J. LOGIC PROGRAMMING 1997, 32(2):119-170 119

A LOGICAL SEMANTICS FOR HYPOTHETICAL RULEBASES WITH DELETION

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▷ This paper addresses a limitation of most deductive database systems: they cannot reason hypothetically. Although they reason effectively about the world as it is, they are poor at tasks such as planning and design, where one must explore the consequences of hypothetical actions and possibilities. To address this limitation, we have developed a logic-programming language in which users can create hypotheses and draw inferences from them. Most previous work in this area has focussed on the hypothetical *insertion* of facts into a database, since insertion is accounted for by a well-established logic: intuitionistic logic. In contrast, our language includes hypothetical *deletion* as well as insertion. In earlier work, we established the data complexity and expressibility of this language. In this paper, we develop its logical semantics, and take a closer look at its expressibility. The paper makes three main contributions. First, we show that hypothetical queries lead naturally to a new notion of expressibility. In this new light, we show that classical logic is poor at hypothetical reasoning, since it cannot express some simple hypothetical queries. Second, we develop a logical semantics for hypothetical insertions and deletions, including a proof theory, model theory, and fixpoint theory. We also give numerous examples showing the utility of the logic and the subtle effect that deletion has on its expressive power. Finally, we augment the logic with negation-as-failure, so that non-monotonic queries can be expressed. We then develop the proof theory and model theory for the logic with negation. The proof theory is inspired by the stratified semantics of Apt, Blair and Walker, and the model theory is inspired by the perfect model semantics of Przymusinski. ◁

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THE JOURNAL OF LOGIC PROGRAMMING

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