

Automatic construction of a fuzzy system with a matrix representation of rules and a correct knowledge base

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Abstract

The object of this study is the process of automatic formation of fuzzy production rules on the basis of a training sample for solving the classification problem. The problem of automatically creating and then checking the correctness of a fuzzy inference model for a classification task is solved. The result is an automatically constructed correct database of rules for solving the classification problem. Analysis of the correctness of the knowledge base is carried out using the criteria of completeness, minimality, coherence, and consistency. To prove the completeness of the rule base, Hoare logic and the resolution method are used. The quality of the classification is assessed using such metrics as accuracy, precision, recall, f1-score. The dependence of the classification result on the size of the training sample is considered.

The expert system has the following features: the ability to learn from data; high level of accuracy; the correct knowledge base. The knowledge base is formed using the objects of the training sample on the basis of linguistic variables and term sets. A production model of knowledge representation is applied, combining the Mamdani and Takagi-Sugeno-Kang models. It is assumed that the left parts of the production rules describe combinations of the features of objects, and the right parts correspond to classes. The matrix representation of the antecedents of the rules is used. Consequents are represented as a column vector. For the automatic construction of the matrix of

antecedents, it is proposed to use the Cartesian product. The formation of the consequent vector is carried out automatically using domain data and a training procedure.

The resulting expert system can be used to solve the problems of classification, clustering, data mining, and big data analysis

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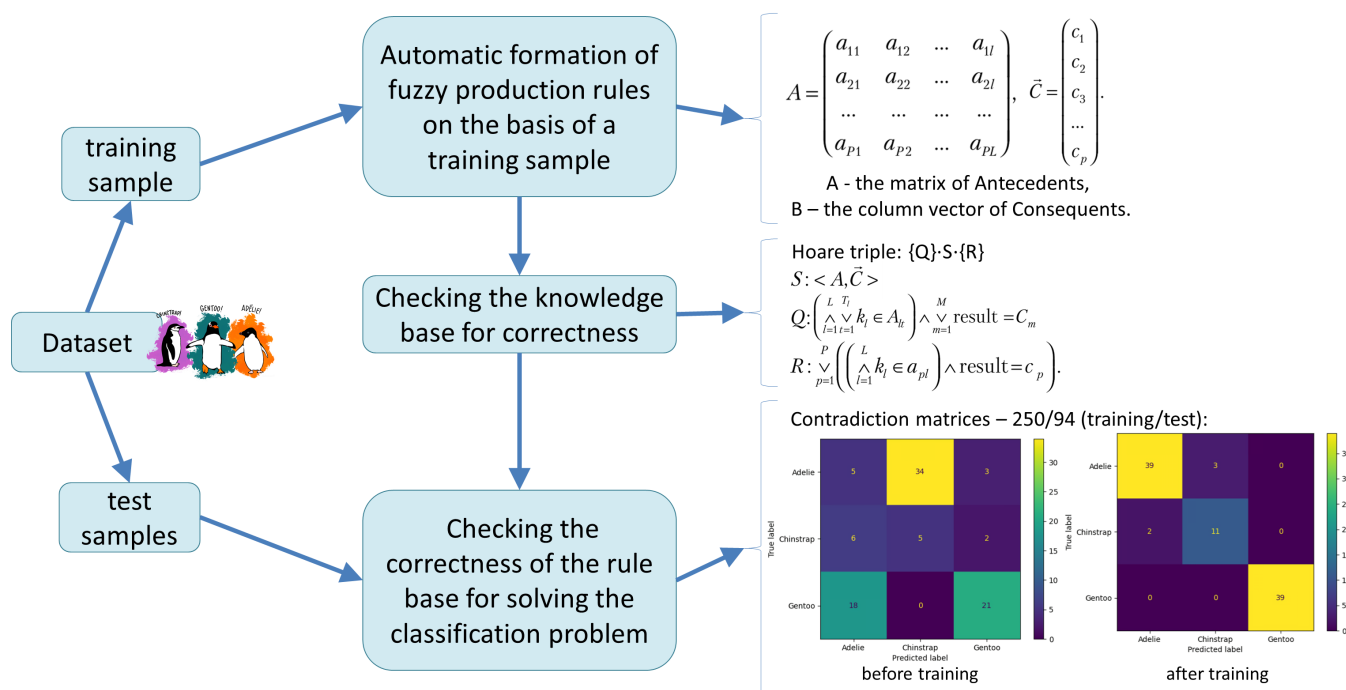
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