



# Canadian Artificial Intelligence

Intelligence Artificielle  
au Canada

July/juillet

1987

No. 12

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

## **PRECARN: Canada's First AI Research Consortium**

**Artificial Intelligence Research  
at University of Toronto**

**Full Report of  
Fifth Generation Society's Ottawa Meeting**

### **Book Reviews**

Robotics Research: The Third International Symposium  
New Horizons in Educational Computing  
The Mathematics of Inheritance Systems

**PRECARN: le premier consortium canadien  
de recherche en IA**

**Recherche en intelligence artificielle  
à l'Université de Toronto**

**Rapport complet sur la rencontre d'Ottawa de  
la Société cinquième génération**

### **Critiques de livres**

Recherche en robotique: le troisième symposium international  
Nouveaux horizons en informatique éducationnelle  
Les mathématiques des systèmes d'héritage



The Symbolics 3600—a new computing paradigm

*Processing with symbols vs. computing with numbers.* The first computers crunched numbers. And regardless

of how powerful they've become, traditional systems still force you to deal with the world in quantitative terms.

Face sophisticated applications, and the limitations can become all too obvious.

An increasing number of computer scientists, researchers and program developers are discovering ways to break through this complexity barrier. Their vehicle—the Symbolics™ 3600.

The 3600 allows talented programmers and engineers to represent objects and knowledge far more flexibly than numeric formats allow.

Through the dynamic manipulation of arbitrary data structures consisting of symbols and their associated properties, a user can resolve problems previously considered impossible or infeasible.

*A few typical applications.* Custom VLSI engineering. The 3600 has a unique ability to deal with large, complex modeling structures. Semiconductor companies use it to assist in the development of the next generation of chips.

A development environment for complex software. Rapid prototyping and an incremental edit/compile/dynamic link/debug loop help

make the 3600 one of the most effective programming environments ever developed.

Expert systems development. Using the 3600's powerful inferencing throughput and ability to handle very large knowledge bases, government agencies and Fortune 1000 companies are developing expert systems in such fields as process control, financial advisory services and image understanding.

*Symbolics—the first name in symbolic processing.* Symbolics was founded in 1980 to commercialize this new technology. Among the founders were the developers, at MIT, of the first hardware architecture designed specifically for symbolic processing.

Today, the 3600 represents the highest expression of symbolic processing technology. Its custom processor design incorporates a tagged memory architecture that manipulates symbols as efficiently as

a traditional computer manipulates numbers.

Using Symbolics-enhanced Lisp, the 3600 provides a powerful integrated software environment which features object-oriented window system, incremental Lisp/Fortran-77/Pascal compilers and exceptional networking and graphics capabilities—for a new dimension in man-machine interaction.

To learn more about symbolic processing, write us at the address below.

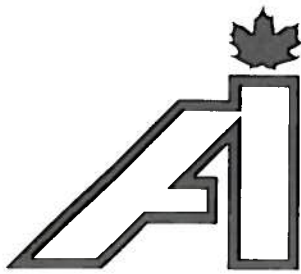
**SYMBOLIC PROCESSING  
WAS DEVELOPED  
TO SOLVE TWO KINDS  
OF PROBLEMS:**

**THE COMPLEX.  
AND THE IMPOSSIBLE.**



**symbolics** (Canada) inc.  
A Member of the NEXA Group

5915 Airport Road, Suite 200,  
Mississauga, Ontario L4V 1T1  
(416) 671-0510



ISSN 0823-9339

**Senior Editor / Rédacteur:**

Graeme Hirst, PhD  
Department of Computer Science  
University of Toronto  
Toronto, CANADA M5S 1A4  
Phone: 416-978-8747  
CSNET, CDNNET: cscsi@ai.toronto  
UUCP: ... !utesri! cscsi

**Assistance / Aide:**

Marina Haloulos, Jim des Rivières

**Traduction / Translation:**

Jean-Pierre Corriveau, Yves Lespérance

**Cover design, production assistance /  
Conception de la couverture, aide pour la  
production:**

Cathy Ledden, University of Toronto Press  
Please send subscriptions, memberships, and  
changes of address to / Prière d'envoyer tout  
abonnement, cotisation, et changement  
d'adresse à:

CSCSI/SCEIO, c/o CIPS  
243 College Street, 5th floor  
Toronto, CANADA M5T 2Y1

Second Class Mail Registration No. 7373

Copyright © 1987, Canadian Society for Computational Studies of Intelligence. All rights reserved; *Canadian Artificial Intelligence* may not be reproduced in any form without the written permission of the editor. Printed in Canada by the University of Toronto Press. The opinions expressed herein are those of their respective authors, and are not necessarily those of their employers, CSCSI, *Canadian Artificial Intelligence*, the editor, CIPS, or the University of Toronto.

Copyright © 1987, Société canadienne pour l'étude de l'intelligence par ordinateur. Tout droit réservé; *Intelligence artificielle au Canada* ne doit être reproduite par quelque moyen que ce soit sans le consentement écrit de l'éditeur. Imprimée au Canada par la University of Toronto Press. Les opinions exprimées dans ce magazine sont celles de leurs auteurs respectifs et non pas nécessairement celles de leurs employeurs, de la SCEIO, de *Intelligence artificielle au Canada*, de l'éditeur, de l'Association canadienne informatique, ou de l'Université de Toronto.

**Résumé en français, 8**

**Contents**

- Canadian company takes over U.S. Lisp machine maker, 5
- Best paper award to Delgrande, 5
- Government initiatives on R&D: Positive action or PR?, 5
- 1988 AI conference will be triple event. 6
- AI in Third World countries. 6
- PRECARN: Canada's first AI research consortium (*Grant Buckler*), 10
- Report on the national meeting of the Fifth Generation Society (*Nick Cercone*), 12
- Notes from members. 14
- Obituary: Ruth H. Macdonald (*Peter Munsche*), 14
- Calls for participation: Artificial Intelligence '88, Vision Interface '88, and Graphics Interface '88, 15
- Research on knowledge-based systems at the University of Toronto (*Evangelos Milios*), 22
- Book reviews, 25
- Books received, 27
- New AI journals, 28
- Abstracts from *Computational Intelligence*, 29
- All-purpose form, 30
- Recent technical reports, 31
- Cartoon (*P. S. Mueller*), 32
- A discussion on user interfaces for knowledge-based systems (*Sue Becker and Armin Haken*), 33
- Forthcoming conferences, and calls for papers, 36

**Advertisers**

- |                       |   |
|-----------------------|---|
| Symbolics, 2          | Lisp Canada, 33                               |
| Applied AI Systems, 7 | Canadian Artificial Intelligence Products, 43 |
| Xerox Canada, 20      | Applied AI Systems, 44                        |
| AI East '87, 24       |   |
| Heurix, 32            |   |

## 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.

**President / Président:** Dick Peacocke, Bell-Northern Research, Box 3511, Station C, Ottawa, Ont K1Y 4H7. Phone: 613-727-2629. UUCP: . . . ! bnr-di! dick

**Vice-President / Vice-Président:** Renato De Mori, School of Computer Science, McGill University, Montréal, Qué H3A 2K6. Phone: 514-392-8274. UUCP: . . . ! musocs! renato

**Secretary / Secrétaire:** Bill Havens, Department of Computer Science, University of British Columbia, Vancouver, B.C. V6T 1W5. Phone: 604-228-6450. CSNET, CDNNET: havens@ubc

**Treasurer / Trésorier:** Randy Goebel, Department of Computing Science, University of Alberta, Edmonton, Alta T6G 2H1. Phone: 403-432-5198. CSNET, CDNNET: goebel%alberta@math.waterloo.edu.

## Canadian Artificial Intelligence

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 be 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.

## Intelligence Artificielle au Canada

*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 apparaît 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* apparaît 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.



---

## AI News

### Canadian Company Takes Over U. S. Lisp Machine Maker

Montreal-based Gigamos Holdings Inc has acquired Lisp Machines Inc (LMI), an American manufacturer of Lisp machines.

It will take over operations of the company and resume sales and development as soon as the sale is finalized. (The necessary waiting time had not expired as this issue of *Canadian A.I.* went to press.)

Gigamos already owns Lisp Canada Inc, which represented LMI in Canada, as well as Silicart Inc, Logo Computer Systems, and other companies. It is not yet known whether or how LMI and Lisp Canada will be integrated.

LMI is one of two companies formed in the late 1970s to manufacture the MIT-designed Lisp machines (the other was Symbolics Inc). It recently sought 'Chapter 11' bankruptcy protection. In bidding for the company, Gigamos beat Data General, Texas Instruments, and Symbolics.

Gigamos have also recently acquired a large office complex in Vaudreuil, Québec, to which it will begin moving its Canadian operations in July. □

### Best paper award to Delgrande

A Canadian, Professor James Delgrande of Simon Fraser University, is the winner of a Best Paper Award at this year's AAAI conference. His paper, in the category of Commonsense Reasoning, is entitled "An approach to default reasoning based on a first-order conditional logic".

The paper will be presented in a special session on 15 July at the Seattle conference.

Canadians have been represented disproportionately often in Best Paper Awards at the U.S. AI conference in recent years. □

### Government Initiatives on R&D: Positive Action or PR?

*Excerpted from CAUT Bulletin*

In recent months, the Conservative government has announced a spate of initiatives in science policy. These moves were heralded by various references to universities and to research in the Speech from the Throne in November where the government promised a

national forum on postsecondary education and a renewed focus on research.

On 4 March, the Prime Minister spoke at the University of Waterloo. He noted that Canada had "relegated research and development to a peripheral role in our national life when in fact it is the cornerstone of great and sustained future endeavour." It was, he said, essential to reverse this trend. He laid great emphasis on the transfer of scientific ideas and technology to industry. He claimed that the new patent policy of the government in the area of drugs would generate \$1.4 billion of new investment. He stated: "We want to be known not only as a resource-rich nation, not only as a trading nation, but as a nation known for our brain power, our ideas, and our intellectual and educational achievements." There were, however, no announcements concerning university research policy and no new federal funds provided despite the fact that it was rumoured in Ottawa that the Prime Minister would announce some \$300 million in new initiatives.

On 12 March, the Minister of State for Science and Technology, Frank Oberle, completed negotiations with his provincial counterparts for the creation of a national science policy. The ministers agreed to six general principles in relation to science policy including a commitment to encourage both basic and applied research and to ensure the availability of highly qualified persons. The federal background paper recognized the vital role of the universities in these areas. The ministers also agreed to create a Council of Science and Technology Ministers to monitor the implementation of policy. Seven working parties were set up under various ministers. It was clearly an achievement on the part of the Tories to have persuaded all ten provincial governments to sign, but no funds were forthcoming for research from either level of government as a consequence of this accord.

The Prime Minister announced the creation of a new National Advisory Board on Science and Technology. This had been promised in the Speech from the Throne. The Prime Minister will chair this committee — a structure which has also been followed in Sweden and in Japan. The Board has had an initial meeting. It has created three sub-committees, including one on university research headed by Pierre Lortie. There was not much publicity because the government feared that those involved might think they were merely part of a public relations exercise. The Committee will meet again in June.

On 24 March, Mr Oberle spoke in Toronto and unveiled another part of his science policy, which he labelled "InnovAction". He noted five areas of federal government involvement: industry innovation and technology diffusion, strategic technologies, management of federal resources, human resources, and public education. He indicated that ministers would be announcing specific policies in the near future. "I think you will see before summer that the

leadership you expect from the government is being provided to take Canada in the direction we all want to go.”

The first such announcement, a month later, was the spending of \$90 million over the next four years on R&D in microelectronics. Of this, \$60 million will be issued by the Department of Regional and Industrial Expansion to match development funds from industry. This will be administered by the office of the Microelectronics and Systems Integration Program, to be operational by July. The remaining \$30 million will be in the form of contracts from the Department of National Defence.

The background paper issued with the InnovAction program recognized that universities faced a serious problem of obsolescence of equipment and that “lack of funds for university research equipment has been identified as a major barrier to technological innovation”. The Minister stated that a Federal-Provincial-Territorial Working Group had been established under the National Science and Technology Policy to examine this and other issues related to basic research in the universities.

Mr Oberle also announced that there would be a national conference on technology next January to review the work of the government to that date. □

*Copyright © 1987 Canadian Association of University Teachers. Used by permission.*

## 1988 AI Conference Will Be Triple Event

The 1988 Canadian artificial intelligence conference will be held in Edmonton simultaneously with the 1988 Canadian conferences on computer vision and graphics and human-machine interfaces.

The conferences will be at the Edmonton Convention Centre, 6–10 June 1988.

Wayne Davis of the University of Alberta will be the general chairman of all three conferences. Each has a separate program committee run by its sponsoring society.

CSCSI/SCEIO is the sponsor of Artificial Intelligence '88. It will be the Society's seventh biennial conference. The previous conference, in Montreal last year, attracted 375 registrants.

The program committee for Artificial Intelligence '88 will be jointly chaired by Nick Cercone of Simon Fraser University and Bob Woodham of the University of British Columbia. The full committee is not yet announced.

The other conferences are Vision Interface '88, run by the Canadian Image Processing and Pattern Recognition Society, and Graphics Interface '88, run by the Canadian Man-Computer Communications Society.

Calls for papers for all three conferences appear on pages 15–19 of this issue of *Canadian A.I.*. All have submission deadlines of 31 October. □

## AI in Third World Countries

*Jose A. Ambros-Ingerson*

We are interested in constructing a global picture of the impact AI is having in the Third World and of the implications this impact can have upon these countries in the future.

We would therefore like to assess the current state of AI in the Third World, especially:

- Current AI research in Third World Countries (3WC).
- Current AI research in the U.S. or Europe related to Third World problems or applications. Research outlines and papers would be most appreciated.
- Current Applied AI in 3WC. Which applications (expert systems, ICAI, planning, robotics, etc.) are being considered for what purpose? Are there any systems currently in use? Any AI companies targeting products at 3WCs?
- Social impacts of AI in 3WC. Reorganization of the work-place, unemployment, economic repercussions, cultural transformations, etc.

We'd also like to assess how the Third World sees the future of AI, and more specifically, whether there are any:

- Government programs for the support or funding of AI research and development similar to the Fifth Generation Project, MCC, Strategic Computing, Alvey or Espirit.
- AI graduate programmes and undergraduate courses in 3WC universities.

Please mail information to me:

Jose A. Ambros-Ingerson  
Dept. of Information and Computer Science  
University of California  
Irvine, CA 92717, U.S.A.  
CSNET: jose@bonnie.uci.edu

The information obtained will be collated and summarized and made available to researchers on request. If enough interest is manifest, a network forum for the interchange of ideas amongst researchers working in similar areas could be considered. □

---

Deadline for the  
October issue  
is 15 August.

---



# How does Q&A's artificial intelligence work?

- Simple: user manages data with normal English sentences: "Show me the houses that cost between \$100,000 and \$200,000, listed by price and bedrooms."
- Powerful: use English sentences to search, sort, calculate and present information, prepare and print reports, fill in or change data.
- Software that learns from you; the more you use it the smarter it gets.
- Entirely menu driven with on-screen prompts.
- pfs-like interface, which 1.5 million users already know how to use.
- Context-sensitive, Concurrent and Custom help.
- Automatically prepares regular reports.
- Not copy protected.
- Speed data entry with programmability, macros, lookup tables, mass updates, data validation, initial values, custom Help screens and calculated fields.
- Flexible searches with 115 indexed fields, multiple keywords and 21 search operators.
- 40 levels of sorting
- 16 million records per database file.
- As fast as dBASE III.
- What you see is what you get...immediately.
- Integrated spelling checker of 60,000 words, user expandable.
- Line drawings; great for organization charts.
- Documents up to 14" wide.
- Link documents for unlimited length.
- Automated mail merge, print envelopes.
- Laser and 40 other popular printers.

Type a request for information in regular English.

Q&A reads and understands the request, then retrieves the information and automatically displays a report!

Who are the sales people whose evaluation is above 6, with their position and the sum of salary and bonus, ranked by evaluation?			
Evaluation	Name	Position	1
7	Guy Mary	Regional Sales Manager	\$56,800.00
	Kelly Colin	Outside	\$33,600.00
	Wilson Ann	Regional Sales Manager	\$56,640.00
	Jacobson Will	Regional Sales Manager	\$61,600.00
8	Turledge Nina	Sales Manager	\$49,450.00
	Dean Sarah	Sales Administrator	\$25,300.00
9	Johnson Nick	National Sales Manager	\$78,800.00
	Sanquinetti Tony	Outside	\$82,600.00

EMPLOYEE.DTF  
 \*\*\*\*\* END OF REPORT \*\*\*\*\*  
 Esc-Cancel F2-Reprint ( + + | PgUp,PgDn )-Scroll ← Continue

Q&A makes data-base access in artificial intelligence more efficient than ever before.

Q&A is available from Applied AI Systems, Inc for \$495 + tax + S&H. For a list of other software handled by Applied AI Systems, Inc see advertisement inside magazine.

Q&A is a registered trademark of Symantec Corporation.



Applied AI Systems, Inc.  
 P.O. Box 13550  
 Kanata, Ontario  
 Canada K2K 1X6  
 Telephone: (613) 592-0084



## Résumé

### Machines Lisp canadiennes, 5

La firme Gigamos Holdings Inc de Montréal vient d'acheter Lisp Machines Inc (LMI), un fabricant américain de machines Lisp. Elle prendra contrôle des ventes et du développement dès que l'achat sera finalisé. Gigamos possède déjà Lisp Canada Inc qui représente LMI au Canada, ainsi que Silicart Inc, Logo Computer Systems et d'autres compagnies. L'on ne sait pas encore si LMI et Lisp Canada seront fusionnées.

### Prix du meilleur article à Delgrande, 5

Un canadien, le professeur James Delgrande de l'université Simon Fraser gagne le prix du meilleur article à la AAAI de cette année.

### Les initiatives gouvernementales en R&D: poudre aux yeux? (*Bulletin ACPU*), 5

Récemment, le gouvernement conservateur annonce l'adoption de nombreuses initiatives dans le cadre de sa politique en sciences.

Le 12 mars, le ministre d'état de la science et de la technologie, Frank Oberle, s'entendait avec ses homologues provinciaux au sujet d'une stratégie nationale en science comportant six principes généraux. Parmi ceux-ci, un engagement à encourager la recherche fondamentale et à assurer un personnel hautement qualifié.

Le premier ministre annonce également la création d'un comité consultatif national en science et technologie. Imitant la Suède et le Japon, le premier ministre fut nommé à la tête de ce comité.

Le 24 mars, M. Oberle, de passage à Toronto, dévoilait "InnovAction", une autre facette du programme, et annonce que d'autres ministres présenteraient bientôt d'autres programmes.

### IA au Tiers-Monde (*Jose A. Ambros-Ingerson*), 6

L'auteur discute de l'emploi, de la recherche, et de l'impact de l'IA au Tiers-Monde.

### PRECARN: Le premier consortium canadien de recherche en IA (*Grant Buckler*), 10

Ce nouveau consortium national cherchera à combler l'écart qui existe entre la recherche académique à long terme et les projets industriels à court terme en IA et en robotique au Canada.

Le consortium, PRECARN Associates Inc., est né de l'Institut canadien des recherches avancées qui subventionne des chercheurs universitaires grâce, en majorité, à

des contributions du secteur privé. Le consortium compte 22 membres et s'attend à ce que ses cinq premières années impliquent un programme de recherche de plus de 130 millions de dollars.

L'institut demanda à Gordon MacNabb, ancien président du conseil de recherche en sciences naturelles et en génie (CRNSG), de trouver des participants pour un tel consortium. Grâce à Macnabb l'idée devint réalité et il fut nommé président du consortium. Allan Crawford, président d'Anatek Electronics Ltd. de Vancouver en est le directeur.

### Compte rendu de l'assemblée nationale de la Société canadienne pour la recherche sur les systèmes de cinquième génération (*Nick Cercone*), 12

L'assemblée annuelle de la SCRSCG a eu lieu à Ottawa en avril. Il s'agissait d'un atelier suivi d'une réunion administrative.

L'atelier regroupait des gens de tous les milieux, venus évaluer les points forts de ce domaine au Canada, ainsi que faire connaître le travail et les besoins de chacun. Contrairement aux deux assemblées précédentes, les présentations portaient principalement sur les points de vue industriel et gouvernemental.

La réunion administrative discuta:

1. d'une certaine accélération dans la marche vers les buts de la société.
2. du rôle actuel de la société, comparativement à ce que déclare sa constitution, ainsi que son champ d'action par rapport à celui d'autres organisations, spécialement la CSCSI/SCEIO et l'ACI.
3. de l'élection de conseillers.
4. des modalités de subventions corporatives.

Il fut convenu que la société est la seule à pouvoir amasser et distribuer certains renseignements. En particulier, les participants ont jugé utile l'information fournie par la société en ce qui a trait à la recherche en cinquième génération au Canada.

Suivant les mises en candidature de l'an passé quatre personnes ont accepté le poste de conseiller:

Gordon MacNabb, Président, PRECARN

Arthur Bourne, World Bank et ICRA

Eric Manning, Doyen, Faculté de génie, Université de Victoria

Pat McGeer, université de Colombie-Britannique

### Billets des membres, 14

### Lettre à l'éditeur, 14

Nicholas Fabian: comment reconnaître une machine d'un



homme.

#### Nécrologie, 14

Ruth H. Macdonald.

#### Trois conférences majeures simultanées, 15

Intelligence Artificielle '88, Vision Interface '88, et Graphics Interface '88 auront lieu simultanément au centre des congrès d'Edmonton en Alberta, Canada, du 6 au 10 juin 1988.

On demande des articles pour chacune de ces conférences.

#### Recherche en systèmes à banque de connaissances à l'université de Toronto (*Evangelos Milios*), 22

Voici quelques-uns des projets en cours à l'université:

- Principes fondamentaux des systèmes de connaissances. Hector Levesque et Ray Reiter s'intéressent avant tout au problème du raisonnement avec une représentation formelle. Levesque étudie les principes sous-jacents des systèmes à banque de connaissances, c'est à dire des systèmes utilisant des représentations explicites qui correspondent à des 'faits' dans un domaine restreint. Le but consiste à découvrir les limites inhérentes à de tels systèmes et d'en comprendre les conséquences.

Ray Reiter emploie la logique formelle en tant qu'outil analytique tant pour étudier des modèles abstraits de raisonnement que le fonctionnement d'applications concrètes. Sa recherche touche au raisonnement non monotone, aux diagnostics, aux niveaux supérieurs de la vision et aux systèmes de maintien de la vérité.

- Systèmes à banque de connaissances en génie des logiciels et en systèmes d'information. John Mylopoulos s'intéresse à l'utilisation des systèmes à banque de connaissances pour les banques de données, le génie des logiciels, la bureautique et les systèmes d'information. Sa recherche se fonde sur la conviction que les langages servant à la conception de logiciels devraient être vus en tant qu'outils qui représentent des connaissances.

- Apprentissage. Russ Greiner étudie des logiciels d'apprentissage dont le comportement s'améliore avec le temps. Récemment il s'est tourné vers les systèmes qui 'apprennent par expérience', c'est à dire qui peuvent utiliser ce qu'ils savent d'anciennes déductions pour accélérer les déductions subséquentes.

Ce projet s'inscrit dans le cadre d'une vaste recherche ayant pour but de construire un environnement *efficace* et *efficient* pour la conception de systèmes experts.

- Systèmes de connaissances pour la compréhension d'images: Le groupe de vision cherche à construire un robot autonome guidé par un système visuel. Ce robot, équipé d'une caméra et circulant dans un milieu comprenant des objets mobiles, servirait à vérifier les théories du groupe.

- Acquisition de connaissances et mise au point des systèmes de connaissances: Armin Haken et Sue Becker travaillent à des outils dans ces domaines. Ils développent également, à partir de MRS (un langage de programmation logique), un environnement pour ceux qui implantent des systèmes experts: l'expert peut y ajouter ou y modifier interactivement les connaissances.

#### Critiques de livres, 25

- *Recherche en robotique: le troisième symposium international*, compte rendu par Ron Gershon.
- *Nouveaux horizons en informatique éducative* par

Masoud Yazdani, compte rendu par Marlene Jones.

- *Les mathématiques des systèmes d'héritage* par David Touretzky, compte rendu par Fahiem Bacchus.
- *Robotique et IA: Une introduction à l'intelligence informatisée*, par Andrew Staugaard, compte rendu par A.A. Goldenberg.
- Livres recus.
- Résumés d'*Intelligence informatique*, 3(2), mai 1987.

#### Résumés de rapports techniques récents, 31

Chacun dans la langue du rapport.

#### Bande dessinée (*P.S. Mueller*), 32

#### Au sujet des interfaces pour les systèmes de connaissances (*Sue Becker et Armin Haken*), 33

Dans le cadre de CHI+GI-87, la conférence portant sur tous les genres d'interfaces, on discuta des interfaces pour les systèmes à banque de connaissances. Il fut établi qu'il est important de permettre à l'utilisateur (*i*) de décrire les connaissances au système, et (*ii*) de suivre l'exécution de ce dernier.

#### Conférences à venir et demandes d'articles, 36

## Annonces

#### Symbolics, 2

La série des machines Lisp Symbolics 3600.

#### Applied AI Systems, 7

Q&A: Une base de données avec interface en anglais.

#### Xerox Canada, Inc., 20

La série Xerox 1100 d'appareils pour le travail en intelligence artificielle.

#### Tower Conference Management, 24

AI East, 28-30 octobre 1987, Atlantic City Convention Center, Atlantic City, New Jersey.

#### Heurix Computer Research Inc., 32

Consultants pour les applications de l'IA.

#### Lisp Canada, Inc., 34

Représentants canadiens pour la série LMI Lambda de machines Lisp.

#### Canadian Artificial Intelligence Products, 39

Touchant à toutes les facettes des systèmes experts.

#### Applied AI Systems, 40

Outils de construction rapide de prototypes pour l'IA: Le Lisp, Gold Common Lisp, Micro-Prolog et APES, l'ensemble de développement de systèmes à banque de connaissances Arity, et l'interface en langue naturelle Q&A de Symantec.

---

L'échéance pour le numéro d'octobre  
est le 15 août.

---

## Canada's First Artificial Intelligence Research Consortium

---

Grant Buckler

---

A new national research consortium in artificial intelligence and robotics will attempt to bridge the gap between long-term academic research and the specific, short-term projects conducted in Canadian industry.

The consortium, PRECARN Associates Inc, is an outgrowth of the Canadian Institute for Advanced Research, a national organization that supports university researchers using a large percentage of private-sector support. It has 22 charter members, including CIAR itself, government agencies and corporations representing many business and industrial sectors. In its first five years of operation, PRECARN expects to be involved with more than \$130 million worth of research activity.

"New challenges demand new solutions," says the consortium's business plan, released in early May. "If Canadian industry is to be competitive in an international marketplace being transformed by technological change, it must develop new, flexible, and collaborative approaches to research and development."

The Canadian Institute for Advanced Research pays the full salaries of faculty members at several Canadian universities, who are known as Fellows of the Institute. These fellows spend 10 per cent of their time or less on academic duties and the remainder on research, and the universities are expected to put the money saved on their salaries back into the departments where they work.

Peter Munsche, executive director of CIAR, says the Institute was looking for a way to do for industrial researchers what it does for those in universities. "PRECARN grew out of an attempt to have industrial fellows," he says. But suitable researchers in industry were "very thin on the ground," Munsche says, so the institute evolved the idea of a research consortium.

The Institute asked Gordon MacNabb, former president of the Natural Sciences and Engineering Research Council (NSERC), to try to find participants for such a consortium. MacNabb got the idea off the ground and has been named President and Chief Executive of PRECARN. Its chairman is Allan Crawford,

President of Anatek Electronics Ltd of Vancouver B.C.

PRECARN is an acronym for PreCompetitive Applied Research Network. The consortium hopes to back research projects which are more applied than much of what is done in universities today, but are precompetitive in that many different companies can use the results as the basis for further development.

MacNabb says the consortium is needed because "it's very difficult to sustain a long-term research effort based upon the vagaries of the corporate bottom line." By working together, he says, participants will be able to afford longer-term research work that most couldn't pay for on their own.

Stelco Inc, one of the participants, sees the consortium as a way of devoting a shared effort to common problems and avoiding duplication, says Les McLean, vice-president of technology at the Hamilton-based steel manufacturer. "If you have an organization of reasonable size, you can focus a pretty fair amount of technical horsepower on the question. It's kind of like hitching all the horses to one wagon."

PRECARN will not do the research itself. In fact, its business plan says the consortium's staff will consist of about nine people. It will co-ordinate and support research done in the facilities of member companies, universities, and possibly government laboratories. In the long term, though, PRECARN believes that this type of research should be done within industry wherever possible.

The consortium plans to develop and fund one long-term research project on its own in 1988, and a second in 1989. It will also be involved in jointly funded projects and submit funding proposals to granting agencies such as NSERC and provincial plans such as the Ontario government's Centres of Excellence program.

PRECARN is also intended to serve as a channel connecting the private sector with the university research supported by CIAR. Munsche speaks of a "receptor capacity" in PRECARN to see that valuable academic research is put to use. The organizations are still working out how to do this, he says, but "placement of knowledgeable people within those companies, who are able to understand long-term research," will be a key element.

The consortium has also set a target of \$40 million of contract research work by 1991, to be managed for a five percent fee which will help to support PRECARN. This work would be contracted out to member organizations or others, says Munsche. According to its business plan, the consortium hopes research management fees will cover its operating costs by 1989.

Plans for specific research have not yet been set. However, Munsche suggested two examples of the type of project suited to PRECARN. The U.S. Space Station project is likely to call for long-term robotics research, he says. Canada's participation in this project might involve contracting such research to PRECARN "The advantage to the country of doing it through PRECARN is that it will be done in such a way that there will be some long-term benefit to the country. There will be all these people looking in through the window."

"We could be a vehicle which would ensure that ground-based industry benefits from space-oriented research," says MacNabb.

Munsche stresses however that there are no commitments to such a project so far. "The corporation is barely out of the womb," he points out.

Another example of the type of research PRECARN has in mind is developing the principles of a high-speed, automated fault detection system. Somewhat like an expert system, this would identify faults in various types of systems — computers, electrical systems, and the like — and prescribe solutions. PRECARN pre-competitive research work could lead to several specific products, Munsche says.

McLean says the steel industry is interested in robotics for use in jobs that are unpleasant for people because of high temperatures or dust, and in artificial intelligence for controlling processes that operate too quickly for a human operator to keep track of all the pertinent data.

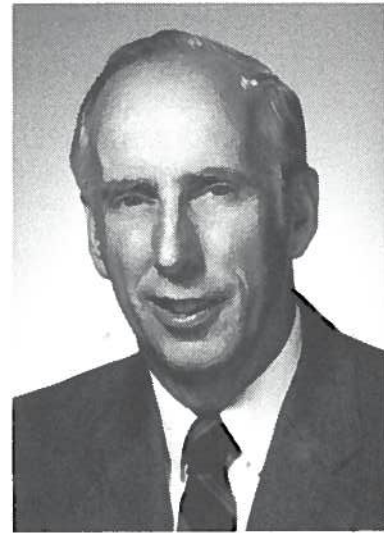
PRECARN has asked the federal government for \$10 million in startup funding. According to MacNabb, both Minister of State for Science and Technology Frank Oberle and Michel Coté, Minister of Regional Industrial Expansion, were approached. "The reception we got from Mr Oberle was very positive," he says, although no commitment has been made yet. PRECARN will proceed with or without government assistance, MacNabb adds.

However, PRECARN's business plan notes that "experience within the United States shows that, without the continuity and assurance provided by government funding, the industrial alliances tend to slip back to addressing shorter-term problems or fail totally."

William Hutchison, president of William G. Hutchison & Co Ltd, of Toronto, one of the partners in PRECARN says the consortium is similar in concept to co-operative efforts by U.S. companies, but is unique because of its association with CIAR. MacNabb

suggests it is even more similar to Britain's Alvey Program, a five-year joint venture between the British government, industry, and universities. The Alvey program deals with several areas of information technology, whereas PRECARN will focus on AI and robotics.

Hutchison says he hopes that his consulting and software development firm can play a role in putting the results of PRECARN research to work in Canadian business and industry. "We may be very helpful in assuring that good use is made of the technology," he says.



*Gordon MacNabb*

PRECARN's other partners are the Alberta Research Council, Alcan Aluminium Ltd, Anatek Electronics Ltd, Atomic Energy of Canada Ltd, Bristol Aerospace Ltd, Falconbridge Ltd, Hydro-Québec, Inco Ltd, International Artificial Intelligence, International Submarine Engineering, LAC Minerals Ltd, MacDonald Dettwiler & Associates Ltd, Manalta Coal Ltd, MPB Technologies Inc, Noranda Inc, the New Brunswick Power Commission, Ontario Hydro, Shell Canada, and Spar Aerospace Ltd.

Each partner is contributing \$25,000 per year. Although some participants could afford considerably more, MacNabb says PRECARN wanted to keep the cost of membership low enough that smaller businesses could get involved.

MacNabb says the consortium hopes to have 50 participants within the next couple of years. "The most exciting thing about it is the cross-section of industry that is supporting it," he says. He attributes this to "the all-pervasive nature of AI and robotics."

McLean of Stelco expects to see synergy resulting from "working with people who have the same over-all objectives, coming from all sorts of different backgrounds."

PRECARN was originally announced in late March as Intelligent Systems Inc. The name was changed because of conflicts in corporate registration, MacNabb says. □

*Grant Buckler is a Toronto-based writer and editor. He specializes in articles on the computer industry.*

---

# Report on the National Meeting of the Fifth Generation Society

*Nick Cercone*  
*President, CSFGR/SCRSCG*  
*Centre for Systems Science*  
*Simon Fraser University*  
*Burnaby, B.C. V5A 1S6*

The Canadian Society for Fifth Generation Research (CSFGR/SCRSCG) held its annual meeting in Ottawa in April. The meeting consisted of a 1½-day workshop followed by a business meeting.

## **Workshop**

The workshop brought together industry, government, and university researchers, administrators, and project directors in an effort to take inventory of Canada's current Fifth Generation computing strengths and ongoing efforts to make each group aware of the needs of the others. The focus on industry speakers and government speakers was in marked contrast to the first two meetings, which focused on academic efforts.

Of 23 presentations on the Workshop portion of the agenda, nine were from industry, ranging in size from multinationals to shops with less than ten research staff. Industries describing themselves at the Workshop were predominantly producers of information technology. Seven presentations at the Workshop were from Federal government departments, including three from the National Research Council (Associate Committee on AI, Research Journals, and the Laboratory for Intelligent Systems), one presentation from NSERC Targeted Research, one from the Department of Communications, one from the Privy Council Office, and one from the Ministry of State for Science and Technology. One provincial research establishment, the Alberta Research Council, made a presentation of their activities at their Calgary office.

While academic participants at the Workshop mostly enjoyed the role of audience, six presentations describing novel research infrastructures had a strong academic component, indeed the academic achievements of most of those, including industrials, who participated in the Workshop is such as to suggest that the amount of education involved in information technology is non-trivial. Western Expert Systems Technology (WEST), Centre de Recherche informatique de Montreal Inc. (CRIM), Canadian Institute for Advanced Research (CIAR), British Columbia Advanced Systems Institute (BCASI), PreCompetitive Applied Research Network (PRECARN), and the Knowledge Sciences Institute (KSI) all include academic research.

government, and industrial components.

The Knowledge Sciences Institute is the most traditionally academic, publishing a peer-reviewed journal as well as accepting contracts for research in knowledge acquisition and application in flexible manufacturing systems. WEST, also on the University of Calgary campus with KSI, is part of a much larger commercial structure for investing in information technology research. WEST's research interests range from telecommunications to contracts in real-time sensor advising.

PRECARN is the most recent addition to the range of novel research infrastructures (see this issue, pages 10-11). With substantial funding from otherwise competitive or unrelated industries, PRECARN is a consortium with objectives of conducting research and technology transfer on a scale which can compete with foreign tri-sector organizations.

BCASI was organized by the provincial government in consultation with academic researchers. BCASI is federally and provincially funded to increase faculty research plus infrastructure for stimulating precompetitive cooperative research and technology transfer.

CRIM was also formed with provincial government stimulation. At the five Montreal-area universities, CRIM research interests are VLSI, CAD/CAM, communications protocols, and expert systems. The CIAR is similar to BCASI in that its research strength is primarily built upon existing academic research strengths. CIAR is national, and has a wider range of research interests than most of the other novel research infrastructures.

The participants at the workshop presented a great deal of valuable information in a very short time. Unsolicited comments from the audience were unanimously appreciative of the information received. This suggests again that exchange of information about Canadian activities is important to the producers and consumers of fifth and future generations of information technology in Canada. What was really surprising was that very few, if any, of the workshop participants brought any written material to the workshop.

For more information about this workshop or the CSFGR/SCRSCG, contact the author.

## **Business Meeting**

On the second afternoon, Nick Cercone called to order the third general meeting of the CSFGR/SCRSCG, with 33 members of the Society present. The participants discussed:

1. Recent progress towards the goals of the CSFGR/SCRSCG.
2. The role of the Society as compared to the purposes stated in the Constitution, the range of possible activities, and the functions currently performed by other organizations.



3. Election of Trustees.
4. Terms of corporate sponsorship.

Some non-member participants of the workshop, who had already generously shared their time and expertise, paid the purposes of the Society the compliment of staying on at the business meeting to contribute much appreciated evaluations of the CSFGR/SCRSCG. If the Society progresses towards its goals, it will be due in part to these contributions.

The President reported to the membership the extent of the CSFGR/SCRSCG's participation in international exchanges of 5G technical information and the progress of outstanding funding proposals. The CSFGR/SCRSCG has successfully implemented the exchange of technical reports between Institute for New Generation Computer Technology (ICOT) and Canadian University Computer Science Departments (see *CSFGR/SCRSCG Newsletters* numbers 1 and 2 for details). It was suggested that the CSFGR/SCRSCG initiate exchange of Technical Reports with other 5G projects, such as Alvey or ESPRIT. Discussion of funds available from industry was deferred until later in the meeting.

Reminded by the previous day's workshop of the range of activities from PRECARN-type organizations to NSERC adjudication of research grants, participants at the meeting then used to good advantage the opportunity to discuss the Society's role in stimulating research and facilitating technology transfer.

Participants were particularly concerned about potential redundancy of the Society, fragmentation of the academic community among a superfluous number of organizations, and representativeness of the CSFGR/SCRSCG. Duplication of effort between CSCSI/SCEIO, CIPS, and the CSFGR/SCRSCG was discussed. It was observed that the CSFGR/SCRSCG encompasses a wider range of interest than studies of computational intelligence as defined by CSCSI/SCEIO. Affiliation with CIPS was suggested as a possibly useful method of public education about 5G technology, since CIPS membership includes a large proportion of interest in industrial applications. Five former Presidents of CSCSI/SCEIO present at the business meeting observed that the close affiliation between the CSCSI/SCEIO and CIPS was educating CIPS about aspects of studies of computational intelligence. Membership suggested that the CSFGR/SCRSCG combine newsletters with CSCSI/SCEIO through *Canadian A. I.* magazine. Membership suggested that CIPS could administer CSFGR/SCRSCG membership dues, and that the CSFGR/SCRSCG could hold its workshops and meetings in conjunction with the CSCSI/SCEIO biennial conferences. Membership also suggested that affiliation with the IEEE could be useful to the CSFGR/SCRSCG.

The participants identified some information gathering and distribution functions which the CSFGR/SCRSCG could uniquely fulfill, and offered suggestions describing the range of information which

should be made available. Industrial, public research, public administration, and academic members said that they perceived as useful the Society's task of making available information describing 5G research currently being conducted in Canada both by individuals and by groups of individuals in the variety of infrastructures emerging in Canada today. Even participants from public laboratories reported difficulty in identifying government and industrial audiences for their research. Lists of to whom to send relevant technical reports would be helpful.

The executive reported that as a result of last year's nominations, four people have agreed to serve as Trustees for the CSFGR/SCRSCG:

Gordon MacNabb, President, PRECARN  
Arthur Bourne, World Bank, CIAR affiliation  
Eric Manning, University of Victoria  
Pat McGeer, University of British Columbia

Morven Gentleman moved that these Trustees be accepted as elected, Zenon Pylyshyn seconded the motion, and it was carried. Then the distribution of the remaining Trustee vacancies among industry, government administration, government research and development, and the private sector was discussed. It was agreed that the Executive should formalize Trusteeship of the four individuals who have to date agreed to serve as Trustees, should use the Constitutional procedure to add four more Trustees from those nominated to date, and the Executive should accept as additional nominees persons nominated at the meeting.

The question of what the CSFGR/SCRSCG could do for industry in return for their financial support was discussed. It was suggested that the Society could offer copies of technical reports, evaluations of technology when technical report distribution is restricted to industry, and information about graduate students entering the workplace to prospective Corporate Associates. Corporate Association was seen as a potentially useful structure if it was implemented so that any employee of a Corporate Associate could attend CSFGR/SCRSCG meetings rather than making attendance contingent upon individual memberships. Participants at the meeting requested that the Executive decide upon and the precise structure of Corporate Sponsorship. Participants from IBM and DEC said that their companies would probably contribute when terms of sponsorship were defined.

Alan Mackworth moved "that the executive be empowered to arrange terms for collaboration with other societies including the use of common facilities and cooperation on the organization of meetings and communication channels. If those negotiations are successful any formal changes in the organizational structure should be submitted to a vote of the membership." Morven Gentleman seconded the motion, and it was carried by a show of hands. □

---

## Notes from Members

Starting this fall, **Nick Cercone** will be Director of the Centre for Systems Science and Professor of Computing Science at Simon Fraser University. Nick, previously Chairman of Computing Science at SFU, is finishing a year's leave at the University of Victoria.

CSCSI/SCEIO Treasurer **Randy Goebel** has taken a new position at the University of Alberta; he was previously at the University of Waterloo. Effective immediately, his address is Department of Computing Science, University of Alberta, Edmonton, Alberta T6G 2H1; phone 403-432-5198; UUCP alberta!goebel.

**LISP Canada Inc**, the Canadian representative of Lisp Machines Inc, will move in July to new offices outside Montreal. The company's new address will be 1000 Boul. Roche, Vaudreuil, Québec J7V 6B3.

Acquired Intelligence, a new AI company in Victoria, is the new home of four members who were previously with the AI division of Interact R&D. They are **Brian Schaefer**, **Beverly Smith**, **Ian Morrison**, and **Julian Siegel**. The company is at 2304 Epworth Street, Victoria, B.C. V8R 5L2.

**K. Tahir Shah**, a consultant specializing in AI applications in industrial process control and hazardous chemicals and nuclear waste spill management, is now operating under the company name of Knowledge Engineering Research. Mr Shah may be reached at 1628 Springwell Avenue, Mississauga, Ontario L5J 3H9, phone 416-822-7365.

Instructional materials for students in knowledge engineering, are being created by **Albert Le Xuan**, a method of top-down conceptual analysis that he has developed. The materials will be used in a course at l'Université de Québec à Montréal by Dr **Jacques Ajenstat**. Interested readers may write to Mr Le Xuan at 4987 Walkley Avenue, Montréal, Québec H4V 2M3.

---

## Letter to the Editor

Re "Turing Test Extended" (*Canadian A.I.*, April 1987):

Assuming that neither the machine nor the human are permitted to lie, Mr Bradshaw Lupton might find the following questions useful:

- "Are you human?"
- "What is your shoe size?"
- "What is your mother's maiden name?"

*Nicholas M. Fabian  
Integrated Wood Research Inc  
Agincourt, Ontario*

---

## Ruth Hutchison Macdonald 1934-1987

Ruth H. Macdonald, Director of Development for the Canadian Institute for Advanced Research, died on March 6th after a long battle with cancer. Since 1984, Mrs Macdonald had raised more than \$7 million for the Institute, much of it for CIAR's Program in Artificial Intelligence and Robotics, which supports a dozen Fellows based at universities across Canada.

Ruth Macdonald was widely respected as an exceptionally able and effective individual. After graduating from the University of Western Ontario, she enrolled in the Harvard-Radcliffe Program in Business Administration (no women were then permitted in the Harvard Business School) and subsequently became a bond trader for Greenshields in Toronto. In 1962, she switched to political organizing for her husband, the Hon. Donald S. Macdonald, and raising a family. She returned to Bay Street in the late 1970s, and soon became active as a Director of a number of organizations, including E.L. Financial Corporation Ltd, Maclean Hunter, Trent University, and the Young Naturalist Foundation.

Ruth Macdonald's considerable intelligence, tenacity, and charm made her a valuable asset for each of the causes she embraced during her life. With her business background, she was particularly effective in arguing to both the private sector and government that increased support for research in AI and other fields should be a national priority. In honor of her memory, the Institute has established the Ruth H. Macdonald Fund, which will be used to support a promising young Canadian researcher. Contributions to the Fund can be sent to the Institute at 434 University Avenue, Suite 502, Toronto, Ontario M5G 1R6.

*Peter Munsche  
Canadian Institute for  
Advanced Research*

Three major conferences  
together

**Artificial '88 Intelligence**  
**Intelligence '88 Artificielle**

**Vision**  
**Interface '88**

**Graphics**  
**Interface '88**

Trois conférences majeures  
simultanées

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

# Artificial Intelligence '88

## Call for Participation

Edmonton Convention Centre  
Edmonton, Alberta, Canada  
6-10 June 1988

In conjunction with  
Graphics Interface '88  
Vision Interface '88

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:**

Nick Cercone / School of Computing Science / Simon Fraser University / Burnaby, B.C., CANADA V5A 1S6.  
Phone: 604-291-4277. NET: nick@lccr.sfu.cdn. UUCP: ubc-vision!sfulccr!nick

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

**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 sollicitées:

- 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 langages
- 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 correspondance à:**

Nick Cercone / School of Computing Science / Simon Fraser University / Burnaby, B.C., CANADA V5A 1S6. Tél: 604-291-4277. NET: nick@lccr.sfu.cdn. UUCP: ubc-vision!sfulccr!nick

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  
Edmonton, Alberta, Canada  
6-10 June 1988

In conjunction with  
**Artificial Intelligence '88**  
**Graphics Interface '88**

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
- Feature Selection and Pattern Analysis
- Motion Representation and Analysis
- Speech Recognition and Synthesis
- Texture and Segmentation
- Special Purpose Architectures
- 3D Vision
- Text Understanding and Verification
- Industrial Applications
- Biomedical Applications
- Remote Sensing Applications

Authors are invited to submit four copies of a draft paper or an extended summary containing sufficient detail, including salient concepts and novel features for a meaningful review and include authors' names, addresses, affiliations and telephone numbers. Inclusion of the accepted papers in the proceedings is conditional on the timely receipt of a camera-ready manuscript.

Proposals for tutorials should be submitted to the General Chairman by 15 November 1987.

**Send papers to the Co-Chairmen:**

T. Kasvand and A. Krzyzak / Department of Computer Science / Concordia University / 1455 De Maisonneuve Blvd West / Montreal, Quebec, CANADA H3G 1M8. Phone: 514-848-3057.

**For general information and tutorial proposals contact the General Chairman:**

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

# Graphics '88 Interface '88

## Call for Participation

Edmonton Convention Centre  
Edmonton, Alberta, Canada  
6-10 June 1988

In conjunction with  
**Artificial Intelligence '88**  
**Vision Interface '88**

Sponsored by the Canadian Man-Computer Communications Society

Graphics Interface '88 is the fourteenth Canadian Conference devoted to computer graphics and interactive techniques, and is the oldest regularly scheduled computer graphics conference in the world. Now an annual conference, film festival, and tutorials, Graphics Interface has established a reputation for a high-quality technical program.

**Four Copies of a Draft Paper due 31 October 1987**

**Tutorial Proposals due 15 November 1987**

**Authors Notified 1 February 1988**

**Cover Submissions due 1 March 1988**

**Final Paper due 28 March 1988**

**Electronic Theatre Submissions due 1 April 1988**

Contributions are solicited describing research results and applications experience in computer graphics, including the following areas:

- Image Synthesis and Realism
- Shading and Rendering
- Graphics and Office Automation
- Industrial and Robotics Applications
- Geometric Modelling
- Medical Graphics
- Computer Animation
- Image Processing
- User Interfaces
- Videotex
- Computer Cartography
- Interactive Techniques
- Graphics for CAD/CAM
- Graphics in Education
- Graphics and the Arts

Proposals for tutorials should be submitted to the General Chairman by 15 November 1987. Submissions are invited for the cover of the *GI '88 Proceedings*; by 1 March 1988 please.

The **Electronic Theatre** is a regular feature of Graphics Interface. Film and video tapes that illustrate the use of computer graphics and interactive techniques will be considered for presentation. All material submitted will be reviewed by the Electronic Theatre Committee. Material may be edited for presentation. Submissions must be received by 1 April 1988.

**Send papers to the Program Chairman:**

Darwyn R. Peachey / Department of Computational Science / University of Saskatchewan / Saskatoon, Saskatchewan, CANADA S7N 0W0. Phone: 306-966-4909.

**Send Electronic Theatre submissions to:**

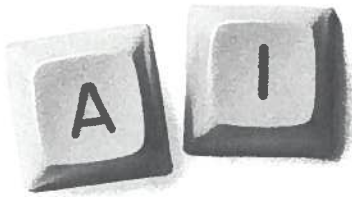
Mark Green / Department of Computing Science / University of Alberta / Edmonton, Alberta, CANADA T6G 2H1.

**Send Proceedings cover submissions to:**

Marceli Wein / Computer Graphics Section / National Research Council / Building M50, Montreal Road / Ottawa, Ontario, CANADA K1A 0R8.

**For general information and tutorial proposals contact the general chairman:**

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



# 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
- Interactive user interface
- Ability to mix interpreted and compiled code
- Multiprocessing capacity
- Support of an extensible, interpreted language
- Display-oriented programming tools
- Local area networks and data communications through XEROX ETHERNET
- 8 Mbytes virtual memory

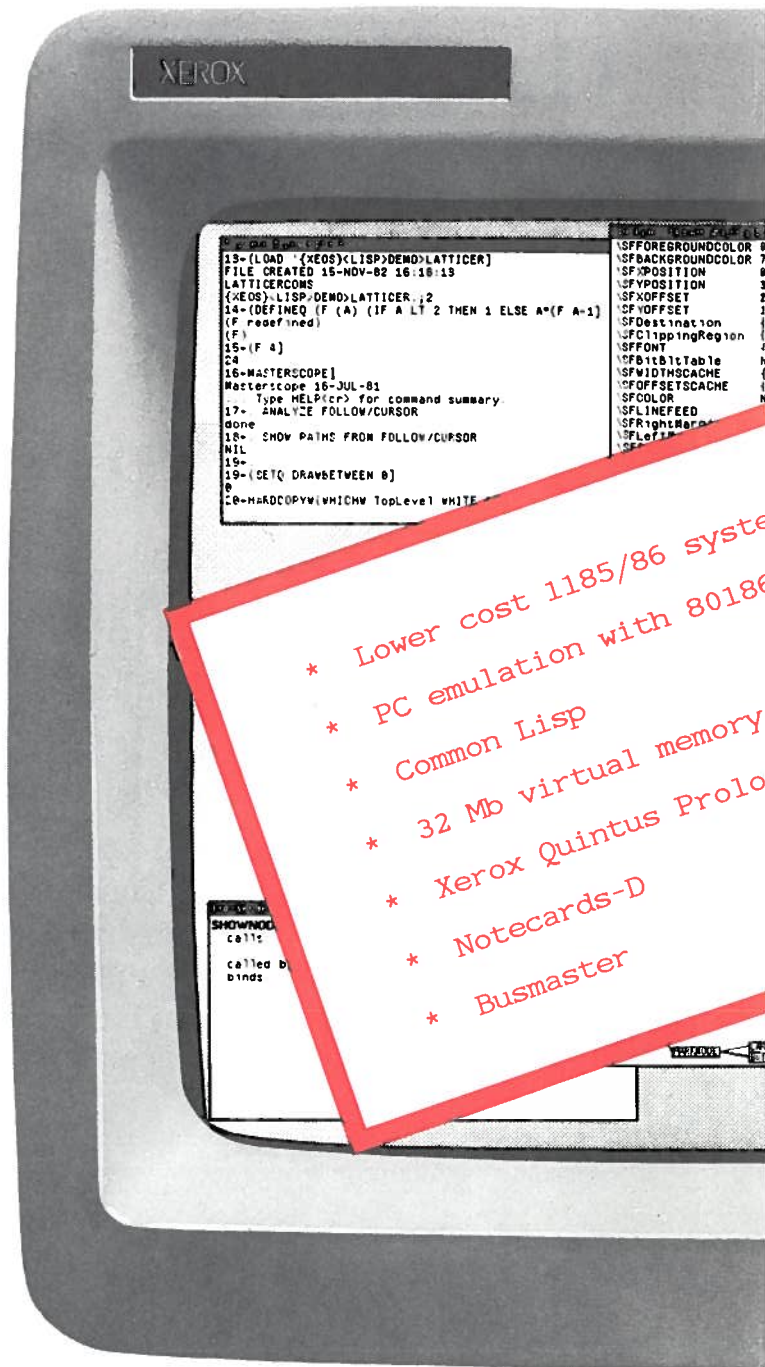
## Power Tools for Programmers

### 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



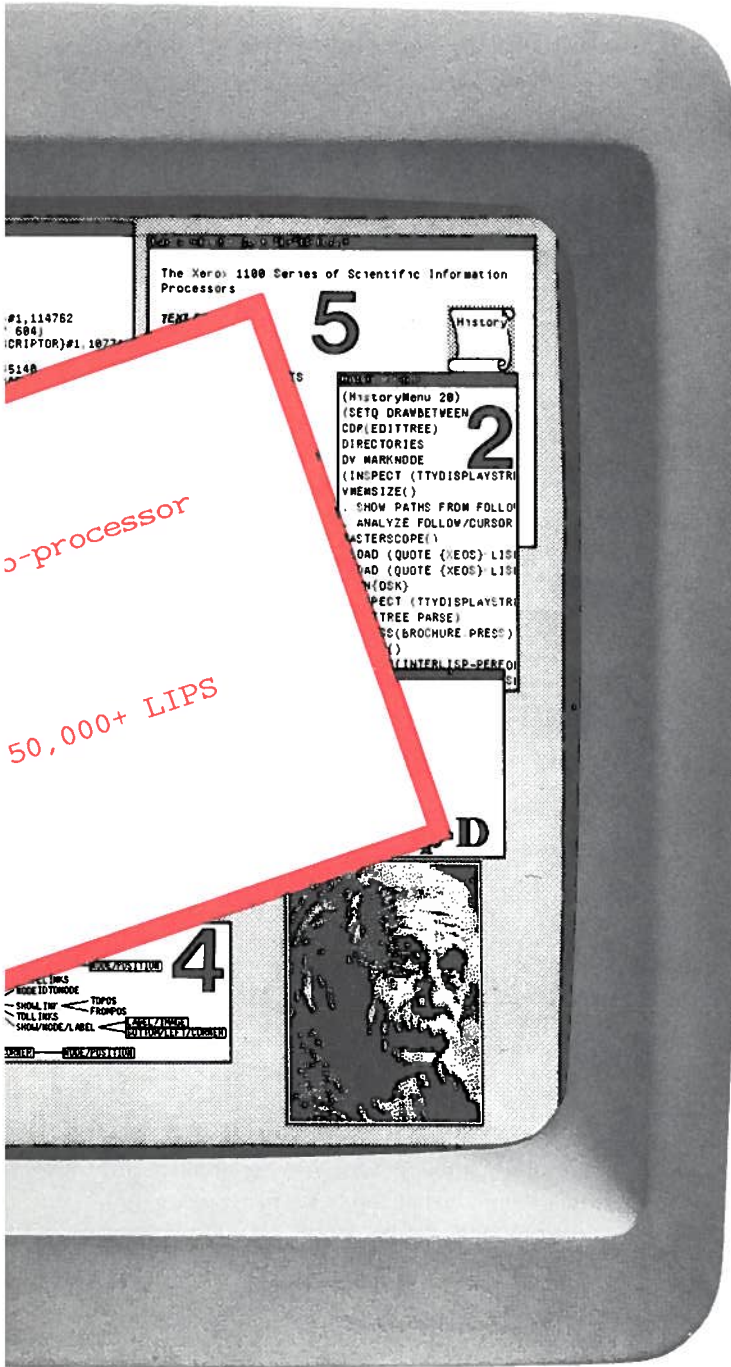
provided is a spelling corrector that automatically corrects spelling mistakes using information from the local context. To simplify file management for the programmer, Interlisp-D automatically keeps track of where in the file system each object is stored and which ones have been modified. In response 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



3-processor  
50,000+ LIPS

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

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

## Xerox Canada Inc.

Advanced Systems Group  
5650 Yonge Street, North York, Ontario M2M 4G7 416-229-3769  
XEROX is a registered trademark of XEROX CORPORATION used by XEROX CANADA INC. as a registered user.

## Research on Knowledge-Based Systems at the University of Toronto

---

Evangelos Milios  
Department of Computer Science  
University of Toronto

---

*Editor's note: This is the second in a series of three articles on AI research at the University of Toronto. The first, on natural language understanding, appeared in the September 1986 issue; the third, on computer vision, will appear in a forthcoming issue.*

Knowledge-based systems research at the University of Toronto over the past few years has focused on the fundamentals of knowledge representation and its applications to areas such as databases, software engineering, computer vision, and signal interpretation. Recent growth of the AI group has added more diversity to AI research, with new faculty interests including machine learning and parallel distributed processing.

### Foundations of Knowledge-Based Systems

The problem of reasoning with a formal representation language is the central research focus of Hector Levesque and Ray Reiter. Levesque's concern is with the foundations of knowledge-based computer systems, *i.e.*, systems that reason with a collection of explicitly represented facts about their environment. These facts can be thought of as the represented beliefs (or knowledge) of the computer system. The objective of the research is to discover the computational limits of formal reasoning and the impact these have on knowledge-based systems. Fundamental questions include: what it is that can make reasoning difficult in general, and how can the representation and reasoning task be varied and manipulated to ensure its tractability, while still remaining useful to a knowledge-based system. There are two major long-term subprojects underway:

- **Tractable reasoning:** The investigation of limited representation languages with correspondingly limited reasoning requirements, and of logical systems with limited notions of inference more suited to automatic reasoning (with Peter Patel-Schneider of Schlumberger Palo Alto Research Center, Ronald Brachman of AT&T Bell Labs, and PhD students Jim des Rivières, Gerhard Lakemeyer, and Bart Selman).

- **Formal models of intentionality:** The development of formal models sensitive to issues of resource limitations of the beliefs, goals, intentions, and plans of cognitive agents, and the application of these models to a theory of communication (with Phil Cohen of SRI International, and PhD students Gerhard Lakemeyer, Greg McArthur, Joe Nunes, and Calvin Ostrum).

Ray Reiter's research invokes logic as an analytic tool for investigating various reasoning patterns in the abstract, and as a computational mechanism for concrete applications. The following are some ongoing research projects:

- **Nonmonotonic reasoning:** The investigation of logical formalisms that sanction plausible, but fallible, inferences.
- **A theory of diagnosis:** A formal theory for determining diagnoses when given only a description of a device or system, and its observed behaviour.
- **Computational vision:** Formal foundations of "high-level" vision, providing a logical characterization of the image interpretation task; logic programming as a computational mechanism for vision tasks (with Alan Mackworth of the University of British Columbia).
- **Assumption-based truth maintenance systems:** The logical and computational foundations for such systems (with Johan de Kleer of Xerox Palo Alto Research Laboratories).

### Knowledge-Based Systems in Software Engineering and Information Systems

John Mylopoulos is involved in research on the applications of knowledge representation in databases, software engineering, office automation, programming languages, and information systems. A basic premise of this work is that requirements and design languages for building software ought to be based on knowledge representation facilities. Another is the idea of viewing software as a multi-layered description that includes a requirements specification, a design and an implementation for a particular software system with inter-layer links that indicate dependencies among the components of the layers.

A second, related, theme of this research attempts to import results from databases and software engineering in dealing with performance and human engineering concerns in the construction of large knowledge bases. This work is focusing on the development of knowledge base management systems, *i.e.*, systems that offer a complete environment for building a large knowledge base and use secondary storage, allow multiple concurrent users, deal with security, error recovery, and query optimization in a predictable, efficient, and robust way.

## Learning

Russ Greiner's research focuses on machine learning, dealing with computer programs whose behaviour improves over time. His dissertation described learning by analogy, a process for proposing plausible new conjectures about a target analogue based on facts known about a source analogue. (That work provided a formal definition of this process, a set of heuristics for finding the "best" analogies first, and some empirical results which confirmed the effectiveness of these ideas.)

More recently, he has begun investigating "learning from experience" — seeking methods of using information gleaned from some earlier deductions to speed up subsequent related deductions. His short term focus is on the *derivational path heuristic*, which attempts to "replay" relevant parts of an earlier source deduction in the context of a new target situation. He and one student (Kinman Tam) have implemented this and are currently characterizing when it will improve an inference engine's performance.

This research project ties in closely with the overall objective of designing an *effective* expert system shell — one whose reasoning mechanism not only returns the appropriate answers, but also returns those answers *efficiently*. Such learning techniques directly address this objective. In the next two years, he and his students will develop and study a collection of reasonable learning algorithms, with the objective of determining when each algorithm can and should be used, based on both empirical and theoretic analyses.

## Knowledge-Based Systems for Image Understanding

An ongoing project within the vision group is the design of an autonomous vision-guided robot, to serve as a testbed for much of the research being conducted by the group. The robot will be equipped with a camera and will navigate in an office environment containing moving people and other objects. Low-level vision tasks will be performed by a selection of independent modules that compute various retinotopic (image-coordinate based) "feature maps" from the sequence of input images. These maps form the input to the high-level portion of the system, in which recognition of instances of known objects occurs. The high level will incorporate attention mechanisms to direct the operation of the low-level modules (which modules to use, resolution at which to compute, area of image) using Tsotsos's ALVEN control paradigm. Greg Dudek, Mike Jenkins, Howie Marcus, Evangelos Milios, and David Wilkes are currently building a working prototype that addresses all aspects of sensor-guided navigation but using range data instead of visual data. After a better understanding of the overall system design issues is achieved, range data will be replaced by visual data.

A second project is directed towards machine interpretation of remotely sensed images. Evangelos Milios and John Tsotsos are currently exploring the

feasibility and performance of a closed-loop control paradigm proposed by Tsotsos in remote sensing data interpretation. The paradigm suggests that both preprocessing and signal to symbol transformation can be adaptively improved by using the semantic meaning assigned to the generated symbols. Shape abstractions are used as an organizational principle for storing and using signal information. One effort currently underway is dealing with automatic interpretation of impulse radar data for river or lake ice measurements (by Master's student Raymond Lee). Another is directed towards the interpretation of visible and infrared satellite weather data for storm forecasting.

## Knowledge Acquisition and Knowledge-Base Debugging

Armin Haken and Sue Becker are working towards knowledge acquisition and knowledge base debugging tools. They are designing and building an environment for the developer of expert systems based on a logic programming language called MRS. The expert adds and modifies knowledge interactively as the system runs. While an expert is correcting or adding rules and terms to the knowledge base, the knowledge acquisition environment holds the expert system in a state in which the new knowledge is relevant to the system. The expert can then immediately see the effects and interactions of new or modified rules. The system prompts the expert for those rules that are necessary for continuing the chain of reasoning and has analogous rules to show the expert. In addition, the expert has tools available for organizing, documenting, tracing, and inspecting rules and terms.

## Computer Facilities

The AI Group is equipped with eight Symbolics 3640 Lisp machines fully networked with the AI Lab's Vax 11/780 running Unix. Several rule- and frame-based languages are available, such as MRS, a superset of Prolog supporting meta-level reasoning developed at Stanford; KRYPTON, a hybrid language combining the frame-based and the logic-based approach developed at Schlumberger Palo Alto Research; PSN, a procedural semantic network language developed at the University of Toronto; and YAPS, an improved version of OPS-5 supporting multiple rule bases. For knowledge-based signal processing and computer vision applications, two packages are available: KBSP, a high-level object-oriented signal processing language developed at MIT; and ImageCalc, a language for image processing developed at SRI. The Group also has a number of Sun workstations, three color display CDA array processors, and a Matrox black-and-white video digitizer. □



# YOU ARE INVITED . . .

## . . . the only major Conference/Exhibition on Artificial Intelligence on the East Coast

October 28-30, 1987  
Atlantic City Convention Center  
Atlantic City, New Jersey

### The Conference

Emphasis will be on COMMERCIAL APPLICATIONS of Artificial Intelligence in business, industry and the professions. Recent technological developments will be examined, with evaluations of advanced computer hardware and software by qualified speakers. 24 Technical Sessions and 11 Tutorials are planned.

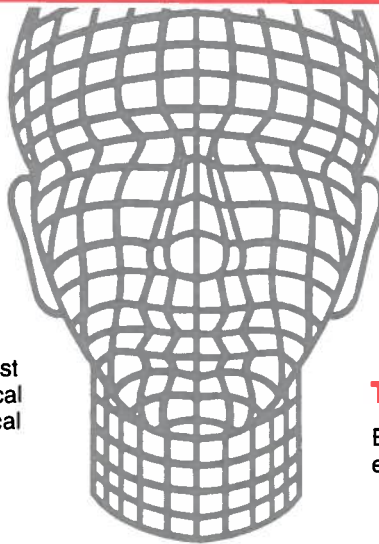
### The Exhibition

Leading suppliers will be displaying their latest equipment, systems and technology. Technical briefings, product demonstrations and practical working data will be made available by the exhibitors' product specialists and senior management.



### Who Should Attend?

Corporate Executives  
Computer Systems Designers  
Office Automation Specialists  
Industrial Engineers  
Government/Military Officials  
Scientists  
Manufacturing Executives  
Academic Researchers  
Computer Specialists  
Banking/Financial Experts  
Industrial R&D Specialists  
Medical Personnel  
Investment Advisors  
Aerospace Scientists  
Office Managers  
. . . and other buyers of AI products and services



### Technical Sessions

AI in Finance/Venture Community:  
Funding of AI Companies  
AI in Software Design/CAD  
AI in Finance/Mainstream Applications  
AI Applications Program  
Integration of AI Components into Complete Systems  
AI in Manufacturing  
AI on Micros  
AI on Standard Architecture  
LISP on Conventional Hardware  
AI on Distributed Processors  
Object-Oriented Programming  
Intelligent Text Retrieval with AI  
Neural Networks  
AI in CAE  
PROLOG  
AI in Mainstream Transaction Processing  
Voice Recognition  
AI in Medicine  
Machine Translation  
AI in Defense  
AI in IBM Environments  
AI in Music  
AI on Wall Street  
AI in the Federal Government

### Tutorials

Eleven Tutorials will offer in-depth presentations on key subjects.

## Artificial Intelligence and Advanced Computer Technology Conference/Exhibition

Mail This Coupon for Details

TO: Tower Conference Management Co.,  
331 W. Wesley St., Wheaton, IL 60187

- Please send information on ATTENDING AI/East '87  
 My company is interested in EXHIBITING. Please contact me with details.

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone \_\_\_\_\_ Telex \_\_\_\_\_

Photocopy coupon for your associates

### Co-Sponsors:



**Applied Artificial Intelligence Reporter**

**PC AI**

**Spang-Robinson Report**

### Organized by:



**Tower Conference Management Company**  
331 W. Wesley St., Wheaton, IL 60187  
(312) 668-8100 Telex 350427  
Fax: (312) 668-8820



## Book Reviews and Publishing News

**Robotics research: The third international  
symposium**

**[Proceedings of the symposium held in  
Gouvieux, France, October 1985]**

*Olivier Faugeras and George Girault (editors)*

(The MIT Press series in artificial intelligence)

Cambridge, MA: The MIT Press, 1986, xi+410 pp

Hardbound, ISBN 0-262-06101-5, \$<sup>US</sup>50.00

*Reviewed by*

*Ron Gershon*

*University of Toronto*

This book contains a record of the Third International Symposium on Robotics Research, held in France in October 1985. The papers were presented by invited participants from Europe, Japan, and the United States. The 48 papers are organized into four main sections: Perception, Decision, Action, and Systems. Each section is composed of two or three chapters, with an introduction describing briefly the main issues preceding each chapter. There was no editing of the papers, in order to speed up the publication, and thus, apart from the brief introductions to the chapters, this book represents the proceedings of the Symposium.

Chapter 1 deals with stereo and motion as means of recovering three-dimensional information and structure from images. The papers dealing with stereo address mainly problems of accuracy and constraints to reduce the matching ambiguity; motion issues addressed are analysis and estimation of image sequences when the camera is known to be moving. Noteworthy is a paper by Bolles and Baker, who suggest a technique for unifying spatial and temporal analysis of an image sequence taken by a camera moving straight lines. Three-dimensional structure information is used for object identification and modelling, the subject of Chapter 2. The papers in this chapter deal with fusion of information produced by a variety of sensing modalities (such as stereo, sonar and touch) into surface reconstruction.

Chapter 3, starting the Decision section, deals with planning and reasoning. It addresses issues such as control strategies and the complexity of inference and planning systems. Problems of making decisions to coordinate several subtasks and smooth execution of complex processes are the topic of chapter 4. The common theme among the papers of this chapter is the

integration of visual information into a robot command system so as to adapt its tasks and resources to changing environments. The next section, Actions, starts with a discussion of kinematics and dynamics (Chapter 5). The main concern of this chapter is to formalize and solve problems of force and volumetric models of rigid bodies in motion in an industrial workspace. The actual issues of control of robot manipulators are then discussed in Chapter 6, with emphasis on algorithms controlling location and force of redundant manipulators or robots.

Chapter 7 deals predominantly with the design requirements of robot manipulators. The important constraints which are taken into account are optimization of kinematic functions, higher accuracy, and increased output torque. The last section, Systems, begins with a discussion of mobile robots (Chapter 8). A number of papers deal with issues of locomotion as applied to either crawler-type or four-legged robots. Other papers address control aspects of mobile robots. One interesting approach is presented by Brooks, suggesting an architecture that consists of a number of layers operating at an increasing levels of competence, each layer being made up of asynchronous modules which communicate over low-bandwidth channels.

Finally, chapter 9 describes multifunctional systems that share the property of using information to guide intelligent action. Such systems employ either mathematical or logical models of certain domains and through the acquisition of more information refine the tasks that they perform, such as grinding or grasping.

I found the book to be very interesting, because it is well balanced, and presents issues relevant and important to the field of robotics. It provides an up-to-date record of current research efforts in the field and the brief introductions to the chapters enable the reader to find the articles of interest with ease. I would have preferred it in a softbound version, since it is definitely not a textbook to be read from start to end, but rather a reference book. Because the book is aimed at a wide range of researchers, and the number of participants in the Symposium was limited, not all specific problems in each area are addressed, and it is the hope of this reader that the choice of issues for subsequent Symposia reflects this situation. □

*Ron Gershon recently received his PhD in computer vision from the University of Toronto.*

### **New horizons in educational computing**

*Masoud Yazdani (editor)*

*[University of Exeter]*

(Ellis Horwood series in artificial intelligence)

Chichester: Ellis Horwood, 1987, 314 pp.

Distributed in Canada by John Wiley & Sons

ISBN 0-7458-0071-8 and 0-470-20792-2,

paperbound, \$<sup>CDN</sup>27.95

*Reviewed by*

*Marlene Jones*

*Alberta Research Council*

Categorizing this book as AI is somewhat misleading. Its appearance in a series of AI books, and the fact that the introduction is titled "AI and Education", might lead one to believe that that is the theme of the book. Not so. For a complex and expanding field of research and development, the introductory presentation is remarkably simplistic.

The book is a collection of papers grouped under the headings of "The World of LOGO", "The Prolog Phenomenon", and "The POP-11 Experience". Unfortunately the material presented is not new. For example, consider the LOGO section. I've been reading approximately the same presentation of ideas and examples by some of the authors for the past decade. I sympathized with the remark by one of Burnett's colleagues "If I see another [LOGO-generated] house, I think I'll scream!" (p 74).

The book may serve a purpose for educators unfamiliar with the use of LOGO, Prolog, or POP-11, but the basics of these languages are readily available elsewhere. What is really lacking in this book is information regarding the actual use of these languages in educational settings. A few anecdotal remarks do appear, but there is little in the way of factual information about relevant studies. To put it bluntly, the book is disappointing and I question the motivation in producing it.

□

*Marlene Jones works on AI approaches to user modelling in computer-assisted education.*

### **The Mathematics of Inheritance Systems**

*David S. Touretzky*

*[Carnegie-Mellon University]*

(Research Notes in Artificial Intelligence)

Morgan Kaufmann, 1986.

*Reviewed by*

*Fahiem Bacchus*

*University of Alberta*

This book is a revised version of the author's doctoral dissertation and it presents a formal treatment of inheritance systems with exceptions. Inheritance systems are hierarchically structured sets of classes and individuals where the individuals can inherit various properties from the classes above it in the hierarchy. For example,

if Clyde is an elephant, then Clyde would inherit the properties of being grey, long-nosed, four-legged, etc., from the class *Elephant*. This results in a considerable saving, because it avoids duplicating all of these properties for each elephant that we know about.

The type of inheritance systems that Touretzky considers are multiple inheritance systems with exceptions. In multiple inheritance systems, an individual may inherit properties from many different superclasses. For example, Clyde may be both an elephant and a circus performer and may inherit properties from both classes. In this case, the hierarchical structure becomes a directed graph structure (generally restricted to being acyclic). When we allow for exceptions we allow certain individuals (or certain sets of individuals) to override their inherited properties. For example we may have a special set of three-legged elephants which override the normally inherited property of four-leggedness.

Touretzky identifies two semantic difficulties in multiple inheritance systems with exceptions. First, how we allow for the overriding of properties in a consistent manner, and second, how do we detect truly ambiguous situations? To solve these problems, he takes a simple intuitive idea and develops a formal apparatus from it which he calls inferential distance ordering. He then proceeds to show how his formalism solves these two problems. The intuitive idea is simply that subclasses should override superclass. Thus if we have the following set of statements:

Elephants are grey.

Royal elephants are elephants.

Royal elephants are not grey.

Clyde is a royal elephant

we should infer that Clyde is not grey, as royal elephants are a subclass of the class of elephants. The subclass-superclass distinction yields only a partial ordering on the set of classes in the system. Thus ambiguous situations like this:

Quakers are pacifists.

Republicans are not pacifists.

Nixon is a Quaker.

Nixon is a Republican.

can be detected by the fact that the classes Quaker and Republican are not ordered by the partial ordering of set inclusion.

The formal treatment is fairly elegant and consists of methods for constructing paths in the inheritance graph. Properties may be inherited only along these paths. By formalizing the inferential distance ordering concept Touretzky develops criteria that yield paths that obey the priority of subclasses over superclasses. He shows that a complete set of paths can be constructed as long as the inheritance graph satisfies certain acyclic criteria. He also gives a semantic model based on tri-valued lattices. Unfortunately the link between the syntactic inheritance graphs and the semantic lattices remains sketchy. In Chapter 5 of the book, he

attempts to give a similar treatment of what he calls 'inheritable relations'. For example, the relation "elephants love zookeepers" can be inherited by the pair of individuals Clyde and Fred if Clyde is an elephant and Fred is a zookeeper. However, limitations in the expressiveness of his syntactic language leave questions as to the usefulness of this treatment. Nor is it clear how his semantic model could be extended handle this case.

There are two chapters which discuss the use of parallel marker propagation machines to implement inheritance systems. A lot of space is taken to discuss the problems which occur and how to circumvent them. However, the only thing that I was convinced of was that such an architecture is simply inadequate for this task. This space could have been better used to expand on other aspects of the thesis. In particular, there is frequent mention of non-monotonic logics, and Touretzky shows how the relations in the inheritance graph can be translated to statements in non-monotonic logic. There is clearly a relationship between deduction in non-monotonic logic and Touretzky's path construction techniques, but this relationship remains unexplicated.

In conclusion, despite the faults mentioned, this book does succeed in presenting reasonable formalism for property inheritance in the case of multiple inheritance with exceptions. The major contribution of this work is that it gives a formal treatment of a commonly used heuristic, and in doing so it provides real criteria for evaluating the validity and applicability of the heuristic — something which is impossible when things remain ad hoc. □

*Fahiem Bacchus is a doctoral candidate at the University of Alberta. He is involved in research into the problems of representing and reasoning with uncertain knowledge. One facet of this is the problem of making 'reasonable' assumptions.*

**Robotics and AI:  
An introduction to applied machine intelligence**

Andrew C. Staugaard, Jr.  
[The School of the Ozarks]

Englewood Cliffs: Prentice-Hall, 1987, x+373 pp.  
Hardbound, ISBN 0-13-782269-3, \$US39.95

*Reviewed by  
A.A. Goldenberg  
University of Toronto*

This book is a useful contribution to the area of Robotics. In particular the reader who is not familiar with AI concepts can use the book as a source of the basic concepts in AI which are applicable in Robotics. Often, experienced robotics engineers and researchers must communicate with AI people, and this book would facilitate this communication.

The book can be used as a textbook or a reference book for courses in Robotics in technology schools and university senior undergraduate classes, taught in the

departments of Industrial Engineering, Electrical Engineering, and Mechanical Engineering. I found Chapters 1 to 5 the most useful from a roboticist perspective. Chapters 1, 2, and 3 are very good in providing the roboticist with the basic elements of AI. Chapter 1 covers an introduction to intelligent robotics, Chapter 2 covers basic concepts of AI and elements of knowledge representation, are presented in Chapter 3. Chapters 4 and 5 cover speech synthesis, recognition, and understanding. These chapters are well written and useful for understanding the techniques and the principles underlying speech and its cognitive elements.

The material of Chapters 6, 7, and 8 is also covered elsewhere — in particular, that of Chapters 6 and 8. Chapter 6 presents a basic knowledge of vision sensing. Chapter 7 presents basic range-finding and navigation methods, and Chapter 8 deals with elementary tactile sensing.

The book and its exercises with answers provide a very useful classroom tool and good reference for roboticists interested in AI. The book does not enhance the AI person's knowledge about robotics. In conclusion, this book recommended to those working in research and development of robotic systems. □

*A.A. Goldenberg is Professor of Mechanical Engineering, Electrical Engineering, and Biomedical Engineering at the University of Toronto and is Director of the Robotics and Automation Laboratory.*

**Books Received**

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

**Research and development in expert systems III:  
Proceedings of Expert Systems '86,  
the Sixth Annual Technical Conference of  
the British Computer Society Specialist  
Group on Expert Systems,  
Bright, 15–18 December 1986**

*Bramer, Max A (editor)  
[School of Computing and Information Technology,  
Thames Polytechnic]*

Cambridge: Cambridge University Press on behalf of  
the British Computer Society, 1987, vii+277 pp  
Hardbound, ISBN 0-521-34154-X, \$US39.50

**†Artificial intelligence and instruction:  
Applications and methods**

*Kearsley, Greg P (editor)  
[Park Row Software]*

Reading, MA: Addison-Wesley, 1987, xiv+351 pp  
Hardbound, ISBN 0-201-11654-5, \$US29.95

**†Knowledge-based expert systems in industry**

*Kriz, Jiri (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,  
\$<sup>CDN</sup>55.95

**Prolog: A relational language and its applications**

*Malpas, John*

Englewood Cliffs: Prentice-Hall Inc, 1987, x+465 pp  
Paperbound, ISBN 0-13-730805-1

**The semantics of destructive Lisp**

*Mason, Ian A*

[*Laboratory for the Foundations of Computer Science,  
University of Edinburgh*]

(CSLI lecture notes 5)

Center for the Study of Language and Information,  
Stanford University, 1987, vii+282 pp

Distributed by the University of Chicago Press  
Hardbound, ISBN 0-937073-05-9, \$29.95; Paperback,  
ISBN 0-937073-06-7, \$<sup>US</sup>14.95

**Encyclopedia of artificial intelligence**

*Shapiro, Stuart Charles (editor-in-chief) and Eckroth,  
David (managing editor)*

[*State University of New York at Buffalo and John Wiley*]

New York: Wiley-Interscience / John Wiley, 1987,  
xxi+1219 pp in two volumes.  
Hardbound, ISBN 0-471-80748-6, \$<sup>CDN</sup>229.50 before  
1 Sept 87, \$267.95 thereafter

*Stillings, Neil A; Feinstein, Mark H; Garfield, Jay L;  
Rissland, Edwina L; Rosenbaum, David A;  
Weisler, Steven E; and Baker-Ward, Lynne*  
[*Hampshire College and University of Massachusetts*]

**Cognitive science: An introduction**

Cambridge, MA: The MIT Press, 1987, xvii+533 pp  
Hardbound, ISBN 0-262-19257-8, \$<sup>US</sup>25.00

**\*Knowledge systems and Prolog: A logical approach  
to expert systems and natural language processing**

*Walker, Adrian (editor); McCord, Michael; Sowa,  
John F; and Wilson, Walter G*  
[*IBM T.J. Watson Research Center and IBM Systems  
Research Institute*]

Reading, MA: Addison-Wesley, corrected reprinting,  
March 1987, xii+475 pp.  
Hardbound, ISBN 0-201-09044-9, \$?

**Object-oriented concurrent programming**

*Yonezawa, Akinori and Takoro, Mario*  
[*Tokyo Institute of Technology and Keio University*]

(MIT Press series in computer systems)  
Cambridge, MA: The MIT Press, 1987, vii+282 pp.  
Hardbound, ISBN 0-262-24026-2, \$<sup>US</sup>25.00

## New AI Journals

A journal whose editorship is a joint Canadian-Japanese venture is among three new AI-related journals recently announced.

*Future Computing Systems* is edited jointly by Professors Brian Gaines and Mildred Shaw of the University of Calgary, and Professors Hajime Karatsu and Michio Sugeno of Tokai University, Tokyo, and the Tokyo Institute of Technology.

The journal's stated objective is "to provide a forum for open, international exchange of considerations relating to future computing systems. The range of coverage extends from underlying technology, through design objectives, to implementation experience, applications studies, and economic and social impact."

The journal, whose first issue appeared recently, is published jointly by Oxford University Press and Maruzen Company Ltd of Tokyo. In North America, subscriptions, at \$<sup>US</sup>100 for volume 1, should be sent to:

Journals Subscription Department  
Oxford University Press  
Walton Street  
Oxford OX2 6DP  
ENGLAND

An abstracts journal for AI recently commenced publication. *Artificial Intelligence Abstracts* will cover 25 journals and 55 corporate memoranda series. Subscriptions in North America for six issues in 1987 are \$<sup>US</sup>50 for individuals, \$104 for institutions; this is a special rate for volume 1 only. The publisher's address is:

Journals Dept  
Basil Blackwell Inc  
Box 1320, Murray Hill Station  
New York, NY 10156, U.S.A.

The CRC Press recently announced the creation of a new journal entitled *CRC Critical Reviews in Artificial Intelligence*, to be edited by J. Bourne and J. Sztipanovits of Vanderbilt University (Nashville, TN 37235, U.S.A.). The journal will seek to provide in-depth reviews of tightly constrained areas within AI. It plans to cover the breadth of the field and publish in the following format. Each volume will consist of 4 issues of roughly 100 pages in each issue. Each issue will contain either 2 or 3 articles. The number of volumes published each year will depend on the interest of the AI community.

Publication of the journal has not yet begun; rather, the editors are soliciting opinions and recommendations from the AI community concerning prospective authors who would be capable of writing and potentially willing to contribute excellent review articles in the various areas to be covered.



Abstracts of papers in  
*Computational Intelligence*,  
3(2), May 1987

**Expressiveness and tractability in  
knowledge representation and reasoning**

*Hector J. Levesque and  
Ronald J. Brachman*

A fundamental computational limit on automated reasoning and its effect on knowledge representation is examined. Basically, the problem is that it can be more difficult to reason correctly with one representational language than with another and, moreover, that this difficulty increases dramatically as the expressive power of the language increases. This leads to a tradeoff between the expressiveness of a representational language and its computational tractability. Here we show that this tradeoff can be seen to underlie the differences among a number of existing representational formalisms, in addition to motivating many of the current research issues in knowledge representation.

**Gödel, Lucas, and  
mechanical models of the mind**

*Robert F. Hadley*

In *Minds, Machines, and Gödel*, J.R. Lucas offers an argument, based on Gödel's incompleteness theorems, that the mind cannot be modelled by a machine. This argument has generated a variety of alleged refutations, some of which are incompatible with others. It is argued here that the incompatibility of these 'refutations' points to a central paradox which has not yet been resolved. A solution to this paradox is presented, and a related paradox, concerning the existence of consistent models for inconsistent humans, is described and solved. An argument is presented to demonstrate that although humans commonly produce inconsistent output, they can, in an important sense, be modelled by *consistent* formal systems, if their behavior is deterministic. It is also shown that Gödel's results present no obstacle to humans' proving the consistency of their own formal models.

**Domain circumscription: A re-evaluation**

*David W. Etherington and Robert Mercer*

Some time ago, McCarthy developed the domain circumscription formalism for closed-world reasoning. Recently, attention has been directed towards other circumscriptive formalisms. The best-known of these, predicate and formula circumscription, cannot be used to produce domain-closure axioms; nor does it appear likely that the other forms can. Since these axioms are important in deductive database theory (and elsewhere), and since domain circumscription often can conjecture these axioms, there is reason to resurrect domain circumscription.

Davis presents an intuitively appealing semantics for domain circumscription, based on minimal models. However, under certain conditions McCarthy's syntactic realization of domain circumscription can induce inconsistencies in consistent theories with minimal models. We present a simple, easily motivated change that corrects this problem but retains the appealing semantics outlined by Davis. We also explore some of the repercussions of this semantics, including soundness and limited completeness results.

**Defeat among arguments:  
A system of defeasible inference**

*R.P. Loui*

This paper presents a system of non-monotonic reasoning with defeasible rules. The advantage of such a system is that many multiple extension problems can be solved without additional explicit knowledge; ordering competing extensions can be done in a natural and defensible way, via syntactic considerations. The objectives closely resemble Poole's objectives, but the logic is different from Poole's. The most important difference is that this system allows the kind of chaining that many other non-monotonic systems allow. Also, the form in which the inference system is presented is quite unusual. It mimics an established system of inductive logic, and it treats defeat in the way of the epistemologist-philosophers. The contributions are both of content and of form: the kinds of defeat that are considered, and the way in which defeat is treated in the rules of inference.

**A hybrid, decidable, logic-based  
knowledge representation system**

*Peter F. Patel-Schneider*

The major problem with using standard first-order logic as a basis for knowledge representation systems is its undecidability. A variant of first-order tautological entailment, a simple version of relevance logic, has been developed that has decidable inference and thus overcomes this problem. However, this logic is too weak for knowledge representation and must be strengthened. One way to strengthen the logic is create a hybrid logic by adding a terminological reasoner. This must be done with care to retain the decidability of the logic as well as its reasonable semantics. The result, a stronger decidable logic, is used in the design of a hybrid, decidable, logic-based knowledge representation system.

**Patterns of interaction in  
rule-based expert system programming**

*Stan Raat and George Drastal*

We study the effect of adding a rule to a rule-based heuristic classification expert system, in particular, a rule which causes an unforeseen interaction with rules already in the rule set. We show that it is possible for such an interaction to occur between sets of rules, even when no interaction is present between any pair of rules contained in these sets. A method is presented that identifies interactions between sets of rules, and an analysis is given which relates these interactions to rule-based programming practices which help to maintain the integrity of the knowledge base. We argue that the method is practical given some reasonable assumptions on the knowledge base.

*Subscription information*

*Computational Intelligence* is published by the National Research Council of Canada and sponsored by CSCSI/SCEIO. Non-institutional CSCSI/SCEIO members may subscribe for \$<sup>CDN</sup>16, a considerable discount on the regular price. To subscribe, use a copy of the all-purpose order form in this issue of *Canadian A.I.* The form must be sent to CIPS, who will certify your membership and forward your request to the NRCC. If you wish to subscribe without joining CSCSI/SCEIO, write to: Distribution R-88 (*Computational Intelligence*), National Research Council of Canada, Ottawa, Ontario, CANADA K1A 0R6. Regular rates are \$<sup>CDN</sup>37 for individuals. \$<sup>CDN</sup>75 for libraries; add \$10 extra for postage outside Canada. Make cheques payable to "Receiver General of Canada, credit NRCC".

Use this form to join CSCSI/SCEIO, to subscribe to  
*Canadian A. I. or Computational Intelligence*, and to order publications

Canadian Society for  
Computational Studies  
of Intelligence

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

## Application for Membership and / or Journal and Conference Proceedings Order

To join CSCSI/SCEIO and receive *Canadian Artificial Intelligence*, fill out this form (or a photocopy of it) and send it to CIPS (which administers membership for the society) at the address below, with the appropriate fee. You need not be Canadian to be a member. This form can also be used to subscribe to the journal *Computational Intelligence*, and to purchase back issues of *Canadian Artificial Intelligence* and CSCSI/SCEIO conference proceedings. Mail it to:

CIPS, 243 College Street (5th floor), Toronto, CANADA M5T 2Y1

- I wish to join CSCSI/SCEIO and receive *Canadian A. I.* (\$25).  
 I am a student (subtract \$10).  I am a member of CIPS (subtract \$10).
- Please send me the following back issues of *Canadian Artificial Intelligence* (\$10 each including postage, except \$15 for #3):\* .....
- Please enter my subscription to *Computational Intelligence* at the CSCSI/SCEIO non-institutional member discount rate (\$16).†
- Please send me the following CSCSI/SCEIO conference proceedings (\$30 for 1986; \$25 for 1982 and 1980; 1984 is out of print. Add \$5 for postage within Canada, \$7 outside):  
 Montréal, 1986.  Saskatoon, 1982.  Victoria, 1980.

Total enclosed: \$..... Cdn. / U.S. (Payment may be made in U.S. dollars at the current rate of exchange.)

Name .....

Mailing Address .....

\*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.

## 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.

□ □ □ □ □

### McGill University

The table below lists recent AI technical reports from McGill University. They may be requested from:

The Librarian  
Computer Vision and Robotics Laboratory  
Department of Electrical Engineering  
McGill University  
3480 University Street  
Montreal, PQ, CANADA H3A 2A7

□ □ □ □ □

## University of Saskatchewan

Requests for any of the following publications should be addressed to:

Gord McCalla  
Department of Computational Science  
University of Saskatchewan  
Saskatoon, Saskatchewan CANADA S7N 0W0

### Dynamic planning of blackboard focus shifts in an automated debugging system

*Teng H. Ng*  
MSc thesis, TR 87-3

Recently, many researchers have been attempting the difficult task of building intelligent automated debugging systems. A particular debugging system, the SCENT system, will form the central focus of this thesis. The architecture of SCENT is based on co-operative processes called entities interacting via a blackboard control scheme. Six conceptual levels of entities have been defined. A controller is needed to schedule entities on the blackboard. Taking advantage of the conceptual levels, attention can be focused on one level at a time. This thesis will discuss how focus shifts can be planned and dynamically altered to suit changing circumstances.

Several kinds of knowledge have to be taken into consideration when performing the scheduling job. Firstly, there is domain knowledge which indicates a relevant set of entities. Secondly, there is knowledge of a debugging process which decides the level of entities that is appropriate at a certain time during debugging. Thirdly, there is knowledge that determines whether or not an entity is feasible to perform a

---

## Recent McGill University AI Technical Reports

Authors	Title	Number
Aubry, S., Hayward, V.	Scene description for a robotic workstation using range imaging	CIM-86-1R
Freedman, P., Michaud, C., Malowany, A.	The design of a robotics data base for a high level programming environment	TR-86-7R
Hayward, V., Lloyd, J.	RCCL user's guide	CIM-86-4
Lloyd, J.	RCCL Reference Manual	CIM-86-5
Lloyd, J.	A summary of the kinematics for common industrial robots	CIM-86-6
Mansouri, A-R, Michaud, C., Malowany, A.S., Levine, M.D.	Issues in robotics	TR-86-6R
Michaud, C., Mansouri, A-R., Malowany, A.S., Levine, M.D.	Some issues in robotics	CIM-86-6R
Sicard, P., Levine, M.D.	An approach to an expert robot welding system	TR-86-1R
Zucker, S.W., Iverson, L.	From orientation selection to optical flow	CIM-86-2
Zucker, S.W., Parent, P.	Trace inference, curvature consistency, and curve detection	CIM-86-3
Zucker, S.W., Sander, P.	Tracing surfaces and surfacing traces, I: Stable local estimates and coarse segmentation by curvature	CIM-86-7

particular task. Fourthly, there is knowledge that determines the priority of an entity, for example, the efficiency and/or importance of an entity.

**Knowledge representation issues in automated tutoring**

*Gordon I. McCalla*

TR 87-4

Representing human commonsense knowledge is an important aspect of all artificial intelligence research. It is an especially crucial need in an automated tutoring system. If it is to behave with subtlety and intelligence, an intelligent tutoring system must have knowledge of its subject, knowledge of the student's capabilities, knowledge of its own capabilities, knowledge of teaching strategies, knowledge of how to interact with the student, and knowledge of what has happened in the past. A number of specific knowledge representation issues are illuminated particularly well in intelligent tutoring, including how to deal with the problem of incomplete knowledge, how to represent misconceptions as well as conceptions, how to handle inconsistency, how to respond to changing knowledge, how to recognize student goals and manipulate system goals, how to reason about knowledge in a multitude of ways, and finally how to represent, choose among, and execute teaching strategies of various sorts. The paper considers these issues, showing why they are important and indicating some of the approaches taken to deal with them. The paper concludes with some predictions about the future of intelligent tutoring.

P. S. Mueller



**EXPERT**  
**HEURIX**  
Computer Research Inc.  
P.O. Box 40, Station "L"  
Toronto, Ontario  
Canada M6E 4Y4  
Tel. 416-654-9414

**KNOWLEDGE**

**ACQUISITION**

**ENGINEERING**

**FORMALISM**

**REPRESENTATION**

**INFERENCE**

HEURIX, A KNOWLEDGE ENGINEERING FIRM, WILL ADVISE YOU AND HELP YOU TO TRANSFER THE AI TECHNOLOGY INTO YOUR ENVIRONMENT.

HEURIX, AN INTELLIGENT WAY TO BUILD SYSTEMS!



## A Discussion on User Interfaces for Knowledge-Based Systems

---

Sue Becker and Armin Haken  
Department of Computer Science  
University of Toronto

---

At the recent CHI+GI-87 conference on Computer-Human Interaction and Graphical Interfaces in Toronto, three members of the University of Toronto's Second Generation Expert Systems Project, Sue Becker, Armin Haken, and Evangelos Milios, organized a Special Interest Group (SIG) meeting on user interfaces for knowledge-based systems. We were fortunate to have a very knowledgeable and diverse group of attendees, from various universities, businesses, and research labs. A most interesting, lively discussion ensued, and we have summarized it here.

The purpose of the SIG was to explore current research in user interface technology for the builder of knowledge-based systems (KBS). In our opening remarks, we described the typical system builder, the tasks she or he engages in, and the types of tools that one could design to facilitate these tasks. The discussion which followed elaborated on these ideas.

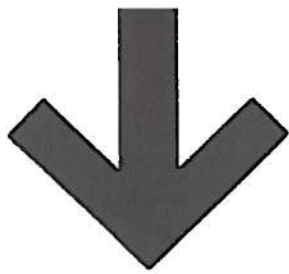
KBS builders are typically a select class of users — knowledge engineers and AI researchers — who know a lot about programming and knowledge representation. (Additionally, they become experts in the application domain of every system they build.) But this need not be the case, and one can come up with very good reasons why it should not, *i.e.*, why non-programming experts should also be able to directly enter knowledge. One reason is that an application expert would like to be able to express her or his knowledge directly to the system, without the need for an intermediary; the intermediary is costly, may introduce errors in the translation process, and is more likely to be biased toward some particular knowledge representation framework in describing the application expert's problem-solving knowledge. Furthermore, end-users may wish to modify an expert system developed for them by a programmer, and should not have to call back the programmer for every correction or enhancement they make to the system.

The expert system shells currently available are making the task of the system builder easier. They reportedly shorten development time, and are virtually

essential for prototyping (although to construct a usable expert system, one usually needs to add a lot more software on top — and the system ends up being predominated by its user interface!). However, even with such development tools, building a KBS is still much like programming, and still can only be done by the expert users described above. The main difficulties preventing end-users and application experts (non-programmers) from becoming system builders include: understanding Boolean logic, certainty factors, complex rule-interactions, and the system's control structure (*e.g.*, why does one rule get fired before another?).

So to design better knowledge representation systems, and expert system shells, our goals should be to make it easy for the user to (i) describe knowledge to the system, and (ii) understand what the system is actually doing. These are two separate, and very important, issues for the usability of a KBS. The first calls for more natural knowledge representation languages, sophisticated interfaces, or better knowledge acquisition tools. The second calls for better explanations by the system; a set of sophisticated tools for viewing the system's reasoning process in a comprehensive way can be valuable during system development. Further, for a system to be at all useful, it must be trusted by its users, and for this it must be able to adequately explain its reasoning.

A number of questions remain about exactly how much power a 'naive' user should be given. Should all users be able to modify the system? Should they only be permitted to add new definitions? Or should they also be able to change the rules? What if the control structure — the heart of the system — needs to be modified? In answer to these questions, the amount of power given to end-users will probably depend on the particular application, and on the particular user. Therefore, we should strive to make our systems as accessible and understandable as possible, so that potentially any user could use our tools to construct her or his own knowledge-based system. It remains to be demonstrated that we can build such usable system development tools. □

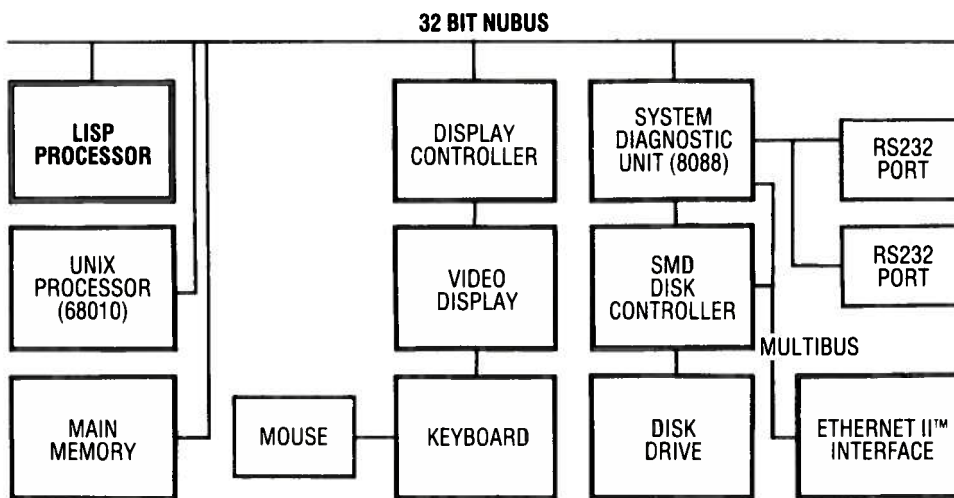


# LISP Canada Inc.

## Distributes and Services the LMI Lambda Machine

---

### LMI Lambda Machine



---

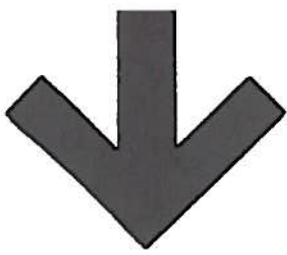
### USERS BENEFIT FROM:

- **MULTIBUS™ Compatibility**
- **Multi-processor Capability**
  - LISP Processor
  - 68010 UNIX Processor
  - 8088 System Diagnostic Unit
- **Virtual Control Store and Microcompiler**
- **Powerful Software Resources**



LISP Canada Inc.  
1000 Boul. Roche  
Vaudreuil, Québec, Canada  
J7V 6B3

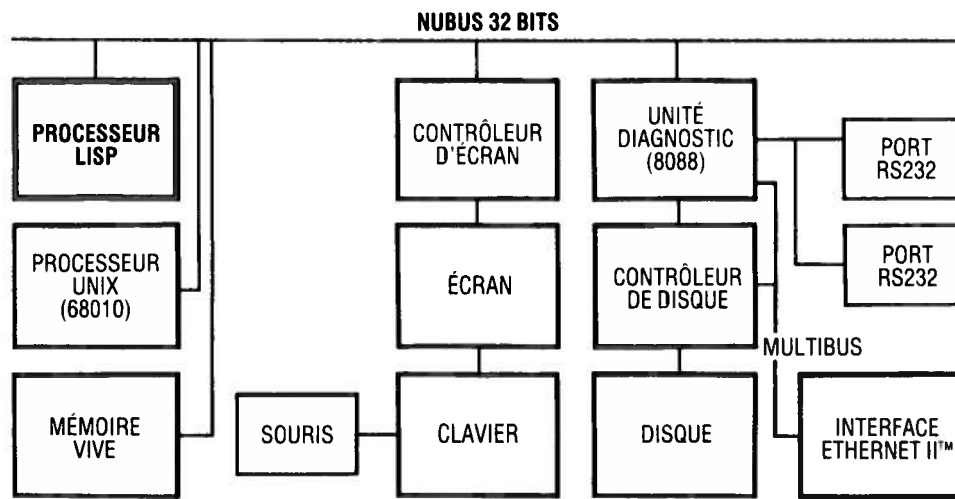
Tel: 514 464 5339



# LISP Canada inc.

## Distribue et entretient la machine Lambda de LMI

### Machine Lambda de LMI



### LES AVANTAGES DU LAMBDA

- **Compatibilité MULTIBUS™**
- **Accès à de multiples processeurs**
  - Processeur LISP
  - Processeur UNIX (68010)
  - Unité de diagnostic (8088)
- **Microcompilateur**
- **Logiciels puissants**



LISP Canada Inc.  
1000 Boul. Roche  
Vaudreuil, Québec, Canada  
J7V 6B3

Tel. 514 464 5339

## 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 15-19 for details.

**Second International Workshop on  
Natural Language Understanding and  
Logic Programming**

*17-19 August 1987*

Simon Fraser University  
Burnaby (Vancouver), B.C.

The workshop will consist of approximately 25 presentations of advanced theoretical and practical research projects in the area of natural language understanding and logic programming. Presentations will cover syntax, semantics, pragmatics, parsing techniques, generation, and relations with other formalisms. In addition, four panel sessions will be held.

For further information, contact  
Patrick Saint-Dizier  
School of Computing Science  
Simon Fraser University  
Burnaby, B.C., CANADA V5A 1S6

□ □ □ □ □

**Office Knowledge:  
Representation, Management  
and Utilization**

*17-19 August, 1987*

University of Toronto  
Toronto, Ontario

This workshop, sponsored by IFIP, will focus on the representation, management and use of knowledge in the office. This research area draws from techniques in artificial intelligence, database management systems, programming languages and communication systems. For more information, contact

Fred Lochovsky  
Computer Systems Research Institute  
University of Toronto  
Toronto, Ontario, CANADA M5S 1A4

Phone: 416-978-7441  
NET: fred@csri.toronto.edu

□ □ □ □ □

### **IEEE ELECTRONICOM '87**

*28-30 September, 1987*

Metro Toronto Convention Centre  
Toronto, Ontario

This conference, sponsored by the Canadian Region of the Institute of Electrical and Electronics Engineers, is divided into a seminar program and a workshop program. The seminars will showcase proven systems and services. The following topics will be considered: engineering applications for personal computers; computer assisted engineering; computer aided design and computer aided manufacturing; standards and quality control; the smart house; integrated services digital network; the integrated office.

The workshop program tentatively includes sessions on: surface mount technology; selecting and applying PCs for engineering applications; computer integrated manufacturing.

For further information, contact:  
ELECTRONICOM '87  
1450 Don Mills Road  
Don Mills, Ontario M3B 2X7

□ □ □ □ □

### U. S. Conferences

#### **AAAI-87:**

**National Conference on  
Artificial Intelligence**

*13-17 July 1987*

Seattle, Washington

The major U.S. AI conference, sponsored by the American Association for Artificial Intelligence. For more information:  
AAAI  
445 Burgess Drive  
Menlo Park, CA 94025, U.S.A.  
Phone: 415-328-3123

□ □ □ □ □

**The Second Conference on  
Theoretical Aspects of  
Reasoning about Knowledge**

*6-9 March 1988*

Monterey, California

The Second Conference on Theoretical Aspects of Reasoning about Knowledge, will be held at the Asilomar Conference Center in 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.

Some suggested, although not exclusive, topics of interest are:



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

You are invited to submit ten copies of a detailed abstract (not a complete paper) to the program chair:

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

Abstracts should be no longer than ten double-spaced pages. The deadline for submission of abstracts is 31 August 1987.

□ □ □ □ □

**Artificial Life:  
An Interdisciplinary Workshop  
on the Synthesis and Simulation  
of Living Systems**

*21-25 September 1987*

Center for Nonlinear Studies  
Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

Artificial life is the study of artificial systems that exhibit behavior characteristic of natural living systems. This includes computer simulations, biological and chemical experiments, and purely theoretical endeavors. Processes occurring on molecular, cellular, neural, social, and evolutionary scales are subject to investigation. The ultimate goal is to extract the logical form of living systems.

The time seems appropriate for a gathering of those involved in attempts to simulate or synthesize aspects of living systems. This workshop will provide a forum to address the fundamental problems inherent in such an enterprise.

The goal of this first workshop on artificial life are:

- To bring the field of artificial life into focus.
- To present current work in artificial life, and to provide an historical perspective.
- To open a channel of communication between researchers from disciplines whose work is relevant to artificial life.
- To produce a list of fundamental questions that the field should address.
- To identify ways in which work on artificial life can contribute to theoretical biology.

Queries about the workshop in general and requests for registration forms should be mailed to:

ALIFE Workshop  
CNLS MS-B258  
Los Alamos National Laboratory  
Los Alamos, NM 87545, U.S.A.  
NET: cgl@lanl.gov  
Phone: 505-667-1444

□ □ □ □ □

**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. Original papers are being solicited in areas such as 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. Papers may present applications, evaluations, limitations, and general tools and techniques. Papers that critically evaluate a formalism or processing strategy are especially welcome. Papers or panel proposals discussing end-user experience with natural language systems are also encouraged.

Authors should submit ten copies of a 6-8 page summary (single-spaced, exclusive of references) by 1 September 1987 to:

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

□ □ □ □ □

**IFIP W.G.5.2 Workshop on  
Intelligent CAD**

*6-8 October 1987*

Massachusetts Institute of Technology  
Cambridge, Massachusetts, U.S.A.

The purpose of this workshop is to provide a forum for discussion of theories and methodologies of intelligent CAD, aiming at better realization of practical systems. This workshop is the first in a series of three, to be held in successive years in the U.S.A., Europe and Japan.

At this first workshop in the series, the organizers wish to bring together researchers in the fields of artificial intelligence and computer-aided design with the goal of identifying and developing basic theoretical foundations for future intelligent CAD systems. This workshop will be a unique opportunity for the exchange of views and ideas.

For more information:

Professor Hiroyuki Yoshikawa,  
Dept. of Precision Machinery Engineering,  
Faculty of Engineering, University of Tokyo  
7-3-1 Hongo, Bunkyo-ku Tokyo 113, Japan  
Phone: (03) 812-2111, ext. 6446  
Fax: (03) 812-8849  
Telex: 272 2111 FEUT J

□ □ □ □ □

**IEEE Computer Society  
Workshop on Computer Vision**

*30 November–2 December 1987*

Fontainebleau Hilton, Miami Beach, Florida

Regular and poster papers are solicited on the following and related topics: 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.

Each paper should be complete and have a cover sheet with the title, authors' names, primary address, index terms including at least one of the above topics, and the type of paper (regular or poster). The cover page will not be sent to the reviewers. The body of the paper must contain the title of the paper and an abstract of about 250 words, followed by the text of the paper. The authors' names and organization should not be on the body of the paper. The paper should not exceed 25 double-spaced typed pages for regular papers (including about 6000 words of text and illustrations), or 12 double-spaced typed pages for poster papers (including about 3000 words of text and illustrations).

Four copies of papers should be sent by 14 July 1987 to:  
Narendra Ahuja  
Coordinated Science Laboratory  
University of Illinois  
1101 W. Springfield Avenue  
Urbana, Illinois 61801, U.S.A.

□ □ □ □ □

**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. Submissions (up to 3500 words) may be made either on paper (5 copies) or on some standard electronic medium by 21 September 1987 to:

Conference on Office Information Systems  
Dr. Robert B. Allen, 2A-367  
Bell Communications Research  
Morristown, NJ 07960, U.S.A.

□ □ □ □ □

**Outside North America**

**IJCAI-87:  
International Joint Conference  
on Artificial Intelligence**

*23–28 August 1987*

Milan, Italy

IJCAI is the major international conference in AI. Conference programs and registration forms were mailed to all CSCSI/SCEIO members in April. For additional copies, phone *Canadian A.I.* at 416-978-8747. Pre-registration forms must

be postmarked by 15 July; after that, you must register on site.

□ □ □ □ □

**COLING-88:  
12th International Conference on  
Computational Linguistics**

*22–27 August 1988*

Budapest, Hungary

Papers are invited on all aspects of computational linguistics. They should report on substantial, original and unpublished research and should indicate clearly the position of the work described within the context of the research in the given domain and emphasize what new results have been achieved.

Authors should submit four copies of an extended abstract not exceeding seven double-spaced pages plus a title page including the name(s) of the author(s), complete address, a short (five-line) summary, and a specification of the topic area. Abstracts must be received not later than 10 December 1987 by the Chairperson of the Program Committee:

Dr Eva Hajicova (COLING-88)  
Charles University  
Faculty of Mathematics, Linguistics  
Malostranske n. 25  
CS-118 00 Praha 1, Czechoslovakia  
Inquiries about the conference, exhibitions, and demonstrations (live and video) should be directed to:  
COLING-88 Secretariat  
c/o MTESZ Congress Bureau  
Kossuth ter 6-8  
H-1055 Budapest, Hungary  
Telex: 225792 MTESZ H

COLING-88 will be preceded by tutorials and workshops, and immediately followed by the 3rd EURALEX Congress on all aspects of lexicography, also to be held in Budapest. (See also the next item.)

□ □ □ □ □

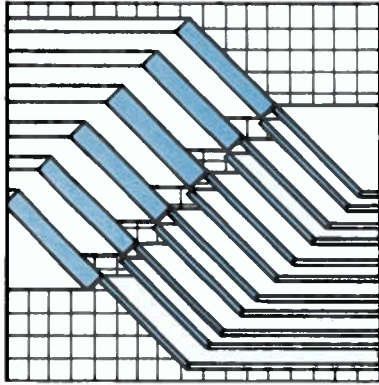
**New Directions in Machine Translation**

*18–19 August 1988*

Budapest, Hungary

Though primarily aimed at visitors of COLING '88 (see previous item), this pre-COLING conference will help to direct attention to developments outside the mainstream of machine translation work in the more established circles of computational linguistics in Western Europe, North America and Japan. In addition to eminent speakers of international reputation, a chance will be given to young talent. For more information:

Klaus Schubert  
BSO/Research  
Postbus 8348  
NL-3503 RH Utrecht  
The Netherlands  
NET: schubert@dl11.uucp



# DELIVERING EXPERT SYSTEMS

## LEADERSHIP

CAIP Corporation is the leading Canada-based organization concentrating exclusively on practical applications of Artificial Intelligence technology. Since its inception in 1984, CAIP has developed extensive experience in the analysis and development of knowledge-based expert systems, the fastest growing segment of AI.

## RESOURCES

CAIP Professionals comprise experienced knowledge engineers, business consultants, systems analysts and many of Canada's leading scientists from universities across the country. The ability to configure project teams that include world renowned academics provides CAIP with a unique service.

## EXPERIENCE

CAIP is a member of International Artificial Intelligence. This affiliation provides CAIP with an unparalleled synergy with many of the leading companies in the fields of AI workstation hardware, AI software shells, mainframe database management systems and office systems technology.

## SERVICES

CAIP provides a full range of client services to organizations throughout Canada.

- EXPERT SYSTEM DEVELOPMENT
- APPLICATION SURVEYS
- FEASIBILITY STUDIES
- PROTOTYPE DEVELOPMENT
- CONTRACT RESEARCH AND DEVELOPMENT
- EDUCATION
- PRODUCT MANAGEMENT

106 Colonnade Road, Suite 220, Ottawa, Ontario K2E 7P4  
(613) 727-0082

5915 Airport Road, Suite 200, Toronto, Ontario L4V 1T1  
(416) 671-4650



**CAIP** CORPORATION

Canadian Artificial Intelligence Products

A member of the NEXA Group.

---

# RAPID PROTOTYPING TOOLS FOR AI



## Le Lisp

A new large Common Lisp subset developed by NRIA, Europe's top AI R&D institution. Both English and French versions available. Rich features include object extensions, multiple inheritance, color support, BIOS access, full screen editor, full debugger, and a large function set. The system enjoys easy transportability to a wide range of machines with efficient implementation and fast execution. \$695



## GCLISP New Products

A new line of products have been added to the popular Common Lisp AI development tools: an advanced processor version, a delivery package, a PC networking, and a graphics tool.

- 286 Developer (\$1718)
- GCLISP RUNTIME (\$140)
- GCLISP NETWORKS (from \$555)
- Halo Graphics (\$359)



## 'Q&A' from Symantec

Database/word processing package with an extensive Natural Language front end. Allows development of databases and documents using natural language. Can interface with popular 4th generation systems such as dBASE, WordStar, and Lotus 1-2-3. Some 25,000 copies sold in the U.S. during the past 9 months. \$495



## LPA Micro-PROLOG/APES Kit

Prolog and Expert System prototyping tool best suited for scientific and educational applications. Refined syntax gives flexibility appropriate for sophisticated programming. Several thousand copies sold throughout the world. \$1148 (PC version, kit) or \$564 (MAC version, micro-PROLOG only).

A R I T Y



## Arity Knowledge Systems Development Pack

A new generation AI prototyping tool for PCs. A prolog interpreter/compiler, a rule/frame-based Expert Systems shell with object hierarchy and inheritance, the external file and database access, a screen design kit, the linkage to conventional languages, and an IBM SQL access. \$1574

---

ORDER AND ENQUIRY: Call (613) 592-0084 or send Purchase Order to Applied AI Systems, Inc. Shipping and handling charges and provincial sales tax (Ontario residents only) apply.

Applied AI Systems, Inc. is an authorized dealer of the above AI software/hardware products.

 Applied AI Systems, Inc.  
P.O. Box 13550, KANATA, Ontario, Canada K2K 1X6  
Telephone: (613) 592-0084