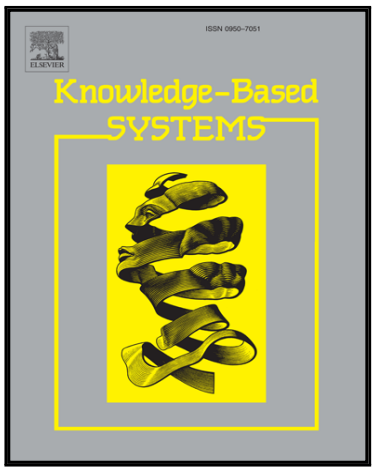

Dynamic updating approximations in multigranulation rough sets while refining or coarsening attribute values

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Dynamic updating approximations in multigranulation rough sets while refining or coarsening attribute values

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Abstract

Multigranulation rough sets have attracted more and more attentions in recent years. In real-life applications, with the development of information technology, the attribute values often dynamically evolve over time. How to update useful knowledge is of great importance for dynamic information systems. Approximations of a concept are fundamental concepts of multigranulation rough sets, which need to be updated incrementally while refining or coarsening attribute values. Motivated by the requirements of dynamic knowledge acquisition due to refining or coarsening attribute values, in this paper, we present the dynamic mechanisms for updating approximations in multigranulation rough sets while refining or coarsening attribute values, respectively. Then, the corresponding dynamic algorithms for updating multigranulation approximations are designed on the basis of the proposed mechanisms. Extensive experiments on six data sets from UCI demonstrate that the proposed dynamic algorithms for updating approximations in multigranulation rough sets are more effective in comparison with the static algorithm.

Keywords: Incremental learning, Knowledge acquisition, Multigranulation rough sets, Decision making.

1. Introduction

Rough set theory, proposed by Pawlak [41–43], is a useful mathematical tool for analyzing various types of data. Now it has been widely used in various fields, such as feature selection, decision making, pattern recognition, machine learning and other applications [14, 27, 50, 51, 53–55, 57].

With the rapid growth of various data in real-life applications, the data may vary over time, i.e., the objects, attributes, and attribute values may change dynamically, which leads to the dynamic change of rough approximations in rough set theory. One naive method to deal with dynamic data changing is recomputing from scratch. However, it is very time-consuming in many real-life applications because it is extremely inefficient. Therefore, it is necessary to develop the techniques to update useful information. Dynamic updating approaches, which take advantages of previous computational results instead of recomputing the whole data sets, have been used in knowledge acquisition and decision making in many kinds of information systems. Many researchers have proposed dynamic updating algorithms for knowledge acquisition when information systems evolve over time. They mainly focused on the following three aspects.

- Updating knowledge by the variation of the objects. Based on the theories of granular computing and rough sets, Li et al. presented incremental knowledge discovery methods to handle big data [24, 25]. Liu et al. defined a concept of interesting knowledge based on accuracy and coverage, and proposed an approach for acquiring knowledge when the objects vary over time [32]. Cheng explored a dynamic approach for updating lower and upper approximations of fuzzy sets based on boundary sets and cut sets [9]. Zhang et al. investigated an incremental maintenance approach in neighborhood rough sets while adding or deleting the objects [60]. Considering

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