

Discovering Fuzzy Rules with Parallelized Linguistic Variable Elimination

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Abstract: Fuzzy rule discovery in collected data with linguistic variable elimination has been successfully used to create classifiers. These classifiers are composed of a group of fuzzy rules which are interpretable by humans. However, large amounts of collected data cause difficulties to obtain accurate and interpretable fuzzy rules speedily enough. In this paper, several parallelization variations of linguistic variable elimination for fuzzy rule discovery in collected data are presented with the purpose of increasing the speed of the discovery. The parallelization variations are based on parallel programming patterns tailored to the elimination so that the discovery uses several cores of the processor and the parallelization is thought in terms of tasks rather than threads. Four implemented parallel variations are compared with two sequential implementations of the original algorithm for linguistic variable elimination. Experiments show speed improvements with parallelization for various given inputs with different amounts of instances and linguistic variables.

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I. Introduction

A group of fuzzy rules is one of human-interpretable knowledge representations which has been used widely in various fields such as control and classification [11]. The discovery of fuzzy rules in collected data is one of research fields in data mining and computational intelligence. An individual fuzzy rule in the group has the form "IF Condition THEN Conclusion" [3]. In the case of classification defined as the task of identifying to which of a set of given classes a new observation or instance belongs [1], Conditions and Conclusions are specified in the following way. Conditions have expressions "Linguistic Variable is possible linguistic term" connected with an operator such as "AND". An example of a condition is "Length of Hospital Stay is average AND Weight is underweight" where Length of Hospital Stay and Weight are linguistic variables and average and underweight are linguistic terms. A linguistic term is a (lexical) name associated with a fuzzy set defined on a universe. A linguistic variable is a set of linguistic terms whose associated fuzzy sets are defined on the same universe. Conclusions always have only one expression "Class Linguistic Variable is class linguistic term", for example, "Diabetes is present". The whole group of fuzzy rules with these types of conclusions forms a classifier allowing to perform the classification task. In it, the class linguistic term is determined for a given instance on the basis of linguistic terms in the conditions of the fuzzy rules.

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