

Characterizing Fuzzy Modal Semantics by Fuzzy Multimodal Systems with Crisp Accessibility Relations

Félix Bou, Francesc Esteva, Lluís Godo and Ricardo Oscar Rodríguez

In [1] the authors considered finitely-valued modal logics with Kripke style semantics where both propositions and the accessibility relation are valued over a finite residuated lattice. Unfortunately, the necessity operator does not satisfy in general the normality axiom (K). In this paper we focus on the case of finite chains, and we consider a different approach based on introducing a multimodal logic where the previous necessity operator is replaced with a family, parametrized by truth values different from zero, of necessity operators each one semantically defined using the crisp accessibility relation given by the corresponding cut of the finitely-valued original accessibility relation. This multimodal logic is somehow more appealing than the original modal one because axiom (K) holds for each necessity operator. In this paper we axiomatize this multimodal logic and we prove that, in the case the starting residuated lattice is a finite BL chain, the modal and the multimodal languages have the same expressive power iff this algebra is an MV chain.

Number-free Mathematics Based on T-norm Fuzzy Logic

Libor Behounek

The paper presents a form of rendering classical mathematical notions by formal theories over suitable t-norm fuzzy logics in such a way that references to real numbers are eliminated from definitions and theorems, being removed to the standard semantics of fuzzy logic. Several examples demonstrate how this move conceptually simplifies the theory in exchange for non-classical reasoning, facilitates certain generalizations, and puts the concepts into a different perspective. The formal framework employed for the number-free formalization of mathematical concepts is that of higher-order fuzzy logic, also known as Fuzzy Class Theory.

T-norm-based Fuzzy Logics and Logics for Human Reasoning

Thomas Vetterlein and Klaus-Peter Adlassnig

We contrast the concept underlying t-norm-based propositional fuzzy logics with the problem to whose solution fuzzy logics are frequently suggested as helpful - namely, to find a model of reasoning with vague information. We argue that fuzzy logics are useful as long as truth values can be identified with the meaning of the considered propositions. This, however, is rarely the case in practice; hence we see the need to broaden the concept underlying this important class of logics and try fresh approaches. In particular, we should flexibilise the formalism to allow that propositions do not arise in the same context, but are just known to be related in some way. We tackle the problem tentatively. We define a set of rules which, as we assume, are minimally required to enable us to argue about vague propositions whose content is not taken into account. Our choice of rules reflects the practical requirements of a certain expert system on which we work. Although we deal here with fuzzy logic in a very direct sense, we arrive at calculi completely different

from the t-norm-based ones. Without incorporating truth degrees explicitly, we are led to Belnap's logic, which can, but need not, be endowed with a semantics based on graded truth degrees. When formalising also truth degrees, we get a logic which can be based on what we call metric De-Morgan lattices.

SS11 - Machine Learning and Data Mining - Part 1 Machine Learning

Tuesday, July 21, 10:10-11:50, Sala 2

Chair: D. Sanchez

On the use of Measures of Separability of Classes to Characterise the Domains of Competence of a Fuzzy Rule Based Classification System

Julián Luengo and Francisco Herrera

In this work we study the behaviour of a Fuzzy Rule Based Classification System, and its relationship to a certain data complexity measures family. As Fuzzy Rule Based Classification System we have selected a recent proposal called Positive Definite Fuzzy Classifier, which is a Fuzzy System that uses Support Vector Machines for its training, obtaining accurate results and a low number of rules. We have examined several data complexity metrics of separability of classes over a wide range of data sets built from real data, and try to extract behaviour patterns from the results for this learning method. Using these data complexity measures and the accuracy results of the Positive Definite Fuzzy Classifier, we have built a rule set which describes both good or bad behaviours of this Fuzzy Rule Based Classification System. These rules use different values of such data complexity measures as antecedents, so we aim to predict the behaviour of the method from the data set complexity metrics prior to its application. Therefore, the rule set could characterise the domains of competence of this particular Fuzzy Rule Based Classification System.

Multi-Dimensional Scaling applied to Hierarchical Rule Systems

Thomas Gabriel, Kilian Thiel and Michael Berthold

This paper presents an approach for visualizing highdimensional fuzzy rules arranged in a hierarchy together with the training patterns they cover. A standard multi-dimensional scaling method is used to map the rule centers of the top hierarchy level to one coherent picture. Rules of the underlying levels are projected relatively to their parent level(s). In addition to the rules, all patterns are mapped onto the two-dimensional projection in relation to the positions of the corresponding rule centers. Visualization is further extended by showing hierarchical relationships between overlapping rules of different levels, which are generated by a hierarchical rule learner. This delivers interesting insights into the rule hierarchy and offers better explorative properties. Additionally, rules can be highlighted interactively emphasizing the subsequent rules at all underlying levels together with the patterns they cover. We demonstrate that this technique allows investigation of interesting rules at different levels of granularity, which makes this approach applicable even for a large number of rules. The proposed technique is illustrated and discussed

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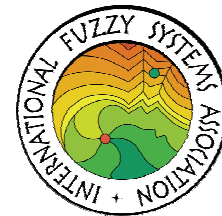
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The Belém Tower (in Portuguese “Torre de Belém”) is a fortified tower located in the Belém district of Lisbon, Portugal. The Belém Tower was built in the early sixteenth century in the Portuguese late-Gothic style, the Manueline, to commemorate Vasco da Gama’s expedition (discovered the sea way to India). This defensive, yet elegant construction has become one of the symbols of the city, a memorial to Portuguese power as it was during the Age of Discovery, which started in the 15th Century and continuing into the 17th Century. In 1983, it was classified, together with the nearby Mosteiro dos Jerónimos (Jerónimos Monastery), as a UNESCO World Heritage Site.

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