Monotone Measures Framework for Machine Learning and Discrete Optimization Problems

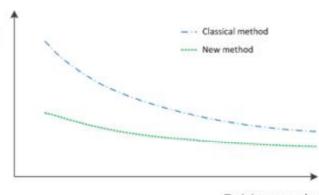*Bidzina Matsaberidze* [a]

E-mail: Bidzina.Matsaberidze@tsu.ge
[a] Department of Computer Science, Ivane Javakhishvili Tbilisi State University
3, I.Chavchavadze ave., 0179, 2nd Building

Modern methods with practical applications of machine learning are mostly based on classical measure theory and thus objects under consideration share the characteristics of classical measures (e.g. countable additivity). Often in real situations this kind of assumption is not natural and the results are imprecise, different from reality.

The paper deals with the idea of replacing classical measures with generalized measures (e.g. monotone measures). This allows us to get more realistic models and to increase precision.

Based on fuzzy (monotone) measures and integrals (as aggregation tools), we build a framework, which can be used in classical problems and methods of machine learning (regression, classification, artificial neural networks, etc.). Obtained experimental results show the advantages of proposed methodology. The results are much more precise and the methods are robust against errors in training data. Also we can get more precise results using less training data compared to classical methods.

Interesting practical results were obtained by introducing monotone measure-based criteria (e.g. possibility measure) in discrete optimization problems as well. Often this kind of problems involves subjective judgments which are intrinsically nonadditive. The advantages of proposed methods were proved using software, developed for optimal decision making tasks.