Preface

The past few years have seen a roughly exponential growth in the application of numerical techniques for uncertainty management in the field of user and student modeling. Most of these efforts have made use of Bayesian networks; but several researchers have applied the Dempster–Shafer theory of evidence, while others have employed techniques from the field of fuzzy logic, as broadly conceived.

These developments have shown that researchers in this field do not have to make a global choice between qualitative and quantitative modeling. Numerical uncertainty management can be integrated with other methods, enhancing their effectiveness in cases where substantial uncertainty has to be dealt with.

The researchers who have been exploring these possibilities have worked largely independently. A typical article has cited only two or three related contributions by other researchers – and not always the most relevant contributions at that. The fact that many researchers have independently determined that these techniques are worth exploring can be interpreted positively, as evidence for their utility for user and student modeling. But future progress will be faster if researchers and designers have a broad overview of the progress that has been made so far, the problems that have been encountered, and possible ways of solving the problems.

This special issue is intended to provide such an overview. Four original research contributions were sollicited from researchers who had been working in this area for some time. These papers offer a fairly representative sample of the issues that have been addressed and of the techniques that have been applied.

Mislevy and Gitomer describe an application of Bayesian networks within a student modeling system that illustrates many of the reasons why this approach to uncertainty management has become so popular. They also offer a more general theoretical perspective on this paradigm from the point of view of student modeling researchers.

Desmarais, Maluf, and Liu address some general practical issues that arise when numerical uncertainty management techniques are applied to user or student modeling problems in realistic settings – in particular the question of the extent to which the necessary numbers can be determined automatically on the basis of a limited amount of empirical data.

Bauer describes the largest-scale application to date of the Dempster–Shafer theory of evidence to user or student modeling. His plan-recognition component for an intelligent help system illustrates several of the considerations that have inclined

some researchers to prefer the Dempster–Shafer theory to Bayesian approaches, at least for some classes of problems.

The paper by Popp and Lödel illustrates some ways in which techniques from the broad field of fuzzy systems can be employed for user modeling – in particular, to deal with vague linguistic input by the user and to model decision processes of the user that could be difficult to model with more traditional numerical methods.

Each of the systems discussed in these four papers also exhibits some innovative features that have no specific connection with numerical uncertainty management.

The introductory overview article by Jameson shows how the four original contributions fit into the overall picture and surveys other systems that have used techniques from the three main paradigms.

Further remarks of an introductory nature will be found at the beginning of the overview article, and a number of the persons who have supported the production of this special issue are acknowledged in the individual articles. So it remains here only to thank those persons whose efforts furthered the production of the issue as a whole. Sandra Katz, Matthias Kölln, and Katherine Sinitsa helped to identify suitable contributors and made useful suggestions concerning the content of the issue. The team of anonymous reviewers for the special issue reviewed the submissions promptly but thoroughly, suggesting many insights that are now reflected in the final papers. The authors of the four original research contributions at times went to great lengths to take the reviewers' suggestions into account, while still managing to meet their deadlines. The production team at Kluwer cooperated to get the special issue to press soon after the manuscripts were completed, so as to enable the issue to remain a useful source of information for some time after its appearance, in spite of the speed with which research in this area is progressing.

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