Canadian Artificial Intelligence

Intelligence Artificielle au Canada

October/octobre
1987 No. 13

An official publication of CSCSI, the Canadian Society for Computational Studies of Intelligence

Une publication officielle de la SCEIO, la Société canadienne pour l'étude de l'intelligence par ordinateur

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See page 6 for details of new editorial addresses. / Voir page 8 pour les détails des nouvelles addresses des rédacteurs.

Please send subscriptions, memberships, and changes of address to / Prière d'envoyer tout abonnement, cotisation, et changement d'adresse à:
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Canadian Society for Computational Studies of Intelligence

Founded 1973

CSCSI is the Canadian society for the promotion of interest and activity in Artificial Intelligence. It conducts workshops and fully refereed national conferences, publishes this magazine, sponsors the journal *Computational Intelligence*, and coordinates activities with related societies, government, and industry.

To join CSCSI, use the membership form in this issue. Non-Canadian members are welcomed.

CSCSI is affiliated with the Canadian Information Processing Society and International Joint Conferences on Artificial Intelligence, Inc.

Société canadienne pour l'étude de l'intelligence par ordinateur

Fondée 1973

SCEIO est la Société canadienne encourageant l'intérêt et la recherche en Intelligence Artificielle. Elle organise des ateliers ainsi que des conférences nationales avec évaluation des articles soumis. Elle publie ce magazine, subventionne le journal *Intelligence Informatique*, et coordonne toute interaction avec, des sociétés parallèles, le gouvernement, et l'industrie.

Pour devenir membre de la SCEIO, veuillez utiliser le formulaire d'inscription de ce numéro. Les non-canadiens sont bienvenus.

La SCEIO est affiliée à l'Association canadienne informatique, et aux International Joint Conferences on Artificial Intelligence, Inc.

Canadian Artificial Intelligence

Intelligence Artificielle au Canada

Founded in 1974 as / Fondée en 1974 en tant que *CSCSI/SCEIO Newsletter*

Canadian Artificial Intelligence is published quarterly by CSCSI/SCEIO, and is a benefit of membership in the society.

Canadian A.I. solicits contributions in English or French on any matter related to artificial intelligence, including:

- Articles of general interest.
- Descriptions of current research and courses.
- Reports of recent conferences and workshops.
- Announcements of forthcoming activities.
- Calls for papers.
- Book reviews (and books for review).
- Announcements of new AI companies and products.
- Opinions, counterpoints, polemic, controversy.
- Abstracts of recent publications, theses, and technical reports.
- Humour, cartoons, artwork.
- Advertisements (rates upon request).
- Anything else concerned with AI.

Please send submissions, either on paper or by electronic mail, to the editor at the address on the previous page. On-line submissions are preferred, but they should not contain justification spaces or hyphenated line breaks as these just have to edited out before typesetting; 'plain typing' is best.

Canadian A.I. is published in January, April, July, and October. Material for publication is due six weeks before the start of the month of publication.

L'*Intelligence artificielle au Canada* est publiée trimestriellement par la CSCSI/SCEIO, et est offerte gratuitement aux membres.

L'*IA au Canada* encourage les contributions, en français ou en anglais, portant sur l'intelligence artificielle. Ceci comprend:

- Des articles d'intérêt général.
- Des descriptions de recherche courante et de cours.
- Des rapports de conférences récentes et d'ateliers.
- L'annonce d'activités à venir, et des requêtes d'articles.
- Des critiques de livres (ainsi que des livres à critiquer).
- L'annonce de nouvelles compagnies en IA et de leurs produits.
- Des opinions, des répliques, tout ce qui est polémique.
- Des résumés de publications récentes, de thèses et de rapports.
- Des trucs humoristiques ou artistiques, des bandes dessinées.
- Des annonces (s'enquérir des frais).
- Tout autre matériel touchant à l'IA.

Veuillez expédier vos contributions, soit sur papier ou par courrier électronique, à l'éditeur dont l'adresse apparait à la page 3. Nous préférons le courrier électronique mais ce qui est ainsi envoyé ne devrait pas contenir d'espaces de justification ni de mots à trait d'union puisque ceux-ci doivent être supprimés avant la mise en page; un texte 'tel quel' est ce qu'il y a de mieux.

L'*IA au Canada* apparait en janvier, en avril, en juillet, et en octobre. Toute communication à publier doit nous parvenir au moins six semaines avant le début du mois de parution.

Marlene Jones

Sheila McIlraith

Editor's notes

Magazine Moves to Calgary as New Editors Take Over

Graeme Hirst
Senior Editor Emeritus

This is my last issue as senior editor of *Canadian Artificial Intelligence*. Faithful readers of this page know that the magazine has for some time been growing too much to be a part-time pursuit of one member of a university department. I'm pleased to announce, therefore, that the magazine will now have two senior editors: Marlene Jones and Sheila McIlraith, both of the Alberta Research Council, will (with the assistance of their colleagues) be responsible for the magazine. And I will remain as editor of the Books Review and Journals section.

CSCSI/SCEIO and *Canadian A.I.* were formed back in the days when artificial intelligence was purely an intellectual curiosity carried out in universities. Now that there is major industrial and government participation in the field, it is fitting that the new editors should come from a government research lab with strong academic and industrial ties. Marlene and Sheila have excellent qualifications for the job, and I'm sure that under their guidance, the magazine and the society it serves will continue to grow.

In the three years that I have produced the magazine at the University of Toronto, I have been helped by many of my colleagues. First Joanne Mager and then later Marina Haloulos typed on-line the copy, both English and French, that arrived on paper. My meagre French was supplemented by that of Jean-Pierre Corriveau, Yves Lespérance, and Jean-François Lamy, who prepared the French summary and other French material, and communicated with francophone members and contributors.

The tasks of sticking labels, stuffing envelopes, and carrying heavy boxes of printing were taken on by Jim des Rivières and Jean-Pierre Corriveau. Cathy Ledden and Laurie Lewis at U of T Press helped me learn about design and printing, and tolerated the perpetual races and latenesses. Cathy also designed the cover for the magazine, using Kathy Finter's logo for CSCSI/SCEIO.

I want to acknowledge the support of our advertisers, who have made the magazine financially possible, for membership fees alone could not have

supported this enterprise. In particular, Takashi Gomi of Applied AI, Xerox Canada, Lisp Canada, and the member companies of the Nexa group, have been particularly faithful supporters.

Lastly, I am grateful to all those who have contributed articles, reviews, and news to the magazine, for they are the people who have made the magazine what it is today. I know that you will give Marlene and Sheila the support you have given me.

□ □ □ □ □

The new address for all matters concerning the content of the magazine, *except* books and journals, is:

Dr Marlene Jones
Canadian Artificial Intelligence
Alberta Research Council
6815 8th Street NE, 3rd floor
Calgary, Alberta, CANADA T2E 7H7
Phone: 403-297-2600
CDNnet: cscsi@noah.arc.cdn
UUCP: cscsi%noah.arc.cdn@alberta.uucp

Book reviews, books for review, and related matters should continue to be sent to:

Graeme Hirst
Canadian Artificial Intelligence
Department of Computer Science
University of Toronto
Toronto, Ontario, CANADA M5S 1A4
Phone: 416-978-8747
CDNnet: gh@ai.toronto.cdn
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Matters concerning memberships and subscriptions should continue to be sent to the Society's secretariat:

CSCSI/SCEIO, c/o CIPS
243 College Street, 5th floor
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Marlene Jones, PhD, is a senior researcher at the Alberta Research Council and an adjunct professor at the University of Saskatchewan. Before joining ARC, Marlene was a tenured Associate Professor at the University of Waterloo. Her qualifications include a PhD (computer science) from the University of Toronto and a Masters in Education (special education) from the University of Saskatchewan. Marlene's main research interests span a variety of AI and Education topics including student modelling, educational diagnosis, and AI approaches to computer-assisted and computer-managed learning.

Sheila McIlraith, MMath, is an AI researcher in the Department of Advanced Technologies at the Alberta Research Council. Since completing her Master's degree in computer science at the University of Waterloo, Sheila has acquired extensive experience in applied AI research, working first as an expert systems consultant in London (U.K.) and then joining ARC where she has provided technical expertise on a variety of projects: character recognition, qualitative analysis applied to well-test interpretation, integration of AI into discrete-event simulation. Sheila plans to return to graduate studies soon to pursue her PhD.

Letter to the Editor

Dear Editor,

This letter has been sent to you for luck. Send copies to people whom you think need luck. Do not send money, as fate has no price. Do not keep this letter. It must leave your hands within 96 hours. Joe Elliot received $40,000 and then lost it because he broke the chain.

Please send 20 copies of this letter and see what happens in four days. Constantine Dias received the chain in 1953 He asked his secretary to make 20 copies, and send them out. A few days later, Mr Dias won a lottery of $2 million. Dalen Fairchild received this letter and, not believing, threw it away. Nine days later, Mr Fairchild died.

Name and address withheld

Thank you, shy reader, for thinking of Canadian A.I. *and its need for good luck. I do have some questions, however. For example, were the names of Messrs Elliot, Dias, and Fairchild already present in the letters they received? If so, how come? If not, then it isn't really the same letter, is it? Also, how come it wasn't Mr Dias's secretary who won the lottery? After all, it was he or she who did the work.* — Editor

Notes from Members

CSCSI/SCEIO Secretary **Bill Havens** has joined the brain drain, and moved from the University of British Columbia to the Research Labs of Tektronix in Beaverton, Oregon. Despite his foreign address, Bill will continue as a member of the Society executive. He may be reached at the following address: Bill Havens, Tektronix Research Labs MS-50-662, PO Box 500, Beaverton, OR 97077, U.S.A. Phone: 503-627-5151. CSNET: havens@crl.tek.com.

In the other direction, the University of Toronto has gained the services of **Geoffrey Hinton**, formerly of Carnegie Mellon University, Pittsburgh. Geoff, who is one of the leading researchers in connectionist systems and neural networks, will have appointments in the Department of Computer Science and the Department of Psychology.

Geoff will be joined at Toronto by **Yann le Cun**, who will be working with him as a research associate. Yann was previously at l'Ecole supérieure d'ingéneurs en électrotechnique et électronique, Paris.

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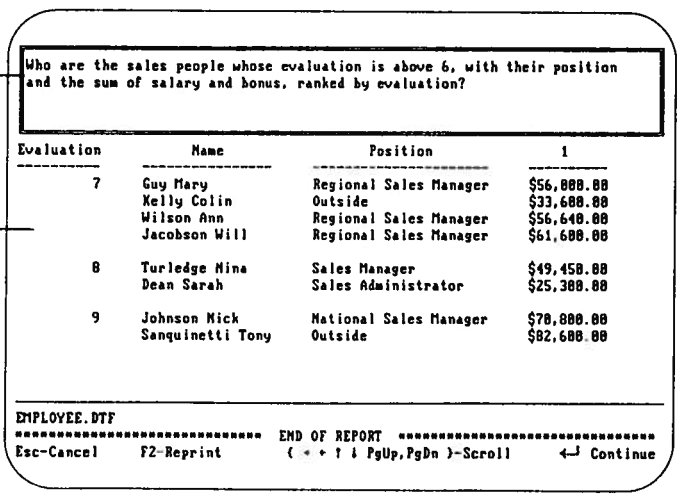

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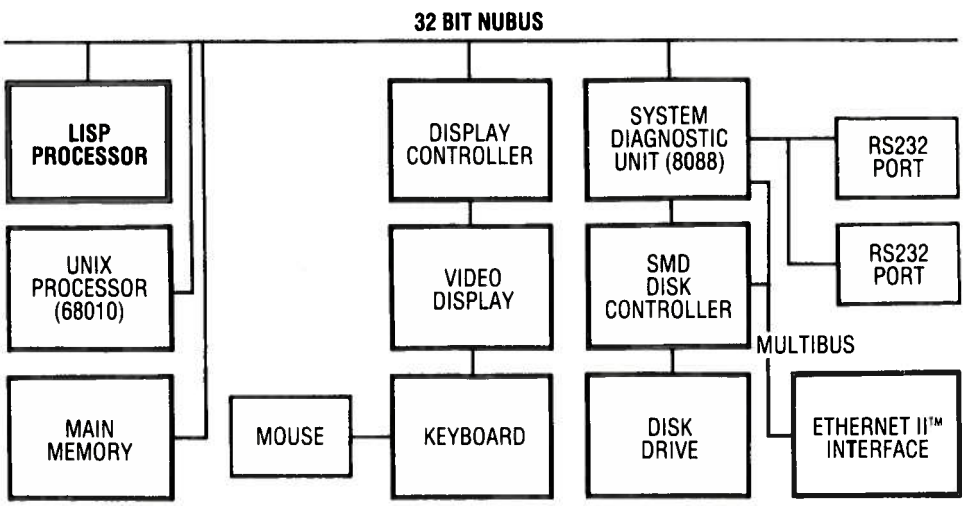

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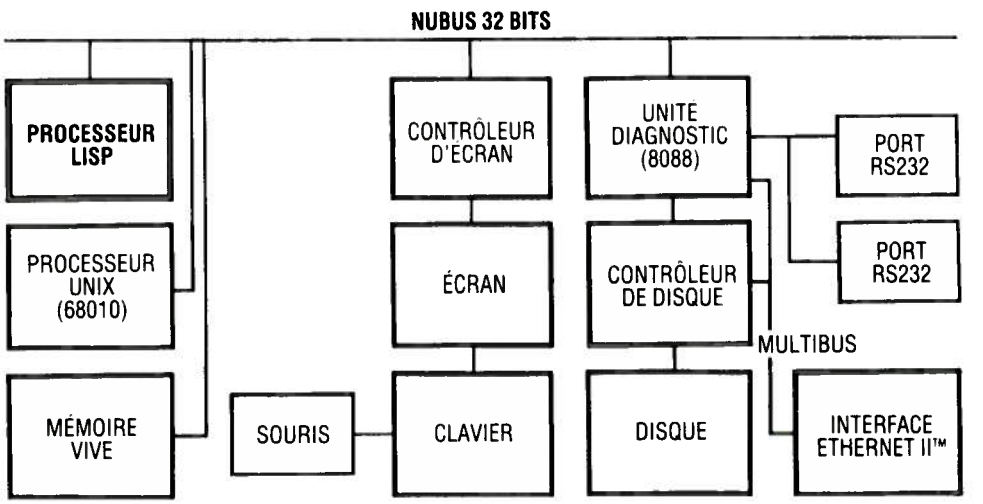

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Workstations for AI: Supplanting Lisp Machines?

Grant Buckler

At the beginning of July, Apollo Computer Inc introduced a desktop workstation capable of processing four million instructions per second (MIPS). With prices starting just under $20,000 in Canada, the new Domain Series 4000 machines approximately doubled the performance available in that price range.

Later that month, Sun Microsystems Inc brought out the Sun 4/260, the first in a new line of workstations, offering 10-MIPS performance for a basic price of $67,900. In Toronto for the announcement, vice-president of engineering Wayne Rosing said the new workstations come within one third of the power of IBM's largest mainframes. "Unfortunately for the competition," he added, "we are not extending our price range upward at a commensurate rate."

Hewlett-Packard Co, as well, offers four-MIPS workstations. "The cost of these workstations has also been coming down," says Ravi Swami, a sales representative for Hewlett-Packard Canada in Toronto, "so to put a very powerful four-MIPS processing on an engineer's desk to aid in expert systems development becomes quite feasible."

Artificial intelligence work and expert systems development projects that once required a large mainframe computer or a dedicated Lisp machine such as those from Symbolics Inc are beginning to be possible on workstations that cost substantially less than $100,000.

That means AI is more and more likely to be done on decentralized hardware, says William J. Spencer, vice-president of the Corporate Research Group of Xerox Corp. "We're talking about workstations today that run five MIPS," Spencer says. "There are machines on the drawing board that are going to raise that to 50 MIPS, probably by the end of the decade."

That trend, notes Spencer, means companies such as Symbolics that did very well in offering dedicated Lisp machines are now running into problems.

David Black, president of Sun Microsystems of Canada Ltd, says workstations are replacing dedicated AI hardware. "Low cost general-purpose workstations are now faster than specialized machines," he says, and they cost less.

Three years ago, Hewlett-Packard made a decision about its future direction in the artificial intelligence market. One alternative was to develop specialized hardware for AI applications, explains Sami Cassis, Hewlett-Packard Canada's Montreal-based program manager for computer-aided design and engineering products. The other was to support artificial intelligence applications on general-purpose hardware.

HP chose the second alternative. Why? "At the time workstations were expensive," Cassis concedes, "but we could see that the price-performance of workstations would improve drastically." HP believed that as a result, the advantages of specialized hardware would eventually disappear.

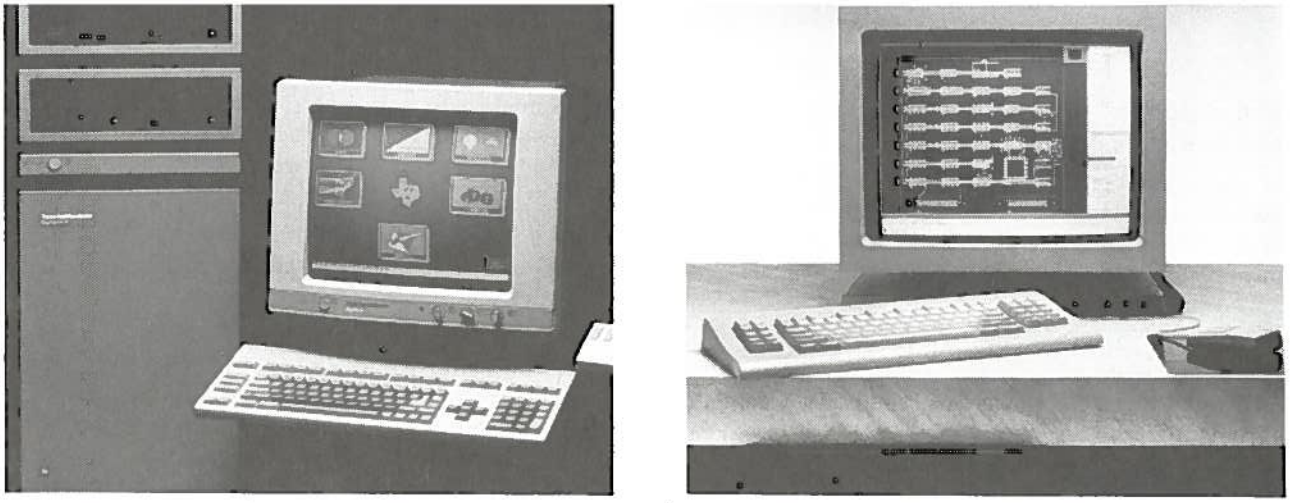
The prediction of improved price-performance has certainly turned out to be correct. The amount of processing power you can buy for a dollar is increasing by about 25 per cent a year, notes Xerox's Spencer.

Xerox has two workstation products, the 1185 and the 1186, aimed at artificial intelligence applications. Spencer says the company is interested in AI more as an "enabling tool" than as an end product in itself. He foresees artificial intelligence techniques will be incorporated in a variety of applications in the future. For example, "all input/output at some time in the future will be speech."

Hewlett-Packard's line of 9000 workstations consists of two series: the 300 machines, which use the standard Motorola 68020 microprocessor, and the 800 models, which use HP's proprietary Precision Architecture, a reduced instruction set computer (RISC) design.

The use of workstations for AI is just beginning to take off. Artificial intelligence applications account for slightly less than five per cent of most vendors' workstation sales — Sun is somewhat stronger in this area than the others with about 12 per cent of its workstation sales going to artificial intelligence applications. But it's clearly a growth area. Ed Hunt, marketing manager for Apollo Computer of Canada, says the company's new Domain 4000 is aimed in part at the artificial intelligence market. "We expect to see continuing growth in that area," he says.

Sun also sees AI as a promising area for the future. In its July 16 announcement of the Sun/4 line, Sun



Texas Instruments Explorer II Lisp machine (left) and Sun 4/260 workstation (right). They all look the same on the outside; it's what's inside that counts. Though as it happens, we had some photos of the new CPU chips we could have printed, but they all look the same too.

listed artificial intelligence development among the key applications for the new hardware. Black says the company worked with several major AI software developers in creating the Sun/4's SPARC architecture. He adds that another Sun product, the 3-60 workstation, offers a lower-priced alternative with as much as 32 megabytes of memory.

Hunt notes that in many cases customers don't buy Apollo workstations primarily for artificial intelligence applications, but along with other applications they are doing a bit of AI work. "There are a lot of people who you don't think are using it," he says. "It enters into a lot of other applications."

Sun Microsystems of Canada recently surveyed its Canadian customers and found that while 13 per cent listed artificial intelligence as the primary application for their Sun equipment, an additional 25 per cent named it as a secondary application.

One advantage of buying workstations rather than larger machines is obvious. The prices for today's workstations start at about $20,000 and run to less than $100,000. That's considerably more affordable than mainframe computers and Lisp machines.

Having enough power and enough memory in a desk-sized machine wouldn't make such hardware practical for AI applications if it weren't for communications capabilities that allow several of these machines to be linked together and to share resources such as file servers and other peripherals. Such a network also allows communication between users.

"You can connect several hundred of these workstations together," says Swami of Hewlett-Packard. And, he says, a network can incorporate a file server

Lisp Machine Companies Fight Back

Graeme Hirst

The Lisp machine manufacturers are not letting the ascendance of high-speed general-purpose workstations go unanswered. Both Texas Instruments and Symbolics have recently announced powerful single-chip CPUs with three to five times the power of the multi-board processors of current Lisp machines, and both compatible with existing software.

The Texas Instruments Lisp microprocessor is the basis of the new TI Explorer II series of Lisp machines, said to be five times as fast as the previous Explorer. The 32-bit processor is one of the most complex ever produced; it is more than 2½ times as dense as the Motorola 68020. The pipelined architecture of the processor can execute many of the Lisp macroinstructions in a single clock cycle.

The Symbolics chip, named Ivory, has seven more bits of address space than the TI chip, and does not require an external RAM for microcode, cache, or garbage collection circuitry. It is three times as fast as Symbolics's present processor, and expected to bcomee five times as fast with future fabrication technology.

For users who also want access to the Unix world, TI are offering an optional 68020-based Unix coprocessor that operates with the Explorer II. This option, also available on earlier Explorers, addresses the challenge of general-purpose workstations by making all Unix software usable on the company's Lisp machines.

TI are not concentrating solely on high-end hardware for AI, however. It has also developed a wide range of AI software for PCs. The Personal Consultant series includes expert system development systems, and a PC version of the Scheme language. □

with a gigabyte or more of memory that any of the machines on the network can use.

Such an arrangement makes it possible to reap the benefits of putting processing power right on the user's desk. "Even if you had the dollars for a larger environment," says HP's Swami, "the fact that you could have a workstation sitting on somebody's desk which doesn't take up much real estate" is a significant advantage.

Giving each user "personal" processing power means that response time remains relatively constant even during peak usage periods.

When compared to specialized AI hardware, general purpose workstations have two other advantages. First, other software developed for those workstations can be useful to AI developers. The facilities of the Unix operating system, for instance, can be helpful to AI developers and users alike.

Second, a workstation isn't just good for AI. Cassis sees this as a sort of "security blanket" for purchasers. They can do other work on the machine as well as AI, and if they no longer want it for artificial intelligence work it can be useful for something else.

Hunt of Apollo says a typical workstation for artificial intelligence work is a diskless machine with at least eight megabytes of memory and preferably 16. Most users want at least a four-MIPS machine, he adds.

If a general-purpose workstation by itself doesn't deliver the desired performance, AI users can beef it up by adding a specialized processor. Hewlett-Packard, for example, allows a processor board to be added to its 9000 workstations to supplement the power of the standard Motorola 68020 that powers the machine.

No matter how well suited the machine is, it's unattractive if the proper software isn't available. Recognizing this, the major workstation vendors have made efforts to put popular AI tools on their hardware.

In January, Apollo announced joint marketing agreements with two major AI software suppliers, Intellicorp and Teknowledge Inc. Apollo is now cooperating with these companies in marketing their products, including Teknowledge's S.1 and M.1 and Intellicorp's Knowledge Engineering Environment (KEE) on the Domain machines.

Hewlett-Packard is concentrating on providing the environment for artificial intelligence work, and encouraging third parties to put their AI software products on the 9000 machines. But although HP doesn't generally develop its own AI applications, one exception is the company's medical division, which is working on an expert system to help analyse electrocardiograms. That system will run on an HP 9000 workstation, Cassis says.

Sun lists among its "technology partners" — firms with which it works to make their software available on Sun workstations — Teknowledge, Intellicorp, Inference Corp, Franz Corp, and ParcPlace. □

Grant Buckler is a freelance writer specializing in the Canadian computer industry.

AI News

NRC Creates Associate Committee on AI

The National Research Council has announced the creation of an Associate Committee on Artificial Intelligence to act as a focal point and forum in Canada for issues of national concern to the scientific and engineering communities.

NRC associate committees also provide advice to NRC and government on new science and engineering technologies.

The chairperson for the Associate Committee on AI is Dr Claude Lajeunesse, President and Chief Executive Officer of the Centre for Research on Information Technologies (CRIM) in Montreal. "AI is an area with great potential to which industrialized countries are committing very substantial resources and effort. This committee will act as a forum to foster communication between many parties with interests in AI," Dr Lajeunesse said.

At NRC, potential applications of AI and related projects are being pursued in the Divisions of Electrical Engineering, Mechanical Engineering, the National Aeronautical Establishment, Space, Industrial Materials Research Institute, and the Institute for Research in Construction.

NRC projects include work in the areas of building design, scheduling of manufacturing operations, machine vision, intelligent robot systems, and automated speech recognition.

The Associate Committee is developing a program of activities that will encourage communication and collaboration between existing groups with interests in AI, with a view to obtaining maximum Canadian benefit. "We have been given an opportunity by NRC to play a role in the development of a technology very important to Canada's future," a committee spokesman said," and we are now responding with a specific set of proposed action plans and priorities."

From its inception in 1916, NRC has relied extensively on the scientific and technical advice of specialized committees, such as this one, constituted to deal with specific problems of national importance. Associate Committees provide an effective means of coordinating scientific activities across the country, as well as contributing to the exchange and dissemination of scientific information. NRC presently has over 25 associate committees, covering topics ranging from biotechnology to the National Building Code.

The members of the NRC Associate Committee on Artificial Intelligence are the following:

Dr M. Ackroyd, Techtrol, Montreal.
Mr L. Bolger, VP Research, Shell Canada, Calgary.
Dr R. De Mori, Director of the School of Computer Science, McGill University, and Vice-President of CSCSI/SCEIO.
Mr P. George, MacDonald Dettwiler and Associates, Vancouver.
Dr J. Ham, Department of Industrial Engineering, University of Toronto.
Dr C. Lajeunesse, President, Centre de recherche informatique de Montréal.
Dr A. Mackworth, Department of Computer Science, University of British Columbia, past president of CSCSI/SCEIO, and past chairman of IJCAI.
Dr J.N. Maksym, Defence Research Establishment (Atlantic), Dartmouth.
Dr E.G. Manning, Dean of Engineering, University of Victoria.
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Mr S.A. Mayman, Director, Division of Electrical Engineering, NRC.
Dr G. McCalla, Department of Computational Science, University of Saskatchewan, and past president of CSCSI/SCEIO.
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Prof J. Vaucher, Département d'informatique et recherche opérationelle, Université de Montréal.

AAAI Special Interest Group in Manufacturing

The American Association for Artificial Intelligence is forming a special interest group for AI in manufacturing, including design, planning, production, distribution, and field service. The group proposes to sponsor an annual workshop and publish a newsletter. For further information, contact:

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Federal Government Continues "InnovAction" Program

The Minister of State for Science and Technology, Mr Frank Oberle, recently announced three new elements of the government's so-called "InnovAction" strategy for science and technology.

The first was the expenditure of $100 million in new funds for "initiatives". "This government is taking decisive action," Mr Oberle said in a press release, "to help our industries to compete internationally and

reach new heights of excellence.

Mr Oberle said that the government was allocating significant new resources for science and technology programs which contribute directly to "the InnovAction strategy's priority thrusts."

It was not immediately announced exactly how the money would be spent. However, Mr Oberle's press release said that it would be "targetted" to help Canadian firms develop and adapt to new technologies; to promote the development of scientists and researchers; and to support selected universities.

A subsequent announcement outlined the allocation of $18 million of the funds. It will go to the government granting agencies, including NSERC, which will receive $7 million for microelectronics research. The other $11 million is for general university-based research, and is eligible for matching funds from industry.

The second "InnovAction" element announced was a new management program for federal laboratories and technology centres, to help promote "technology diffusion".

And thirdly, through NRC, the government is supporting the Canadian Manufacturers' Association in establishing CAN-MATE, the Canadian Manufacturing Advanced Technology Exchange. CAN-MATE will help Canadian manufacturers to apply advanced technologies, such as AI, CAD, and robotics, in production and processing. □

P.S. Mueller

Conference report

AAAI-87: The Sixth National Conference on Artificial Intelligence Seattle, Washington

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Some of us can remember the first AAAI conference in 1980 — a cozy 400 AI researchers, tucked away in one corner of a university's campus. There were only two parallel sessions of papers, filling one relatively thin proceedings volume, no tutorial sessions and no exhibition hall. For better or worse, the field of artificial intelligence has grown considerably in the subsequent seven years. The recent Sixth National Conference on Artificial Intelligence, AAAI-87, involved over 6,700 people,[1] and required the full accommodations of The Seattle Center in Seattle, Washington (former site of the world's fair) for its four parallel technical sessions and exhibition show; and it still needed the University of Washington campus for its four parallel tutorial sessions. While these annual meetings continue to involve active AI researchers, they now cater also to AI developers and AI salespeople, as well as a host of curious on-lookers. Many AI companies now spend a sizable sum displaying their commercial systems in elaborate exhibition booths, which filled the basketball Coliseum (not to mention their lavish private hospitality suites), replete with the hype and flashy give-aways associated with any other commercially successful product. Both this field, and these conferences, have indeed moved out of academia; we assume it is unintentional (if a bit ironic) that this most recent one was situated in the midst of a amusement park.

Organization

The programme chairmen, Ken Forbus for Science and Howard Shrobe for Engineering, are to be congratulated for producing an excellent conference. There were a great many high-quality, and well-presented papers, as well as a host of excellent invited surveys, covering thirteen different (sub)subareas of artificial intelligence.[2] The organizers did a good job of assigning the 149 papers to (well-titled) sessions — for example, devoting different sessions to "Machine Learning: Explanation Based", "Machine Learning: Induction", and "Knowledge Acquisition" — and also (trying to) avoid conflict between related areas. Also, related papers — from both science and engineering — were presented (by design) on the same or adjacent days; *e.g.*, all of the Machine Learning and Knowledge Acquisition sessions (all four sets of technical papers and both surveys) were presented at different times on Monday and Tuesday. (This is an improvement over the arrangement used last year: AAAI-86 was divided into a science subconference followed by an engineering one.)

As in previous years, several of this year's papers were awarded prizes; this year there were eight award-winning papers, each selected from a different subarea. These papers were presented in plenary sessions at the middle of the conference. Many of these are mentioned below.

A few final, general comments: Most of the speakers, and especially the eight award-winners and thirteen invited surveyers, gave excellent presentations — an impressive feat given the huge dimensions of the rooms used, including a hockey arena. Our only general criticism is that many assumed too little of the audience, and spent (it seemed) too much time presenting background, and not enough time presenting their problems and solutions.

So much for the "environment" and "feeling" of the conference; now to discuss its content. This review will not (and cannot) adequately cover all of its papers, exhibits, tutorials, etc. We will, instead, focus on only certain aspects — a biased sampling, representing mostly the sessions we reviewers attended.

(Continued next page)

We gratefully acknowledge financial support from the Natural Sciences and Engineering Research Council.

[1] This included about 5,000 paid attendees, slightly down from the 5,400 of last year. This is probably due to this year's conflict with the international conference in Milan, IJCAI-87.

[2] The conference proceedings are published by Morgan Kaufmann Publishers, and are distributed in Canada through John Wiley and Sons Canada Ltd (ISBN 0-934613-42-7, $^{CDN}84.95). The surveys were not included in the proceedings, but Morgan Kaufmann plan to publish an edited version of the transcriptions of the presentations.

Knowledge Representation and Reasoning

We counted sixteen papers dealing with issues in default reasoning, about five more on technical issues in temporal reasoning and nine others on miscellaneous topics in knowledge representation and reasoning. Within default reasoning, questions of reasoning in temporal domains and connections with the notion of causality were addressed by a number of researchers. Many papers addressed the use of justification-based and assumption-based truth maintenance system. Many papers emphasized a better understanding of the complexity and formal properties of their approaches; this seems to indicate that the field as a whole is maturing.

One of the central topics in default reasoning is dealing with multiple extensions: given a set of facts and default rules, there may be different incompatible extensions, depending on which default rules are selected. The challenge here is to find the most meaningful of these extensions. Many papers about the multiple extension problem are responses to the challenge issued by Hanks and McDermott (1986). An approach based on possible worlds and that does not require an exhaustive knowledge of all qualifications to an action is presented by Ginsberg and Smith. Haugh proposes using the notion of causality to identify preferred extensions. The award-winning paper on incremental causal reasoning by Dean and Boddy, incidentally, is typical of a trend to provide a better analysis of the computational properties of reasoning tasks.

The traditional problem of representing inheritance hierarchies with exception is addressed within the framework of default logic by Etherington. Preferred interpretations can be identified by considering inferential distance. Inheritance and non-monotonic reasoning are also discussed in a paper by Horty, Thomason, and Touretsky.

A different framework for default reasoning is introduced by Delgrande in his award-winning paper. An interesting feature of the logic is that its semantics does not rest on a notion of consistency with a given set of assertions. Other papers about formal investigations in the nature of non-monotonic reasoning include Levesque's work on an modal operator for "only knowing". In a different vein, Pearl discusses differences between default rules that associate events in the outside world and default rules that guide how we reason about the world. It is claimed that such a distinction is essential. A paper by Lifschitz on circumscriptive theories and one by Zadorzny also contribute to the formalization of default reasoning.

There were several sessions that dealt with the issues of truth maintenance systems. For example, Morris's award-winning paper explores the logical extensions sanctioned by justification-based truth maintenance systems and relates them to Reiter's default logic. Reiter and de Kleer define formally clause management systems and do a logical reconstruction of ATMSs in that framework. Provan's notable paper provides an interesting analysis of the performance of an assumption-based TMS. Using a simple scene labelling problem, he shows that non-pathological problems can lead to unacceptable performance of ATMSs.

Several papers describe particular uses and approaches to theory revision — that is, changing an inconsistent knowledge base into a "close" but consistent knowledge base; *e.g.*, the papers by Seet Derthick and Borchardt.

One last important area discussed was temporal reasoning. Shoham's survey talk identified key issues in choosing temporal representations and addressed the problem of anomalous extensions in reasoning about persistence. An interesting semantic model of concurrent actions that uses complete time lines as possible worlds is presented in a paper by Pelavin and Allen. More technical issues about the properties of interval temporal logics are addressed by Ladkin; temporal constraints networks are discussed in papers by Tsang and Valdéz-Pérez.

Machine Learning

Within the last few years, "machine learning" (ML) has emerged as the subfield of AI which deals with techniques for improving the performance a computer system; it is now distinguished from studies of how people learn, and from general knowledge acquisition tools. (While the machine learning and knowledge acquisition papers all appear in one section of AAAI-87's proceedings, these papers were presented in different sessions; this section describes only the ML talks.)

Almost all of the papers in years past dealt with induction and clustering mechanisms — *i.e.*, with ways of learning concept descriptions from a series of examples and counterexamples. Quinlan presented an excellent summary of induction techniques in his survey talk, "Data-Driven Approaches to Learning Classification Rules". He characterized these systems as having a minimal domain theory, and relying almost exclusively on the examples shown to propose meaningful categories. Using simple examples, he explained many of the difficulties of this task, and then presented many of the dimensions by which systems can differ — *e.g.*, the complexity of the input language, whether the data is given incrementally versus all at once, etc. He used these dimensions when presenting a good cross-section of systems, including the AQ family of clustering algorithms of Michalski *et al.*, Quinlan's ID3 system, the exemplar-based approach of Stanfill and Waltz, Schlimmer and Granger's STAGGER system and the connectionist approach to learning classifications. He also mentioned some theoretical results in the area, which point to polynomial learnability of decision lists. In technical papers, Connell and Utgoff, Fisher, and Schlimmer describe particular ways of finding apt generalizations; and Haussler provides some complexity

results concerning certain forms of induction.

Each of these systems is *learning at the knowledge level* (Dietterich 1986) in that its conclusions (*i.e.*, the inductively-found categories) are not guaranteed — *i.e.*, they are reasonable guesses, not logical entailments of the examples themselves. Russell and Grosof, however, show that some inductive techniques can be implemented as sound deduction from the examples *and the system's biases*, where "bias" refers to the (usually implicit) additional constraints on the allowed generalizations (Mitchell 1980).

Other machine learning processes improve the efficiency of a derivation. These systems begin with a rich domain theory, one capable of solving the posed problem; their objective is to modify the system to allow it to find the solution faster. One approach (called "explanation-based learning", EBL) begins by explaining a given solution to a specific query — finding, in particular, the conditions which are sufficient to derive the query. After abstracting away the details specific to this particular query, the remaining set of conditions are provably sufficient to solve a general class of queries; this information constitutes a new "chunk" or "compiled rule", which is then added to the system's knowledge base, and can be used when solving future problems. Five of the ten ML papers deal with such knowledge-rich systems. Prieditis and Mostow and Shavlik and DeJong describe how their specific systems can extend and generalize a given explanation. The "output" of the abstraction process is often in a different vocabulary from the input; Kedar-Cabelli and Keller (the award-winning paper in ML) each deal with characterizing that output vocabulary, in terms of the system's *purpose* and an *operationality* criterion, respectively. Rosenbloom, Laird, and Newell describe how their SOAR system can incorporate new information from the outside, using the same "chunking" mechanism as EBL-style learning.

Analogical reasoning is another traditional sub-area of ML. Gentner, a psychologist, presented a very thorough survey of this topic — covering more than her title, "Cognitive Modeling of Analogy", would suggest. After presenting her "dimensions" for the analogy process, she succinctly discussed the myriad of recent works in this areas, in each case fitting that research within her model. She also discussed her experiments with people, to provide a psychological validity for various claims — for example, that the mechanism for *accessing* an analogy (*i.e.*, going from a "target problem" to the relevant target and base analogues) is different from the one which uses the analogy (*i.e.*, which *uses* the target and base analogues to understand more about the target analogue, and/or to solve the target problem). The cognitive modelling paper, "Analogical Processing: A Simulation and Empirical Corroboration" by Skorstad, Falkenhainer, and Gentner, describes an implementation of these ideas.

As a final comment: The ML community has become increasingly concerned about validation — demonstrating solid results from their research. This has lead to an increased emphasis on both theoretical statements (such as Haussler's complexity results, and Russell and Grosof's explication of the assumptions underlying many inductive systems) and on comparisons between systems. For example, Connell and Utgoff compared their system's performance with others which have attempted the same task (balancing an inverted-pole), and Fisher ran his system on the same data set which others have used (Stepp's (1984) soy bean data).

Qualitative Engineering Problem Solving

Over the past several years, research on qualitative physics has slowly started making its way into systems for engineering problem-solving. At the same time, a lot of work is directed towards extending the as yet sparse theoretical foundations of the field, including order-of-magnitude reasoning, reasoning about algebraic expressions, structure and function of devices and diagnosis. Wellman presented a probabilistic semantics for the qualitative influence of a random variable a on random variable b, based on the notion of first-order stochastic dominance between the conditional probability distribution of b given various values of a. The result is a formalization of the intuitive notion that "a makes b more (or less) likely". Yip presented a formalism for extracting the qualitative behavior of nonlinear dynamical systems from a limited number of numerical experiments. His program interprets phase portraits (two-dimensional contours) generated by simulation experiments and chooses different parameter values and/or initial conditions for new experiments that are needed in order to complete the description of the system. Sacks presented a program that proves inequalities between functions over finite sets of constraints by maintaining a hierarchy of increasingly complex algorithms. Thus the program is capable of resolving more inequalities than any single algorithm in the hierarchy. Joskowicz presented a two-step algorithm for the qualitative analysis of mechanical devices. The first step takes the geometric descriptions of the parts and their initial position and produces a description of the possible relative motions of pairs in contact. The second step computes the actual motion of each object by using constraint propagation. Downing presented the design of a diagnosis system that derives symptom-fault associations from an underlying causal model. At the heart of the approach is qualitative sensitivity analysis using mixed confluences and a constraint satisfaction system for finding all associated interpretations.

AI Architectures and Software

Papers covered the areas of parallel architectures, blackboard architectures, matching algorithms for production systems, and constraint satisfaction / dependency tracking systems. Flann, Dietterich, and Copron

presented FORLOG, a forward-chaining logic-programming language that extends ATMS and the consumer architecture to include most of first-order logic, including existentially quantified variables and backward chaining (by reformulating it into a form of forward reasoning with identical behavior). Rowley, Shrobe, and Cassels presented JOSHUA, a system for providing syntactically uniform access to heterogeneous knowledge bases. JOSHUA is embedded in Lisp and includes pattern matching and a protocol of inference that facilitates the integration of diverse data representations and inference processes.

Vision

A total of fourteen vision papers were presented, covering, among other areas, solid modelling for recognition, shape from motion, shape from optical flow and shape from shadows, and heterarchical vision systems. Terzopoulos, Witkin, and Kass (an award-winning paper) presented a symmetry-seeking energy-based model for representing deformable objects. They demonstrated an interactive system, in which the user provides an initial condition, which the system completes into an accurate model. Energy constraint mechanisms are proposed as a potentially useful way of incorporating higher-level knowledge in the reconstruction process. Barron, Jepson, and Tsotsos presented an extensive sensitivity analysis of an algorithm for computing motion and structure from a spatio-temporal distribution of image velocities that are assumed to belong to the same 3D planar surface. Solina and Bajcsy used superquadrics in classifying mail pieces from their range images. The approach requires solution of a nonlinear least-squares problem for finding the parameters of the superquadric. Results on real data are reported. Szelinski showed that regularization theory can be viewed as a special case of Bayesian modelling, and that the use of regularization theory for the problem of surface interpolation gives rise to fractal models.

Other papers reported efforts towards building robust specialized vision systems by incorporating external knowledge about the image domain and/or combining information from multiple low-level processes. Fua and Hanson presented an approach towards shape (edge and region) extraction in aerial images that uses generic geometric models for buildings, roads and trees, and exploits the constraints they impose on the image. Huertas, Cole, and Nevatia presented a runway detection system for aerial images which generates runway hypotheses by detecting and merging linear features, and then verifies them by detecting appropriate runway markings. Moerdler and Kender reported a system that integrates shape from texture information extracted by two different algorithms.

Other Topics

AAAI-87 Presidential Address. The AAAI president, Patrick Winston, delivered a sentimental, humorous, and optimistic talk, discussing the state-of-the-art in AI research as it was ten years ago, how it has progressed to where we are now, and where it will be ten years down the road. Ten years ago, the leading edge AI research was concerned with semantic net, rule-based, and logical representations, and techniques of searching and chaining. The "Big Surprises" since then include object-oriented programming, powerful and inexpensive machines, massively parallel architectures, and the AI Biz ("If someone will buy it, it's art"). The "Architecture Anarchy" has brought us from GPS and perceptrons to non-monotonic logics, blackboards, connectionism, communities of actors, and the Society of Mind. As for the future, Winston's preference is to put the fun back into AI: we'll see prancing robots jumping through hoops and collecting Coke cans, and manipulating mechanical objects like tire gauges and tiltmeters to find out how they work.

Surveys. Georgeff's survey, "Reasoning About Actions and Plans", illuminated the progression this field has made from single-agent planning to ever more complex systems, involving multiple agents interacting with each other and embedded in changing environments. The single-agent planning task has traditionally been viewed as a state-space search for a sequence of actions leading to a goal. This has led to a number of problems: theorem provers finding non-executable plans, prohibitive inefficiency, and the classical frame problem. Attempts at improving efficiency such as forming partial plans and hierarchical planning have not proved to be terribly useful; in fact, DARPA's Automated Land Vehicle project began using the above techniques, but abandoned them in favor of linear programming. More recent attention has focused on multi-agent planning, dealing with issues of interference, synchronization, cooperation and communication, and the representation of time and causality. Finally, recent work on embedded systems deals with changing circumstances in the middle of plan execution, and finding some sort of "best response" in the face of real-time constraints.

Lehnert surveyed the area of knowledge-based natural language understanding. Although biased towards the Shankian school of NLU research, Lehnert's presentation gave a nice overview of the field, from its very beginnings to the present. The earliest NLU systems were either problem-driven (*e.g.*, Charniak's thesis dealt with story fragments) and thus overly ambitious, or technology-driven (*e.g.*, Winograd's SHRDLU) and thus suffered from the typical "micro-world" restrictions. The first knowledge-based NLU approaches incorporated scripts and plans; later came inference-generation approaches. Some of the interesting recent work includes connectionist approaches which allow parallel syntactic and semantic processing, analogical reasoning about idioms, and

Riesbeck's "recognize and record" (episodic memory style) model of language understanding.

One of the high points of this conference was Korf's superb survey of "Search". In his allotted 90 minutes, he covered everything from depth-first search through iterative-deepening A^* and onto the basics of game-playing. It was quite impressive; and demonstrates that there are areas papers descficial intelligence which have, indeed, matured into a science.

Pearl gave a critical overview of "Evidential Reasoning", describing systems that must make decisions in the face of uncertainty. He contrasted *extensional* systems, which represent uncertainty by combining weights (*e.g.*, EMYCIN), versus *intentional* systems, which represent uncertainty using modal logics with possible world semantics (*e.g.*, model-based systems). The latter are semantically cleaner, but less computationally attractive. One problem that most of these systems were claimed to suffer from is that "strange conclusions" can result from the propagation of new evidence. Recent work by Pearl and others on belief networks (recursive models) overcomes some of these problems, and allows one to reason explicitly about different types of evidence, including probable, plausible, possible, conflicting or insufficient evidence.

Bledsoe presented a comprehensive survey of "Automated Deduction". So much has been published in this field that it was a prohibitive task to do it justice in but one hour. Bledsoe described a few of the milestone results — such as Robinson's resolution rule (a complete decision procedure for propositional logic), and Green's answer clause in Prolog — but for the most part his talk attempted to briefly mention all of the major pieces of work in this area. Fortunately, in case you were weighed down by all those names he mentioned, he provided a reference list at the end of his talk.

Review of Exhibits

Commercial activity in AI is trying to transform research results into software engineering practices in the form of efficient Lisp implementations, expert system shells and specific applications.

Numerous Lisp implementations were displayed, mostly Common Lisp (CL), for both UNIX workstations (Lucid, Franz, and Kyoto CL) and personal computers (PowerLisp (virtual memory), Golden CL). Lisp machine manufacturers provide both hardware and software support for delivering systems on Intel 386-based personal computers while developing them on Lisp machines. Symbolics has a coprocessor board and a 386 application development package.

Several expert system shells were displayed that run on personal computers and come close to the expensive ones (like KEE and ART) in terms of functionality — Acquaint, KES, Rulemaster2, Nexpert, Guru, GoldWorks. The facilities they include are one or more of forward and backward chaining, pattern matching, object-oriented programming with class inheritance, mechanisms for dealing with uncertainty and dependency tracking (or truth maintenance). It is still unclear what impact these facilities have in reducing the cost of developing expert systems, because very few of them have been used in building substantial applications systems.

Worth noting was a tool for expert system building by example (Superexpert), and also learning tools based on simulated neural networks (NeuralWare, Nestor). Finally, an algebraic programming and manipulation system was shown (Reduce by HP).

Competition between the Lisp machine companies is intense. Texas Instruments announced the Explorer II, based on its new VLSI Lisp chip *(see page 13)*. The IIM Lisp machine (by a startup company in California) with a 40-bit word and 8-bit tag is claimed to be faster again than the Explorer II, and is not based on a VLSI Lisp chip. Also worth noting is TI's Odyssey board for the Explorer, specially designed for signal, image, and speech processing applications, and containing four TMS32020 digital signal processing chips.

Several applications systems were demonstrated, many by expert system shell companies, which are also in the consulting business. Inference Corp demonstrated several systems based on ART, including NAVEX (NASA navigation expert system), a foreign exchange advisory system, a credit authorizer's assistant, a financial expert system development framework, and a battlefield radio signal analysis system. Carnegie Group demonstrated tools for intelligent design, production scheduling and field service. Worth noting was a wide-spectrum specification language that can be mixed with low-level programs (by Reasoning Systems Inc).

We also noticed a strong presence of AI-related publishers, who figured prominently among the exhibits (19 booths). Several university research groups demonstrated project-oriented work: the Cognitive Systems Lab of the University of Alabama at Huntsville, the Center for Productivity Enhancement of the University of Lowell, the AI program of the University of Massachusetts at Amherst, and the USC Information Sciences Institute.

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PRELIMINARY ANNOUNCEMENT

International Conference on Intelligent Tutoring Systems:
The state of the art

June 1-3, 1988 Montréal, Canada

Conference General Chairperson:

Claude Frasson
Université de Montréal

Organizing Committee General Chairperson:

Jan Gecsei
Université de Montréal

The goal of the conference is to discuss the *state of the art* in ITS. It will feature invited presentations, panels, tutorials and submitted contributions. The papers will be refered in English or French. Themes will include:

Learning environments
Methodologies and architectures for educational systems
AI programming environments for educational use
Student modelling and cognitive diagnosis
Curriculum and knowledge representation
Instruction methodologies for ITS
Evaluation of tutoring systems and learning environments
Theoritical foundations of ITS
Empirical aspects of ITS
Knowledge acquisition
Design issues in building a computer tutor
Practical use of ITS

Authors are requested to submit five copies (in English or French) of a double-spaced manuscript between 10 to 30 pages by december 15 to prof. Gregor V. Bochmann.

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Important Dates

Papers Submission Deadlines:	December 15, 1987
Notification of acceptance:	February 29, 1988

GIRICO et l'informatique cognitive des organisations

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(In English, page 25)

Le Groupe Interuniversitaire de Recherche en Informatique Cognitive des Organisations (GIRICO) a été créé à Québec en 1986 par des chercheurs de l'Université Laval, de l'Université de Sherbrooke et de l'Université du Québec et de ses constituantes.

Au moment de l'assemblée constituante, en septembre 1986, 75 chercheurs répondant aux critères d'adhésion manifestaient leur intention de se joindre au groupe.

Quelques mois après sa mise sur pied, le GIRICO organisait le premier colloque Québécois en informatique cognitive des organisations. Ce colloque, financé par les universités partenaires, s'est tenu en juin 87. Plus de 150 chercheurs universitaires, étudiants ou représentants de l'industrie y ont participé et on a pu y assister à près de 30 communications scientifiques, conférences ou démonstrations.

L'enthousiasme qu'éprouvent les chercheurs pour le GIRICO s'explique par plusieurs caractéristiques originales de cette initiative québécoise:

- l'attrait du domaine de recherche choisi, l'informatique cognitive des organisations, un des volets les plus dynamiques de l'intelligence artificielle;
- le cadre interuniversitaire de cette organisation de recherche;
- la structure multirégionale du GIRICO;
- l'accent mis sur la coopération Université-Industrie-Gouvernement;
- la synergie du modèle d'organisation de la communauté de chercheurs du GIRICO.

L'informatique cognitive des organisations

Depuis moins d'une décennie, l'informatique de gestion a connu deux phases importantes d'évolution. La première a été amorcée par le développement de langages-systèmes de quatrième génération et par l'essor de l'informatique personnelle et de la bureautique. Cette évolution est d'une telle ampleur qu'elle nous incite à parler désormais d'une "informatique des organisations". La seconde phase a été lancée par le développement de systèmes à "bases de connaissances" qui apportent une nouvelle dimension aux systèmes d'information. Celle-ci résulte d'une capacité de représentation non plus seulement de données mais également de "connaissances" et d'une capacité de "raisonnement" permettant de déduire de nouvelles connaissances exactes ou plausibles à partir des connaissances et des faits consignés dans le système.

L'intégration aux structures fonctionnelles des organisations de systèmes à bases de connaissances ouvre de nouvelles avenues de recherche et jette les fondements de l'"informatique cognitive des organisations". On peut définir celle-ci comme une discipline qui a pour objet la mise au point de méthodes, de modèles et d'outils pour la conception, le développement et l'évaluation de systèmes d'exploitation de connaissances, fondés sur la modélisation de processus cognitifs qui ont cours dans les organisations. La figure 1 ci-dessous schématise cette définition.

L'informatique cognitive des organisations (ICO) se situe dans une zone commune à l'intelligence artificielle et à la science cognitive et vise à résoudre des problèmes vécus dans les organisations et concernant des thèmes tels que l'acquisition, la représentation, le traitement et la communication des connaissances.

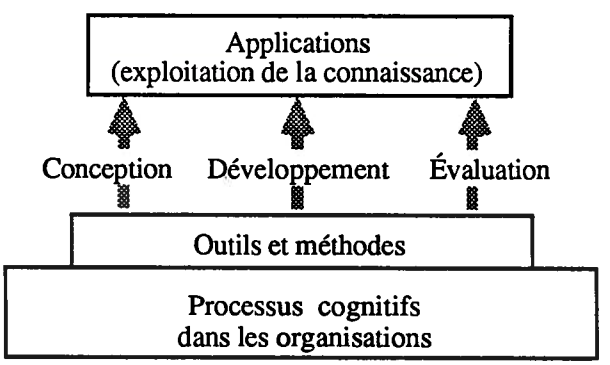

Figure 1

De nombreuses applications de l'informatique cognitive des organisations sont envisagées. En voici une brève liste:

- Systèmes de traitement de données factuelles qui servent à analyser et à générer des textes: compréhension des discours, résumé automatique de textes, indexation automatique, rédaction assistée, etc.
- Systèmes d'interprétation qui déduisent la description d'objets ou de situations à partir d'observations: compréhension des discours, analyse de données et élaboration de modèles cognitifs, filtrage d'information, etc.
- Systèmes de prédiction qui déduisent des conséquences à partir d'une situation donnée et de règles d'évaluation: évolution de la demande pour un produit, comportement d'une catégorie de clients, etc.
- Systèmes de diagnostic qui identifient les disfonctions d'un système à partir d'observations et de modèles de fonctionnement: diagnostic concernant le fonctionnement de logiciels ou d'organisations, diagnostic relatif à la pertinence de la prise de décision ou à un défaut d'apprentissage, etc.
- Systèmes de conception permettant de développer des configurations d'objets qui satisfont des contraintes de conception: outils d'aide à la conception de logiciels ou de bases de données, élaboration de budgets, aménagement de locaux, etc.
- Systèmes de surveillance qui comparent les observations du comportement d'un système avec des caractéristiques cruciales pour la réussite d'un plan (dérèglements potentiels: systèmes de suivi de gestion financière, contrôle de projet, etc).
- Systèmes de formation intègrant plusieurs des fonctions précédentes pour adapter un contenu de formation aux comportements des étudiants et à la mise en service des fonctions d'encadrement pédagogique: tutorat, acquisition de comportements d'intérêt pour l'organisation, dépannage d'étudiants au cours de leur processus d'apprentissage, etc.

A titre d'exemple, l'insertion de ces systèmes aura pour effet dans divers secteurs et à plusieurs niveaux de l'entreprise, de rendre accessible des expertises très spécifiques dont la distribution se révèle onéreuse dans les grandes organisations. Par ailleurs, l'acquisition ou la consultation de systèmes experts par des P.M.E. pourra leur permettre de profiter d'une grande diversité d'expertises spécifiques, ce qui est actuellement l'apanage exclusif des grandes organisations. Ces quelques exemples suffisent à illustrer le rôle structurant que l'informatique cognitive sera susceptible de jouer au sein des organisations dans un avenir proche.

Les objectifs du GIRICO. En somme, le GIRICO s'inscrit dans le mouvement mondial d'étude des ordinateurs de cinquième génération, mais il entend mener cette étude dans la perspective particulière des besoins

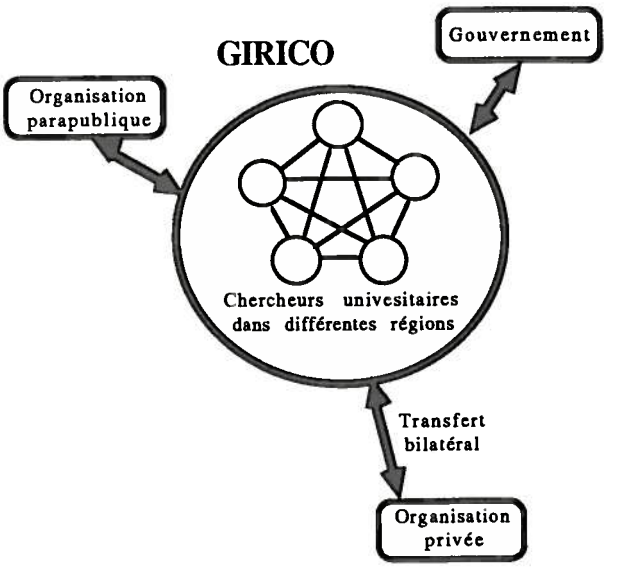

Figure 2

propres aux organisations, et non pas en se consacrant exclusivement à la seule dimension du matériel et du logiciel. Les perspectives que nous venons d'évoquer ont incité ce groupe de chercheurs à élaborer un modèle de structure interuniversitaire de recherche dont les buts principaux sont les suivants:

1. Travailler activement au développement au Québec de la recherche en informatique cognitive des organisations;
2. Contribuer à la formation de chercheurs québécois dans tous les secteurs de l'informatique cognitive des organisations;
3. Contribuer au développement des organisations (privées, publiques et parapubliques) par le transfert de connaissances dans les domaines de l'informatique cognitive.

Le GIRICO est une fédération de chercheurs interuniversitaires oeuvrant dans les domaines reliés à l'informatique cognitive des organisations. Cette fédération offre une structure organisationnelle destinée à promouvoir et à consolider les recherches conjointes entre les équipes universitaires et les coopérations avec le monde industriel. Le GIRICO a choisi de prendre la forme d'une corporation à but non lucratif qui lui permet d'interagir facilement avec le monde industriel. On peut voir sur la figure 2 qu'il agit ainsi comme une interface entre les entreprises et les universités, pour les projets de recherche concernant l'informatique cognitive des organisations et impliquant des chercheurs de plusieurs universités partenaires. Le GIRICO préconise une structure multirégionale apte à assurer une mise en valeur des ressources de recherche de toutes les institutions universitaires du Québec dans le domaine spécifique de l'informatique cognitive des organisations. La structure multirégionale constitue un laboratoire d'essai pour l'expérimentation des technologies de

communication, de travail à distance, de résolution coopérative de problèmes, qui sont appelées à s'insérer de façon croissante dans les pratiques quotidiennes des organisations.

Cette approche du travail à distance permet d'assurer la cohésion du groupe, d'accélérer les échanges d'information et de connaissances au sein de la communauté québécoise des chercheurs en informatique cognitive des organisations, tout en facilitant les échanges internationaux. Les entreprises, les organisations gouvernementales et, à long terme, toute la société québécoise bénéficieront certainement de ce développement du travail coopératif à distance.

Le GIRICO collabore avec l'industrie par voie contractuelle et permet la mise en oeuvre de projets que les entreprises pourraient difficilement mener à bien par elles-mêmes (collaboration de plusieurs entreprises et d'équipes universitaires, projets requérant l'implication de plusieurs spécialistes universitaires, etc.). De plus, le GIRICO encourage la participation de chercheurs de l'industrie aux travaux de ses équipes. Le GIRICO est donc en mesure d'accueillir les contrats de recherche et de développement concernant les applications de l'informatique cognitive des organisations provenant de l'industrie ou du secteur gouvernemental. En effet, le GIRICO peut réunir rapidement et efficacement la masse critique de spécialistes universitaires du Québec, nécessaire pour mener à bien des projets d'envergure en informatique cognitive des organisations, et pour coordonner le travail de recherche conjoint entre les chercheurs de plusieurs universités.

En mettant à profit les expériences de coopération Université-Industrie vécues au Canada et dans d'autres pays, le GIRICO entend développer un modèle qui met l'accent sur le transfert bilatéral de connaissances et de technologies. Selon ce modèle, tout transfert dans le sens Université-Industrie a, comme exigence primordiale de réalisation effective, l'arrimage des projets dans l'environnement de l'entreprise. Celle-ci est, en effet, le lieu naturel d'exploitation des résultats de la recherche et de la commercialisation des produits qui en découlent. De la même façon, le transfert de technologie dans le sens Industrie-Université a plus de chance de se réaliser effectivement si le point d'ancrage de la recherche se situe dans l'environnement de l'Université. Ces conditions optimales de transfert bilatéral déterminent dans la pratique un éventail très large de formules de coopération qui se concrétisent dans des protocoles où sont définies d'un commun accort les règles de partage des responsabilités de financement et d'exploitation des résultats de la recherche.

Pour plus d'information:
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AI Organizations

GIRICO and Cognitive Computer Science for Organizations

Vianney Côté
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Université de Sherbrooke
Sherbrooke, Québec J1K 2R1

(En français, page 23)

In 1986 researchers from Université Laval, Université de Sherbrooke, and Université du Québec and its constituents founded GIRICO (in French, Groupe Interuniversitaire de Recherche en Informatique Cognitive des Organisations), an interuniversity research group for investigating cognitive computer science within the framework of organizations.

At its founding meeting held in September 1986, 75 researchers satisfying membership criteria expressed their desire to belong to the group.

A few months following its establishment, GIRICO organized the first Québec symposium on cognitive computer science for organizations. The symposium — which was financed by partner universities — was held in June 1987. More than 150 university researchers, students and representatives from industry participated in it and some 30 scientific papers, lectures, and exhibits were presented.

Enthusiasm demonstrated by researchers for GIRICO results from several original features of this Québec initiative which are:

- The attraction created by the chosen area of research: cognitive computer science applied to organizational structures, one of the most dynamic areas in artificial intelligence;
- The interuniversity framework of this research organization;
- The multiregional structure of GIRICO;
- The emphasis put on multilateral cooperation: University, Industry, and Government;
- The synergy of the organizational model formed by the GIRICO community of researchers.

(Continued next page)

Cognitive Computer Science for Organizations

In less than a decade, computer science applied to management has undergone two important evolutionary phases. The first began by the development of fourth-generation language systems and by the growth of personal and office computers. This evolution has been so phenomenal as to incite us to speak from now on of "computer science for organizations". The second phase was launched by the development of "knowledge-based systems" which opens a whole new dimension in data systems. No longer is it appropriate to speak of automated data representation, it is now possible to represent "knowledge" and a capacity for "reasoning" that enables the extraction of accurate or plausible new knowledge from existing knowledge or facts recorded in a system.

The integration of knowledge-based systems into the operational structures of organizations blazes new trails for research and lays the foundations for cognitive computer science within the framework of organizations. For that matter, cognitive computer science for organizations can best be defined as a discipline whose object is the production of methods, models and tools for designing, developing and evaluating operational knowledge systems, based on cognitive process modeling, that are used in organizations. Figure 1 illustrates this definition.

As a branch of knowledge and hence, research, cognitive computer science applied to organizations overlaps both artificial intelligence and cognitive science and aims at solving problems experienced in organizations and is also concerned with phenomena such as the acquisition, representation, processing, and communication of knowledge.

Many applications for cognitive computer science to organizations are projected. Here is just a sampling:

- Factual systems for analysing and generating texts, speech analysis, text summarizing, indexing, text composition, etc.

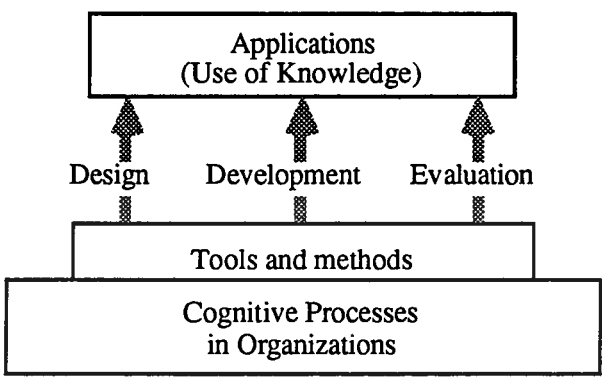

Figure 1

- Deductive interpretative systems for describing objects or situations from observations: discourse comprehension, data analysis and cognitive data modeling, data filters, etc.
- Predictive systems for inferring consequences of given situations and evaluation rules: product demand trends, behaviour of a class of consumers, etc.
- Diagnostic systems operating from observations and operational models that identify systemic dysfunctions: diagnosis of software operations or organizations, diagnosis as to decision-making relevance or some learning deficiency, etc.
- Conceptual systems enabling the development of object configuration to satisfy design constraints: tools for assisting software and database design, drafting budgets, distributing office and work space, etc.
- Monitoring systems for comparing system behaviour observations with critical factors to determine the success of some plan (potential deregulation: financial management follow-up procedures, project control, etc.).
- Training systems for integrating several of the preceding functions so as to adapt training content to student behaviour as well as for implementing educational supervisory functions: tutorials, acquisition of skills of interest to an organization, assistance for students in difficulty, etc.

To illustrate the practical impact of these points, we may consider that by inserting such systems into various business sectors and at different levels, the overall effect will be one of increased accessibility of numerous specific skills whose present use in large organizations is quite costly. Furthermore, the acquisition or consultation of expert systems by small and medium-sized businesses will allow taking advantage of a wide range of specialists that at present are the exclusive domain of larger well-to-do organizations. These few examples should suffice in illustrating the rationalizing role that cognitive computer science will be likely to play within the organizational framework in the near future.

GIRICO Objectives

Basically, GIRICO is one out of many groups following a worldwide trend toward the study of fifth-generation computers; nonetheless it intends to conduct this study within the defined limits of organizational needs, and not by restricting itself to the sole dimension of hardware and software.

The preceding perspectives have incited GIRICO researchers to design an interuniversity model for conducting research whose main goals are the following:

1. Actively participate in R&D on cognitive computer science for organizations in Québec;

2. Contribute to the training of Québec researchers in all sectors of computer science for organizations;
3. Contribute to the development of public, parapublic and private organizations through the exchange of information in the field of computer science for organizations.

Since GIRICO is a federation of researchers whose common goal is to investigate cognitive computer science for organizations, its organizational structure is so built as to promote and consolidate research carried on by teams working jointly and severally in all sectors. For this reason, GIRICO has taken the legal form of a non-profit corporation so as to enable it to interact dynamically with all sectors. In Figure 2 it may be noted that GIRICO is a flexible interface for channeling actions between partners in industry, government and university. The GIRICO infrastructure rests on a multiregional basis which is favourable for enhancing the value of research resources for institutions throughout Québec. As such, its open structure constitutes a province-wide laboratory for experimenting communication technologies, remote project performance, joint problem-solving ventures which are just some of the many procedures that are a daily part of organizational tasks.

This approach to remote task performance will ensure the cohesion of work groups and will accelerate data and knowledge exchange throughout the Québec community of researchers working on cognitive computer science for organizations. Various spin-offs from joint remote efforts can be anticipated: facilitation of international exchanges and benefits for the Quebec government and in the long run, its population at large.

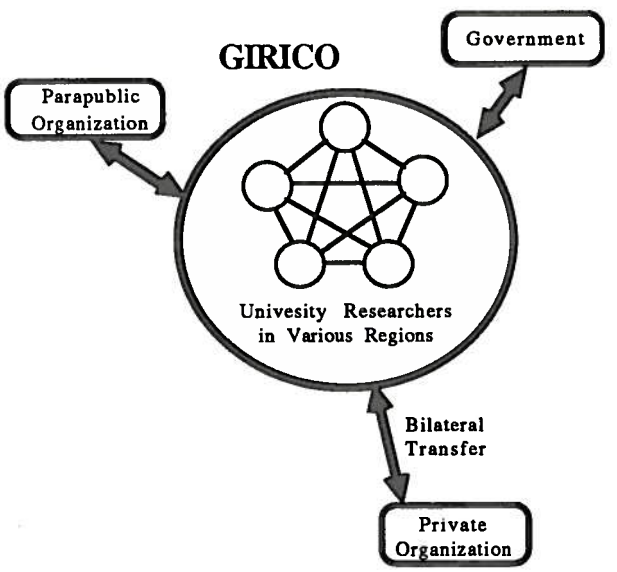

Figure 2

GIRICO and the private sector cooperate through contractual relationships, which permits the implementation of joint-ventures that businesses alone could hardly undertake (for instance: cooperation between several private enterprises and university research teams, projects mobilizing the resources of many university specialists, etc). Furthermore, GIRICO encourages the participation of industrial researchers within its work groups. Thus, for cognitive computer science applied to organizations, GIRICO is capable of managing R&D contracts emanating from the public and private sectors. In fact, GIRICO can on short notice efficiently constitute a critical mass of Quebec university researchers needed for carrying out and coordinating large-scale joint projects in the field of cognitive computer science for organizations.

By taking advantage of cooperative experiences carried out between universities and industries in Canada and abroad, GIRICO intends developing a model that emphasizes the bilateral transfer of knowledge and technology. In following through with this model, any transfer between university and industry has as a basic prerequisite to real success the establishment of projects in an industrial environment. This is, of course, the "natural habitat" for exploiting the product of research and marketing deriving from such efforts. In the same vein, technological transfers under such conditions have a greater chance to materialize if the hub for research is centered in a university-like environment. These optimal conditions for bilateral transfer are becoming the practical framework for a wide range of cooperative formulas for defining on a common basis of agreement the sharing of responsibilities for financing and use of research results.

For further information:
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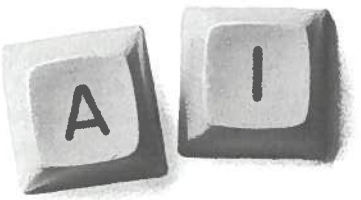
Phone: 418-657-3551, -2245



The keys to Artificial Intelligence are at Xerox.

The Xerox 1108 Series of Artificial Intelligence Workstations provide an affordable, high-performance line of personal computers in an integrated, interactive environment that greatly enhances programmer productivity.

- High resolution graphics display
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- Ability to mix interpreted and compiled code
- Multiprocessing capacity
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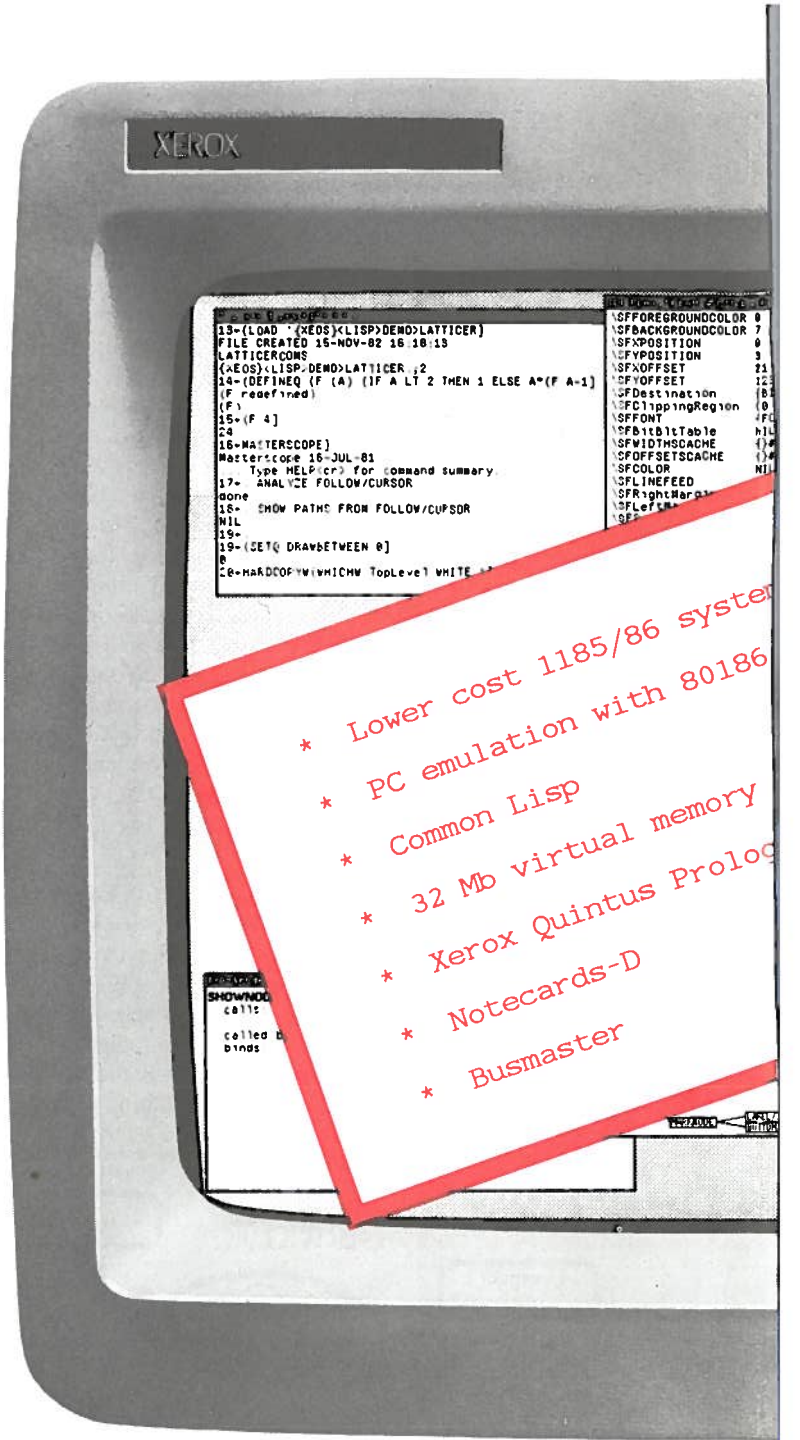


Power Tools for Programmers

1. Display Editor and Inspector

The display-based structure editor allows the interactive editing of programs and other list data. Structure-based editing exploits the form of an object, emphasizes the meaning of its parts, and thus reduces errors. The data inspector extends the philosophy to both system and user data types, allowing easy inspection and modification of any object in the system.

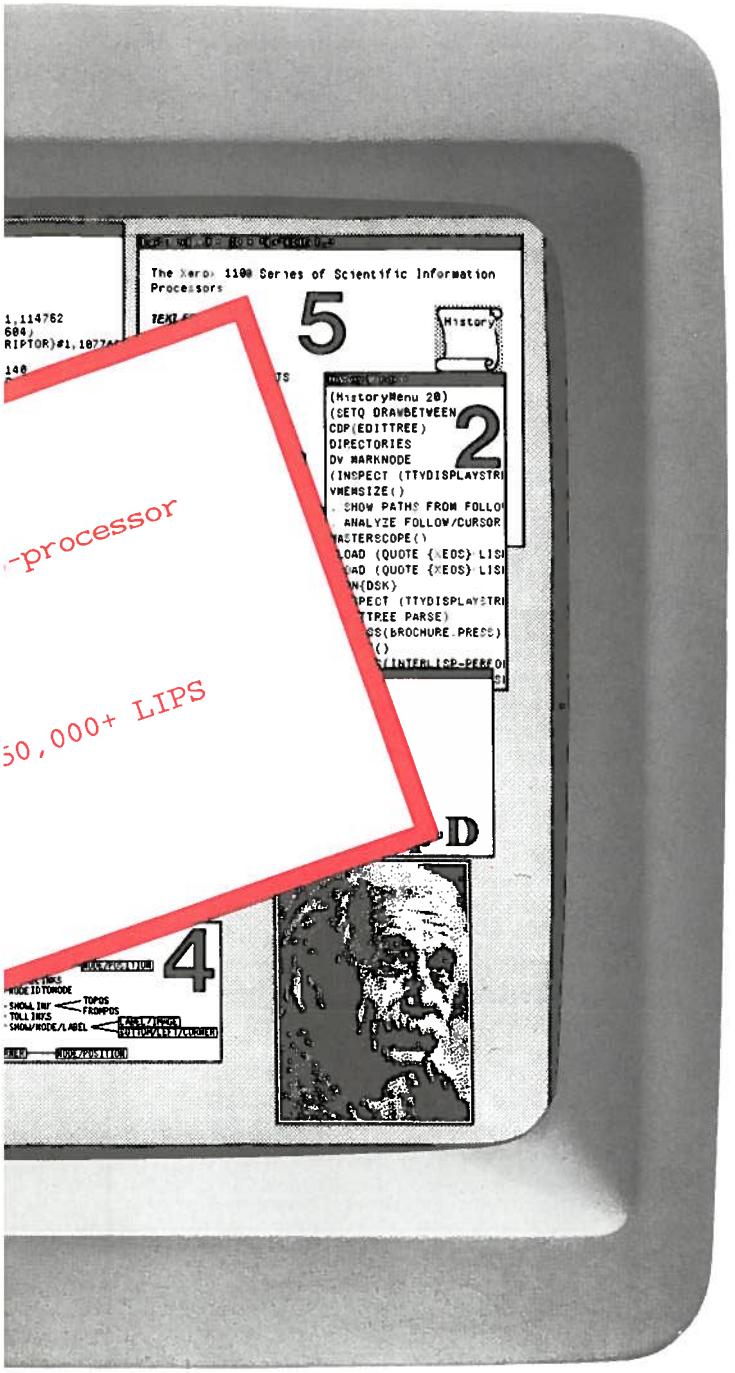
2. Programmer's Assistant

The Programmer's Assistant provides an intelligent assistant and bookkeeper that frees the programmer from much mundane detail. The Programmer's Assistant includes an error analysis capability and also monitors and records all user inputs. For example, a history is kept of the commands typed, their side-effects, and the results. Thus, one can request that a previous command or sequence of commands be repeated, modified and then repeated, or even undone (which undoes all the changes it may have caused). Also provided is a spelling corrector that automatically corrects spelling mistakes using information from the local context. To simplify file management for the programmer, Interlisp-D automatically keeps track of where in the file system each object is stored and which ones have been modified. In response to a simple request, the system can therefore save the user's state, updating all changed files automatically. The Programmer's Assistant provides a programming environment which cooperates in the development of programs allowing the user to concentrate on higher level design issues.

3. Debugging Tools

Debugging tools allow the user to break and trace

XEROX



arbitrary functions, and examine the state of the machine at any desired level of detail. Not only can the state of a suspended computation be displayed and perused graphically, but it can be manually unwound to a specified point, the offending program edited, and execution resumed, all without loss of state. Also included is the capability of specifying complex, user-defined intervention conditions, such as allowing breaks only when a given function is called from another given function. These debugging tools allow bugs to be tracked down quickly and easily.

4. Program Analysis

The Masterscope facility can analyze a user's program and use that information to answer questions, display the program's structure and assist in the process of making modifications automatically. Because Masterscope is interfaced with the file package and editor, it re-analyzes a program whenever it is modified. Information about program calling structure, variable and data structure usage, and side effects can be graphically displayed and used to provide a map or browser for the system. The same information can be used to make systematic changes automatically. Further, Interlisp-D's measurement tools can be used to analyze the behavior of a system after it has been developed to pinpoint those areas that may need improvement.

5. A Professional Workstation

A high bandwidth user interface is provided by combining the mouse and the high resolution display. The mouse permits the user to specify and manipulate positions or regions on the screen. The interactive display facilities include complete raster graphic functions as well as a display management system supporting multiple overlapping windows, menu driven selection of operations, and a wide range of built-in graphical abstractions. Functions are also provided to display text in multiple fonts, manipulate raster images, and draw spline curves. The large format, high resolution display and the sophisticated multiple window system allow concurrent sessions, close-up views, and simultaneous displays of multiple representations of complex data. It is easy to create windows with text, graphics, or both and to make them scroll, update and interact in useful ways with the end user.

6. Knowledge Programming System (Optional)

LOOPS extends the programming environment to provide a powerful tool for research and expert system development. LOOPS combines four programming styles:

- Procedure-Oriented
- Data-Oriented
- Object-Oriented
- Rule-Oriented

Xerox Canada Inc.

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Abstracts of papers in *Computational Intelligence*, 3(3), August 1987

In issue 3(3), *Computational Intelligence* introduces a new feature, "Taking Issue", in which controversial AI issues are debated. The format is based on the peer commentary system of *The Behavioral and Brain Sciences*: an author submits a 'target' paper, upon which other researchers are invited to write commentaries, pro or con. The target paper and commentaries are published together, along with the author's reply to the commentaries.

This section, which will appear in *Computational Intelligence* from time to time, is inaugurated by an outstanding contribution edited by Hector Levesque of the University of Toronto, debating the merits of logical approaches to artificial intelligence.

TAKING ISSUE: A critique of pure reason

Drew McDermott
with peer commentary edited by Hector Levesque

The relevance of logic to AI has been hotly debated from the very beginnings of the field. Just when the issue seemed to be finally cooling down, Drew McDermott, a noted researcher and hitherto loyal advocate of logic, wrote a paper explaining why, after a decade of research, he has changed his mind about the use of logic. The special section of *Computational Intelligence* will examine this issue in detail. After a short introduction, the section will contain McDermott's paper, together with commentaries on it by a number of prominent AI researchers: James Allen and Henry Kautz, Danny Bobrow and Mark Stefik, Ken Bowen, Ron Brachman, Eugene Charniak, Johan de Kleer, Jon Doyle, Ken Forbus, Pat Hayes, Carl Hewitt, Robert Kowalski, Robert Moore, Geoff Hinton, Jerry Hobbs, David Israel, John McCarthy and Vladimir Lifschitz, Nils Nilsson, Sandy Pentland, David Poole, Ray Reiter, Stan Rosenschein, Len Schubert, Brian Smith, Mark Stickel and Mabry Tyson, Richard Waldinger, Terry Winograd, and Bill Woods. Finally, McDermott replies to his critics.

Equivalent logic programs and symmetric homogeneous forms of logic programs with equality

Kwok-Hung Chan
University of Western Ontario

This article introduces the notion of CAS-equivalent logic programs: logic programs with identical Correct Answer Substitution. It is shown that the notions CAS-equivalence, refutational equivalence, and logical equivalence do not coincide in the case of definite clause logic programs. Least-model criteria for refutational and CAS-equivalence are suggested and their correctness is proved. The least-model approach is illustrated by two proofs of CAS-equivalence. It is shown that the symmetric extension of a logic program subsumes the symmetry axiom, and the symmetric homogeneous form of a logic program with equality subsumes the symmetry, transitivity, and predicate substitutivity axioms of equality. These results contribute towards the goal of building equality into Standard Prolog without introducing additional inference rules.

Pragmatic modelling: Toward a robust natural language interface

M. Sandra Carberry
University of Delaware

One of the most important ways in which an information-provider assimilates an information-seeking dialogue is by inferring the underlying task-related plan motivating the information-seeker's queries. This paper presents a strategy for hypothesizing and tracking the changing task-level goals of an information-seeker, and building a model of his task-related plan as the dialogue progresses.

Naturally occurring utterances are often imperfect. The information-provider often appears to use inferred knowledge about the information-seeker's underlying task-related plan to remedy any of his faulty utterances and enable the dialogue to continue without interruption. This paper presents a strategy for understanding one kind of defective utterance. Our approach relies on the information-seeker's inferred task-related plan as the primary mechanism for suggesting how an utterance should be understood, thereby considering only interpretations that are relevant to what the information-seeker is trying to accomplish.

Subscription information

Computational Intelligence is published by the National Research Council and is sponsored by CSCSI/SCEIO. Non-institutional CSCSI/SCEIO members may subscribe for $^{CDN}16, half the regular price, by using a copy of the all-purpose order form on page 46.

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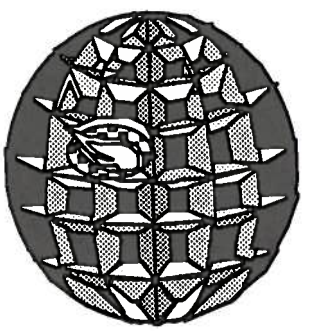

Artificial Intelligence '88

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Sponsored by the Canadian Society for Computational Studies of Intelligence

Artificial Intelligence '88 is the seventh biennial conference on Artificial Intelligence sponsored by the Canadian Society for Computational Studies of Intelligence.

Three copies of the paper due 31 October 1987
Authors notified 1 February 1988
Camera-ready copy due 28 March 1988

Contributions are requested describing original research results, either theoretical or applied, in all areas of artificial intelligence research. The following areas are especially of interest:

- Knowledge Representation
- Perception (Vision, Touch, Speech)
- Natural Language Understanding
- Expert Systems and Applications
- Reasoning (Formal, Qualitative)
- Learning
- Robotics
- Knowledge Acquisition and Maintenance
- Cognitive Modelling
- Social Aspects of AI
- Architectures and Languages
- Applications

All submissions will be refereed by the Program Committee. Authors are requested to prepare *full papers* of no more than 5000 words in length and to specify in which area they wish their papers to be reviewed. All papers must contain a concise statement of the original contribution made to AI research, with proper reference to the relevant literature. At the time of submission, authors must indicate if the paper has appeared, or has been submitted, elsewhere. Failure to do so will lead to automatic rejection. Figures and illustrations should be professionally drawn. Photographs, if included, should be of publication quality. All accepted papers will be published in the conference proceedings. As a condition of acceptance, the author, or one of the co-authors, will be required to present the paper at the conference.

The international journal *Artificial Intelligence* has offered a prize for the best paper at the conference. Selection will be made by the Program Committee.

Send papers and other program correspondence to either of the Program Co-Chairmen:

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For general information contact the General Chairman:

Wayne A. Davis / Department of Computing Science / University of Alberta / Edmonton, Alberta, CANADA T6G 2H1. Phone: 403-432-3976.

Intelligence Artificielle '88

Appel aux Communications

Centre des congrès d'Edmonton
Edmonton, Alberta, Canada
6–10 juin 1988

Conjointement avec
Graphics Interface '88
Vision Interface '88

Commanditée par le Société canadienne pour l'étude de l'intelligence par ordinateur

Intelligence artificielle '88 est la septième conférence biennale sur l'intelligence artificielle commanditée par la Société canadienne pour l'étude de l'intelligence par ordinateur. La conférence de 1988 se tiendra à Edmonton conjointement avec Graphics Interface '88 et Vision Interface '88.

Echéance de réception de trois exemplaires de la communication: 31 octobre 1987
Envoi d'un avis d'acceptation: 1 février 1988
Echéance de réception de l'exemplaire "camera-ready": 28 mars 1988

Nous vous invitons à soumettre des communications décrivant des résultats de recherche originaux dans tous les domaines de l'intelligence artificielle théorique ou appliquée. Les communications dans les domaines suivants sont particulièrement solicitées:

- Représentation du savoir
- Perception (visuelle, tactile, de la parole)
- Acquisition et mise à jour des connaissances
- Compréhension des langues naturelles
- Systèmes experts et applications
- Raisonnement (formel, qualitatif)
- Robotique
- Apprentissage
- Architectures et languages
- Modèles cognitifs
- Aspects sociaux de l'IA
- Applications

Toutes les communications soumises seront jugées par le comité du programme. On demande aux auteurs de préparer des *communications complètes* d'au plus 5000 mots et de préciser le domaine auquel se rapporte leur communication. De plus, il est indispensable de spécifier clairement et brièvement les contributions majeures à la recherche en IA et de fournir les références appropriées. Au moment de la soumission, les auteurs doivent indiquer si la communication a paru ou a été soumise ailleurs. L'absence de cette information entraînera le rejet automatique. Les graphiques et illustrations doivent être impeccables. Si des photographies sont incluses, elles doivent être d'excellente qualité. Toutes les communications acceptées seront publiées dans les actes de la conférence. Si une communication est acceptée, l'auteur, ou un des co-auteurs, devra être présent à la conférence pour donner la communication.

Le journal international *Artificial Intelligence* offre un prix pour la meilleure communication de la conférence. Le comité du programme sélectionnera la meilleure communication.

Veillez faire parvenir les communications ou toute autre correspondence à:

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Bob Woodham / Department of Computer Science / University of British Columbia / Vancouver, B.C., CANADA V6T 1W5. Tél: 604-228-4368. NET: woodham@vision.ubc.cdn, woodham@ubc.csnet. UUCP: woodham@ubc-vision

Pour de plus amples informations veuillez contacter le responsable:

Wayne A. Davis / Department of Computing Science / University of Alberta / Edmonton, Alberta, CANADA T6G 2H1. Tél: 403-432-3976.

Vision Interface '88

Call for Participation

Edmonton Convention Centre
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6–10 June 1988

In conjunction with
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Sponsored by the Canadian Image Processing and Pattern Recognition Society

Vision Interface '88 is the second Canadian Conference devoted to Pattern Recognition and Picture Processing. It is the newest regularly scheduled conference in Canada sponsored by the Canadian Image Processing and Pattern Recognition Society.

Four Copies of a Draft Paper due 31 October 1987
Tutorial Proposals due 15 November 1987
Authors Notified 1 February 1988
Final Paper due 28 March 1988

Papers describing original work in all aspects of computer vision are invited:

- Model-Based Vision Systems
- Knowledge Representation for Vision
- Models of Human Perception
- Image Understanding and Object Recognition
- Computational Geometry
- Image Processing
- Robot Vision
- Interactive Systems
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Opinion

Free Trade: A Good Thing for Canadian High-Tech Industry, If . . .

Roy M. Woodbridge
President
Canadian Advanced Technology Association

In this article, I will talk about the task of adjusting to freer trade, when it comes, rather than about the merits of free trade itself. Specifically, I want to discuss a range of science and technology related initiatives that are required to ensure the competitiveness of the Canadian economy.

Rapid technological advance and resulting changes in the international marketplace are forcing Canada to rely increasingly on knowledge-based, industrial activity to generate wealth and jobs. Free trade will accelerate the impact of these changes on the Canadian economy. Consequently, if we are to reap maximum benefit from the freer trade push, we must vigorously and urgently strengthen our knowledge-based, industrial capability.

I want you to understand right up front, however, that the Canadian Advanced Technology Association and the great majority of the advanced technology community in Canada strongly support moving forcefully and effectively towards a freer, international trading environment. The reason for this is straightforward. Everything about advanced technology is international. The markets for advanced technology goods and services are international. Research, the sharing of scientific information, the sourcing of new product ideas, the transfer of technology, venture capital financing, and the formation of business partnerships are all increasingly independent of national boundaries. Indeed, advanced technologies by their very nature are "internationalizing". Their development and use is moving the entire global economy towards a more knowledge-intensive future: They are making the world a smaller place.

Given these realities, and the small size of the domestic Canadian market, it will simply not be possible to build significant advanced technology strength in Canada behind tariff barriers or other protectionist measures. This is not a frightening prospect. Particularly in the Canada-U.S. context, we have been moving steadily closer to this goal for 15 to 20 years.

There is also optimism within the advanced technology community about the ability of Canadian companies to compete in the international marketplace. Indeed, a great majority of even the smallest Canadian-based technology companies are now dependent on exports. That means they are already competing internationally on the basis of price, quality, delivery, and service. Overall, they feel confident of their ability to compete successfully for a larger share of the growing international markets that freer trade would give them access to.

I want you to be aware of those views, for much of what I am now going to say implies a good deal of skepticism about the prospects for Canada actually reaping a significant level of national benefit from the free trade talks.

First, there are negotiating problems. We have concerns about our ability to negotiate appropriate trade-offs with the Americans. For example, in the area of government procurement policy, unless we can gain much broader access to U.S. military markets and offset the protection afforded to U.S. companies by small business set-asides, there is little we can or should give up in this area. Indeed there could be a strong case for actually strengthening the "Buy Canadian" policies of our governments, which are weak in comparison to U.S. practice.

However, even if this and other specific concerns are taken fully into account in the negotiating process, even if we get "a good deal" from the Americans, or internationally through GATT, it will still leave unanswered the question of how to make the transition to a knowledge and technology-based society. Other measures are needed to build competitiveness.

To a large extent, freer trade is being pursued as an isolated policy initiative as if, by itself, it will cure all that ails Canada. That may be true: free trade is a powerful tool. The potential is certainly there, and there is no question that some countries will benefit. But Canada will only be among the winners if our economy is strong and competitive. It is on this issue that our most serious concerns about the free trade option emerge.

The free trade talks are taking place at a time when technological advance is revolutionizing international markets and altering the basis of national comparative advantage. We are quickly moving to the point where

our only source of longer-term, national comparative advantage will lie in our knowledge-based industrial strength.

Yet, we are not well positioned to make this transition. We need to build national science and technology strength, we need to do this urgently, and we need to do it regardless of whether freer trade happens or not. However, because freer trade will accelerate the impact of technological advance, the trade talks make the need for action in the science and technology fields all the more pressing.

Therefore, our central message is that free trade, by itself, is simply not enough. It must be pursued together with the implementation of a meaningful national science and technology strategy. These two policy thrusts must be regarded as opposite sides of the same coin.

The great dilemma we face is that we are charging ahead with the free trade talks: a deal could be struck in a matter of months. Yet, we are only crawling forward when it comes to the creation of knowledge-based, industrial strength and it could take a decade for the policy initiatives we take today to bear fruit.

In the remainder of this article, I would like to review the central elements of a national science and technology strategy in more detail and look at the implications of this strategy in the context of the move to a more open, international trading environment.

The Science and Technology Challenge to National Competitiveness

To provide a context for this discussion, I would like to draw on the analysis contained in the report of last year's CATA National Technology Policy Roundtable. That report argues that we are falling behind in the international race for technology leadership. This is constraining the ability of the national economy to create wealth and jobs for Canadians. It threatens our standard of living and our ability to survive as an independent, sovereign nation.

Part of the reason for this is that the pace of technology diffusion around the world is accelerating. The time frames required for countries to become sophisticated users of advanced production technologies is shortening. As a consequence, Third World countries that used to base their competitive strength on low wages are now becoming technological competitors as well. It is, therefore, increasingly difficult for industrialized countries to retain price competitiveness in established industrial and resource sectors.

Our national competitiveness is also being eroded by the fact that other countries are outstripping us in the race for leadership in advanced technology sectors. It has been estimated that 90% of all the scientific and technological knowledge existing in the world around 1980 was created in the previous 30 years and that this volume of knowledge will double again before the year 2,000.

This massive, world-wide concentration of human effort on innovation is driving economic growth. More importantly, it is the source of opportunity for new wealth and job creation.

The advanced technology share of world trade has been growing at more than two times the rate for world trade in general. A recent report prepared by the Ministry of State for Science and Technology estimates that high technology could account for 25% of world trade by 1995, up from the present 12%. That growth is not coming in areas in which we have been strong in the past, but where we are weak at present!

These two themes are linked, for it is the use of our knowledge-based technologies that will create the productivity gains and cost reductions required to sustain competitiveness throughout all of Canadian industry.

There is also a direct link between advanced technology industry strength and the competitiveness of our established industries: a vibrant high-technology sector is the most effective conduit for diffusing technology throughout society.

Thus, Science and Technology weakness also limits the ability of our established industries to reap maximum benefit from free trade.

Clearly then industrial development policy must concentrate on two things. We must make determined efforts to build our advanced technology industry base. We also have to become more effective "users" of knowledge-based technologies in all industrial sectors.

To achieve that goal, a six-point strategy was conceived through the roundtable process to build strength at each stage of the innovation chain (see also *Canadian A.I.*, April 1987, page 11):

1. The Human Resource Base. The chain begins with people. The driving force in a knowledge-based society resides in the skills and collective mindset of its people. The educational system and related measures to develop human resource strengths are integral parts of the innovation chain.

2. The R&D Base. The next step in the chain is the conduct of basic science. Market research then filters out the concepts or ideas that might be transformed into commercially viable products at the applied research stage. Thus, we have to build our national research and development capability.

3. The Advanced Technology Industry Base. We then need an advanced technology industry capability to conduct applied research and to commercialize new product ideas. Thus, we have to build a dynamic and diversified advanced technology industry base.

4. The Use of Knowledge-Based Technologies. Our relative sophistication in the application or use of knowledge-based technologies will determine the competitive position of much of Canadian industry. Thus, mechanisms to diffuse technology throughout society

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Roy Woodbridge

are part of the innovation chain.

5. A Human Face on Labour Force Adjustment. Measures to facilitate and encourage work force adaptation are an essential part of the move to a knowledge-based economy.

6. A Science and Technology Culture. Finally, the countries likely to be most successful in building strength throughout this chain will be those having a clear perception of the relevance of technological leadership to their own quality of life and to national economic performance. They will be societies which value science and technology within the public culture and which have a strong political commitment to technological innovation and change.

It is important to understand that there are no simple or quick solutions to this national challenge. Determined initiatives must be pursued in all of these areas, together. A comprehensive, integrated long-term approach is required if we are to be successful. For example:

- There is no point in educating our youth for employment in a knowledge-intensive economy if we have not built the industrial base to create employment opportunity.
- We can put in place the most powerful R&D incentives in the world, but they will not be effective if we do not have skilled people to perform the work.
- We can expand our research activity, but it will produce little national benefit if we do not have an industrial base capable of absorbing and commercializing the product ideas flowing out of those efforts.
- Industrial sectors will continue to lag in the rate and effectiveness of technology diffusion if we do not have a vibrant/advanced-technology community to facilitate dissemination.
- Labour will be more receptive to technological innovation if established industrial sectors are competitive and alternative employment opportunity is being created by a growing advanced-technology industry. Similarly, labour's willingness to embrace new technologies will be affected by the availability of education and training options.
- And finally, the scale of the challenge facing the country and the requirement for long-term commitment to change require a high level of visionary political leadership and broad public support for the achievement of science and technology goals.

There is a synergy between the parts of the strategy that magnifies the impact of efforts made in each area. Weakness in any link in the chain will reduce our national competitiveness.

Are we making progress?

On the surface we seem to have made great strides over the course of the last year in putting the institutional framework in place — the policy structure — to more effectively address science and technology issues.

Premier Peterson in Ontario began the process by establishing an Advisory Council on Science and Technology, which he chairs. This was followed by the creation of the Prime Minister's National Advisory Board on Science and Technology. At least two other provinces are now giving serious thought to establishing similar groups.

These are important initiatives. They have the effect of moving science and technology closer to the centre of political decision-making. The personal involvement of the Prime Minister and individual premiers should raise the priority accorded to science and technology by individual governments.

It is also encouraging that the federal and provincial Science Ministers have reached accord on the goals to be achieved through their recently announced "National Science and Technology Policy". The goals set out by the ministers concentrate on technology use or diffusion. They may not give sufficient emphasis to the need to build advanced technology industrial strength. Nevertheless, with this possible exception, there is a strong consonance between the National Policy and the six pillars of the National Strategy identified through the roundtable.

Moreover, some governments have begun the process of putting flesh on these policy bones. Industry/University funding arrangements for cooperative R&D, the decision to establish the Space Agency, the "InnovAction" program and the $90 million Federal Microelectronics Strategy announced recently are a good beginning at the national level. A wide range of initiatives are also being implemented at the provincial level, which I can't list in the space available.

Clearly there is a lot going on, but a half effort is not enough. We are dealing here with the things that determine our ability to create wealth and jobs for our citizens. We are, in effect, in an international war for economic survival. It is a war in which science and technology are the strategic weapons. And it is a war that we are losing!

Despite the lengthening list of policy and program initiatives across the country, it is not clear that we are even doing enough to simply hold our position — to stop the slide. We certainly are not yet positioned to close the gap with the world's technology leaders.

This is definitely a war we can win! But to do that we have to pull out all the stops. We are now fighting this war with only one arm, for we are still doing only about half of what we should be doing in the six action areas.

Space doesn't permit a full analysis of the manner in which we fall short, or the specific initiatives CATA would like to see put in place to address this situation. However, I would like to flag for you four areas where urgent action is required.

1. The R&D Base. In R&D, basic performance indicators give serious grounds for concern. Canada's expenditure on R&D slipped from 1.36% of GDP in 1985 to 1.3% in 1986. This reflects a slower rate of growth in private sector investment in R&D, together with a virtual freeze in public sector support.

The prospects for improvement in the short run are not encouraging. There is little or no real growth forecast in government R&D spending for the next two or three years. Moreover, a major industry survey conducted last fall indicated that industry will probably cut back further on the growth of its R&D expenditures this year (*Directions 86*, Toronto: W.G. Hutchison & Co). As well, tax incentives to encourage investment in innovation have been weakened.

Because research is the source of new product ideas and the base upon which a good deal of product enhancement is made, any slowdown in R&D expenditures could see a corresponding decline in the growth of sales and exports of our advanced technology sectors two or three years down the road.

This dismal performance, and the gloomy prospect, are all the more discouraging when compared with the effort being mounted in competitor countries. The comparable U.S. R&D level is now more than twice that of Canada's and the Japanese have committed to achieve and R&D expenditure to GDP ratio of 3.6% by the early 1990's. The government of Finland has legislated an increase in government-supported R&D of 15% per year for the next five years. They are now locked in by law to achieve this. The government of Sweden is preparing a similar bill that takes this multi-year approach to expansion. And it is not just our traditional competitor countries that we must be concerned with. Korea will reach a ratio of 2% this year.

We are also up against a problem of scale in the R&D field. We have nothing in Canada to compare with the multi-billion-dollar U.S. Star Wars program, the Alvey Program in Great Britain, the Eureka Program in Europe and the $10 billion Human Frontiers project in Japan. Even in specific program areas, the comparison is unfavourable. Our $90 million, four-year Microelectronics Fund, for example, must be contrasted with a $1 billion three-year program in West Germany.

It is inconceivable that we will ever be competitive with the world's technology leaders if the current gaps in relative, national R&D performance are sustained.

2. The Advanced Technology Industry Base. Our advanced technology industries now account for about half of the comparable share of the national economy of leading competitors. Moreover, that base is not growing as strongly as the expansion of international markets would allow or as fast as the high-tech base in competitor countries.

The problem can be seen in our balance-of-trade figures. Regardless of how you define "high technology", the trade deficit has grown at an unacceptable rate of between 15% and 20% per year since 1970. This has been happening while the advanced technology share of world trade has been growing at more than two times the rate for world trade in general.

We are short-changing the Canadian public by failing to take advantage of the opportunities offered by the world-wide growth of advanced technology enterprise. The MOSST study referred to earlier suggests that if we retain our current share of world markets in high tech products (3.2%), total sales in 1995 could reach $25.4 billion. If we increased our share to 5.4%, a figure we could probably achieve, Canadian production would top $42 billion. That is the potential — yet we face the prospect of a further decline rather than a rise in market share.

3. The Human Resource Base. As I emphasized earlier, innovation is a people-intensive process. The Innovation chain is driven by the creative abilities, knowledge, and, eventually, the entrepreneurial skills of people. Yet we are not investing heavily enough in developing the human resource skills and aptitudes required for creating an innovative and technologically intensive society. We are not educating for the demands of a knowledge and technology intensive future.

Well over 60% of all university graduates and over 80% of PhD students, for example, opt for careers in the public sector, not the private sector. Thus, we are not orienting our best and brightest to develop the skills and pursue the occupations on which our future economic well-being depends. Clearly, we have to quickly raise the profile of science, technology and entrepreneurship within the educational stream.

Nor are we adequately supporting our trained people once they are in the workplace. In the university environment, for example, a study done for NSERC stated, "There is a significant danger that Canada will lose many of its best scientific and engineering researchers to other countries unless funding is increased". Forty percent, or 2,400, of the researchers presently receiving NSERC grants are now attempting to leave Canadian universities because of the low level of financing available in this country. That is an astonishing figure that must be made an issue of national concern.

And the situation in industry is not any better. On a per capita basis, Canada employs roughly half the number of scientists and engineers that other leading industrialized countries do. Nor are we doing much to keep the human resource skills of individuals within the workplace current. It is estimated, for example, that we invest approximately two hours per employee per year on in-service training: the comparable figure in Japan is 200.

It is not surprising, then, that we have been slower to diffuse new technology throughout established, industrial sectors: technology diffusion is, after all, a people-intensive process.

4. The Science and Technology Culture. And finally, I would like to flag the fact that a great many initiatives, like the approach to free trade, are being taken on a stand-alone, independent basis. Our national policy response to the science and technology challenge is piecemeal. There is also a tendency to pursue these initiatives on a narrowly focused, regional basis.

This fragmented, often parochial approach to science and technology reflects the absence of a deep-seated awareness and appreciation of the central role which science and technology plays in establishing the competitive position of the Canadian economy within the international marketplace. Equally, there is little discernible evidence in the initiatives taken to date of the integrated nature of the policy response that is required.

The science and technology imperative tends to be sidetracked by the crisis-of-the-day, or obscured under layers of political jargon, emphasizing concepts such as equity and fairness in the distribution of national wealth and opportunity.

To use the power of science and technology for maximum gain, it is important that we take a longer term, national approach. If the definition and achievement of science and technology goals continue to be motivated by short-term political concerns, rather than long-term social welfare, we will end up competing with each other rather than with the rest of the world.

Conclusions

There are no quick-fix solutions to building our base of technological strength. We need a compelling, integrated national strategy. That strategy must be vigorously pursued in a coordinated way by all of our governments and by industry working cooperatively together. And that effort must be sustained for at least a decade if we are to be successful. The changes in the global marketplace, to which we must adapt, will continue to take place regardless of whether or not we pursue freer trade. Sooner or later, whether we like it or not, the country, and the industries within it are going to have to adjust to new economic realities.

Freer trade will accelerate the pace at which these changes will impact on Canadian industry. For this reason, we have argued that the benefits of freer trade will not accrue to Canadians unless we implement a national science and technology strategy in concert with the trade negotiations. The six elements of a science and technology strategy are the recipe for effective economic and social adjustment to the rigours of competition in a freer international trading environment.

Free trade is a bold initiative. If it can be successfully negotiated, and then implemented in concert with a meaningful science and technology strategy, Canada will indeed be faced with major opportunities for economic and social advance.

It is not an exaggeration to suggest that these measures could position the country to achieve the greatness that earlier generations of Canadians had forecast for us in the 20th century. And it is possible to be tremendously optimistic about our ability as a nation to succeed in this task.

In the last analysis, success depends on nothing other than the skills and attitudes of individual Canadians. We simply have to mobilize the united will of the citizens of this country to become a more knowledge and technology intensive and entrepreneurial society.

If we fail to mobilize this kind of effort, it will only be because of some stubborn shortfall in the Canadian psyche — because of a lack of vision or of national will or the ability to persevere. And if we fall short, we will wake up one morning in the not too distant future to find the economy hanging over the precipice and come to realize, as Pogo did when he went looking for the enemy, that "it is us". □

Roy Woodbridge has been President of the Canadian Advanced Technology Association since 1985. Previously, he was Director of Economics of the Mining Association of Canada.

Book Reviews and Publishing News

Prolog Multiprocessors

Wise, Michael J
[New South Wales Institute of Technology]

Sydney, NSW: Prentice-Hall Australia, 1986
Hardbound, ISBN 0-13-730755-1, xii+168pp

Reviewed by
Jia-Huai You
University of Alberta

This book emerges out of a seven year research endeavour conducted by Michael Wise, who is one of the first researchers examining the issue of Prolog multiprocessing.

The advances of VLSI technologies; the problems associated with the Von Neumann model of computation; and new applications demanding large-scale symbolic computations, have for the last decade provoked serious investigations of new principles in programming language design and computer architecture. The focus has been on high-level declarative languages, such as functional and logic-based, for which parallelism can be elegantly explored and directly supported by parallel systems consisting of a large number of processors. Among these efforts, the EPILOG project, which is the major focus of the book, explores an exciting approach towards parallel processing of a Prolog-like language on data-flow architectures.

Although the book contains seven chapters and four appendices, it is primarily organized into three parts: the introduction, the EPILOG project, and an extensive, in-depth review of related research. The author leads the reader through the development of the EPILOG project since its inception in 1979. The book is a very pleasant read for both specialist and nonspecialist. It is a vivid and absorbing story about the evolution of the EPILOG project, supported by philosophical considerations and technical justifications.

The first three chapters are of an introductory nature. A lucid introduction to parallel computation based on the data-flow model is presented. The introduction to Prolog provides a fresh view of unification, which serves as one of the key mechanisms in the approach. Some of the problems associated with the data-flow model are discussed. It is these problems which motivate the author to look into a Prolog solution. The introduction is elegantly presented; it gets to the point smoothly and quickly without much diversion; it is interesting enough to researchers in the field and simple enough to encourage nonspecialists to proceed.

The next three chapters are devoted to the evolution of the EPILOG project and consist of language issues, architectural considerations and simulation results. Contrary to the traditional practice in which computers always came first, new generation computer projects tend to give the language a higher priority and look for direct support of the language by appropriate architectures. This approach is the soul of the EPILOG project. The EPILOG language is an extension of Prolog with several control constructs. A number of typical network configurations are considered and simulation results discussed. The most interesting conclusion reached is that the choice of a good strategy for distributing work appears to be more important than the choice of a specific architecture.

In the last few years, the subject of Prolog multiprocessing has become a very "crowded" area of research. A large volume of work has appeared and a variety of ongoing projects have been reported. For anyone who wants to get a quick and clear picture of the field, I would like to recommend reading of this book, particularly Chapter 7, which compares Wise's approach with a rich background of related work. This comparison is thorough, insightful, and critical. The most distinct feature in Wise's work against others is its parallel processing of literals in a goal statement, independent of whether or not these literals are related by common variables. The responsibility for synchronization is completely handled by the system. On the other hand, the degree of parallelism is partially placed into the user's hand by providing a number of control constructs. Indeed, it is too early to conclude now which approach provides more appropriate tradeoffs amongst a number of considerations, such as degree of parallelism, effectiveness of computation, cost of communication, utility ratio of available hardware, and user convenience, etc.

One of the best features of the book is provision of a comprehensive view of Prolog multiprocessing, from language design to architectural considerations and to simulation.

Although the book is not intended to be a textbook, it certainly can be read profitably by students interested in the subjects of multiprocessing, logic programming, and next generation computer systems. The book is a

valuable addition to any course concerning these topics. Serious researchers in the field may also find it very useful, especially the thorough survey, which forms about the half of the text, and the insightful discussion which pervades the book. □

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Knowledge-based expert systems in industry

Jiri Kriz (editor)
[Brown Boveri Research Centre, Baden, Switzerland]

(Ellis Horwood books in information technology)
Chichester: Ellis Horwood, 1987, 161 pp.
Distributed in Canada by John Wiley & Sons
ISBN 0-7458-0188-9 and 0-470-20833-3,
hardbound, $^{CDN}55.95

Reviewed by
Innes Ferguson
Bell-Northern Research

This book is a collection of twelve papers presented at the Workshop on Knowledge-Based Systems in Industry, which was held at the Brown Boveri Research Centre in Baden-Dättwil, Switzerland, on 9 June 1986. The main purpose of the workshop was to provide a forum for both scientists and engineers to present work on realizations of knowledge-based systems and practical experiences with AI techniques and tools.

The papers included in the text cover a fairly wide range of topics related to knowledge-based systems. The reader-groups at which the various papers appear to be aimed also span a wide range. In fact, it's this latter point that concerns me. The editor attempts to bring new readers up to speed by including an introductory chapter on knowledge-based systems in industry. Albeit well-written and easy to understand, it alone could not provide newcomers with enough background knowledge to read (or at least appreciate) several of the book's chapters. I would therefore suggest that some familiarity would be useful, not only with some of the principles of knowledge-based systems, but also with logic programming, given the notable popularity of Prolog among the (predominantly European) authors; seven out of twelve papers involve it.

As mentioned above, a wide variety of topics are discussed in the book — too many, in fact, to describe here in detail. Worth noting is a paper which discusses the limitations of production rules for providing system-generated explanations, suggesting alternative paradigms such as meta-rules and causal models. Also worth reading are the paper on APES (the Prolog-based expert system shell from Imperial College, London), and the one by Austin Tate on O-Plan and planning systems in general.

Several papers describe various applications involving Prolog. While most present novel and interesting work, some go into unnecessary detail regarding low-level implementation issues (code excerpts and the like). The various papers address: "marrying" Prolog with the relational data model Ingres; PLM, a parallel multiprocessor hardware architecture for running sequential Prolog programs; a new language combining features of Modula-2 and Prolog; a frame-based design, simulation, and diagnostic system implemented in Modula-Prolog; and a troubleshooting expert system for analog circuits, which is implemented in VM/Prolog.

The remaining papers describe a model-guided vision system for interpreting image (line) primitives, a Lisp-based expert system for configuring technical systems, and finally, a paper which was intended to describe CONAD (a network configuration advisor developed by Nixdorf), but which ends up being more of a sales pitch for Nixdorf's expert system shell TWAICE.

In general, I am not overly impressed with either the format or the content of the book. Besides the unusually high number of spelling and grammatical errors in many of the papers, there is also a considerable imbalance in quality and technical content throughout the various chapters of the book. In my opinion, some of the papers tended to be overshadowed by the poorer quality ones. □

Innes Ferguson is with the Knowledge Technology Group (AI Development) at Bell-Northern Research, Ottawa.

Artificial intelligence and instruction: Applications and methods

Greg P. Kearsley (editor)
[Park Row Software]

Reading, MA: Addison-Wesley, 1987, xiv+351 pp
Hardbound, ISBN 0-201-11654-5, $^{US}29.95

Reviewed by
Marlene Jones
Alberta Research Council

This book is a collection of chapters by different authors, most of whom are very well known within the field of AI and Education. The book is well-written, enjoyable to read, and does a good job of surveying the area of intelligent tutoring systems (ITS). The material is partitioned into sections, each with a brief introduction by Kearsley.

The first section contains a relatively thorough survey of both intelligent computer-aided instruction (ICAI) and computer-based instruction (CBI) systems, including useful comparison information summarized in table format. This article is an excellent starting place for readers not already immersed in the area.

The chapters in section 2 describe 3 different ICAI projects: PROUST (Johnson and Soloway), Micro-

Search (Sleeman), and an article by Thompson regarding mathematical microworlds. These three articles provide the reader with a feeling for the variety of research within the field, including the different approaches being employed.

Section 3 concerns AI applications within training, an appropriate section due to the recent burgeoning interest in training systems. At the beginning of this section, Kearsley succinctly points out some of the differences between the application domains of education and training, and the present thrusts within each.

Part 4, titled "Building Intelligent Tutors", contains a chapter by Clancey on methodology in which he uses the Mycin/Guidon/Neomycin project as an illustrative example, a chapter by Woolf which focuses on the major different types of knowledge needed within an ITS, and an article on the Teacher's Apprentice (Lewis et al). The final section deals with some of the more practical problems of implementing ICAI systems.

Although most of the chapters focus on particular systems under development, the authors have made an effort to raise the relevant research issues while discussing the projects. In fact, in Clancey's article the relevant research problems are listed explicitly. In general, the authors have specified the underlying theoretical bases — domain content, educational philosophies, AI methodologies — upon which the systems are being developed. Because the chapters have been written by different authors, there is some minor overlap regarding the basics such as ICAI components.

Although those familiar with the area of intelligent tutoring systems will have read articles regarding these various systems and issues before, the book is still an excellent general reference. Furthermore, I would highly recommend this book as an introduction to the area. □

Marlene Jones is co-chair of the program committee of next year's International Conference on Intelligent Tutoring Systems.

An artificial intelligence approach to legal reasoning

Anne von der Lieth Gardner

Cambridge, MA: The MIT Press / Bradford Books
1987, xiii+225 pp
Hardbound, ISBN 0-262-07104-5, $^{US}22.50

Reviewed by
Judy Dick
University of Toronto

This is the revision of a thesis completed in 1984 at Stanford under the supervision of Terry Winograd. Dr Gardner has expanded upon her view of legal reasoning in terms of the jurisprudential literature and dealt in depth with a number of questions which arose in her thesis.

The objective of the research was to replicate, using AI techniques, some of the analytical skills of lawyers. Specifically, the program was designed to identify legal issues and to classify them as hard or easy, when presented with a problem in contract law. The problems upon which she worked were first-year law school examination questions.

Gardner's approach to legal reasoning is discussed in the light of modern legal theory. She relies especially on H.L.A. Hart. For example, she uses Hart's definition of open texture, as it relates to legal concepts, as a basic component of her work.

The review of past work in AI and law is excellent, concise, and insightful. It penetrates as far back as the jurimetrics experiments of the sixties. To my knowledge there is no similar review of the literature available.

In conjunction, her writing style is nice, clear, and hard. There are no shadowy inferences along the way. She is fully bilingual and repeatedly translates her ideas from AI language to the language of the law, and the reverse. As a reader with some background in both AI and law, I found her explanations very helpful. I assume the monolingual reader would be even more pleased.

This project is an attempt to replicate the cognitive activity of a beginning law student. In the past, research in AI and law has often dealt with problems considered by lawyers to be trivial. Gardner uses a real problem. Beginners in law, as in other disciplines, are often taught the basic principles, the outlines of the subject in question, but not the details. Their examination questions are similarly broad, and lend themselves to many interpretations. The limitations of AI to deal with a heavy duty task, the analysis of a general question resulting in many alternatives, became apparent early. Nevertheless, the difficult problems which arose in the course of the research have been attacked directly.

The traditional analysis resulting in a collection of relevant facts and legal concepts is used. Processing is done with the objective of separating easy from hard issues. Hard problems are (to simplify) those requiring use of human judgement, or for which an argument can be made on either side of the issue.

A limited amount of very simple commonsense knowledge is represented as rules. Legal knowledge is represented in sets of *if-then* rules which share the same conclusions. MRS is the representation language.

An ATN is used in processing because of the need to sequence events during analysis. The nodes are legal states, such as "a contract exists" or "an offer is pending", and the arcs are logical expressions of the legal categorization of events, such as *(offer x)*.

Processing is on four levels. The first two embody some basic deductive analysis about the events in the problem. Level three applies heuristic reasoning to deal with the possibility of whether or not an open-textured

legal predicate applies, and level four finds arguments on both sides of a hard question.

Determining the meaning of language is a problem central to legal reasoning, as it is to knowledge-oriented computation. Gardner recognizes the now-generally-held idea that legal vocabulary is not distinct. It includes some keynote phrases and many everyday words with restricted meanings. Where the ambiguity of the language makes it difficult to know whether the knowledge is common sense or legal knowledge, in here system, it is classified as legal. It is used in the legal problem analysis where uncertainties are subjected to repeated processing. The language problems encountered in representing facts are usually considered to be more difficult than those in the representation of concepts. Gardner also found this to be true.

Much of the research on legal systems has used statute law. The processing of language used in case law is more difficult. Drafting conventions and a definitional approach to writing establish a kind of vocabulary control in statutes that simplifies processing. Case-law language is freer and more expressive. This research constitutes a head-on approach in dealing with the problems of processing case-law language; and the work is described in detail.

The legal knowledge represented is derived from the same kinds of sources a lawyer would use in his research: from texts, treatises, and cases. The discussion of *The Second Restatement of The Law: Contracts* will be interesting to knowledge engineers as an example of an accumulation of expert knowledge in the legal area.

Only two cases are represented, and only partially so. "Patterns" are derived from the cases and included in the knowledge base, because of the difficulties encountered in representing the cases in their entirety. Here Gardner has made a crucial decision to use the AI method of representation for cases. She admits it is not truly adequate for law, because it involves the possibility of misinterpretation of the text. She chose it over the full-text information retrieval approach which, although it forces the user to guess the words in the case in order to retrieve it, nevertheless makes the full text of the decision available to the reader without interpretive editing. There is no further discussion of this problem, only the recognition that the interpretive representation of legal knowledge makes knowledge-based systems unsuitable as replacements for lawyers in case-oriented analysis of legal problems.

She goes even further and admits that AI systems cannot be considered as a viable replacement for lawyers, even in the future. The position she sees for them is a complementary one. They can retrieve information, they can analyze problems logically rather than intuitively and in so doing they can provide a useful adjunct to the lawyer's collection of skills and tools. At present, some expert systems are effectively performing the professional function of classifying incoming cases as easy or hard, then routing them appropriately for machine or human analysis. However, they work in areas of law that are particularly rule-oriented, especially where a detailed statute applies, for example, income tax or estate planning. Case law domains are another thing.

Finally, with clear foresight Gardner closes off with a description of the limitations of what she has been able to accomplish and with recommendations for approaching what are surely the most significant problems — language processing and the recognition and processing of arguments in case analysis. □

Judy Dick is a doctoral candidate in the Faculty of Library and Information Science, University of Toronto. Her research concerns AI approaches to legal information retrieval systems.

In Brief

Semantic interpretation and the resolution of ambiguity

Graeme Hirst
[University of Toronto]

(Studies in natural language processing)
Cambridge, England: Cambridge University Press
1987, xiv+263 pp
Hardbound, ISBN 0-521-32203-0, $^{US}39.50

A detailed chronicle of what the editor of *Canadian A.I.* magazine does in his so-called 'research' time. The cover design is horrible, but the typography is very nice. Would make a good Christmas present for that Special Someone. — *G.H.*

Expert systems 1987: An assessment of technology and applications

Terri C. Walker and Richard K. Miller

SEAI Technical Publications, 1987, 772 pp
Paperback, ISBN 0-89671-082-3, $^{US}325.00
(Available from the publisher at
PO Box 590, Madison, GA 30650, U.S.A.)

The 1986 edition of this book was described (*Canadian A.I.*, June 1986) as "having more expert systems catalogued than you have ever thought existed yet, and they don't stop at the U.S. border." This is the 1987 edition, and it is more than double the size of the previous one. If you want to know about expert systems for just about any application, no matter how esoteric, this is the place to look first. — *G.H.*

Books Received

[Books marked † will be reviewed in future issues; books marked * are available for review.]

From text to speech: The MITalk system

Allen, Jonathan; Hunnicutt, M Sharon; and Klatt, Dennis; with Armstrong, Robert C and Pisoni, David
[MIT]

(Cambridge studies in speech science and communication)

Cambridge, England: Cambridge University Press
1987, xi+216 pp
Hardbound, ISBN 0-521-30641-8, $US29.95

Memory and context for language interpretation

Alshawi, Hiyan
[SRI International Cambridge]

(Studies in natural language processing)
Cambridge, England: Cambridge University Press
1987, ix+188 pp
Hardbound, ISBN 0-521-34059-4, $US29.95

POP-11 programming for artificial intelligence

Burton, Mike and Shadbolt, Nigel
[University of Nottingham]

(International Computer Science Series)
Wokingham, England: Addison-Wesley, 1987, xi+207 pp
Paperback, ISBN 0-201-18049-9, $US21.95

The linguistic basis of text generation

Danlos, Laurence
[Centre National de la Recherche Scientifique, Paris]

(Studies in natural language processing)
Cambridge, England: Cambridge University Press
1987, x+222 pp
Hardbound, ISBN 0-521-32398-8, $?

AI in the 1980s and beyond: An MIT survey

Grimson, William Eric Leifur and Patil, Ramesh S (editors)
[MIT]

Cambridge, MA: The MIT Press, 1987, x+374 pp
Hardbound, ISBN 0-262-07106-1, $US24.95

Computational linguistics: An introduction

Grishman, Ralph
[New York University]

(Studies in natural language processing)
Cambridge, England: Cambridge University Press
1987, viii+193 pp
Hardbound, ISBN 0-521-32501-1, $US39.50
Paperback, ISBN 0-521-31038-5, $US14.95

Language and spatial cognition

Herskovits, Annette
[Wellesley College]

(Studies in natural language processing)
Cambridge, England: Cambridge University Press
1987, x+208 pp
Hardbound, ISBN 0-521-26690-4, $US34.50

†Neural networks:
Implementing associative memory models in neurocomputers

Miller, Richard K

Madison, GA: SEAI Technical Publications, 1987, 243 pp
Looseleaf binder, ISBN 0-89671-088-2, $US485.00

Fundamentals of human-computer interaction

Monk, Andrew (editor)
[University of York]

(Computers and people series)
London: Academic Press, 1984, xvii+293 pp
Hardbound, ISBN 0-12-504580-8, $US32.00

Machine translation:
Theoretical and methodological issues

Nirenburg, Sergei (editor)
[Colgate University]

(Studies in natural language processing)
Cambridge, England: Cambridge University Press
1987, xv+350 pp
Hardbound, ISBN 0-521-33125-0, $US49.50
Paperback, ISBN 0-521-33696-1, $US17.95

Medical language processing:
Computer management of narrative data

Sager, Naomi; Friedman, Carol; and Lyman, Margaret S
[New York University]

Reading, MA: Addison-Wesley, 1987, xiii+348 pp
Hardbound, ISBN 0-201-16810-3, $41.95

†Expert systems for business

Silverman, Barry G (editor)
[Institute for Artificial Intelligence, The George Washington University]

Reading, MA: Addison-Wesley, 1987, xvi+446 pp
Paperback, ISBN 0-201-07179-7.

New Journal on AI and Society

The latest new AI journal to be announced is slightly different from the recent spate of technical journals. It is called *AI and Society*, and bills itself as "The journal of human and machine intelligence".

Among the topics to be covered are:

- Problems of knowledge and skill transfer;
- AI and human decision making;
- Ethical issues of AI;
- The relationship between civil and military research;
- AI and social action in education, training, health and welfare, law, and the arts and creativity;
- New technology and the international context.

The journal will be edited by Karamjit Gill of Brighton Polytechnic, England, and published by Springer-Verlag. The first issue was to appear in July. There will be two issues in 1987 (subscription price $US55) and thereafter four per year (for $US110). The first two years may be ordered together for $US150. Orders may be placed with:

Springer-Verlag NY Inc
44 Hartz Way
Secaucus, New Jersey 07094, U.S.A.

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( ) Montréal, 1986. ( ) Saskatoon, 1982. ( ) Victoria, 1980.

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*If an issue you request is out of print, a photocopy will be provided. Issue #3 (March 1985) includes the supplement *Towards a Canadian Fifth Generation Research Plan.*

† *Computational Intelligence* subscriptions are filled by its publisher, the National Research Council of Canada. CIPS only certifies your eligibility for the discount and forwards your order.

Rapport de congrés

Systèmes experts en Europe: Les septièmes journées internationales d'Avignon

Luc Loslier
Département de Géographie
Université du Québec à Montréal

Capitale de la chrétienté pendant près d'une centaine d'années, au quatorzième siècle, Avignon, pour cette raison surnommée la "Cité des Papes", a été, du 13 au 15 mai, la capitale européenne des systèmes-experts.

Pour la septième année, Avignon accueillait en effet les "Journées internationales consacrées aux systèmes-experts et à leurs applications". Composées de conférences (plus de quatre-vingt-dix, selectionnées par un comité d'évaluation international), avec traduction simultanée en anglais ou en français, et d'une exposition, les "Septièmes journées d'Avignon" étaient organisées de main de maître par la société EC2 (Editions, Colloques et Conseils), sous le patronage de l'ECCAI (European Coordinating Committee for Artificial Intelligence).

Quelques chiffres montrent que les "Journées d'Avignon" sont devenues un évènement considérable: en 1981, on a compté une soixantaine de participants; en 1985, il y en avait 750, et cette année, on en dénombrait environ 1500, sans compter les personnes inscrites au congrès lui-même. L'exposition rassemblait plus d'une centaine de sociétés en 1987, contre 48 il y a deux ans. Les chiffres indiquent donc qu'il s'agit d'un rassemblement assez important par la quantité (c'est pourquoi d'ailleurs, malheureusement, le congrés n'avait pas lieu cette année, sauf pour une trés agréable réception, au Palais des Papes, mais au Parc des expositions, à quelques kilométres du centre d'Avignon (avec transport efficace, offert par la societé Texas Instruments). Un examen plus attentif de ce que recouvrent ces chiffres — organisation, conférenciers, thèmes traités et produits exposés — permet de mieux saisir le véritable intérêt des Journées d'Avignon.

Un événement international

Même s'il est parrainé par une organisation européenne (l'ECCAI), l'examen des listes d'organisateurs et de conférenciers montre que le congrès d'Avignon a une portée qui dépasse les frontières de l'Europe: le comité du programme, par exemple, comptait 61 membres, dont 23 Français, 22 autres Européens, sept Américains et deux Canadiens. Chez les conférenciers, les deux-tiers n'étaient pas originaires de France, représentant 30 nationalités. Dix-huit conférences ont été présentées par des auteurs américains, alors que quatre conférences ont été présentées par des équipes originaires d'universités canadiennes. Des équipes de tous les continents étant présentes, on peut dire que les journées d'Avignon permettaient de se faire une idée de l'état de la recherche sur les syste`mes-experts à l'échelle mondiale.

Les thèmes de conférences

Les conférences ont été regroupées en sessions thématiques; que l'on nous permette ici une liste un peu longue, mais qui montre la variété des sujets: bâtiment, agriculture, techniques de validation, conception et configuration, chimie et génie chimique, recherche documentaire, raisonnement approximatif, stratégies d'entreprise, génie logiciel, finance et fiscalité, Prolog, avionique et spatial, statistiques et analyse de données, linguistique, environnement et risques naturels, droit, CAO de circuits intégrés, apprentissage, fabrication, interfaces, et enfin quelques sujets-vedettes ayant nécessité plus qu'une session: contrôle de processus et temps réel, environnements de développement, acquisition des connaissances, représentation des connaissances, diagnostic technique. On avait donc une variété de sujets théoriques, méthodologiques et d'application. A cela s'ajoutait la troisième vidéo-conférence sur l'intelligence artificielle, organisée par Texas Instruments, comprenant une série de reportages sur différentes applications de l'intelligence artificielle réalisées en Europe et aux Etats-Unis, ainsi qu'une table-ronde d'experts de renommée internationale.

Signalons que pour les néophytes du domaine, ou pour ceux qui voulaient rafraîchir leurs connaissances, le congrés a été précédé de deux journées de cours sur

English summary

The seventh international conference on expert systems was held in Avignon recently. System applications in a wide variety of domains were discussed. The exhibition included a large number of expert system software products and languages.

les systèmes-experts, donnés en français et en anglais par des spécialistes français et américains.

Les produits exposés

Pour résumer, on peut regrouper la plupart des produits exposés en quelques groupes. Il y a d'abord les langages: on a dénombré dix-huit implémentations de langages orientés-objet, dont neuf de Prolog, qui semble le plus populaire (on est dans son pays d'invention), trois de Lisp et six de différents langages. Un autre groupe comprenait quatre produits qui sont des interfaces ou des programmes visant à apporter de l'intelligence artifiecielle à des applications traditionnelles (chiffriers et SGBD). Un troisième groupe est constitué de coquilles ou de "boîtes à outils" voulant faciliter le développement de systèmes-experts; dix-neuf produits se trouvaient dans cette catégorie.

Dernière catégorie: les systèmes-experts dédiés. Il s'agit de la catégorie la plus importante, avec près de cinquante produits spécialisés; là encore, une liste partielle des sujets d'application permet d'en illustrer la variété: production et stockage de pièces, sécurité, diagnostic dans différents domaines (systèmes électromécaniques, pannes dans le métro de Paris, etc), construction et entretien de routes, permis de construction, entretien d'équipement de chemin de fer, pathologie végétale, traitement thermique de l'acier, combat des feux de forêt, chimie, affaires militaires, production de papier, de bouteilles de plastique, conseils en investissement, en prêt hypothécaire, et enfin le domaine classique de la médecine, avec par exemple un expert en diagnostic psychiatrique, en voie d'installation a l'hôpital Ste-Anne, à Paris.

En conclusion, on peut dire des Journées d'Avignon sur les systèmes experts qu'il s'agit d'un événement d'envergure mondiale. La variété et la qualité des sujet traités permettent de faire le point sur l'état des connaissances dans le domaine, alors que l'exposition renseigne sur les réalisations existantes. Quant à l'organisation, il faut dire qu'elle était très bonne, quant aux horaires, au transport, aux locaux, aux repas du midi, inclus dans l'inscription, qui favorisaient l'interaction sociale. Et enfin, ce qui n'est pas la moindre des choses, chaque participant recevait, à son arrivée, un porte-documents d'allure "design" contenant entre autres les textes des conférences, reliés en deux volumes totalisant 1670 pages avec (heureusement!) index, ainsi qu'un catalogue de l'exposition et quelques autres documents. Quel plaisir, d'obtenir une documentation complète bien faite et ainsi présentée, plutôt que d'avoir à déambuler avec une masse de documents sous le bras ou dans sa sacoche dont les coutures craquent!

Quant au câdre du congrès, disons simplement qu'il serait bien difficile de trouver mieux: Avignon est une ville animée et magnifique. □

Project report

Progress in Intelligent Robotics at the National Research Council

N. Burtnyk
Head, Computing Technology
Laboratory for Intelligent Systems
National Research Council
Ottawa, Ontario K1A 0R8

The Computing Technology Section of the NRC Laboratory for Intelligent Systems is continuing to develop two major tools for use in intelligent robotics. Harmony* has been developed as a realtime multiprocessing, multitasking operating system that is ideally suited for multisensor robot control. The 3-D laser rangefinder technology developed by a companion group of the same laboratory (Photonics and Sensors Section) has been adapted to produce a compact 3-D profile scanner that mounts on the wrist of a robot. This scanner provides a single profile of range data from the perspective of the robot wrist twenty-six times per second. It weighs only 600 grams and has been used with Harmony for experiments in automated parts acquisition and tracking of moving objects. A dual-head version of this device has also been constructed which provides profiles along two orthogonal directions in the form of a cross.

A robot controller for a Puma 560 robot is being developed to run on a Harmony multiprocessor. This will allow the robot applications programmer to integrate realtime sensory data and robot control within a common multiprocessing environment.

More details of this and related research can be found in the following papers:

1. Gentleman, W.M., "Using the Harmony Operating System", December 1983, 3rd revision March 1987. NRC/ERB-966. NRC 27469.
2. Rioux, M., "Laser range finder based on synchronized scanners", *Appl. Opt.*, **23**(21), 3837, 1 Nov 1984.
3. Archibald, C., Rioux, M., "Witness: A systems for object recognition using range images", NRC/ERB-986, January 1986.
4. Roth, G., "Determining grasp position for a parallel type

*Mark reserved for the exclusive use of Her Majesty the Queen in Right of Canada by Canadian Patents and Development Ltd / Société canadienne des brevets et d'exploitation ltée.

robot gripper'', NRC/ERB-984, January 1986.
5. Dhome, M., Kasvand, T., ''Polyhedra recognition by hypothesis accumulation from range data'', NRC Report ERB-985, May 1986.
6. Blais, F., Rioux, M., ''Biris: A simple 3D sensor'', *SPIE Proc*, **728**, 235-242, 20-21 Oct 1986.
7. Rioux, M., Boulanger, P., Kasvand, T., ''Segmentation of range images using sine wave coding and Fourier transformation'', *Appl. Opt*, **26**(2), 287, 15 Jan 1987.
8. Roth, G., O'Hara, D.H., ''A holdsite method for parts acquisition using a laser rangefinder mounted on a robot wrist', IEEE International Conference on Robotics and Automation, Raleigh, NC, March 1987.
9. Domey, J., Burtnyk, N., ''3D vision for robotics and automation'', Canadian Engineering Centennial Convention, Montreal, May 18-22, 1987.

Project report

ARIES: Intelligent Educational Systems Research in Saskatchewan

Jim Greer
University of Saskatchewan

ARIES is the newly formed laboratory for Advanced Research in Intelligent Educational Systems that has been established to further research efforts in artificial intelligence and education at the University of Saskatchewan.

Dr Gordon McCalla is the laboratory director. He has been instrumental in the development of the SCENT intelligent tutoring system, and numerous other AI and education efforts at the University, including dynamic planning of courses, discovery environments for the social sciences, and knowledge representation for intelligent tutoring systems.

He is joined by Dr Marlene Jones, formerly of the University of Waterloo, and now at the Alberta Research Council and an Adjunct Professor at the University of Saskatchewan. Dr Jones's research interests have spanned a wide variety of AI and education topics, including AI-based educational diagnosis, student modelling, and AI approaches to computer assisted learning.

Dr Jim Greer, a recent graduate from the University of Texas at Austin and now a Postdoctoral Fellow at the University of Saskatchewan, is also one of the founding members of the laboratory. His research has been in the areas of computer science education, student modelling, machine learning, and expert systems. Dr Rick Bunt, Gord McCalla's collaborator on the SCENT project, is also a member of the laboratory.

The laboratory will also be used by graduate students with interests in AI research in education and cognition. The present complement of graduate students working in these areas includes two doctoral students and four masters students.

The laboratory is currently equipped with two Symbolics 3640 Lisp machines with a Chaosnet and laser printer. This hardware was made available through the support of NSERC and International Artificial Intelligence Inc.

The ARIES laboratory will be establishing a technical report series and hopes to sponsor invited talks in order to foster communication with other researchers in Canada and abroad.

For further information please contact:
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UUCP: ...!sask!kimnovax!skorpio!aries

Abstracts

Recent AI Technical Reports

Editor's Note: Recent Canadian AI technical reports are listed in this department. Abstracts will be included as space permits, with preference being given to theses.

□ □ □ □ □

University of Toronto

The following reports are available upon request from:
The AI Group Secretary
Department of Computer Science
University of Toronto
Toronto, Ontario, CANADA M5S 1A4

The Use of Color in Computational Vision

Ron Gershon

Ph.D. Thesis, TR RBCV-TR-87-15
June 1987, $10.00

Colour has always been part of the visual percept, yet research in computer vision seemed to focus on other properties, mainly because they did not require the additional information colour provides. In this thesis, various aspects of

colour perception and computation are discussed.

We start by examining and analyzing biologically motivated models of early chromatic visual processing. Two non-linear models of colour measurement are investigated, and tested with different stimuli designed to reveal some of their spatio-chromatic properties. This analysis leads to several speculations about the use and functionality of the models and the operators they employ.

One application of the above models is to the problem of distinguishing shadow boundaries from material changes. We examine and formulate the behavior of shadows under different illumination conditions through the use of a model of reflection. Based on this analysis, we suggest a technique which makes use of a subset of the operators mentioned above which determines which discontinuities in images are material changes and not shadow boundaries. This technique is shown to be more accurate and robust than previous methods reported.

Another problem addressed is that of colour constancy, which is the perceptual ability of the human visual system to assign the same colours to objects under different lighting conditions. We use a method, based on finite-dimensional linear models of reflectance and illumination, which allows the transformation of [R,G,B] images into colour constant images. In contrast to previous work, we show that good results can be obtained using a 3-receptor system and statistical measurements of natural materials and illuminants.

Finally, we address the problem of identifying highlights in images through the use of chromatic information. We show that understanding reflection, through the use of existing models, allows us to make predictions about the behavior of highlights. In particular, some observations can be made regarding the shift in colour from diffuse to specular reflection. Based on these observations, we developed an algorithm which segments images into regions and looks for shifts in colour between adjacent regions, and labels the ones which fit the expected relation between diffuse and specular reflection.

Techniques for Disparity Measurement

Michael R. M. Jenkin, Allan D. Jepson, and John K. Tsotsos

RBCV-TR-87-16, July 1987

Many different approaches have been suggested for the measurement of structure in space from spatially separated cameras. In this report we will critically examine some of these techniques. Through a series of well-chosen examples we will show that none of the current mechanisms of disparity measurement are particularly robust. By considering some of the implications of disparity in the frequency domain, we present a new definition of disparity that is tied to the inter-ocular phase difference in band-pass versions of the monocular images. Finally, we will present a new technique for measuring disparity as the local phase difference between band-pass versions of the two images, and we will show how this technique surmounts some of the difficulties encountered by current disparity detection mechanisms.

Symposium on Noise and Disorder in Vision

Report RBCV-TR-87-17, June 1987

A collection of abstracts of papers presented at the Symposium on Noise and Disorder in Vision held in May at the University of Toronto.

The Logic of Depiction

Raymond Reiter and Alan K. Mackworth

RBCV-TR-87-18, June 1987

We propose a theory of depiction and interpretation that formalizes image domain knowledge, scene domain knowledge and the depiction mapping between the image and scene domains. This theory is illustrated by specifying some general knowledge about maps, geographic objects and their depiction relationships in first order logic with equality.

An interpretation of an image is defined to be a logical model of the general knowledge and a description of that image. For the simple map world we show how the task level specification may be refined to a provably correct implementation by invoking model preserving transformations on the logical representation. In addition, we sketch logical treatments for querying an image, incorporating contingent scene knowledge into the interpretation process, occlusion, ambiguous image descriptions, and composition.

This approach provides a formal framework for analyzing existing systems such as Mapsee, and for understanding the use of constraint satisfaction techniques. It can also be used to design and implement vision and graphics systems that are correct with respect to the task and algorithm levels.

Principles of Inference Processes

Russell Greiner

CSRI-193, December 1986

This report presents several important principles of logic-based inference processes. The first part demonstrates that this class includes systems capable of deduction, simulation, synthesis, induction and diagnosis. It also partitions this space into three distinct categories, and describes many of the problems associated with each division. The next part presents an answer to many of these difficulties, all based on exploiting "inferential support information", i.e., the justifications and assumptions associated with each assertion. In total, this research demonstrates that essentially every type of reasoning process can exploit this type of information.

Incorporating Agents' Beliefs in a Model of Presupposition

Diane Lynn Horton

MSc thesis, CSRI-201, August 1987

The full communicative content of an utterance consists of its direct meaning, as well as a variety of indirect information that can be inferred from the utterance. Presupposition is one category of such information.

Many theories of presupposition have been postulated. Most implicitly assume that presuppositions are facts, and that all agents involved in a discourse share knowledge of the presuppositions that it generates. We argue that these assumptions are unrealistic and propose a new view which eliminates them by considering presuppositions to be beliefs associated with particular agents. We then develop a definition of presupposition which embodies this view. We conclude that a model of presupposition which incorporates agents' beliefs, in addition to being more correct, is able to account for presuppositional phenomena which could not be accounted for otherwise.

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Simon Fraser University

The table below lists recent AI technical reports from the Laboratory for Computer and Communication Research. They may be requested from:

Administrative Assistant
Laboratory for Computer and Communication Research
Simon Fraser University
Burnaby, BC, CANADA V5A 1S6

Recent AI Technical Reports from Simon Fraser University

Authors	Title	Number
Charles Brown	Towards a theory of NL generation: The connection between syntax, context, and semantics	LCCR-87-8
Charles Brown, T. Pattabhiraman, Michel Boyer, Diane Massam, and Veronica Dahl	Tailoring Conceptual Graphs for use in NL Translation	LCCR-86-14
Charles Brown, Veronica Dahl, Sharon Hamilton, Diane Massam, Pierre Massicotte, and T. Pattabhiraman	Tailoring Government and Binding Theory for Automatic Natural Language Generation	LCCR-86-4
Veronica Dahl, Charles Brown, Michel Boyer, T. Pattabhiraman, and Diane Massam	Mechanizing Expertise in GB Theory	LCCR-86-10
Veronica Dahl, Charles Brown, and Sharon Hamilton	Constrained Discontinuous Grammars and Logic Programming	LCCR-86-17
Veronica Dahl, and Patrick Saint-Dizier	Constrained Discontinuous Grammars — A Linguistically Motivated Tool for Processing Language	LCCR-86-8
James Delgrande	A First-Order Conditional Logic for Prototypical Properties — Extended Report	LCCR-86-15
Robert Hadley	Two solutions to logical omniscience: a critique with an alternative	LCCR-86-3
Robert Hadley	Logical Omniscience, AI Semantics, and Models of Belief	LCCR-86-9
Robert Hadley	Model-Theoretic vs. Procedural Semantics	LCCR-87-10
Gary Hall, WoShun Luk, and Nick Cercone	Disambiguating Queries Using Dependency Graph	LCCR-87-7
Homenaje A. Hurtado, Charles Brown, and Juan Antonio Sempere	Los cliticos del espanol vistos como inflexiones	LCCR-86-16
Mimi Kao, Nick Cercone, and WoShun Luk	What do you mean Null?: Turning Null Responses into Quality Responses	LCCR-86-5
Patrick Saint-Dizier	DISLOG: Programming in Logic with Discontinuities	LCCR-87-13

Forthcoming Conferences, and Calls for Papers

Conferences in Canada

Artificial Intelligence '88
Vision Interface '88
Graphics Interface '88

6–10 June 1988

Edmonton, Alberta

See announcements on pages 31–35 for details.

International Conference on Intelligent Tutoring Systems

1–3 June 1988

Montreal, Quebec

See announcement on page 22 for details.

U.S. Conferences

AAAI-88: National Conference on Artificial Intelligence

22–26 August 1988

St. Paul, Minnesota

The major U.S. AI conference, sponsored by the American Association for Artificial Intelligence. Topics of interest include:

AI and education
Automated reasoning
Cognitive modeling
Commonsense reasoning
Expert systems
Impacts of AI technology
Knowledge acquisition
Knowledge representation
Machine architecture and computer languages for AI
Machine learning
Natural language
Perception and signal understanding
Philosophical foundations
Robotics
User interfaces

Authors should submit six complete copies of their papers to:
AAAI-88
American Association for Artificial Intelligence
445 Burgess Drive
Menlo Park, CA 94025-3496, U.S.A.

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AAAI Spring Symposium Series

22–24 March 1988

Stanford University
Stanford, California

AAAI (in cooperation with the Stanford University Department of Computer Science) offers five mini-symposia on various topics in AI. The format of each symposium will be a series of panel discussions in which position papers are presented and debated among the panelists and audience.

Symposium titles are:
Computer Games
How Can Slow Components Think So Fast?
Explanation-based Learning
Artificial Intelligence in Medicine
Physical and Biological Approaches to Computational Vision

For more information:
1988 Symposium Series
AAAI
445 Burgess Drive
Menlo Park, CA 94025-3496, U.S.A

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The Fourth IEEE Conference on Artificial Intelligence Applications

14–18 March 1988

San Diego, California

This conference is devoted to the application of AI techniques to real-world problems. For more information:
CAIA-88
The Computer Society of the IEEE
1730 Massachusetts Avenue, NW
Washington, DC 20036-1903, U.S.A.
Phone: 202-371-0101

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Second Conference on Applied Natural Language Processing

9–12 February 1988

Austin, Texas, USA

This meeting, organized by the Association for Computational Linguistics, will focus on the application of natural language processing techniques to real-world problems. It will include invited and contributed papers, panel discussions, tutorials, exhibits, and demonstrations. Topics include human-machine interfaces (including databases, expert systems, report writers, etc), speech input and output, information retrieval, text generation, machine translation, office automation, writing aids, computer-aided instruction, tools for natural-language processing, and applications to medical, legal, or other professional areas.

For futher information:
Bruce Ballard
AT&T Bell Laboratories, 3C-440A
Murray Hill, NJ 07974
Phone: 201-582-5440
NET: allegra!bwb@ucbvax.berkeley.edu

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The Second Conference on Theoretical Aspects of Reasoning about Knowledge

6–9 March 1988

Monterey, California

While traditionally research in this area was mainly done by philosophers and linguists, reasoning about knowledge has been shown recently to be of great relevance to computer science and economics. The aim of the conference is to bring together researchers from these various disciplines with the intent of furthering our theoretical understanding of reasoning about knowledge.

Topics include:
Semantic models for knowledge and belief
Resource-bounded reasoning
Minimal knowledge proof systems
Analyzing distributed systems via knowledge
Knowledge acquisition and learning
Knowledge and commonsense reasoning
Knowledge, planning, and action
Knowledge in economic models

For more information:
Moshe Y. Vardi
IBM Research
Almaden Research Center K53-802
650 Harry Rd.
San Jose, CA 95120-6099, USA
Phone: 408-927-1784
NET: vardi@ibm.com, vardi@almvma.bitnet

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IEEE Computer Society Workshop on Computer Vision

30 November–2 December 1987

Miami Beach, Florida

This workshop will focus on topics related to: Image structure (edges, regions, texture); Vision-guided manipulation and navigation; High-level vision; Segmentation and 2-D description; 3-D from 2-D (motion, stereo, texture); Industrial vision; Vision systems; Shape and 3-D description; Human visual perception; Range imaging; Model-based vision.

For further information:
Narendra Ahuja
Coordinated Science Laboratory
University of Illinois
1101 W. Springfield Avenue
Urbana, Illinois 61801, U.S.A.

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Conference on Office Information Systems

23–25 March 1988

Palo Alto, California

COIS is concerned with intelligent processing of information in organizations. AI-related topics of interest include: Object-oriented and intelligent databases, planning systems, distributed artificial intelligence, and user models. For more information:
Conference on Office Information Systems
Dr. Robert B. Allen, 2A-367
Bell Communications Research
Morristown, NJ 07960, U.S.A

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AAAI Workshop on Architectures for Intelligent Interfaces: Elements and Prototypes

29 March–1 April 1988

Monterey, California

The goal of the workshop is to explore ways in which AI techniques can be used to provide the adaptability and reasoning capabilities equired for a more intelligent human-machine interaction. Topics include models (user, system, task), channels of communication, planning, interface-building tools. Limited attendance. For further information contact:
Joseph W. Sullivan
Lockheed AI Center
2710 Sand Hill Rd.
Menlo Park, CA 94025, U.S.A.
NET: wiley!joe@lll-lcc.arpa
Phone: 415-354-5200

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Expert Systems Technology in the ADP Environment

2–3 November 1987

Washington D.C.

The Naval Regional Data Automation Center in Washington, D.C., the Oak Ridge National Laboratory, and the Data Systems Research and Development Program, Martin Marietta Energy Systems are hosting the conference; its primary focus is on the use of AI in traditional computing domains and its potential for further exploitation. The conference covers the following areas:
ADP project and systems management
Knowledge-based simulation and modelling
Intelligent human-machine interfaces
Intelligent databases
AI in software engineering
AI as a tool for decision-making
Innovative applications in MIS or scientific computing.

For more information:
Lloyd F. Arrowood
Program Chairman
Oak Ridge National Laboratory
Building 4500-North, Mail Stop 207
Oak Ridge, TN 37831, U.S.A.
NET: lfa@ornlstc.bitnet

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Ninth International Conference on Automated Deduction

23–26 May 1988

Argonne National Laboratory
Argonne (near Chicago)

Papers are invited in the following or related fields: Theorem-proving; Logic programming; Unification; Deductive databases; Term rewriting; Automatic theorem-proving for non-standard logics; Program verification; Inference systems.

Papers should be sent to arrive before 23 November 1987 to:

Ewing Lusk and Ross Overbeek, chairmen
CADE-9
Mathematics and Computer Science Division
Argonne National Laboratory
Argonne, IL 60439, U.S.A.

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International Neural Network Society Annual Meeting

6–10 September 1988

Boston, Massachusetts

The International Neural Network Society (INNS) is an association of scientists, engineers, students, and others seeking to learn about and advance our understanding of the modelling of behavioural and brain processes, and the application of neural modelling concepts to technological problems. Abstracts must be typed on the INNS abstract form in camera-ready format and postmarked no later than 31 March 1988. For information:

Neural Networks
AT&T Bell Labs, Room 4G-323
Holmdel, NJ 07733, U.S.A.

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Second International Conference on Expert Database Systems

25–27 April 1988

Tysons Corner, Virginia

The conference will explore theoretical and practical issues in making database systems more intelligent and supportive of AI applications. The Program Committee invites original theoretical and application papers (of approximately 5000 words) addressing (but not limited to) the following areas:

Theory of knowledge bases
Object-oriented systems
Reasoning on knowledge- and databases
Knowledge management
Distributed knowledge- and databases
Intelligent database interfaces
Natural language interaction

Authors should submit five copies of papers by 14 October 1987 to:

Prof Larry Kerschberg
Dept. of Information Systems and Systems Eng.
George Mason University
4400 University Drive
Fairfax, VA 22030, U.S.A.

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26th Annual Meeting of the Association for Computational Linguistics

7–10 June 1988

State University of New York at Buffalo
Buffalo, New York

Papers are invited on all aspects of computational linguistics, including pragmatics, discourse, semantics, syntax, and the lexicon; phonetics, phonology, and morphology; interpreting and generating spoken and written language; linguistic, mathematical, and psychological models of language; machine translation and translation aids; natural language interfaces; message understanding systems.

Authors should submit 12 copies of an extended abstract not to exceed 8 double-spaced pages (exclusive of references) in a font no smaller than 10 point (elite). The title page should include the title, the name(s) of the author(s), complete addresses, a short (5 line) summary, and a specification of the topic area. Submissions that do not conform to this format will not be reviewed. Papers are due by 4 January 1988. Send to:

Jerry R. Hobbs
ACL88 Program Chair
Artificial Intelligence Center
SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025, USA
Phone: 415-859-2229
NET: hobbs@warbucks.ai.sri.com

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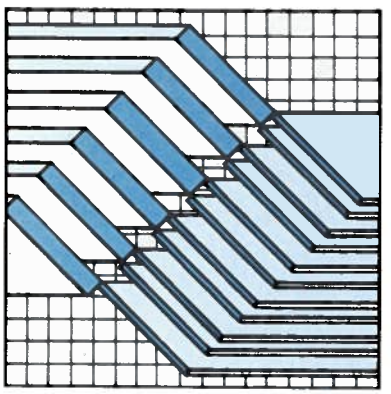
Fifth International Conference on Machine Learning

12–15 June 1988

University of Michigan
Ann Arbor, Michigan

The goal of the conference is to bring together researchers from all areas of machine learning. The deadline for submissions is 15 January 1988. Authors should send four copies of their papers (in the required format) to:

Machine Learning Conference
Cognitive Science and Machine Intelligence Laboratory
The University of Michigan
904 Monroe Street
Ann Arbor, MI 48109-1234, U.S.A.
NET: ml88@csmil.umich.edu



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