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A New Approach to Hypersoft Sets and their Application in Decision Making

R.K. Mohanty[1], B.K. Tripathy[2,*]

Abstract

An uncertainty based model, parallel to the soft set (SS) model introduced by Molodtsov, was proposed by Smarandache in the form of hypersoft sets (HSS). The basic characteristic of both these models is that these are parametrized family of sets which are induced by the parameters involved. However, Smarandache had left open the basic operation on HSS. In this paper, we first redefine HSS using the characteristic function based approach, and through it standardize the basic operations like union, intersection and complementation, which are logical and uniform besides being easy to use. We further extend HSS to propose the notions of extended hypersoft set (EHSS) and fuzzy hypersoft set (FHSS). As an application, we propose a decision making algorithm on FHSS model and illustrate the process through an example. This is the first such algorithm using FHSS.

Keywords: Soft set, hypersoft set, extended hypersoft set, fuzzy hypersoft set, decision making

INTRODUCTION

To model uncertainty in data several models have been proposed. Prominent among them are fuzzy set [1], rough set, intuitionistic fuzzy set, soft set and their hybrid models. The soft set model was introduced by Molodtsov [2] as a parametrization tool. Many hybrid models of soft set are found in the literature. However there were no individual models which are different from soft set but have its characteristics. In 2018, Smarandache introduced one such model which he calls as hypersoft set (HSS) [3] and also some related models. It may be noted that HSS is different form soft set as instead of assigning a subset of the universal set to every parameter defined over it, HSS assigns subsets to each tuple of values of the parameters. With every HSS is associated a Cartesian product of domains of a set of parameters. Under no circumstances hyper soft set reduces to a soft set. But, it has its own importance as shown in some subsequent papers on the topic. Yolcu and Ozturk [4] has given an application of FHSS in decision making. The notion of soft set was re-defined by using a characteristic function approach in [5]. As observed by them it makes the concepts more concise and the operations were easily definable. Several hybrid fuzzy set based models of soft sets were defined and their properties are studied in [6–12]. In this paper our objectives are:

- To re-define HSS using the characteristic function approach
- To propose generalized versions of HSS in the form of EHSS and FHSS
- To define basic operations on HSS using this approach
- To propose a decision making algorithm using FHSS
- Illustrate the execution of the decision making algorithm through an example

***Author for Correspondence**
B.K. Tripathy
E-mail: tripathybk@vit.ac.in

[1]Ph.D. Scholar, School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India
[2]Professor, School of Information Technology and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India

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Table 5. Demographic influence.

	$\mathbf{m_1}$	$\mathbf{m_2}$	$\mathbf{m_3}$	$\mathbf{m_4}$	$\mathbf{m_5}$	$\mathbf{m_6}$	$\mathbf{m_7}$
Hindu General	0.132	0.121	0.11	0.11	0.044	0.132	0.066
Hindu SC	0.06	0.06	0.096	0.072	0.048	0.06	0.06
Hindu ST	0.035	0.035	0.042	0.056	0.035	0.042	0.042
Hindu OBC	0.168	0.168	0.168	0.168	0.084	0.168	0.14
Muslim	0.032	0.032	0.048	0.048	0.144	0.032	0.048
Christian	0.012	0.016	0.02	0.02	0.016	0.012	0.034
Other	0.066	0.055	0.055	0.066	0.044	0.066	0.055
Demographic Quotient	0.505	0.487	0.539	0.54	0.415	0.512	0.445

Table 6. Rank table.

	$\mathbf{m_1}$	$\mathbf{m_2}$	$\mathbf{m_3}$	$\mathbf{m_4}$	$\mathbf{m_5}$	$\mathbf{m_6}$	$\mathbf{m_7}$
NEQ	0.55	0.76	1	0.98	0.41	0.61	0.54
NIQ	0.64	0.96	0.68	0.81	1	0.74	0.85
NDQ	0.94	0.90	1	1	0.77	0.95	0.82
Score	0.70	0.87	0.89	0.93	0.73	0.77	0.74
Rank	7	3	2	1	6	4	5

Construct the demographic influence Table (Table 5) by multiplying the values in Table 3 to the respective category values in Table 4.

Table 6 constructed as the process mentioned in the steps 7 and 8 of algorithm.

So, the candidate m_4 is the most suitable candidate for the election with best winnability score. The next best suitable candidates are $m_3, m_2, m_6, m_7, m_5, m_1$ respectively.

CONCLUSION

The characteristic function approach used to define HSS is convenient to use and interpret. EHSS and FHSSs are proposed as generalizations of HSS. An algorithm on decision making using FHSS is proposed and its working principle is demonstrated through a real life example.

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