PREFACE

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The first ideas of mechanical reasoning date back to Leibniz. He took up the task of defining a formal language built up from symbols denoting objects and relations between them and of introducing a logical system with rules by means of which every reasoning could be replaced by a finite number of formal transformations. Nowadays, after Godel's discovery of undecidable propositions in a formal number theory, and after Church's theorem, we know that expectations of Leibniz could not be realized and no universal decision procedure is possible for formalized mathematics. Nevertheless, systematic methods exist for theorem-proving such that when confronted with a valid sentence they will always be able to prove its validity and exhibit a proof. Introducing computers into common use starts a widespread intensive interest in mechanical theorem-proving techniques. Moreover, there has been an increase in awareness of the importance of logical systems in computer science, and a number of important applications have come to the fore in which the major problems can be conveniently transformed into a task of finding proofs of theorems. Among important examples of these applications are problem solving, knowledge representation, natural language processing, information retrieval, analysis and synthesis of programs, programming languages. As a consequence, mechanical theorem-proving is a fast growing field of both logic and computer science.

The present issue of *Logique et Analyse* concerned with mechanical proof methods for non-classical logic has the objective of presenting examples of formal logical systems for which deduction methods are developed enabling us to mechanize a process of finding proofs of theorems. The choosen formal systems are based on the non-classical logics which are related to computer science applications.

Mechanical proof methods can be divided into four standard types. A first type is that of resolution style proof methods which are based on the classical Robinson method for predicate calculus. The method provides a test for formulas, transformed into a certain normal form, in order to find out if they are contradictory. A method of this kind for modal logic Q is presented in the paper by Fariñas del Cerro, and for m-valued Post logic in the paper by Orlowska. A second type is that of Gentzen-style proof methods related to natural deduction systems. In the paper by Orlowska and Wierzchon a Gentzen-style system is given for fuzzy logic, and in the paper by Orlowska natural deduction for Post logic is presented. In the paper by Thistlewaite, Meyer and McRobbie Gentzen-proof methods in a production system format for relevant logic are considered. A third area is the development of tableau methods. An overview of these methods for temporal logic is given in the paper by Wolper and in the paper by Gumb a Tableau Reduction Method for free intuitionistic logic is given. Methods of a fourth type are based on interpretability of a logic in another logic. If a translation of a formal language into the other language, preserving validity, can be found, then one can use a deduction method of the first language to prove theorems of the other. An example of such a method is given in the paper by Colmerauer and Pique.

The key question in the development of automatic proof procedures is efficiency. Usually, if a method is applied in a straightforward systematic manner it will also produce a great number of valid sentences which are irrelevant to the purpose in hand, this being to prove just one particular theorem. There are two trends in research aimed at overcoming these difficulties. First, a number of strategies have been proposed, in addition to original methods, to limit the amount of data processing carried out. Second, work continues on nonstandard methods going beyond the four types of classical methods. The present issue reports on some recent advances in the development of such methods. In the paper by Michel a method is presented of modelling temporal operators by means of finite automata. In the paper by Morgan a new mechanical deduction method for a wide class of propositional logics is described.

In recent years a spectacular growth of work in computer science applications of non-classical logics has been done. In particular, the majority of the work done on modal and many-valued logics is motivated by the consideration of computer application. Examples of these applications are mentioned in all the papers in the present issue.

The examples of proof methods for non-classical logic given in the present issue cover all the four types of classical methods and some of nonstandard methods. That are restricted to propositional or first order logics, higher order logics are not included.

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