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An inductive logic can be formulated in which the elements are not propositions or probability distributions, but information systems. The logic is complete for information systems with binary hypotheses, that is, it applies to all such systems. It is not complete for information systems with more than two hypotheses but applies to a subset of such systems. The logic is inductive in that conclusions are more informative than premises. Inferences using the formalism have a strong justification in terms of the expected value of the derived information system.

Explanation of Probabilistic Inference for Decision Support Systems

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This paper reports work in progress on an explanation facility for Bayesian conditioning aimed at improving user acceptance of probability-based decision support systems. Design of the facility, which appears to be reasonably domain-independent, is based on an information processing model that accounts for both biased and normative behavior in reasoning about conditional evidence. Preliminary results indicate that the facility is both acceptable to naive users and effective in improving understanding of Bayesian conditioning.

Automated Generation of Connectionist Expert Systems for Problems Involving Noise and Redundancy

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When creating an expert system, the most difficult and expensive task is that of constructing a knowledge base. This is particularly true if the problem involves noisy data and redundant measurements. This paper shows how to modify the MACIE process for generating connectionist expert systems from training examples so that it can accommodate noisy and redundant data. The basic idea is to dynamically generate appropriate training examples by constructing both a "deep" model and a noise model for the underlying problem. The use of winner-take-all groups of variables is also discussed.

These techniques are illustrated with a small example that would be very difficult for standard expert system approaches.

A Measure-Free Approach to Conditioning

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In an earlier paper, a new theory of measure-free "conditional" objects was presented. In this paper, emphasis is placed on the motivation of the theory. The central part of this motivation is established through an example involving a knowledge-based system. In order to evaluate combination of evidence for this system using observed data, auxiliary attribute and diagnosis variables, and inference rules connecting them, one must first choose an appropriate algebraic logic description pair (ALDP): a formal language or syntax followed by a compatible logic or semantic evaluation (or model). Three common choices for this highly nonunique choice are briefly discussed, the logics being classical logic, fuzzy logic, and probability logic. In all three, the key operator representing implication for the inference rules is interpreted as the often-used disjunction of a negation $(b \ni a) = (b' v a)$, for any events a, b.

However, another reasonable interpretation of the implication operator is through the familiar form of probabilistic conditioning. It can be shown, quite surprisingly, that the ALDP corresponding to probability logic cannot be used as a rigorous basis for this interpretation! To fill this gap, a new ALDP is constructed consisting of "conditional objects," extending ordinary probability logic and compatible with the desired conditional probability interpretation of inference rules. It is shown also that this choice of ALDP leads to feasible computations for the combination of evidence evaluation in the example. In addition, a number of basic properties of conditional objects and the resulting conditional probability logic are given, including a characterization property and a developed calculus of relations.

Convergent Deduction for Probabilistic Logic

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This paper discusses the semantics and proof theory of Nilsson's probabilistic logic, outlining both the benefits of its well-defined model theory and the drawbacks if its proof theory. Within Nilsson's semantic framework, a set of inference rules that are provably sound are derived. The resulting proof system, in contrast to Nilsson's approach, has the important feature of convergence—that is, the inference process proceeds by computing increasingly narrow probability intervals that converge from above and below on the smallest entailed probability interval. Thus the procedure can be stopped at any time to yield partial information concerning the smallest entailed interval.

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Estimation Procedures for Robust Sensor Control

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Many robotic sensor estimation problems can be characterized in terms of nonlinear