Algebraic Properties of Rough Set on Two Universal Sets based on Multigranulation

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ABSTRACT

The rough set philosophy is based on the concept that there is some information associated with each object of the universe. The set of all objects of the universe under consideration for particular discussion is considered as a universal set. So, there is a need to classify objects of the universe based on the indiscernibility relation (equivalence relation) among them. In the view of granular computing, rough set model is researched by single granulation. The granulation in general is carried out based on the equivalence relation defined over a universal set. It has been extended to multi-granular rough set model in which the set approximations are defined by using multiple equivalence relations on the universe simultaneously. But, in many real life scenarios, an information system establishes the relation with different universes. This gave the extension of multi-granulation rough set on single universal set to multi-granulation rough set on two universal sets. In this paper, we define multi-granulation rough set for two universal sets U and V. We study the algebraic properties that are interesting in the theory of multi-granular rough sets. This helps in describing and solving real life problems more accurately.

Keywords: Rough Set, Granule, Solitary Element, Solitary Set, Completeness, Roughness

INTRODUCTION

The traditional concept of crisp sets has been extended in many directions as far as modeling of real life situations is concerned. The earliest is the notion of fuzzy set by L. A. Zadeh (1965) that captures impreciseness in information. On the other hand rough sets of Z. Pawlak (1982, 1991) capture indiscernibility among objects to model imperfect knowledge. The basic philosophy is that human knowledge about a universe depends upon their capability to classify its

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objects. So, classification of a universe and indiscernibility relations defined on it are known to be interchangeable notions. The basic idea of rough set is based upon the approximation of sets by pair of sets known as lower approximation and upper approximation. Here, the lower and upper approximation operators are based on equivalence relations. However, the requirement of equivalence relation is a restrictive one and failure in many real life situations. In order to achieve this, rough set is generalized to binary relations (Yao, (1998,2001,2004); Kondo, 2006; Pawlak & Skowron, 2007a), fuzzy proximity relations (Tripathy & Acharjya (2008, 2010)), intuitionistic fuzzy proximity relations (Tripathy, 2006; Tripathy & Acharjya (2009, 2011)), boolean algebras (Liu, 2005; Pawlak & Skowron, 2007b), fuzzy lattices (Liu, 2008), completely distributive lattices (Chen et. al., 2006) and neighborhood systems (Lin, 1989). Development of these techniques and tools is studied under different domains like knowledge discovery in database, computational intelligence, knowledge representation, granular computing etc. (Saleem Durai et al., 2012; Acharjya et al. (2011, 2012); Tripathy et al., 2011).

In the view of granular computing, a general concept described by a set is always characterized by lower and upper approximations under static granulation. It indicates that the concept is depicted by means of single equivalence relation on the universe. However, in many real life situations, many concepts are described by using multi equivalence relations. Therefore, basic rough set model has been extended to rough set on multigranulations (Qian et al., (2006, 2007)) in which the set approximations are defined by using multi-equivalences on the universe. On the other hand, rough set models on two universal sets are generalized with generalized approximation spaces and interval structure (Wong et al., 1993). Here, the equivalence relation is generalized to binary relation.

In this paper, we propose the rough set on two universal sets based on multigranulation, where set approximations are defined by using multi binary relations on the universes. The main objective of the article is to investigate mathematical properties of rough set on two universal sets based on multigranulation. The rest of the paper is organized as follows: the fundamental concepts of rough set on two universal sets are reviewed then rough set on two universal sets based on multi granulation is proposed. Mathematical properties of the proposed model are established and it is followed by conclusion.

FOUNDATIONS OF ROUGH SET

Rough set was first put forward and established by Zdzislaw Pawlak (1982) to deal with vague and uncertain data. The basic definition of rough sets is based upon the approximation of a set by a pair of sets known as lower and upper approximation. Let \( U \) be the universe of finite non empty set of objects. Let \( R \subseteq U \times U \) is an equivalence relation on \( U \). The equivalence relation \( R \) partitions the set \( U \) into disjoint classes and it is denoted as \( U / R \). Let \( X \) be a subset of \( U \). Therefore, the target set \( X \) can be described by lower and upper approximation as below, where \( RX \) and \( RX \) are \( R \)-lower and \( R \)-upper approximations of \( X \) respectively.

\[
\begin{align*}
RX &= \bigcup\{X' \in U / R : X' \subseteq X\} \\
RX &= \bigcup\{X' \in U / R : X' \cap X \neq \phi\}
\end{align*}
\]

Boundary region of the set \( X \), \( BN_R(X) \), is the objects in \( X \) that can be distinguished neither as a member nor as a non-member of \( X \) employing the relation \( R \). It is denoted as \( BN_R(X) = RX - RX \). A set \( X \) is said to be definable if \( RX = RX \) and the target set is a crisp set i.e., there is no boundary line objects. Similarly, it is said to be rough if \( RX \neq RX \) or equivalently \( BN_R(X) \neq \phi \). The algebraic properties that are directly established from the definition of lower and upper approximation by Pawlak (1982) are mentioned in the following.
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Sunanda Das and Asit Kumar Das (2018). International Journal of Rough Sets and Data Analysis (pp. 1-12).
www.igi-global.com/article/probability-based-most-informative-gene-selection-from-microarray-data/190887?camid=4v1a