In: Wolfgang Pohl: Logic-Based Representation and Reasoning for User Modeling Shell Systems.
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Foreword

After nearly 20 years of research in the field of User Modeling and User-Adapted Interaction, the first practical and commercial results have recently emerged. One of the most visible is a component offered in Microsoft's Office 97, the "Office Assistant", which monitors each user's interaction with the system and draws limited inferences as to the user's intentions. Another example is Web-based learning environments used by students from four Dutch universities. The environments make assumptions about the subject areas that each student is already familiar with, and indicate the topics that the student is ready to learn next. Applications like these demonstrate that adaptation of interactive computer systems to the individual needs of their users is feasible and beneficial.

Current practical systems employ mostly limited representation and reasoning mechanisms: objects that stand for concepts, goals, topics, and other domain entities are tagged by binary, multi-valued or continuous variables. These express the degree to which the system believes that the user knows or aims for the respective object. Inferences are mostly performed through specialized procedures, with no formal foundation for their operation.

Future practical user-adaptive systems will impose considerably higher demands on the underlying representation and reasoning groundwork. They will have to represent more than one type of assumption about the user at the same time, such as representing what the user knows, wants, plans, and is able to do (current systems deal mostly with only one type of assumption). They will have to represent "negative" assumptions, i.e., representing what the user is believed not to know, want, plan, or be able to do (most current systems do not distinguish between a "negative" assumption and no assumption at all with respect to some user characteristic). Inferences will have to take more than one assumption type as well as "negative" assumptions into account. They should also allow for uncertainty in the system's reasoning as well as vagueness in the concepts that are employed. And finally, future systems will possibly also have to represent and reason with "reflexive" assumptions, like a system's assumptions about the user's assumptions about the system's knowledge, goals and plans.

Research on more advanced representation and reasoning formalisms also started about 20 years ago with the pioneering work of Paul Cohen and James Allen, and Robert Moore. Continuing in the spirit of the "declarative/procedural controversy" at this time, two research camps evolved that largely ignored each other: the logic-based approach (which quickly concentrated on modal logic), and the "partition approach" where each assumption type is separately represented and reasoned about. Each approach has pretty much complementary advantages and disadvantages with regard to representational power, formal justification for inferences, and computational realizability and efficiency.

The exciting scientific contribution of Wolfgang Pohl is a framework that unites the two adversarial approaches. It is soundly based in the theory of modal logic, but leaves ample room for the inclusion of specialized representation and reasoning mechanisms for

assumption types. Five levels of reasoning (ranging from simple data base access without reasoning to full modal-logic reasoning including modal axioms) guarantee a free choice in the degree of inferential completeness and computational efficiency. As if this were not enough, the author also develops a new theory and a specialized representation for "negative assumptions", and helps correct some obscurities and misconceptions that so far pervaded quite some of the literature in user modeling and reasoning about knowledge.

The author implemented a special instantiation of his framework in BGP-MS, a user modeling shell system that is freely available on the web and has meanwhile been used by several research groups who developed user-adaptive applications, both in single-user environments and in multi-user web applications. This concern for both theoretical substantiation and practical usability is truly outstanding. It is only consequential that the original dissertation on which the present work is based was unanimously accepted with highest distinction (summa cum laude) by Wolfgang Pohl's dissertation committee.

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