Preface

This special issue is devoted to various aspects of reconstructing the existing body of mathematics within a formal framework of a computer-based environment. Since the inception of the first systems designed for formalizing mathematics the research on automated theorem proving and proof checking has produced numerous proof-assistant tools. Their involvement in large-scale formalization projects revealed that practical formalization of whole theories, complete mathematical monographs or especially challenging proofs requires a substantial amount of dedicated work. It has become evident that for this sort of task accumulating and distributing previously formalized data is indispensable.

In this spirit the Mizar community initiated in 1989 a long-term project of building a comprehensive library of formally interrelated mathematical data, the Mizar Mathematical Library (MML) and several other proof-assistants followed. Among the collected contributions there are three articles devoted to the problems connected with maintaining such libraries, expanding them, and at the same time making them coherent, well-organized and suitable for querying. There is a presentation of the current state of the biggest digital libraries of formalized mathematics. Admittedly, it has been estimated that building a formal library to cover only undergraduate mathematics would require about 140 man-years. Therefore it has been recognized that developing a library to base further formalizations on is equally essential as improving the capabilities of proof-assistance software.

Another three articles deal with the complete process of formalizing certain proofs which starts with considering different possible approaches and finally chosing one which suits best the proof-checking system, the choice being based on known existing proofs and the contents of the library available for the proof checker. The works contain valuable observations on the underlying knowledge that is used in "normal" mathematical practice and its reconstruction in the formalization process. This reconstruction makes it possible to point out some inefficiency of the current proof-assistants as compared to the standard mathematical apparatus.

The support offered to the end-user by proof-assistants is addressed in another three articles. They describe recent enhancements in this area, ways of efficient encoding of formal data, and presenting it to the users in an attractive way following the notions used in standard mathematics. All these enhancements are highly dependent on the linguistic capabilities of a language used for formalization. A particularily valuable contribution is presented in one of the papers that proposes theoretical foundations of an alternative to the existing languages for encoding formal mathematics. The features of this proposal, which comes from within the mathematical community, can stimulate further development of existing proof tools.

Handing to the readers this special issue dedicated to the computer reconstruction of the body of mathematics, we would like to disseminate research experiences with proof-assistant systems that collect user contributions in an organized manner, attempt to build proof libraries and allow for new developments on top of previously accumulated mathematical knowledge. We believe that expanding such libraries and at the same time making them coherent and well-organized is a highly non-trivial enterprise. The collected works show that these activities are crucial for surpassing the limitations of contemporary proof-assistants.

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