.6

Say the buyer has the following requirements

- ▶ The house should be beautiful at least to a certain extent.
- ▶ The house should not be in bad surroundings.
- ▶ There are no budget constraints.
- ▶ There is no limit to which the house may be wooden.

This can be formalized as follows:

$$A \quad \textit{expensive} \quad \textit{wooden} \quad \textit{beautiful} \quad \textit{good} - \textit{surroundings}$$
$$\alpha \quad \left(\quad 0 \quad \quad 0 \quad \quad 0.6 \quad \quad \quad 0.5 \quad \quad \right)$$

On applying α -cut with the given values, we get the reduced fuzzy parametrized soft set

(G, B)	<i>expensive</i>	<i>wooden</i>	<i>beautiful</i>	<i>good – surroundings</i>
o_1	1	1	1	1
o_2	1	1	0	0
o_3	1	1	1	1
o_4	1	1	0	1
o_5	1	1	1	0
o_6	1	1	0	0

A	<i>expensive</i>	<i>wooden</i>	<i>beautiful</i>	<i>good – surroundings</i>
<i>membership</i>	0.15	0.3	0.4	0.6

Fuzzy Inference System

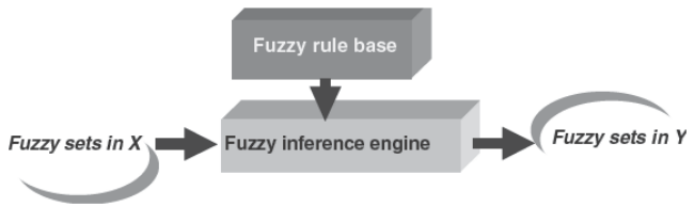


Figure : Fig. no. 1.4, Introduction to Fuzzy Logic using MATLAB, S.N. Sivanandam et al.

Decision making with Fuzzy Soft Set Inference Systems

The fuzzy soft set (F, A) denotes 'Candidates with Technical skills',

(F, A)	<i>low</i>	<i>medium</i>	<i>high</i>
σ_1	0.5	0.2	0.1
σ_2	0.1	0.8	0.1
σ_3	0.1	0.2	0.6
σ_4	0.2	0.25	0.3

(G, B) denotes 'Candidates with Leadership skills' and,

$$\begin{array}{l} (G, B) \quad \textit{normal} \quad \textit{exta - ordinary} \\ o_1 \quad \left(\begin{array}{cc} 0.2 & 0.4 \\ 0.3 & 0.4 \\ 0.9 & 0.1 \\ 0.2 & 0.6 \end{array} \right) \\ o_2 \\ o_3 \\ o_4 \end{array}$$

(H, C) denotes 'Candidates with Communication skills'.

$$\begin{array}{l} (H, C) \quad \textit{low} \quad \textit{medium} \quad \textit{high} \\ o_1 \quad \left(\begin{array}{ccc} 0.6 & 0.1 & 0 \\ 0.2 & 0.6 & 0.1 \\ 0 & 0.1 & 0.5 \\ 0.3 & 0.4 & 0.3 \end{array} \right) \\ o_2 \\ o_3 \\ o_4 \end{array}$$

General Form for rules

If A is A_0 and B is B_0 then C is C_0

Output fuzzy soft sets on mapping some set of rules with input -
Suitability for Technical Department

U	<i>low</i>	<i>medium</i>	<i>high</i>
σ_1	0.7	0.1	0
σ_2	0	0.9	0.1
σ_3	0.1	0.25	0.6
σ_4	0.2	0.4	0.35

Suitability for Administrative Department

U	<i>low</i>	<i>medium</i>	<i>high</i>
σ_1	0.1	0.4	0.3
σ_2	0.5	0.2	0.1
σ_3	0.6	0.25	0.1
σ_4	0.1	0.15	0.3

Suitability for Human Resources Department

U	<i>low</i>	<i>medium</i>	<i>high</i>
σ_1	0.2	0.2	0.6
σ_2	0	0.9	0.1
σ_3	0.3	0.2	0.1
σ_4	0.2	0.3	0.5

Further Analysis

- ▶ direct decision making from output
- ▶ constructing comparison tables
- ▶ aggregation

Strengths

- ▶ Easier to frame problems.
- ▶ Simple implementation.
- ▶ More generic/configurable in operation compared to Fuzzy inference System.

Weaknesses

- ▶ Not suitable for simple cases.
- ▶ Needs functional expert to frame rules.
- ▶ Rules can't be generalized.

Summary

- ▶ α cut on fuzzy parameterized fuzzy soft sets.
- ▶ A fuzzy inference system for fuzzy soft sets.

Future Work

The proposed algorithm can be extended for intuitionistic fuzzy soft sets.



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