

AN ANNOTATED BIBLIOGRAPHY

John Fox

SURVEYS

Johnson, Tim "The commercial application of expert systems technology" Ovum Ltd, 14 Penn Road, London, England. In this analysis Johnson examines the likely markets for expert systems, including likely growth patterns; technology of systems and alternative programming languages; applications, both present and expected, and describes main suppliers in the USA and UK. A substantial, comprehensive volume written in a readable style.

d'Agapeyeff, A "A short survey of expert systems in UK business. Report to the Alvey Directorate, 1984; available from the Alvey Directorate, Department of Industry, Millbank Tower, Millbank, London. The report looks at what is happening at the grass roots in the UK, and emphasises the value of simple "skills systems" and the concept of "rare skills archiving". The main message (repeated in d'Agapeyeff's contribution in this volume) is the potential value of modest as well as exotic uses of expert system concepts.

B R Gaines "Perspectives on Fifth Generation Computing". To appear in Oxford Surveys in Information Technology, Autumn, 1984. Gaines considers fifth generation computing from a wide range of perspectives in order to understand the logic behind the programme, its chances of success, and its technical and social impact. The need for a consumer market for mass-produced powerful integrated circuits underlies the Japanese objectives, it is argued. Each of the main objectives is analysed and Gaines argues strongly that most if not all these aims are simply a logical extension of current knowledge, and achievable in the stated timescales. Unusually, he discusses the social implications of the technology in detail and suggests that they grow out of, rather than drive, society's needs. The basis for a Western response is summarised.

GENERAL DESCRIPTIONS OF AI

McCorduck, P "Machines who think" San Francisco: Freeman, 1979. A well informed journalist's view of the history of artificial intelligence. McCorduck argues that modern artificial intelligence is only the latest form of a preoccupation that has existed for hundreds of years. The events and personalities that shaped its modern development are described entertainingly, sometimes critically. She also analyses some of the resistance, and the reasons for it, that have marked its growth. Includes a brief discussion of major themes in robotics, perception, language, and applied artificial intelligence. An entertaining and illuminating read.

Artificial Intelligence and Natural Man, M Boden, Harvester Press, 1977. A humanist looking at artificial intelligence and its implications for psychology. This is a highly readable account of the major themes of artificial intelligence and cognitive science more generally. The book discusses language and understanding; perception and imagination; learning, creativity and problem-solving. Experiments that explore the application of information processing ideas in the development of ideologies and the development of abnormal belief systems are also described. The general philosophical and social relevance of artificial intelligence ideas in relation to classical approaches to the understanding of mind and society are also discussed.

INTERNATIONAL DEVELOPMENTS

"An Alvey survey: advanced information technology in the UK" Future Generations Computer Systems, 1 (1), 1984, pp. 69-78. The British Alvey Programme is a national project covering a number of "enabling" technologies; software engineering, man-machine interface, intelligent knowledge-based systems and VLSI. The "Alvey Report" and the "Alvey Directorate" to which it led to are described, together with the goals in the four areas and an additional one of communication and infrastructure. The author ("J.M.") comments on the economic and social problems faced by the Directorate and its approach to overcoming them.

L W Sumney and R M Burger "VLSI Research in the USA" Future Generations Computer Systems, 1 (1), 1984, pp. 31-38. Discusses the relative positions of USA, Japan and Europe in advanced semiconductor technology. The US Semiconductor Research Corporation is discussed in detail; its research goals in basic science, design and manufacturing, and its main academic centres and projects. The overall research programs in processes, materials, devices and interconnection techniques are reviewed.

Lindamood, G E "The structure of the Japanese Fifth Generation Computer Project – Then and Now" *Future generations computer systems*, 1 (1), 1984, pp. 51–55. The Japanese Fifth Generation Project was not a sudden development but has been through several stages of planning. The general themes – basic application system, basic software, advanced architectures, VLSI, systematics and support technology are outlined. Lindamood emphasises that the project is not rigid but subject to substantial and frequent revision as experience is obtained.

Fredriksson, E H "Introduction" to *Future generations computers systems*, 1 (1), 1984, pp. 3–7. A brief discussion of the origins and objectives of the fifth generation, in Japan, USA, Federal Republic of Germany, France and the UK. Particular attention paid to the national projects and cooperative research programs, and emphasis on the shortage of skilled personnel.

"ESPRIT: Europe challenges US and Japanese competitors in information technology" *Future Generations Computer Systems*, 1 (1), 1984, pp. 61–68. The European Strategic Programme for Research and Development in Information Technology aims to strengthen European competitiveness by fostering precompetitive technological research. This article discusses the origins and goals of ESPRIT, its budgets and focus. The completed "pilot phase" in microelectronics, software technology, advanced information processing, office automation and CAD/CAM are described.

Hertzberger, L O "The architecture of fifth generation computer systems" *Future generations computer systems*, 1 (1), 1984, pp. 9–21. The architecture of the FGCS sequential and parallel inferences machines are described. Particular attention is paid to research and development targets and the role of Prolog. ICOT's personal sequential inference machine, an early version of which has already been built, is described in detail covering system configuration and hardware organisation. Models for future parallel inference machines, including dataflow, functional and logic models are also discussed, and preliminary designs and results of experimental simulations are presented.

THE FIFTH GENERATION

Kowalski, R "Software engineering and knowledge-based systems in new generation computing" *Future generations computer systems*, 1 (1), 1984, pp. 39–49. Kowalski's SPL Insight Award lecture, in which he discusses the nature and significance of logic programming, prolog and their contribution to software development. He argues that logic-based software unifies structured systems analysis with databases of conventional and rule-based material. He goes on to argue the importance of the contribution of logic programming to expert systems, and suggests that the analysis and simulation of legislation (eg the British Nationality Act) is a critical and instructive application. Other applications of Artificial Intelligence to Software Engineering more generally are explained (and vice versa) and his view of the social implications of his work are discussed.

Treleaven, P C and Lima, I G "Future generation of computers" In *Proceedings of Impact 84, SPL-Insight*, Abingdon, Oxfordshire, UK. The authors analyse the possible architectures of fifth generation computers in detail, and argue that a "decentralised" architecture which encompasses FGCS, supercomputers and von Neumann is a wisely conservative approach to achieving the goals of the new generation. They believe that these computers will be based on control flow designs, and propose an evolutionary approach called the decentralised control flow architecture. Differences between trends in academic research and industrial developments highlight sharp differences in direction.

THEORY OF KNOWLEDGE

"The knowledge level" A Newell, *Artificial Intelligence Magazine*, 1982. A piece that distinguishes a new computer level, knowledge, that is distinct from, and probably independent of, the more familiar program and hardware levels. The concept of "rationality" is discussed; what we mean by it and how it is entirely relative to the knowledge and goals of a reasoning system. This was Newell's presidential address to the American Association of Artificial Intelligence.

Ringle, M "Psychological studies and artificial intelligence" *The AI Magazine*, vol 4, no 1, 1983, pp 37–43. The paper argues that psychological studies are relevant to most facets of AI research and that closer ties between AI and psychology will enhance the development of both AI principles and its computer implementations. Raising psychological assumptions from the level of ad hoc intuitions to the level of systematic empirical observation will improve the quality of AI research and help to integrate it with other disciplines.

Ernst, G W and Banerji, R B "On the relationship between strong and weak problem solvers" *The AI Magazine*, vol 4, no 2, Summer 1983, pp 25–29. The article argues that problem solvers are essentially

interpreters that carry out computations implicit in the problem formulation. A good problem formulation gives rise to what is conventionally called a strong problem solver; poor formulations correspond to weak problem solvers. Knowledge-based systems are discussed in this context.

LEARNING AND DISCOVERY

Lenat, D B "The nature of heuristics" *Artificial Intelligence*, 1982, 19, 189–249. Lenat is well known for his work on AM (the Automated Mathematician) and Eurisko, which are knowledge based programs designed to explore and extend knowledge bases using heuristic techniques. These programs, it is claimed, can learn or discover new concepts by applying meta-knowledge to existing knowledge. In this paper Lenat analyses the concepts of heuristics and suggests reasons for their power. Lenat's ideas are widely acknowledged to be exciting and they may be important in the future, but he is controversial.

Ritchie, G D, and Hanna, F K "AM: A case study in AI methodology" *Artificial Intelligence*, vol 23, no 3, 1984, 249–268. Many people have questioned the true significance of Lenat's work on AM and Eurisko. This paper, which took four years to appear from its original submission, presents a careful and critical analysis of the contribution of AM. They particularly criticise the construction of large impressive-looking programs, the theoretical content of which may not always be clearly stated.

Lenat, D B and Brown, J S "Why AM and Eurisko appear to work" *Artificial Intelligence*, 23 (1984) pp 269–294. This is a response to the discussion by Ritchie and Hanna. Lenat and Brown analyse the criticisms, accepting some and questioning others.

Dieterich, T G and Michalski, R S "Inductive learning of structural descriptions" *Artificial Intelligence*, 16, 1981, 257–294. A number of AI techniques for learning that have been reported are discussed, including the methods of Buchanan, Hayes-Roth, Winston and Michalski. Important aspects of structural learning in general are examined and criteria for evaluating learning methods are presented, including adequacy of the representation, generalisation rules, efficiency, flexibility. Suggestions are made for areas of future research.

Wilkins, D E "Domain independent planning" *Artificial Intelligence*, 22, 1984, 269–301. A domain-independent planning program that supports automatic and interactive generation of plans is described. The program is compared and contrasted with various predecessors, and its basic mechanisms and their performance are described. Particular emphasis is placed parallel operations and reasoning about resources.

Fox, J "Doubts about induction" *Bulletin of SPL Insight*, 1984, SPL International, Abingdon, Oxford, England. Various authors have argued that the bottleneck in developing expert systems is in the development of comprehensive, accurate knowledge bases. The author outlines the case for this position and the arguments of D Michie that the only practical solution is to use automatic techniques for inducing knowledge from example problems. A particular commercial system, Expert-Ease, and the general induction approach are examined critically. It is concluded that the problem of building knowledge bases is difficult and important, but that induction techniques only solve a small part of it and distract attention from techniques which are likely to be more profitable.

Bundy, A., Silver, B and Plummer, D "An analytical comparison of some rule-learning programs" In *proceedings of Expert Systems 83*, Churchill College, Cambridge, 1983; London: British Computer Society. Various rule learning programs are surveyed and compared with concept learning programmes. The programmes have much in common but some techniques are shown to subsume others.

EXPERT SYSTEM TECHNIQUES

Stefik, M., Aikins, J., Balzer B., Benoit, J., Birnbaum, L., Hayes-Roth, F., Sacerdoti, E. "The organisation of expert systems, a tutorial". Expert systems are examined with particular reference to the types of task that they have been developed for (interpretation, diagnosis, monitoring, prediction, planning, design). Examples are given and the implications of the different features of the tasks for the organisation and mechanisms of the systems are described.

Hayes-Roth, F., Waterman, D A., and Lenat, D B., *Building Expert Systems*, Reading, Massachusetts: Addison Wesley, 1983. A variety of interesting chapters covering less usual issues such as basic organisations and tasks, comparative studies of different designs, evaluation and so on. About building expert systems in the big, expensive American style, but full of thoughtful contributions from members of a community with more experience than any other.

Clancey, W J., "The epistemology of a rule-based expert system – a framework for explanation" *Artificial Intelligence*, 20 (1983) pp 215–251. The paper examines MYCIN's rules from the perspective of a teacher trying to justify them and convey a problem-solving approach. It turns out that individual rules have different functions and justifications, and incorporate important structural and strategic knowledge which is implicit. It is argued that making this sort of knowledge explicit will enhance the ability to understand and to modify this sort of rule-based expert system.

Clancey, W J and Shortliffe, E H (eds) "Readings in medical artificial intelligence, the first decade" 1984, Addison-Wesley. A number of classic papers on the development of medical expert systems are reprinted, together with commentary and specially commissioned papers. PIP, Casnet, INTERNIST, MYCIN and VM are among the many systems which are described in a historical perspective.

Buchanan, B G and Shortliffe, E H "Rule-based expert systems, The Mycin experiments of the Stanford Heuristic Programming Project". This is a "grand view" of all the many projects that have sprung from Shortliffe's original version of MYCIN, together with discussions of many topics of general interest to expert systems designers. Mycin is described in detail, the techniques for building knowledge bases and reasoning under uncertainty, explanation etc. Later work on generalising MYCIN (EMYCIN), different forms of knowledge representation, issues of evaluation and human engineering, and modifications of MYCIN for teaching, are all discussed in this comprehensive book.

Suwa, M., Scott A C., and Shortliffe, E H "An approach to verifying completeness and consistency in a rule-based expert system" *The AI Magazine*, 3 (4), 1982, 16–21. A program for verifying that a set of rules in an expert system comprehensively spans the knowledge of a specialised domain. The program has been devised and tested within the context of the Oncocin system, a rule-based consultant for clinical oncology. Its capabilities suggest a general mechanism for correcting many problems for knowledge base completeness and consistency before they can cause performance errors.

SYSTEM DESCRIPTIONS

McDermott, J "R1: A rule-based configurer of computer systems" *Artificial Intelligence* 19, 1982, pp 39–88. R1 is a classic expert system developed at the Carnegie-Mellon University for configuring VAX computers. Given a computer order it decides what, if any modifications are required to make the order complete and sufficient and assembles the components list. R1 is implemented as a production system, in which the basic technique underlying its operation is 'match', which uses forward chaining rather than the backward chaining, theorem proving ideas which are typically used in most famous expert systems.

Duda, R O and Shortliffe, E H "Research in expert systems" *Science*, 1982 Overview paper by two pioneers. "Artificial intelligence, long a topic of basic computer science research is now being applied to problems of scientific, technical and commercial interest. Some consultation programs, though limited in versatility, have achieved levels of performance rivalling those of human experts. A collateral benefit of this work is the systematization of previously unformalised knowledge in areas such as medical diagnosis and geology.." [Authors' summary.] The paper surveys a lot of (American) systems, reporting on the evaluations as well as the ideas.

Lenat, D B., Sutherland, W R., Gibbons, J "Heuristic search for new microcircuit structures: an application of artificial intelligence" *The AI Magazine*, 1982 (3), pp 17–33. Eurisko is an AI program that learns by discovery. It is being applied to the task of inventing new kinds of three-dimensional microelectronic devices that can be fabricated using laser recrystallisation techniques. The paper describes three experiments with Eurisko, and suggests some novel designs and design rules which have emerged.

Nii, H P., Feigenbaum, E A., Anton J J., Rockmore, A J "Signal-to-symbol transformation: HASP/SIAP case study" *The AI Magazine*, Spring 1982, pp 23–35. The HASP/SIAP projects attempted to apply knowledge based techniques to the traditional thorny problem of interpreting ambiguous signals, in their case military signals like sonar data. Their approach is to back up a knowledge based inference system to a conventional signal processing package. One of the few papers on signal processing currently available, but irritatingly vague and full of jargon.

van Melle, W "A Domain independent production rule system for consultation programs" *Proc. 8th International Joint Conference on Artificial Intelligence*, pp 923–925 (1979). The first expert system package, much emulated, derived from the MYCIN medical expert system and preserving all its innovative features including rule-based knowledge representation, backward chaining control structure, explanation techniques, and with some tools for knowledge base development added. EMYCIN is written in INTERLISP and not easily available for most people, but many groups have nevertheless

exploited it in a number of areas.

Duda, R O and Reboh, R. "AI and decision making: the Prospector experience" Syntelligence Inc, Menlo Park, California. Prospector was another classic backward chaining system, which introduced some concepts which were different from those of EMYCIN in particular the use of a semantic net representation as well as rules for knowledge. Also handles uncertainty differently, combining both bayesian and fuzzy logic techniques. The system has been applied to geological prospecting, and is reputed to have paid for its development many times over from some mineral deposits it located.

Shortliffe, E H. Computer based medical consultations: MYCIN. Elsevier, NY, 1976. The book about the classic expert system that started much of the excitement. The general problems of applying computers in medicine are discussed, in the context of artificial intelligence as a whole. The problem of diagnosing and treating bacterial infections is presented and the design considerations these implied for the MYCIN system. The consultation system itself is described in detail, particularly the use of rules, and the combination with numerical calculations of uncertainty. The control and explanation facilities are described, and the advantages of the MYCIN approach and possible extensions are discussed.

FUNDAMENTAL AI TECHNIQUES

Feigenbaum et al (Eds), Handbook of Artificial Intelligence, Pitman, 1981-83 (in three volumes). The authoritative voice of American Artificial Intelligence. These handbooks are assembled from papers provided by many workers but the overall structure maintains a readable and consistent style. The volumes cover major areas of research such as natural language, perception, expert systems, learning etc with the aim of providing a reference and tutorial text which records lasting ideas rather than current developments, by discussing specific classical programs and general AI principles.

Waterman, D A and Hayes-Roth F (eds) Pattern-directed inference systems, New York: Academic Press, 1978. A collection of papers about "data driven" techniques primarily, but also covers some general expert system topics. Papers are divided into sections on architecture and design, deductive inference, learning, cognitive modelling, natural language understanding, multilevel systems and complexity. The volume is a selection of papers from a conference in Hawaii in 1977 and is beginning to age, but the focus on data driven systems is not to be found elsewhere. Some of the material is particularly relevant to those interested in signal processing applications.

Davis, R and Lenat, D B Knowledge-based systems in artificial intelligence, McGraw Hill, 1982. A book derived from two well known theses on knowledge acquisition an knowledge-based innovation. Davis describes his work on Tiersias, and extension of the MYCIN expert system designed as an expert system to acquire knowledge from a human user in a structured, guided way. Lenat describes his work on AM, a system exploring the potential of knowledge based systems to use heuristics to create new knowledge, with particular reference to mathematical number theory. Detailed but hard to read.

Pearl, J "Heuristics, Intelligent search strategies for computer problem solving" 1984, Addison-Wesley. A central topic in AI and expert systems is that of "heuristics" – rules of thumb, educated guesses, "intuitive" judgements etc. This book presents an analysis of the nature and the power of typical heuristic methods, primarily those used in artificial intelligence and operations research to solve problems of search, reasoning, and planning.

Sowa, J F Conceptual Structures: Information processing in mind and machine, Reading, Massachusetts: Addison-Wesley, 1984. An informed and very well written book, covering an enormous amount of ground in artificial intelligence and cognitive science. Sowa introduces the major AI ideas, philosophical basis and psychological counterparts. He presents a particular theoretical idea, the conceptual graph, which is an attempt to unify these themes with traditional concepts in computer science, such as databases. Reasoning and computation, language, and knowledge engineering are discussed in detail. The author is extremely well informed and writes entertainingly. Hard work in places but well worth it.

LOGIC PROGRAMMING

Kowalski, R., Logic for problem-solving, North Holland, 1979. Kowalski's classic book advocating the use of logic programming in a variety of artificial intelligence and other applications. Discusses logic and theorem proving techniques, planning and problem solving. Although the title suggests problem solving the book has a narrow interpretation and ignores, for example, psychological studies of problem solving and what can be learned from them. The book has a formal, "text-book" style.

Nilsson, N J "Symbolic computation: Principles of Artificial Intelligence" Berlin: Springer Verlag 1982.

Another strong theoretician in the logic school, hard, well written and authoritative. Nilsson introduces artificial intelligence and discusses a number of major themes in detail; productions systems and their theory; search strategies for production systems of various types; the role of predicate calculus and resolution theorem proving; rule-based deduction; planning and object representation. The book goes into its subject in depth, but only deals with a narrow slice of artificial intelligence, ignoring such topics as vision, speech and natural language.

Clark, K L and Tarnlund, S A "Logic Programming", Academic Press, 1982. Updated proceedings of the first international workshop on logic programming in Hungary, 1980. Logic programming is introduced by Kowalski and then a number of sections on techniques, natural language, implementation issues and metalevel issues are presented. Other technical sections deal with specification and transformation of programs, control in logic programming and AI systems, logic programming languages and computability. An excellent and informative collection.

KNOWLEDGE BASED APPROACHES TO UNCERTAINTY

Cohen P R and Grinberg, M R "A theory of heuristic reasoning about uncertainty" The AI Magazine, Summer, 1983, pp 17-24. The authors criticise conventional methods of dealing with uncertainty by using ad hoc combinations of logic and variants of probability theory. They observe that it is often unclear what numerical representations of uncertainty should mean, that numerical representations suppress information that may be important for explanations, and consequently they also make it impossible to reason about the reasons for uncertainty. A 'theory of endorsements' is described which the authors suggest is an alternative approach to reasoning in particular domains which avoids these problems. They discuss the theory in the context of a system for giving financial advice.

Doyle, J "Methodological simplicity in expert system construction" The AI Magazine, 4(2), 1983, 39-43. Probabilistic rules and their variants have supported several successful applications of expert systems, in spite of the difficulty of committing informants to particular conditional probabilities or "certainty factors". Recent developments which offer hope for avoiding the practical elusiveness of probabilistic rules while retaining theoretical power are surveyed.

Fox, J Barber, D and Bardhan, K D "Alternatives to Bayes? A quantitative comparison with rule-based diagnosis" Methods of Information in Medicine 1980, 19(4), 210-215. A comparison of statistical and rule-based approaches to building medical diagnosis systems. A rule-based system that was closely modelled on clinical thinking is described and a quantitative comparison with a successful Bayesian system for the diagnosis of indigestion is presented. The results suggest that the rule-based approach may have considerable potential as an efficient alternative to Bayesian inference.

KNOWLEDGE ACQUISITION

Welbank, M "A review of knowledge acquisition techniques for expert systems", Martlesham Consultancy Services, British Telecom Research Labs, Martlesham Heath, Ipswich. A good, non-technical review of ways of approaching the "bottleneck" of expert system development, knowledge acquisition. Covers relevant subjects in psychology etc as well as in the narrow field of expert systems and AI. Text livened up by a number of pithy cartoons.

Michie, D "Towards a knowledge accelerator" In proceedings of Impact-84, SPL-Insight, Abingdon, Oxfordshire, UK. Michie has long argued that expert system technology will only achieve its potential when we can overcome the "bottleneck" of knowledge base development using induction techniques for automatic synthesis of knowledge. Here he repeats that argument, and gives examples of the use of induction. He also argues for the use of chess as an important domain for experiments in artificial intelligence in general and induction of knowledge in particular.

Stefik, M and Conway, L "Towards the principled engineering of knowledge" The AI Magazine, 3(3), Summer 1982, pp 4-16. The conventional approach to building expert systems assumes that the knowledge exists, and that it is feasible to find an expert who has it. The article considers the practice of knowledge engineering when these assumptions are not true. The authors focus particularly on the field of VLSI design. They suggest principles and methods for solving these knowledge engineering problems.

Berry, D C and Broadbent, D E "On the relationship between task performance and associated verbalizable knowledge" Quarterly Journal of Experimental Psychology, 1984, 36A (2), 209-231.. In this psychological study the authors look at the relationship between performance on a "cognitive" task and the explicit, or reportable, knowledge associated with the performance. They also examine the effects of variables like practice, instructions and giving running commentaries on ability to explain the skills involved in controlling simulated systems (eg sugar production). The study produces some

interesting results highly relevant to understanding knowledge acquisition techniques.

Myers, C.D., Fox, J., Pegram, S.M., Greaves, M.G. "Knowledge acquisition for expert systems: experience using EMYCIN for leukaemia diagnosis". A quantitative study of the advantages, and dangers, of the empirical approach to building knowledge bases. In proceedings of British Computer Society, Expert Systems 83, Churchill College, Cambridge.

MAN-MACHINE INTERACTION

Fox, J. "Intelligent Knowledge Based Systems and Man Machine Interaction: Final Report", IKBS Architecture Study, Science and Engineering Architecture Study (1982) volume 2. A report on the potential of expert systems to contribute to how we design user interfaces, and vice versa. Examines the contributions in both directions and includes commentary by many specialists in both fields. A substantial bibliography is also included.

Fox, J., Alvey, P., and Myers, C. "Decision technology and man-machine interaction: the PROPS package" In proceedings of Expert Systems 83, Cambridge, November 1983, British Computer Society, London. Much of the justification for expert systems is their potential attractiveness to users, but in practical most expert system shells leave much to be desired. This paper considers EMYCIN as a representative system, commenting on the runtime interface for the user and the buildtime interface for the knowledge engineer. Criteria for an improved design are identified and a prototype system with the required features, PROPS, is described.

Kidd, A. and Cooper, M.B. "Man-machine interface for an expert system" In proceedings of Expert Systems 83, Cambridge, November 1983, British Computer Society, London. This paper provides a discussion of the man-machine interface issues arising from the development and use of a Prospector-type expert system shell. Implications for designing good interfaces for future expert systems are discussed.

Brownridge, G., Fitter, M and Sime, M. "The doctor's use of a computer in the consulting room: an analysis" International Journal of Man-Machine Interaction. 21 (1), July 1984, pp 65-90. This is a detailed practical study of the effects of introducing an on-line decision support system into a medical clinic. Although the technology was traditional (based on statistical decision making methods) the authors discuss issues and effects on the doctor, the organisation of her work, and relationship with her patient, which are equally relevant to the use of expert systems, and relevant to the use of decision technology in fields outside medicine.

PAPERS AND SYMPOSIA ON EXPERT SYSTEMS

Proceedings of the 8th International Joint Conference on Artificial Intelligence, Karlsruhe, August 1983 (Two volumes.) The major biannual conference proceedings, containing papers on all topics in artificial intelligence. The quality is mixed but gives a good impression of the state of the field internationally. In this particular conference there were nine multi-paper sessions on expert systems, theory and applications.

Proceedings of Expert systems 83, Churchill College, Cambridge, December (British Computer Society, London). A collection of papers showing the kind of work currently going on in UK industry and elsewhere. 25 papers in this conference covering case studies, realtime applications, expert system shells, techniques, applications and knowledge acquisition. This is an annual technical conference, and the proceedings of the 1984 conference will also be available in December.

DESCRIPTIONS OF AI LANGUAGES

“Poplog – a multi-purpose program development environment” Hardy, S, and Sloman, A, University of Sussex, 1982. Poplog is the only environment that combines Lisp, Prolog and a conventional algorithmic language, POP11, together with development tools.

“LISP” Winston, P H and Horn, B K P, Addison-Wesley Inc, 1981. There are many LISP dialects, for different machines and with different strengths. This book is based on MACLISP but gives a good feel for what AI programming in LISP is like, and shows how to implement data-structures, knowledge structures, inference mechanisms, natural language techniques and the like in good detail.

“Programming in Prolog” Clocksin, W F and Mellish, C S, Berlin: Springer Verlag, 1981 (New edition expected). Originally intended as “lecture notes” but published as a book, this isn’t a perfect treatment of Prolog programming. However it was the best for a long time, and it is based on the “Edinburgh” syntax of Prolog, which is perhaps the most standard.

“micro-PROLOG: programming in logic” Clark, K L and McCabe, F G, London: Prentice-Hall, 1984. This prolog is misnamed – it was originally a micro-based language but now commands a lot of respect as it is more powerful than some other versions. The authors come from Kowalski’s Imperial College group which is the authoritative logic programming group.