"window": The similarity between input and output is a measure of the compatibility between test results and standard. A window is a subset of a segment and represents the range of values that are of particular interest. In most cases the boundaries of the windows cannot be defined with certainty.

Most decision processes involve many alternatives that may depend on several dimensions. For each alternative, a "stack of windows" is defined by specifying a window for each dimension. Then decision making is equivalent to filtering the characteristics of a given situation through the stacks. The acceptability of each alternative is determined by an evaluation function that assesses the extent of individual matches.

Available knowledge-acquisition techniques support this form of knowledge representation. Fuzzy windows facilitate the establishment of consensus among experts and the analysis of composite solutions. Classification systems built with this approach allow the use of different evaluation functions and support the development of a database that can be searched. Knowledge representation by fuzzy windows is substantiated by findings in decision making and creative thinking.

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Backward Chaining with Fuzzy Goals and Rules

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This paper describes a knowledge engine that employs a backward-chaining control structure that is generalized to fuzzy variables and rules. The engine extends earlier fuzzy linguistic variable processing systems developed by the authors that employ fuzzy linguistic variables and fuzzy logic in their data and rules. The backward control mechanism permits more sophisticated, efficient use of diagnostic knowledge-centered decision support systems. Design criteria, implementation notes, and possible extensions are discussed. This is a publicly owned, research-oriented system; the procedures, dubbed BACHFUGUE (written in the APL programming language), are available from the authors.

Related systems exist or are under development. BACHFUGUE is being interfaced with a synthetic grammar system that manages the linguistic terms in SAPIR. Although originally written in LISP, SAPIR has been translated into APL for compatibility with BACHFUGUE.

Relations, as well as if-then rules, are powerful expressive mechanisms in symbolic knowledge systems. Fuzzy relations in the present system must be decomposed (edited) into if-then rules. A more automatic means of dealing with such relations is being explored.

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A New Concept of Fuzzy Rule-Based Expert Systems

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The concept of fuzzy rule-based expert systems based on soft (interactive) rather than hard (noninteractive) fuzzy operators is developed. A methodology is provided for the inclusion of certainty factors (CFs) in the expert systems associated with the belief attributed to the data and production rules. A new fuzzy implication operator for implementing soft production rules and a new fuzzy inference system for fuzzy firing the soft rules are proposed. The advantages of this system are its simplicity and modularity (more complex forms of fuzzy rules can easily be represented using the suggested structure). Being highly modular, the system lends itself to VLSI implementation. This base system is used to develop a forward fuzzy-fired rule-based expert system shell, called FUZZTRAN (FUZZy TRANslation), in which each forward fuzzy rule is translated into a prolog clause. By executing this translated fuzzy PROLOG program, forward reasoning can be done without a rule interpreter. A system prototype using a military situation assessment fuzzy knowledge base is under investigation.

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On Fuzzy Graph Searching

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Graph searching finds applications in many areas. Fuzzy graphs are the most natural means to incorporate the uncertainties inherent in certain problems. Pattern recognition and artificial intelligence are just two examples of many areas where uncertainties should be addressed in solving realistic problems. The objective of this paper is to introduce a searching algorithm for fuzzy graphs that finds the shortest path. The complexity of the algorithm is $O(n^2)$ for a graph with n nodes. The complexity of the algorithm can be reduced to $O(n)$ if parallelism in the algorithm is considered.

Fuzzy Process Modeling

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The problem of the influence of constructional parameters in a fuzzy model on the accuracy of process description in terms of fuzzy relations is considered. A method of constructing this relation on the basis of a linguistic model of the object is described. Particular attention is given to those constructional parameters that do not have an explicit mathematical interpretation, i.e., the definition of a fuzzy implication and interpretation of the sentence connective ALSO. The influence of those parameters on the accuracy of the fuzzy model is considered. The dependence of the effect upon character, among others, of which relations are the best models as a function of the shape of the performance curve of the described model is also investigated.

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