

Fuzzy models in analogy and case-based reasoning

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I. ABSTRACT

Analogy is a natural means of drawing a conclusion on the basis of past experience. Several of its forms have been identified in psychology and some of them have given rise to developments in artificial intelligence. The capability of fuzzy logic to model human reasoning and to cope with the imprecision common in human judgements provides interesting solutions for knowledge representation and approximate reasoning. We start from the two basic components of analogy, namely a link between two universes on the one hand, for instance a universe of cases and a universe of decisions, and a relation defined on each of the universes on the other hand, for instance a similarity relation. We study these elements in a fuzzy setting and we present fuzzy models of decision-making based on analogy. We introduce a particular analogical scheme based on measures of similitude, assuming that gradual knowledge is involved in the analogy. We insist on the expressiveness of the obtained decision, proposing to use linguistic modifiers for this purpose, appropriately chosen according to the context and the selected measure of similitude. We focus on two paradigms taking advantage of an analogical approach.

The first paradigm is case-based reasoning, and methods are proposed for the adaptation of solutions to already solved

cases in order to determine a solution to a new case, taking into account similarities, and having in mind the necessity to obtain linguistic descriptions of results. We point out several methods enabling the user to perform the transformational adaptation of the solution to a similar problem, based on the utilization of specific linguistic modifiers associated with measures of similitude. Their interest is to ensure a gradual passage between cases and the global utilization of the set of already solved problems.

The second paradigm is related to interpolative reasoning in a fuzzy environment, with the purpose of using sparse rules or incomplete knowledge in decision-making. It is also presented as a method available for the above-mentioned transformational adaptation of solutions in case-based reasoning.

Keywords: *analogy, adaptation, interpolation, fuzzy logic, linguistic modifier, similarity, measure of similitude, graduality*

II. SHORT BIO.

Bernadette Bouchon-Meunier is a director of research at the National Center for Scientific Research, head of the department of Databases and Machine Learning in the Computer Science Laboratory of the University Paris 6.

Graduate from the Ecole Normale Superieure at Cachan, she received the degrees of B.S. in Mathematics and Computer Science, Ph.D. in Applied Mathematics and D. Sc. in Computer Science from the University of Paris.

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She is the (co)-editor of 21 books and the (co)-author of four books in French and one in vietnamese on Fuzzy Logic and Uncertainty Management in Artificial Intelligence. She is a co-founder and co-executive director of the International Conference on Information Processing and Management of Uncertainty in Knowledge-based Systems (IPMU) held every other year since 1986.

She is an IEEE senior member and an International Fuzzy Systems Association fellow. Her present research interests include approximate and similarity-based reasoning, as well as the application of fuzzy logic and machine learning techniques to decision-making, data mining, risk forecasting, information retrieval and user modelling.

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