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Fuzzy sets in approximate reasoning, Part 1: Inference with possibility distributions

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Abstract

A survey of about twenty years of approximate reasoning based on fuzzy logic and possibility theory is proposed. It is not only made as an annotated bibliography of past works. It also emphasizes simple basic ideas that govern most of the existing methods, especially the principle of minimum specificify and the combination/projection principle that facilitate a comparison between fuzzy set-based methods and other numerical approaches to automated reasoning. Also, a significant part of the text is devoted to the representation of truth-qualified, certainty-qualified and possibility-qualified fuzzy statements. A new attempt to classify the numerous models of fuzzy â€œifâ€¦thenâ€ rules from a semantic point of view is presented. In the past, people have classified them according to algebraic properties of the underlying implication, or by putting constraints on the expected behavior of the inference process (by analogy with classical logic), or by running extensive comparative trials of particular implications on test-examples. Here

the classification is based on whether the rules qualify the truth, the certainty or the possibility of their conclusions. Each case corresponds to a specific way of deriving the underlying conditional possibility distribution. This paper focuses on semantic approaches to approximate reasoning based on fuzzy sets, commonly exemplified by the generalized modus ponens, but also considers applications to current topics in Artificial Intelligence such as default reasoning and qualitative process modeling. A companion survey paper is devoted to syntax-oriented methods.

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Keywords

Approximate reasoning; fuzzy logic; possibility theory; generalized modus ponens; uncertainty

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