VLSI chips, and 'LEXMEA: Learning Expert System Model for Engineering Applications' discusses the issues of planning (also in VLSI circuit design), and the mechanism of learning by tuning and incremental refinements using three different learning paradigms.

The philosophy of decision-making in the human world and the general principles for building expert systems which operate on knowledge that is purely human is presented in 'A framework to build expert systems for decision support'. The acquisition of knowledge has always been the bottleneck for knowledge engineers and crucial in expert system construction. In this context, Chiang and Brown's paper discusses the automation of the knowledge acquisition process by presenting a prototype system called DSPL Acquirer.

The remaining papers address the topic of AI application in aerodynamic simulation, database management, diagnosis, communication systems, and robotics.

In summary, Sriram and Adey have provided a readable and well thought-out collection. However, the book lacks in organization. The collection could have been ordered according to the type of applications or AI topic. An index would have been very useful.

Reviewed by: Dr Hayat Zerkani, Chemical Engineering Department, University of Technology, Loughborough, UK.

Knowledge representation: An AI perspective by Han Reichgelt

It is a great and unusual joy to find a book on any subject that may be as fervently and wholeheartedly recommended as Han Reichgelt's text on knowledge representation. Despite the rather discouraging spelling mistake on the cover (for all their punchy name Thomas Phon Graphics managed to misread the contents page and write 'semantics networks'), this is an excellent introductory text both for graduate and undergraduate students taking a basic course in knowledge engineering, as well as AI researchers who want to know something about a vastly important topic.

The book is beautifully clear as a result of both the straightforward language used, and the avoidance of unecessary mathematical notation. Mr Reichgelt would rather call a spade a spade than 'a tool used for digging or cutting the ground', and would rather write 'p implies q' than $p \supset q$, except when absolutely necessary. This alone makes the book worth reading; proof that complex scientific ideas can be conveyed in the kind of words Orwell advocated in his *Politics and the English Language*, a work which should be on the required reading list of everyone who has to write. This is true even of the section on non-monotonic logics, a subject that usually causes even the most articulate authors to retreat behind a dense barrage of complex notation. Indeed, the description of circumscription is the clearest that I have come across, and contains nothing more complex than the symbols for conjunction and implication. Of course, there is a price to be paid for such clarity, and that is the sacrifice of a complete mathamatical description of each technique in its most intimate detail. In my view, however, this is not a problem. If you want to know the formulae for determining the minimal models of the predicate circumscription of a theory, they you follow up the original paper, which is given in the bibliography. If not, and I believe the bast bulk of the readers of this book do not need or wish to know such things, you can pass on to more urgent matters, such as acquiring a basic idea of the differences between production rule systems and semantic networks.

Although I am not the best judge given my limited knowledge of the subject matter, the text seems to cover a respectable breadth of material. For someone who has built a career out of logic, Reichgelt is unbiased in his account of first order predicate logic, giving it no more credit than any other formalism, and no more space it deserves. Indeed, he even apologises, unecessarily, for making the chapter on logic longer than others on the grounds that it introduces certain general concepts, and overall he is extremely even-handed. One chapter each is allocated to logic, production rule systems, semantic networks, frame-based representation languages, mixed representation formalisms, and parallel distributed processing, and they are all discussed with the

same apparent authority and breadth of background reading. Furthermore, Reichgelt admits that while the bulk of the book describes methods that accept the knowledge representation hypothesis, the claim that any intelligent process contains knowledge that may be identified by external observers, there is much to be said for connectionist methods, which explicitly reject such a thesis. This is an extremely surprising admission for one who clearly believes in the logicist approach.

The evenhandedness extends to the assessment of each of the techniques covered. Reichgelt explains the advantages and disadvantages of each method in connection with a series of criteria set out in the first chapter. This allows comparisons to be made between the approaches, and goes some way towards providing a critical review of the subject; something which seems to be sorely needed by a subject of such critical importance as knowledge representation.

To illustrate the excellence of the book, consider the section on the representation of uncertainty, a subject with which I am very familiar. The section begins with a balanced discussion of the reasons why uncertainty is important, and three references for further reading, two of which seem appropriate. Then there is a detailed explanation of the certainty factor model which, while it has been heavily criticized, is still in wide commercial use. This is followed by a clear and concise account of Dempster–Shafer theory, an account which I have not seen bettered. Finally, and most commendably of all, there is a discussion of non-numerical formalisms, techniques which are only just beginning to catch on amongst those working in uncertainty. Indeed, Reichgelt goes so far as feel he needs to justify talking about uncertainty in quantitative terms, when in most circles it is assumed without question that uncertainty can only be handled with the use of numbers. An enlightened man indeed.

So, the overall verdict has to be that if you want a text that explains the basics of knowledge representation in plain English whilst being written with authority and no perceptible bias, and which provides clear criteria for discussing and choosing between formalisms, then look no further. Buy this book.

Reviewed by: Simon Parsons, Department of Electronic Engineering, Queen Mary and Westfield College, Mile End Road, London, UK.

Inheritance hierarchies in knowledge representation and programming languages edited by M Lenzerini, D Nardi and M Simi, John Wiley, Chichester 1991, pp 310, £22.50. ISBN 0 471 92741.

Reviewed by: Andrzej Glowinski, Advanced Computation Laboratory, Imperial Cancer Research Fund, London, UK

"Classification is a method of generalisation. Several classifications may, therefore, be used with advantage; and the physician, the pathologist, or the jurist, each from his own point of view, may legitimately classify the diseases and the causes of death in the way that he thinks best adapted to facilitate his inquiries, and to yield general results.

The medical practitioner may found his main divisions of diseases on their treatment as medical or surgical; the pathologist, on the nature of the morbid action or product; the anatomist or physiologist on the tissues or organs involved; the medical jurist on the suddenness or the slowness of death; and all these points well deserve attention in a statistical classification."
William Farr, Registrar General of England and Wales, Sixteenth Annual Report, 1856

The desire to impose structural order upon our knowledge of the world can be traced back to the origins of science and philosophy, but ancient schemes have long been abandoned in favour of the more objective and systematic approach introduced in the mid-eighteenth century by Linnaeus in his *Systema Naturae*. In essence, although the range of topics covered has expanded well beyond Linnaeus' classification of plants, the way in which concepts are organized into classes and hierarchies has not altered substantially since his time, with construction and use of the classificatory structures tending to employ methods which are informal, usually variable, often ill defined and sometimes uncomfortably *ad hoc* . More recently, however, there has been a steady growth of