the resources, and the users. Would that such a thorough approach was adopted for many traditional, non-expert, systems! Most of the key points on systems implementation are covered although sometimes somewhat superficially. Problems associated with sizing, for example, tend to be dismissed with advice such as "break the project down into separately budgeted stages". The chapter's message, that of taking a wider view when implementing a business system, is a sound one which should be welcomed.

This brings me to my final point. In taking the stance of the potential business user, as it claims to do, the most obvious question is surely, why expert systems? What's in it for my business? For me, these questions are not satisfactorily resolved by this book. Many managers are now alert to the potential of expert systems. What they are looking for is success stories which they can see as relevant to their own business. In this sense the book is disappointing. Perhaps it's too early yet to expect such successful applications, at least for larger systems. What makes more encouraging reading, for those eager to see expert systems introduced, is the inclusion of the contextual factors as essential ingredients in successful expert system implementation.

In conclusion, the book ought at least to wet the appetite of the manager curious to learn a little more of expert systems.

Reviewed by N A D Connell.

Automated theorem proving (second revised edition) by Wolfgang Bibel, Vieweg 1987.

This second edition has only minor changes from the first edition as the author considered that the contents and structure of the first edition were successful. This must be "successful" used with a relative interpretation. The cover note on this book claims that it can be viewed as a standard logic text with a strong emphasis on the computational features of logic. While the emphasis is certainly on computation, in my opinion it is not a standard logic text. The detective story of the first chapter certainly is an amusing way to introduce formal logic. But this is deceptive, Chapter 2 plunges into a morass of notation and definitions designed to serve the central thesis of the book.

The book is essentially a presentation of, and the author's justification for, the connection proof procedure. The author claims that the connection method is the most advanced proof procedure for first order logic presently available. "Advanced", here, must be interpreted in the sense of the most efficient, not the easiest to understand. The author claims that this method embodies all previous proof procedures in a unified formalism.

In the preface the author admits to the complexity of the connection method and that presentation is a real problem. He claims that because it is so complex a rigorous treatment is essential so that serious errors or misjudgements can be avoided. The author attempts to mitigate the unilluminating notation, definitions and rigorous proofs with informal descriptions. For this reviewer, this attempt was not successful; the informal descriptions did not provide much insight and I did not really gain a good understanding into what was going on until Chapter 4. I particularly found the convention for section and formulae numbering annoying, as there are many internal references, and this was an additional burden in a book which otherwise requires hard work and determination to finish. I suspect most readers would have given up well before Chapter 4; the book consists of only five (large) chapters.

Chapter 4 describes the Gentzen-Schutte calculus for first order logic. This calculus provides a synthetic schema for constructing valid formulae, the most fundamental one of which is $P \vee \neg P$. Such a disjunction of positive and negative literals in a formula is called a connection. In contrast the connection proof procedure is an analytic approach to determining the validity of a given first order formula. It is the analytic dual of the synthetic Gentzen-Schutte calculus in that it is an algorithm for determining the validity of a given formula which works by attempting to find a set of connections spanning the formula.

In general, the method is applied to formulae which have been transformed into a disjunction of conjunctions of disjunctions of conjunctions of... of literals. The transformation method is the same as reduction to disjunctive normal form but stops short of the use of the distributive law. The objection to use of the distributive rule $A \wedge (B \vee C) = (A \vee B) \wedge (A \vee C)$ stems from the fact that it results in a duplication of literals so increasing the computational complexity of the validity proof. An underlying theme of the book is that it does not encourage any formula transformations which entail any increase in complexity. Having said this, however, the connection method for predicate calculus is initially introduced by application to formulae in disjunctive normal form because it is easier to understand the application to the less transformed formulae.

An enjoyable feature of the book is the bibliographical and historical remarks at the end of each chapter. As an example: "The history of resolution is more complex than is usually described in the literature, which mentions J A Robinson as its discoverer . . ." And "Unification was first considered by Herbrand" in his thesis of 1930. "It only became well known after Robinson brought it into an elegant algorithmic form for use in resolution."

Enhancements of resolution proof procedures such as linearity are adopted by the connection method in Chapter 4. The resolution proof procedure is generally associated with refutation proofs while the connection method provides a validation proof of a formula in an affirmative manner. No new formulae are derived in the connection method in contrast to the resolvents produced by resolution. The section on performance evaluation of the connection method in relation to other methods in this chapter is rather inconclusive given that the author argues how difficult it is to assess.

The connection method might be the most advanced proof procedure for first order logic presently available, but I doubt this book is going to convince many people. I do not believe this book will serve for as wide a spectrum of readers as the author envisages. The author admits the book is not a textbook, but expects it might be used in instructor-student settings for which purpose a number of exercises appear at the end of each chapter. However, I think only those that are very determined to understand the connection method, and reviewers, will persevere. A novice reader interested in an introduction to automated proof would be better served by, what is now a rather old but transparently explained, Chang and Lee (1973). Chang and Lee, after a long period of being unavailable, is now back in print.

Reference

Chang, C-L and Lee, R C-T, (1973). *Symbolic Logic and Mechanical Theorem Proving*, Academic Press.

Reviewed by G A Ringwood, Dept of Computing, Imperial College, London.