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Book reviews

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The electronic design studio reviewed by Sara Jones, City University, London EC1V 0HB.
Approximate reasoning models
Reviewed by Paul J Krause, Advanced Computation Laboratory, Imperial Cancer Research Fund, PO Box 123, Lincoln's Inn Fields, London WC2A 3PX.
Search, inference and dependencies in artificial intelligence
Reviewed by Paul J Krause, Advanced Computation Laboratory, Imperial Cancer Research Fund, PO Box 123, Lincoln's Inn Fields, London WC2A 3PX.
Expert systems for business: concepts and applications reviewed by Jonathan Gee, Imperial Cancer Research Technology, Sardinia House, Sardinia Street, London WC2A 3NL.
Knowledge based systems for test and diagnosis reviewed by Jan Talmon, University of Limburg, Maastricht, Netherlands.
Neural network design and the complexity of learning reviewed by Johnny Farringdon, Department of Psychology, University College London, Gower Street, London WC1E 6BT.

Artificial Intelligence, Simulation, and Modelling by L E Widman, K A Loparo and N R Nielsen (eds.), Wiley, New York, 1989, pp 556, £35.50.

This book provides a survey of the history and recent achievements in the field combining artificial intelligence (AI) and simulation. It is useful for people involved in research or wanting to become involved. Some parts may be hard to read for beginners, but they can be understood with the help of the many references to the literature. The book is not, however, suitable for people looking for a ready-made tool to solve their complex real-life problems. Techniques in this field are not yet as mature as, say, expert systems.

There are 20 chapters in the book. The first introductory chapter provides a critical survey and lucid historical basis of AI, simulation, and modelling. The remaining chapters are structured into three sections dealing with

1. The conceptual basis for AI and simulation (8 chapters).
2. Simulation in AI (3 chapters).
3. AI in simulation (8 chapters).

Examples of real-life problems in the book include stand diffusion, scheduling, manufacturing and flight simulation. Each chapter contains a good bibliography; the total in the whole book is 689.

The fields of AI and simulation have a lot of common interests and complementarity which is the reason why the combination has been recently given increasing importance. Systems utilizing both techniques can overcome some limitations of each of them if used separately. For example, it is hard to represent hierarchical structure or knowledge about structure in dynamic systems using conventional procedural simulation methods. The book can be recommended to those in AI who want to enrich their systems with simulations, and to those working in simulation who need to extend their simulation by AI techniques. As the majority of contributing authors work mainly in AI, the book is probably more understandable for AI people than simulationists.

People working in related research can find ideas in the book about complementary approaches, or even hints how to solve their own problems. But it is unlikely that they will find detailed solutions, because approaches described are often rather application-specific and specialized for particular software and/or hardware. Also, research in this field is in an early stage, and the techniques are often presented and tested using only toy-examples.

A substantial part of the book deals with problems of qualitative simulation and the use of "landmarks" in qualitative representations. The intrinsic ambiguity of qualitative methods can be reduced by introducing new landmarks, constraints based on confluences, or semi-quantitative ranges. At least a whole chapter is given to each of these three approaches.

Promising topics in simulation modelling presented in the book comprise inference of sensitivity, and different levels of abstraction. The straightforward approach to sensitivity analysis requires running a simulation many times, perturbing individual parameters and evaluating the differences of the results. This is extremely expensive, and as a result is seldom properly carried out. The alternative approach is based on representation of sensitivities of all functions in a model and then the desired global sensitivity can be assessed by propagating the individual sensitivities through the computation.

Another technique which will be important for future systems is learning. Reinforcement learning, for example, which can be defined as the process by which the response probability of a system to a stimulus is strengthened by a reward or weakened by a penalty, has been applied in a hierarchical framework for process control. It can be successful even if the process dynamics and process disturbances are unknown.

Two chapters deal with parallelism which may be very important for complex simulations, but currently techniques for effective parallelising simulations are limited as it is extremely hard to achieve substantial speed-ups because, for example, of the heterogeneity and asynchronicity of many complex systems.

This is the first comprehensive book on this subject. It presents contributions of leading researchers, and shows the development of the field which will have definitively increasing importance in the future. It can be recommended to researchers in both fields, AI and simulation, as a good background and as a source of ideas for problems which may arise in this combined field, and it may facilitate attempts to search for a solution.

The electronic design studio by M McCullough, W J Mitchell and P Purcell (eds.), MIT Press, Cambridge, MA, pp 493, £44.95.

On coming to this book, I knew little more about the use of CAD tools for architectural design (CAAD) than could be gleaned from the glossy pictures of 3D graphics workstations in the CAD/CAM press. But the book itself provides all that is needed by way of introduction. CAAD tools have apparently been in existence for almost 20 years. During this time they have evolved in a number of ways in attempts to support more of the creative design process, and are now beginning to make use of a number of knowledge-based system techniques.

This review will attempt to provide a brief overview of the field of CAAD and the characteristic problems in this field which are being tackled by the introduction of KBS techniques. The book is divided into four sections: an introduction to the theoretical foundations of CAAD, a section on "Information Delivery Systems for Design", a collection of case studies on the use of CAAD in real design situations, and a set of more theoretical papers on the use of KBS techniques. The approach described means concentrating on the first and last of these sections (which constitute together about half the book), though other sections contain material which may be of more interest to teachers and practitioners of architectural design.

Architectural design is defined as "the computation of shape information that is needed to guide fabrication or construction of an artifact". This computation involves recursively transforming and combining shapes according to rules defined by an appropriate "shape algebra" until it can be shown that a set of pre-defined constraints on the final design have been satisfied. However, even