Different Concepts, Similar Computational Complexity: Nguyen's Results about Fuzzy and Interval Computations 35 Years Later

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Abstract When we know for sure which values are possible and which are not, we have crisp uncertainty – of which interval uncertainty is a usual case. In practice, we are often not 100% sure about our knowledge, i.e., we have fuzzy uncertainty – i.e., we have fuzzy knowledge, of which crisp is a particular case. Usually, general problems are more difficult to solve that most of their particular cases. It was therefore expected that processing fuzzy data is, in general, more computationally difficult than processing interval data – and indeed, Zadeh's extension principle – a natural formula for fuzzy computations – looks very complicated. Unexpectedly, Zadeh-motivated 1978 paper by Hung T. Nguyen showed that fuzzy computations can be reduced to a few interval ones – and in this sense, fuzzy and interval computations have, in effect, the same computational complexity. In this paper, we remind the readers about the motivations for (and proof of) this result, and show how and why in the last 35 years, this result was generalized in various directions.

Key words: fuzzy logic, interval computations, Nguyen's theorem, Zadeh's extension principle, fuzzy uncertainty, interval uncertainty, data processing

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