Discussion of "Exploiting Relevance through Model-Based Reasoning" by Roni Khardon and Dan Roth.

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Much research on relevance in knowledge representation is focussed on the question of how to determine what information is relevant and what is irrelevant for a given query. By ignoring irrelevant information, one can speed up query processing. An underlying assumption in this approach is that the knowledge base (KB) contains a rich representation of the world, and therefore contains much information that is not relevant for any particular query. Khardon and Roth propose an intriguing alternative in their "learning to reason" (L2R) model. In this approach, the KB is constructed through a learning process and, in some sense, contains only information relevant to the query distribution under consideration. Khardon and Roth are able to show several concrete computational advantages of this strategy.

Perhaps the main future challenge of the L2R framework will be in showing its practical applicability. The approach uses a model-based knowledge representation scheme. A key question is whether interesting domain theories, such as used in, for example, qualitative physics [2] and diagnosis [1, 6], have polynomial size model-based encodings.

A practical application of the L2R approach may also require that some background knowledge is hand-coded. This raises the question as to how natural the model-based representation is when it comes to hand-coding information. A model-based encoding is to a certain extent quite similar to an encoding in disjunctive normal (DNF) form. Despite the good computational properties of DNF theories w.r.t. deduction and abduction, the DNF format has rarely been used in AI to capture domain-theories. The standard format has been conjunctive normal (CNF) form (or at least a form close to CNF), since this allows for an incremental specification of the KB by simply stating a series of properties ("axioms") of the domain. It remains be seen whether a model-based representation will also enable the user to hand-code some information or whether the entire KB must be acquired through a learning process.

The work in AI on case-based reasoning [4] suggests that one may be able to construct interesting model-based representations of certain domains. Unfortunately, the representation schemes used in case-based reasoning systems are often not purely declarative, in that they contain various forms of procedural information. Research on frames, scripts and mental models [5, 7, 3] also argues in favor of a model-based approach over a formula-based or "axiom-based" representation. But again, these proposals often allow for procedural information to be part of the KB. It would be interesting to see whether a model-based representation as introduced by Khardon and Roth could be extended to include certain rule-based information while maintaining good computational properties.

Despite the various open questions, it is clear that the Khardon and Roth proposal opens up a very interesting new research direction in the area of knowledge representation and reasoning.

References

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