Rabin's Tree Theorem is proved using the Forgetful Determinancy Theorem of Gurevich and Harrington, and a simplified (albeit still difficult) proof of the decidability of the Shelah class is given. Complexity analysis of the decidable cases, where known, is also given; for most, the satisfiability problem has very high computational complexity, a consideration which becomes very relevant when attempting to extend decidability results to theorem proving and model checking methods. Chapter 8 presents other decidable cases of the decision problem such as first-order logic with two variables.

The Classical Decision Problem is a treasure which will be greatly appreciated by many.

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HENRY PRAKKEN, **Logical Tools for Modelling Legal Argument: a study of defeasible reasoning in law**, Kluwer Academic Publishers, Dordrecht, 1997, US$125, pp. xiii + 314, ISBN 0-7923-4776-5.

Legal reasoning exhibits several distinctive characteristics. First, it is always necessary to come to a decision, whether or not all the relevant information is available: 'don't know' is not an option. Second, legal conclusions are typically defeasible: a prima facie case may be rebutted, and a decision may be overturned on appeal. Third, the domain seems to contain contradictions: certainly high level legal principles often come in conflicting pairs, and often laws themselves are in conflict also. Sometimes the conflict is between acts and sometimes within an act, as setting out the general case and some exceptions to it is a fairly common way of drafting legislation. These phenomena are, of course, linked: defeasibility may occur because a decision was made in ignorance of a fact which later comes into play, or because a conflict can be resolved differently. These phenomena present a challenge to classical logic, where we need all the premises of an argument to draw a conclusion, where reasoning is monotonic, and where any conclusion whatever can be drawn from a contradiction. None the less the feeling that logic has a role to play in legal argument persists: it cannot be that logic and notions such as soundness are abandoned when we step into a courtroom. There should be some way of modelling legal argument from a logical point of view.

This book attempts to meet the challenge: it attempts to explain the phenomena of legal argument, particularly defeasibility and normative conflict, within a logical framework. It represents the fruits of some ten years of investigation into the topic. The author entered the field in 1988, and gave

us an interim report, in the shape of his PhD thesis, in 1993. From that thesis the first five chapters are more or less unchanged in this book, but the remainder have been greatly changed to reflect his maturing thought. Much of this work has been previewed in a series of papers with his collaborator Giovanni Sartor. Thus this volume represents the consolidation of a serious and long standing investigation. It is by no means the last word, however. The later chapters open up further possibilities, and we can, I think, hope for another volume in three or four more years.

In 1988 there were two mainstream approaches to modelling legal argument. Case Based Reasoning, like legal realism, takes law to be revealed in decisions, and operates by matching the current case to some past case. Legal argument then consists in trying to show that a favourable past decision is 'closer' to the current case than any unfavourable past case. The best example of this work is the HYPO system of Edwina Rissland and Kevin Ashley, best described in Ashley (1990). The problem is that 'closeness' is not a well defined notion, and that the logic of the arguments produced remains implicit. The other main approach, most clearly seen in Sergot *et al* (1986), modelled legislation as a logic program. In this approach conflicts were dealt with by the execution strategy of the program, and so were resolved in advance by the ordering of the clauses in the Program. Defeasibility arose only when a new fact became known, so that a clause which previously failed succeeded, blocking access to the later clauses. Problems with this approach were both that the logic program enshrined some particular interpretation, and that the need to make these exceptions explicit often did violence to the structure of the original legislation

A third way, drawing on ideas from general AI, was to model the legislation using some non-monotonic logic, which explicitly addressed the defeasibility issue. This was Prakken's starting point. Prakken gives a thorough consideration to the various ways of modelling non-monotonicity. The position he reaches, however, is that it is important to allow for the representation of incompatible solutions and then choose the one which is to be preferred. It is important that this choice be explicit rather than incorporated into the logic itself. The key reason for this is that there is no generally applicable criterion for preferring one solution rather than another — at least in the legal domain. Many nonmonotonic logics rely on specificity as a criterion. This is often a good solution, and corresponds to the widely used legal principle of "Lex Specialis Derogat Legi Generali" — the more specific law derogates the more general law. But there are other legal principles which can override this one; that the law from the higher authority is preferred to the law of a lower authority (especially important in case law, but also applicable where laws can be made by local as well as central governments)

and that the more recent law is to be preferred to the later law. What this gives us is a two layer model of legal argument: first we have a logic which determines which arguments can be constructed and then a layer (called by Prakken the "dialectical layer"), which defines such notions as "counterargument", "attack", "rebuttal" and "defeat", and which provides criteria to evaluate arguments emerging from the logic layer, and to allow us to choose which to accept. This was roughly the position reached at the end of his 1993 book.

The presentation in this book, however, reflects advances in Prakken's thinking since 1993. Three important additions are made. First the system is enriched by means of a non-provability operator. This is important for legal reasoning since, because it is recognised that a decision must be made even if not all the relevant information can be obtained, there is a need to be able to distinguish between what can be shown true, what can be shown false and what can neither be shown true nor false. Second, machinery for explicitly reasoning about the priorities to be given to different norms is provided. Third the presentation is recast in an intuitive dialectical form rather than the less intuitive fixed-point approach used previously.

Another important change is the recognition that it is unrealistic to regard the starting point of a dispute as a fixed set of premises from which arguments can be constructed. Rather a dispute develops over time, and premises are introduced and challenged as new arguments are stated. Part of legal argument is the construction of a theory in which argument can take place, and it is often argued that once the theory has been constructed resolution of the dispute is rather easy. This involves adding a third layer to the logic and dialectic layers, a procedural layer which sets out the protocols for conducting the dispute. This is central to legal reasoning where the main justification for a decision is often that it has resulted from a properly conducted dispute.

At the very end of the book Prakken hints at a fourth later, a heuristic layer, which is supposed to guide us to reason effectively within the protocols supplied in the procedural layer. I think this clear separation between what it is to argue properly and what it is to argue well is much needed to dissolve problems that result from confusing these two aspects, and is likely to prove a very fruitful source of future work.

This book represents a careful and thorough treatment of the issues which arise in the course of producing the kind of model of legal argument summarised in this review. It represents one of the best pieces of work in the field of AI and Law, and since I believe that those who wish to learn about reasoning in practice would do well to look more at jurisprudence than mathematics, I would commend it to anyone interested in practical argument.

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M. SCHIRN (ed.), **The Philosophy of Mathematics Today**, Clarendon Press, Oxford, 1998, pp. xii + 638, £75, ISBN 0-19-823654-9.

This book contains, essentially, papers given at a conference of the same name held in Munich in 1993. The volume is divided into five sections. *I. Ontology, Models, and Indeterminacy.* This section contains discussions relating to Benacerraf's well known papers on mathematical objects, with essays by Hale, Field, and Benacerraf himself; and discussions relating to Etchemendy's critique of Tarski's account of logical consequence, with papers by Shapiro and Chihara. *II. Mathematics, Science and Method* contains discussions on various aspects of methodology in mathematics, and comprises papers by Maddy, Burgess, Hellman, and Resnik. *III. Finitism and Intuitionism* contains papers that are concerned mainly with Hilbertean finitism. The authors here are Parsons, Niebergall and Schirn, and Detlefsen. The papers in *IV. Frege and the Foundations of Arithmetic* all concern Frege's philosophy of mathematics. This section contains a paper by Dummett, two papers by Wright, one by Boolos and Heck, and another by Heck on his own. The final section, *V. Sets, Structure and Abstraction*, contains papers on mathematical structuralism and mathematical abstraction. Here there are papers by Tait, Simons and Fine. There is a useful introduction by the editor that contextualises and summaries the papers. The volume is a collection of papers by many of the most important people working in the contemporary philosophy of mathematics. I think it to be essential reading for all those interested in the area.

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