Canadian Artificial Intelligence

Intelligence Artificielle au Canada

January/janvier 1988 No. 14

An official publication of CSCSI, the Canadian Society for Computational Studies of Intelligence
Une publication officielle de la SCEIO, la Société canadienne pour l'étude de l'intelligence par ordinateur

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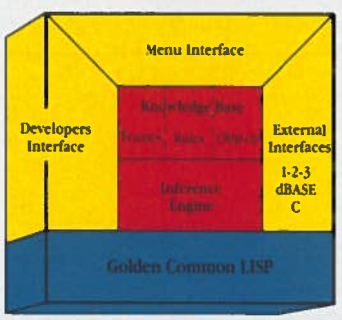

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–Randy Reiter, Athena Group

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Contents

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 affilée à l'Association canadienne informatique, et aux Intemational Joint Conferences on Artificial Intelligence, Inc.

Canadian Artificial Intelligence

Intelligence Artificielle au Canada

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

Memberships for CSCSI:
Membership form is contained within this issue. Please send subscriptions, memberships, and changes of address to:
CSCSI/SCEIO, c/o CIPS, 243 College Street, 5th floor
Toronto, Ontario, CANADA M5T 2Y1

Submissions:
Canadian Artificial Intelligence is published quarterly by CSCSI/SCEIO and is a benefit of membership in the society. *Canadian AI* 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. Paper or electronic submissions are welcome. Electronic submissions are preferred and should be unformatted. *Canadian AI* is published in January, April, July, and October. Material for publication is due six weeks before the start of the month of publication.

Advertising:
Advertising rates and press kits are available upon request from the address below, or phone 403-297-2600.

Please send submissions to / Prière d'envoyer contributions à:
CDNnet: CSCSI@noah.arc.cdn
UUCP: cscsi%noah.arc.cdn@alberta.uucp
ou à / or to: Marlene Jones
Canadian Artificial Intelligence
Alberta Research Council
6815 8th Street NE, 3rd floor
Calgary, Alberta, CANADA T2E 7H7

Cotisations pour SCEIO:
Le formulaire d'inscription est dans ce numéro. Prière d'envoyer tout abonnement, cotisation, et changement d'addresse à:
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Toronto, Ontario, CANADA M5T 2Y1

Contributions:
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 publication récentes, de thèses et de rapports; des trucs humoristiques ou artistiques, de bandes dessinées; des annonces (s'enquérir des frais); tout autre matériel touchant à l'IA. Contributions, sur papier ou par courrier électronique, sont bienvenues. Nous préférons le courrier électronique mais les submissions ne devraient pas avoir un format. L'*IA au Canada* apparait en janvier, en avril, en juillet, et en octobre. Toute communication à publier doit nous parvenir au moins six semaines avant le début du mois de parution.

Réclame:
Les prix pour les annonces et les trousses pour la presse sont disponibles sur demande. Écrivez à Marlene Jones à l'addresse à la gauche ou téléphonez 403-297-2600.

Book reviews and candidate books for review should be sent to:
Envoyez des critiques de livres ainsi que des livres à critiquer à:
CDNnet: gh@ai.toronto.cdn;
CSNET: gh@ai.toronto.edu;
UUCP: gh@utai.uucp.
ou à / or to: Graeme Hirst, *Canadian Artificial Intelligence*
Department of Computer Science, University of Toronto
Toronto, Ontario, CANADA M5S 1A4

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Executive Notes

One of my first duties as a new editor of *Canadian Artificial Intelligence* is to thank the previous editor, Graeme Hirst. Those of you who have read the magazine since its inception are well aware of Graeme's outstanding contributions. Graeme has managed to transform *Canadian AI* into a polished magazine, and he has done it largely on his own. True, he has had assistance, but not to the extent one might expect for a flourishing magazine. He has done everything from soliciting ads, articles, books and memberships to writing, typesetting and paste-ups. Sheila and I are very fortunate that Graeme has agreed to serve as Editor Emeritus and that he is extremely conscientious and prompt about answering his mail. Graeme will also continue to serve as book editor.

For this magazine to survive and continue to flourish, the responsibility must be shared. From my years in academia, I know that the various members of the AI academic community always have more on their plate than hours in the day. From my current position within a government research lab, I can assure you that the situation is no different! Sheila and I are fortunate to have a force of "volunteers" assisting us (as indicated on the left-hand side of this page), without whom this magazine would still not be ready to go to press. We would like to thank our colleagues for their enthusiasm, endurance and patience.

Because we have chosen to use a desktop publishing system for formatting the magazine, one of our main tasks was to re-establish the various layouts. Fortunately we had some professional assistance in this task and we would like to thank Ona Stonkus for making time in her busy schedule. This arrangement was made possible through financial assistance from the Advanced Technologies Department, Alberta Research Council, for which we would like to thank Dr. Brian Barge. Feedback and advice from the readers is, of course, welcome regarding the magazine's layout. More importantly, we want input from the readers regarding the content. Please send us opinion pieces, research reports, conference reports, etc. Tell us what topics you want discussed and what conferences you want reviewed. We want to include more discussion from the readers in future issues; so please send us mail!

I would also like to take this time to ask the help of the Canadian AI community in actively seeking further support for the magazine through additional members, sponsors and advertisers. To help in this regard, I have a few simple suggestions. Would every faculty member please inform both their senior undergraduate and graduate students regarding the society and magazine. I am always amazed to discover how many students interested in AI are not members of the society. If every student who graduates and moves into an industrial environment informed their colleagues, we would do a more thorough job of reaching the AI industrial community. Because our membership fees are very low, the magazine cannot be supported through membership fees alone. We need sponsors. In particular, we need advertisers. There are many manufacturers and software developers who wish to inform us of their wares, who wish to entice our graduate students into available jobs, and who wish to support the Canadian AI community through advertising. We would like your help in soliciting ads. We will gladly send you advertising information and back issues to distribute; or just send us the names of potential advertising contacts. I would also like to take this opportunity to thank Dr. Ernie Chang for initiating several advertising contacts on behalf of the magazine.

So each of you is now in charge of your own membership drive and advertising campaign. But as you assume these additional duties, please do not neglect your roles as contributors of articles, book reviews, abstracts, conference reports, cartoons, etc. No wonder we're all so busy!

Marlene Jones
Senior Editor

Treasurer's Report

There have been a lot of changes in the CSCSI in the last little while. One of the most notable is the change of editor for *Canadian Artificial Intelligence* magazine. This issue is the first to be produced by Marlene Jones and Sheila McIlraith, of the Alberta Research Council (Calgary), since taking over the editorial duties from Graeme Hirst.

As treasurer, I have been tracking the flow of funds and found the need for yet another change—an increase in membership dues. As of January 1, 1988, the new membership dues structure will be as follows:

Full member	Cdn$35
Student	Cdn$25
CIPS member	Cdn$25
Student CIPS member	Cdn$15

Our previous rates were

Full member	Cdn$25
Student	Cdn$15
CIPS member	Cdn$15
Student CIPS member	Cdn$ 5

There are several reasons for the increase. One is that our current agreement with CIPS National reduces our gross dues income by $10.00 for each non-CIPS member (an overhead charge for mailing maintenance, membership management, etc.). For $5 a year a non-CIPS student would previously have received four issues of *Canadian AI* magazine and have enjoyed reduced registration at conferences.

Everyone seems to agree that our magazine is one of the best benefits of membership. But magazine production costs exceed advertising revenue by about $2000 per issue. As reported in our financial statement for the period April 1, 1985, to March 3, 1986 (see issue No. 9), our net revenue from dues for that period was about $5,400. The bottom line is that magazine production for the last fiscal period produced a net loss of about $600.

While our last conference was financially the most successful yet, conference income is currently just enough to support our magazine losses and have something left over for organizing the next conference. There has been a suggestion that we must have some kind of meeting (e.g., a workshop) in non-conference years, or perhaps a yearly conference. This issue remains unsettled.

Our current membership is just under 900, down slightly from last spring (just after the Montreal conference), but up from September 1985 (650) and March 1984 (283). With the increase in membership dues for 1988, our society will break even only if we maintain the current level of membership. It is usually a membership dues increase that causes a reduction in membership numbers, but given the modest cost, I am hopeful that the Canadian AI community will respond by not only renewing their membership, but encouraging others to join as well.

Finally, it is important to remember that this is a volunteer organization. Your renewed support is the only mechanism to encourage the people who expend enormous amounts of time and energy to perpetuate the world's oldest national AI society.

Randy Goebel
CSCSI/SCEIO Treasurer

Notes from Members

New Binding

Ron Gershon of the University of Toronto to Expert Systems Centre, Allied Signal Canada Inc., 48 St. Clair Ave. West, Toronto, Ontario M4V 3A3.

Humour—Dear Dr. Rob

Dear Dr. Rob:

How can I tell if my project is "strong" AI or "weak" AI?

—Concerned

Dear Concerned:

If it can beat you at arm wrestling, it's strong AI.

Dear Dr. Rob:

I recently lost my shirt on the stock market. How can I use expert systems to avoid a repeat?

—M. Perkins, Mutual of Funds

Dear Mutual:

First you must recognize that the stock market is essentially mathematics. So by defining an n by m matrix P, where m is the length of the model and n is the number of stocks in your portfolio, the entries in P are determined by the average selling price of your stocks. Taking the null space of the transpose of P gives a Galois field which is isomorphic to a coded transcript of the financial pages of your newspaper, using the batting averages of the Expos as the basis vectors. It follows that multiplying your result by the phase of the moon combined with every fourth byte in the object code of a Lisp compiler written for MS-DOS will give you function f. This function gives the expected price distribution of stock Pij on market Z on day j.

Coding this into an expert system is now a trivial process. If the price of a stock is higher on day j than day j-1, simply buy the stock on day j-1 and sell on day j.

An alternate solution is encapsulated in the following expert system:

```
IF found(item=shirt,place=stock_market) THEN
    forward-to(item=shirt,recipient=m_perkins)
```

Dear Dr. Rob:

My two-year-old child will soon be entering play school and I was wondering which artificial intelligence tools you would recommend.

—Over-Achiever

Dear Over-Achiever

As a rule, I never recommend LISP machines for children under four. For your child, I would suggest the patented, world-famous "Dr. Rob Tiny Tot Beginner's AI ToolKit", which contains the materials necessary for creating small expert systems using a variety of knowledge representation techniques which are readily extensible to complex real-life situations, such as when to spill food for maximum parental impact. The kit may be ordered for only $999.95, in small unmarked bills, to Dr. Rob ToolKit, Caveat Emptor Enterprises, P.O. Box 31, Wawa, Ont. Please specify computer type, size and colour and allow 4-6 weeks for delivery.

Short Takes

Late Journals

Due to the financial collapse of one of the NRC's printing contractors, the publication and distribution of *Computational Intelligence*, as well as four other journals, has been delayed. The NRC expects that everything will have returned to normal by the end of 1987.

NRC Studies Canada's Science and Technology Future

The NRC has begun major studies into four areas of science and technology that it views as crucial to the Canadian economy. With the aims of focusing Canadian R&D on important national issues and on new technologies needed to counter growing economic pressure, the goal is to refocus NRC expertise and to develop new expertise in the areas of transportation, resources, optoelectronics, and health care technology.

Transportation is considered crucial because transportation problems are such a major factor in Canadian life. Canada spends proportionally more on transportation than any other industrialised country—40% more than the US, for example. This cost reduces the competitiveness of Canadian goods in the international marketplace.

Resource industries directly constitute 14% of Canada's GDP and nearly 35% of its gross exports; consequently, they have a major impact on the economy. Research in the resource areas is intended to address issues such as environmental impact and the application of computer technology, automation and robotics, instrumentation and sensors, and biotechnology to resource extraction and production.

Optoelectronics and pure optical devices are emerging technologies of great potential; Canada, with its heavy reliance on, and competence in, communication systems, is in a good position to both benefit from and exploit these technologies. To counter foreign initiatives in these areas, it is hoped to set up a national optoelectronics/optics program in partnership with industry and the universities.

Health care is facing a crisis in Canada, and we are not alone in this. Rising costs are presenting us with the prospect of reduced access and reduced quality of health care delivery. The aim of this initiative is to develop technologies that will help the health care system maintain the quality of health care while containing the costs.

The four study groups report back to the NRC Council, the governing body of the NRC, at the end of 1988.

Matching Grants Increased

The federal government has added $11 million to its matching funding program for universities for 1987/88. These funds are used to match industry grants for university research.

Prise de vue

Journaux en retard

Un des imprimeurs utilisés par le CNR ayant fait faillite, la parution et la distribution d'*Intelligence Informatique*, ainsi que de quatre autres journaux, sont retardées. Ces ennuis seront rectifiés d'ici la fin de 1987.

Le CNR étudie l'avenir du Canada en sciences et en technologie

Le CNR a entrepris d'importantes études dans quatre domaines scientifiques jugés cruciaux pour l'économie canadienne. Il s'agit d'encourager la recherche et le développement canadiens à aborder des questions d'intérêt national ainsi qu'à s'intéresser aux nouvelles technologies requises pour faire face aux pressions économiques sans cesse croissantes. Pour atteindre cet objectif, le CNR compte repenser son champ de compétence et acquérir de l'expertise en matière de transports, de ressources naturelles, d'optoélectronique, et de techniques de santé.

Le domaine des transports constitue un problème majeur au Canada. Nous y engloutissons plus d'argent que tout autre pays industrialisé; 40% de plus que les Etats-Unis, par exemple. Ces sommes réduisent notre compétitivité sur le marché international.

L'industrie des ressources naturelles représente 14% du PNB et 35% de nos exportations: une facette importante de notre économie! La recherche en ce domaine portera tout autant sur les questions d'environnement que sur les technologies informatiques, l'automatisation et la robotique, l'instrumentation, les sondes, et la biotechnologie, pour la mise en valeur de nos ressources naturelles.

L'optoélectronique constitue une technologie fort prometteuse dont le Canada, leader en systèmes de communication, peut tirer grand profit. Un programme national en optoélectronique, regroupant universités et milieux industriels, sera lancé pour faire contrepoids aux initiatives étrangères en ce domaine.

Le domaine de la santé est en crise au Canada, comme ailleurs. La hausse des coûts nous conduit à la possibilité d'une baisse de qualité voire à un accès réduit aux services. L'étude lancée espère développer des technologies qui permettront d'offrir la même qualité de service tout en limitant les coûts.

Les quatre groupes d'études feront rapport au CNR à la fin de 1988.

Subventions augmentées

Le gouvernement fédéral a ajouté $11 millions à son programme de subventions aux universités en 1987/88. Ces fonds sont utilisés pour verser des subventions égales aux contributions industrielles.

IRAP Funds Increased

The NRC's IRAP (Industrial Research Assistance Programme) will receive $28 million in new funds in the next four years. The increase works out to about 10 percent per annum.

WEST

WEST, Western Expert Systems Technologies, which set up shop in Calgary a year ago, is pursuing industrial contracts for expert systems technology. They are approaching the market with the premise that expert systems are no longer experimental, and that the basic tools needed to build marketable expert systems have been available for ten years or more. WEST has contracts for process control, manufacturing, and consultant expert systems.

CRIM Expands

CRIM, la Centre de récherche informatique de Montréal, Inc., is expanding, with new corporate members, new projects, and more staff. CRIM is a joint industry-university research centre.

GigaMos Buys LMI

GigaMos Holdings, Inc., has purchased LISP Machines, Inc., beating out Data General. LMI has been renamed GigaMos Systems, Inc., and is busy rehiring staff and upgrading customer equipment.

Neural Network Sandbox

Neural Systems, Inc., of Vancouver, has developed Awareness, a neural network demonstration program aimed at corporate users who wish to investigate neural networks.

Knowledge Garden

Knowledge Garden, Inc., of Nassau, NY, announced two products at AAAI-87: KnowledgePro and KnowledgeMaker. KnowledgePro is a PC-based AI development environment comprising frame- and rule-based inference, a list processing language, and the latest rage in tools, hypertext. KnowledgeMaker, written on KnowledgePro, is an induction engine designed to find relationships in data and to output the relations in rules compatible with a number of PC-based AI tools and languages, or in English statements.

Sun 4/260

Sun Microsystems, of Mountain View, Calif., has announced a new workstation, the 4/260. This is the first member of a new family of workstations based on a scalable RISC (Reduced Instruction Set Computer) processor architecture called SPARC. The 4/260 has a performance rating of 10 MIPS, more than twice the power of Sun's next most powerful model, and of equivalent power to the DEC Vax 8800. A fully configured system would cost in the order of $100,000.

This is interesting in the AI community because of an agreement between Sun and Xerox, Inc., whereby the Xerox InterLisp-D environment will be ported to the SPARC architecture. Xerox will replace its current 1100-

Plus d'argent pour l'IRAP

L'IRAP (Industrial Research Assistance Programme) du CNR recevra 28 millions pour les quatre prochaines années. Ceci représente une hausse d'approximativement 10% par année.

WEST

WEST, Western Expert Systems Technologies, qui a pignon sur rue à Calgary, travaille à des contrats pour des systèmes experts. La compagnie considère que ces systèmes n'en sont plus au stage expérimental et que les outils requis pour l'élaboration de tels systèmes existent depuis plus de dix ans. WEST développe des systèmes experts en contrôle, en production et en consultation.

CRIM s'agrandit

CRIM, le centre de recherche informatique de Montréal, Inc., se dote de nouveaux partenaires industriels, de nouveaux projets, et de nouveaux employés. CRIM est un centre de recherche conjoint université-industrie.

GigaMos achète LMI

GigaMos Holdings, Inc., a fait l'acquisition de LISP Machines, Inc., devançant Data General. Depuis, LMI s'appelle GigaMos Systems, Inc., et s'affaire à engager du personnel et à améliorer son équipement.

Réseau Neural

Neural Systems, Inc., de Vancouver, produit Awareness, un programme de démonstration d'un réseau neuro-physiologique pour ceux du milieu industriel qui s'intéressent à ce sujet.

Knowledge Garden

Knowledge Garden, Inc., de Nassau, NY, annonçait deux produits à AAAI-87: KnowledgePro et KnowledgeMaker. Le premier est un environnement de développement en IA pour les PC. Il comprend un langage pour le traitement de listes, des inférences par règle et par cadre, et la série d'outils hypertext. KnowledgeMaker, écrit en KnowledgePro, est un système de déduction qui analysent les relations existant entre des données et qui les extériorisent soit en anglais, soit sous forme de règles que plusieurs outils et langages d'IA sur PC peuvent utiliser.

Sun 4/260

Sun Microsystems de Mountain View en Californie a annoncé son nouveau poste de travail, le 4/260. C'est le premier-né d'une famille de postes de travail employant une architecture OIR (Ordinateur d'Instruction Réduit) appelée SPARC. Le 4/260 tourne à 10 MIPS, l'équivalent d'un DEC VAX 8800, soit deux fois la puissance du modèle Sun jusqu'alors le plus performant. Le système au complet coûte environ 100,000$.

La nouvelle est d'importance pour ceux qui travaillent en IA car, grâce à une entente entre Sun et Xerox, InterLisp-D de Xerox sera installé sur SPARC. Xerox remplacera au cours des prochaines années ses postes 1100 par des postes de travail utilisant SPARC. Sun devrait possiblement offrir InterLisp-D à tous ses clients.

series workstations with workstations based on the SPARC architecture in the next few years; presumably, Sun will market the InterLisp-D environment to its AI customers.

Gold Hill Has Been Busy!

Gold Hill, Inc., has been aligning itself with corporations worldwide:

- with Computer Engineering and Consulting, Ltd., of Japan, for the translation and marketing of Gold Hill's products in Japan;
- with Applied Expert Systems, Inc., regarding the latter's Computed Text product, which generates natural language end user reports from expert systems and Common LISP programs. It will be available for Gold Hill products in the first quarter of 1988;
- with Data General to develop and market Gold Hill's products, including GoldWorks, for PCs managed by Data General's Personal Computer Integration product;
- with Wang to promote Gold Hill products on Wang's PC 280 and PC 380 series;
- with Symbolics, which will deliver MACSYMA, the symbolic mathematics tool, on PCs using Gold Hill's GCLISP Developer software;
- with Honeywell Bull's Knowledge Engineering Center, which will use Gold Hill products to develop AI applications.
- with Prime Computer—Gold Hill products will be used by Prime regional offices as a teaching tool; the students are Prime's employees.

Symbolics Announces New Products

Symbolics, Inc., has announced a number of new products, with the aim of increasing its presence in mainstream computing:

- the CommonLisp Operating Environment (CLOE) allows certain applications developed on Symbolics workstations to be delivered on 80386-based PCs;
- the Symbolics 386 Coprocessor Board plugs in to Symbolics 3600-series workstations and allows applications to be run under UNIX and MS-DOS under the control of Genera, the Symbolics operating environment;
- Symbolics C, an ANSI draft standard compliant C compiler integrated into the Genera environment;
- Symbolics SNA 3270, a software interface that allows Symbolics workstations to connect to SNA networks;

Common Lisp and Relational Databases

MAD Intelligent Systems, Inc., of San Jose, Calif., has announced RelationalLISP, a CommonLisp/relational database integrator. The product allows the user to represent and manipulate relational databases within the CommonLisp paradigm.

OPS5 for PCs and Macintoshes

Computer Thought Corporation is shipping a protected mode version of its OPS5+ development system. This new version allows accessing of up to 24 MBytes of memory and runs on 80286- and 80386-based PCs and the Apple Macintosh.

Gold-Hill bosse!

Le champ d'action de Gold Hill, Inc., est mondial. La compagnie travaille conjointement à

- la traduction et la mise en marché de ses produits au Japon en coopération avec Computer Enginnering and Consulting, Ltd., du Japon.
- Computed Text, qui génère des rapports en langue naturelle à partir de systèmes experts et de programmes en Common Lisp; un produit d'Applied Expert Systems, Inc.. Ce système sera disponible pour les produits Gold Hill au premier quart de 1988.
- la mise en marché des produits Gold Hill, y compris GoldWorks, pour les PC roulant le Personal Computer Integration de Data General.
- bis pour les ordinateurs PC 280 et 380 de Wang.
- MACSYMA, l'outil de mathématique symbolique de Symbolics, qui utilise le GCLISP de Gold Hill.
- la conception du Bull's Knowledge Enginnering Center de Honeywell, qui utilisera les produits Gold Hill pour les applications en IA.
- l'utilisation par les employés de Prime Computer des produits Gold Hill en tant qu'outils d'apprentissage.

Symbolics annonce de nouveaux produits

Symbolics, Inc., vient d'annoncer de nouveaux produits visant un plus vaste marché:

- CLOE, le CommonLisp Operating Environment, qui permettra l'emploi de certaines applications développées pour les postes de travail Symbolics sur des PC utilisant le 80386.
- Le coprocesseur 386 de Symbolics qui permet à leurs postes de travail de rouler sous UNIX et MS-DOS, sous le contrôle de Genera, le système d'exploitation Symbolics.
- Symbolics C qui respecte le standard ANSI et qui est intégré à Genera.
- Symbolics SNA 3270, un logiciel qui permet aux postes de travail Symbolics de se brancher dans des réseaux SNA.

CommonLisp et les bases de données relationnelles

MAD Intelligent Systems, Inc., de San Jose en Californie, annonce "RelationalLISP", qui intègre CommonLISP et bases de données relationnelles. Ceci permet à l'usager de se servir de telles bases à l'intérieur de CommonLISP.

OPS5 sur les PCs et le Macintosh

Computer Thought Corporation vend une version du système OPS5 qui permet l'accès à 24 Moctets de mémoire, et qui roule sur le Macintosh d'Apple ainsi que sur les PC utilisant le 80286 ou le 80386.

SmallTalk sur les HP9000s

ParcPlace Systems, la filiale de Xerox PARC qui commercialise le langage SmallTalk, vient d'annoncer l'implantation du langage SmallTalk sur les postes de travail HP9000S de Hewlett-Packard. HP participera à ce projet.

Symbolics s'envole!

Symbolics, Inc., a décroché un contrat de $50,000 US du NASA Ames Research Center pour la conception initiale

SmallTalk on HP9000s

ParcPlace Systems, the Xerox PARC spinoff set up to commercialize the SmallTalk language, has announced that they will be porting SmallTalk to the HP9000 series of technical workstations from Hewlett-Packard. HP will be assisting with the port.

Symbolics Trips Out

Symbolics,Inc. has been awarded a US$50,000 contract by NASA Ames Research Center for the preliminary design of a Spaceborne Symbolic Processor (SSP). The SSP is intended for both symbolic and numeric computation applications aboard the space station, the next generation space shuttle, and several other space vehicles. The design is based on Symbolics' 40 bit Ivory chip, a single chip symbolic processor.

Texas Instruments Announces New Explorers

Texas Instruments, Inc., has revamped the Explorer workstation family with two new machines based on TI's proprietary symbolic processor chip. TI claims performance five times better than with the previous Explorers; coprocessors allow the new Explorers to run UNIX System V concurrently.

Machine Translation System

Smart Communications, Inc., has demonstrated a machine translation expert system that translates English into French and Spanish. Running on a Sun workstation, the system can translate 90,000 words per minute, translating technical documentation. The system is comprised of some 2500 rules and relies on an application-specific database.

Knowledge Craft Unbundled

The Carnegie Group has announced that they will now be selling the modules that make up Knowledge Craft separately. Module prices will range from US$7,80-US$23,200.

Neurocomputing

Hecht-Nielsen Neurocomputer Corp. is selling their ANZA AZ1500, a neurocomputer integrated with an Intel 80386-based host computer.

Neural Network Wares

Neuralware, Inc. has announced two products. The first is Neuralworks, a system that allows the user to design and edit neural networks in logical layers. The second is a book, *The 1987 Annotated Neuro-Computing Bibliography*.

Olivetti AI

The huge Italian computer company, Ing. C Olivetti & C. S.p.A., has quietly been building its AI presence since 1985. It currently has two AI labs, one in Italy and one in California. Projects/products cover the range from in-house applications to natural language systems, PC-based tools, and AI workstations.

d'un Spaceborne Symbolic Processor (SSP). Ce processeur sera utilisé pour des applications numériques et symboliques à bord de la station spatiale, de la prochaine génération de navettes, et de plusieurs autres véhicules spatiaux. SSP est fondé sur la puce 40 bit Ivory, une unité centrale.

Texas Instruments et les nouveaux Explorers

Texas Instruments, Inc., a relancé la famille de postes de travail Explorer en la dotant de deux nouveaux modèles utilisant un processeur TI. Ces machines devraient rouler cinq fois plus vite que les anciens Explorer. De plus, un coprocesseur permet l'utilisation en parallèle du système V de Unix.

Système de traduction informatisée

Smart Communications, Inc., a présenté un système expert de traduction de l'anglais au français et à l'espagnol. Le logiciel, qui tourne sur un Sun, traduit 90,000 mots de documentation technique à la minute. Il comprend 2500 règles et dépend de bases de données spécifiques au domaine d'emploi.

Knowledge Craft

Le Carnegie Group annonce que, désormais, ils vendront séparément les modules formant Knowledge Craft. Le prix varie entre $7,800 US et $23,000 US.

Approche neuro-physiologique

Hecht-Nielsen Neurocomputer Corporation vend ANZA AZ1500, un réseau neuro-physiologique intégré à un Intel 80386.

Neuralware

Neuralware, Inc., annonce deux produits: Neural Works est un système qui permet à l'usager de construire et de modifier un réseau neuro-physiologique en strates logiques. Le deuxième produit est un livre, la *1987 Annotated Neuro-Computing Bibliography*.

IA chez Olivetti

Olivetti, l'énorme compagnie italienne d'informatique, accroit discrètement sa présence en IA depuis 1975. La compagnie a un laboratoire en Italie et un autre en Californie. Les projets et les produits vont des applications-maison aux systèmes de langue naturelle, aux outils pour PC, et aux postes de travail pour l'IA.

Lexique bilingue sur l'IA

(Yves Lespérance et Graeme Hirst)

Lorsqu'une discipline scientifique invente de noveaux mots, ou utilise des mots existants avec un sens nouveau, elle engendre par la même occasion un problêmeau niveau de la traduction de cette nouvelle terminologie dans des langues aures que celle d'origine.

La plupart des mots du vocabulaire de l'informatique et de l'intelligence artificielle sont d'origine anglaise. Plusiers groupes francophones au Canada et ailleurs développent leurs propre terminologie française, laquelle est souvent incompréhensible à l'exterieure de leur departement. Le problême de maintenir une certaine

Bilingual Glossary for AI

(Yves Lespérance and Graeme Hirst)

When a science invents new words or uses old words in new ways, there is always the problem of how the new terminology is to be translated into other languages. In computer science and artificial intelligence, most of the words are born in English. Many French-speaking groups in Canada and elsewhere develop their own French terminology, which is not always understood outside their own department. Consistent translation of terms has been a recurring problem for this magazine.

One solution is technical translation dictionaries. For example, the Quebec Office de la langue française has published *Terminologie de l'informatique* (Les publications du Québec, October 1983: ISBN 2-551-05790-6), which lists 3,875 English computing terms with their French translations; an index allows translation from French to English. Unfortunately, such dictionaries quickly become out of date, especially in rapidly developing subfields such as AI.

It is therefore good to see that artificial intelligence is the topic of the latest glossary published by the federal Department of the Secretary of State, Terminology and Linguistics Branch. The glossary, which contains about 1,000 terms in artificial intelligence, is in the branch's terminology series.

The coverage of the field is far more extensive and up to date than the broader Quebec book provides. The translations are generally very good and tend to be descriptive of current usage rather than normative; the majority are fairly literal renderings.

The glossary was compiled under the direction of Silvia Pavel, with the assistance of Noël Lazure. Professor Stan Matwin, of the University of Ottawa, reviewed the corpus. The compilers are particularly interested in receiving feedback from those who use the terminology; an address is given in the preface to the book.

It is always easy to criticize such works for their omissions, but such criticisms are relatively minor. The glossary will be a great help to anyone writing about AI in French, not to mention the volunteer translators of *Canadian AI*.

The glossary is available free of charge (in small numbers) from: Publications Service Promotion and Client Services Directorate, Department of the Secretary of State, Ottawa, Ontario, Canada K1A 0M5; (819)994-0715, (819)997-1275.

AI and Cognitive Science in Toronto

The AI and cognitive science community centered at the University of Toronto is large and widely distributed. To help everyone keep abreast of what's going on where, a new newsletter, *Toronto Intelligence* (an oxymoron? – Ed.) is reporting on events and research.

Toronto Intelligence describes itself as an "interdisciplinary forum on intelligence and cognition issues and research". It is published monthly: a "full" issue every second month, alternating with an issue listing talks, seminars, and other forthcoming events in Toronto in such areas as AI, linguistics, psychology, and philosophy. The newsletter is edited by Timothy Horton, a graduate student in Computer Science at the University of Toronto, and is sponsored by the McLuhan Program in Culture and Technology.

uniformité dans la traduction des termes est toujours présent pour ce magazine.

Les dictionaires de traduction technique sont une solution à ce problême. Par example, l'Office de la langue française du Québec a publié *Terminologie de l'informatique* (Les publications du Québec, Octobre 1983: ISBN2-551-05790-6) où 3875 termes anglais du vocabulaire de l'informatique sont associé à leur equivalents français. Un index permet la traduction du français à anglais. Malheursement, tels dictionaires deviennent rapidement désuets, particuliérement dans des domaines en évolution rapide tels que l'intelligence artificielle.

La parution d'un lexique sur l'intelligence artificiellé publié par le Secretariat d'état du Canada, Direction générale de la terminologie et des services linguistique ne peut donc être acquillie qu'avec enthousiasme. Le lexique, qui contient près de 1000 termes du vocabulaire de l'intelligence artificielle, fait partie d'une série publié par cette agence gouvernementale (Les cahiers de terminologie).

La couvreture du domaine est beaucoup plus étendue et plus à jour que celle de l'ouvrage plus général de l'Office de la langue française. Plusiers entrées contiennent des définitions explicatives. Les traductions sont généralement très bonnes. L'ouvrage vise à répertorier l'usage courant plustot qu'à une normalisation de l'usage. La majorité des traductions sont plutôt littérales.

Le lexique a été compilé sous la direction de Silvia Pavel, avec l'assistance de Noël Lazure. Le Professeur Stan Matwin de l'Université d'Ottawa a passé en revue le corpus. Les auteurs sont particulièrement intéressés à recevoir les commentaires des utilisateurs du lexique; une addresse est donné dans la préface du livre.

Il est toujours facile de critiquer de tels ouvrages pour leurs omissions. Mais ces critiques sont relativement mineures. Le lexique sera d'un grand secours à quiconque écrit sur l'IA in français, sans compter les fraducteurs bénévoles de L'IA au Canada.

Le lexique est disponible gratuitement (en quantités restreintes) de: Service des publications Directions de la promotion et des service aux clients Secrétariat d'état, Ottawa, Ontario, Canada. K1A 0M5; (819)994-0715, (819)997-1275.

Toronto Intelligence Bulletin d'information sur l'IA et les sciences cognitives à Toronto

La communauté qui s'intéresse à l'IA et aux sciences cognitives autour de l'Université de Toronto est importante et très décentralisée. Le nouveau bulletin d'information *Toronto Intelligence* vise à mieux disséminer l'information sur les événements courants et la recherche dans cette communauté. *Toronto Intelligence* se décrit comme "un forum interdisciplinaire sur les questions de l'intelligence et de la cognition et sur la recherche dans ces domaines". C'est un mensuel: une édition "complète" à tous les deux mois alterne avec une édition plus brève qui énumère les conférences, séminaires, et autres événements à venir dans des domaines tels que l'IA, la linguistique, la psychologie, et la philosophie. L'éditeur de Toronto Intelligence est Timothy Horton, un étudiant gradué en informatique à l'Université de Toronto. Le bulletin est commandité par le Programme McLuhan sur la culture et la technologie. Le

The newsletter is available free of charge to anyone and is accessible through the U of T campus mail or the Ontario interuniversity mail system (IUTS). To subscribe, to submit an article or listing, or for more information, contact the editor:
Timothy Horton, Department of Computer Science, University of Toronto, Toronto, Ontario M5S 1A4;
Net: tjhorton@ai.utoronto.edu,
CDNnet: tjhorton@ai.toronto.cdn;
(416)979-3109, (416)978-5182

bulletin d'information est disponible gratuitement à toute personne qui peut être rejointe par la poste du campus de l'Université de Toronto ou le système postal interuniversitaire de l'Ontario (IUTS). Pour souscrire, soumettre un article, annoncer un événement, ou obtenir plus d'informations, veillez contacter l'éditeur: Timothy Horton, Department of Computer Science, University of Toronto, Toronto, Ontario M5S 1A4; Poste électronique: tjhorton@ai.toronto.edu; tjhorton@ai.toronto.cdn; Tél: (416)979-3109; (416)978-5182.

Opportunities for the Use of Artificial Intelligence Systems within the Government of Canada

by Nordicity Group and CAIP Corporation

Le potentiel d'utilisation des systèmes d'intelligence artificielle à l'intérieur du gouvernement canadien.

RÉSUMÉ: Ce rapport explore les possibilités d'application des technologies d'intelligence artificielle (IA) à l'intérieur du gouvernement fédéral et examine les effets multiplicateurs potentiels des achats gouvernementaux pour la stimulation du développement industriel dans le domaine de l'IA au Canada. Le rapport identifie un certain nombre d'applications potentielles dans le gouvernement. Il a recommendé qu'une stratégie planifiée et bien coordonnée devrait être utilisée pour développer ces applications. De plus, le gouvernement devrait établir des politiques d'achat spécifiques visant à promouvoir l'essor des fournisseurs domestiques de produits d'IA.

A study to explore opportunities within federal government operations to use artificial intelligence (AI) technologies and to examine the potential leverage of procurement for stimulating industrial development in the AI field in Canada has recently been released by the Department of Supply and Services. The work was undertaken by Nordicity Group and CAIP Corporation under contract to the Department of Supply and Services, with the Ministry of State for Science and Technology as the Scientific Authority for this contract.

The following is a summary of the findings and recommendations of the final report. The conclusions and recommendations do not necessarily reflect policy of the federal government.

If you require further information regarding the report or wish to obtain a copy, please contact: Strategic Technologies Branch, Ministry of State for Science and Technology, 240 Sparks Street, 8th Floor West, Ottawa, Ontario, K1A 1A1, Attn: Mr. Peter K. MacKinnon; or phone, (613) 993-7597.

Study Findings

The study was aimed at identifying opportunities for AI applications in government. Some forty candidate AI opportunities were identified. It is anticipated that these opportunities represent only a fraction of possible applications.

Type of AI Applications: The most frequent AI applications identified were expert systems, followed by the use of natural language for database query.

Type of Applications Being Replaced or Supported by AI: Most of the AI opportunities lie in areas whose current operations are performed by humans; the majority of the remainder involve semi-automated information systems, while only a few of the AI opportunities are extensions of fully automated systems.

Timeframe for Implementation: Over a third of the AI opportunities identified were found to be suitable for immediate implementation using current AI technology; fewer than a quarter require considerably more technical developments in AI before they can be implemented.

Nordicity Group is an Ottawa-based research management consultant on communication and information technologies. CAIP Corporation is an Ottawa-based company that implements applications of AI technology.

Conclusions and Recommendations

The conclusions and recommendations are divided into two groups, those dealing with the application of AI to government operations and the use of government procurement as a vehicle to stimulate the Canadian AI supplier base.

Government Use of AI

The study concluded that AI applications in government operations have the potential to improve government productivity, to provide faster and better decision support systems, and to improve service to the public.

Given the potential application of AI technologies to government, its introduction into the federal government should be the result of a deliberate strategy, rather than a haphazard and potentially redundant process. For immediate applications, the report pointed out that AI applications should receive priority where implementation can be achieved easily and where the payoff to government is clear. On the other hand, the government should also consider longer-term needs.

The conclusions of the report proposed an implementation plan as follows:

- each department pursues a course of AI implementa-

tion through demonstration projects;

- each department evolves its own internal coordination mechanisms to ensure department-wide implementation;
- an interdepartmental user group be established to support and stimulate the development of AI applications in government;
- one agency be designated to coordinate a government-wide strategy for AI and act as the central focus in determining how government can exploit AI opportunities effectively; and
- over time, the central or service agencies such as Supply and Services, Treasury Board and Public Service Commission, develop specific AI plans in terms of procurement, productivity enhancement, personnel classification and budgetary allocation.

Government Procurement of AI

Government procurement is important for the growth of AI supplier companies by providing these companies with opportunities to commercialize technologies developed in response to government needs. In return, these companies become part of an AI infrastructure, which can help upgrade productivity across the board in government. As well, these same companies will contribute to productivity gains in the private sector and enable Canada to have "something to trade" in the world pool of technology.

Canadian suppliers are still developing and face formidable barriers relative to their U.S. counterparts. It is concluded then, that procurement policy should be developed as an aspect of industrial stimulation, or else Canada is likely to have a very weak AI supplier base.

Strategic Targets: A procurement strategy needs targets for industrial development, as well as mechanisms to implement the strategy. Therefore, it is recommended that the government establish targets for the evolution of an indigenous AI supplier industry over the next five years.

To achieve these targets, Canada will have to specialize in certain AI fields and applications. The federal government will have to work closely with industry to concentrate the investment in areas of high potential commercial payoff.

Development targets should also consider the need for critical mass and regional objectives. AI applications should establish key linkages to regional university and federal and provincial government research activities, in this way becoming agents of technology transfer.

Finally, the report recommended that federal government procurement should be constructed so as to facilitate the innovative business arrangements of the AI supplier industry, which include such practices as consortia and strategic partnerships.

Procurement Guidelines: The report concluded that the general thrust of a supplier development strategy would be to create a demand for AI products and services through federal government procurement, with explicit use of the contracting out policy. Additional guidelines are as follows:

- companies and government must be prepared for multi-year commitments, so that the companies have something marketable to the world afterwards;
- the government procurement process should also foster Canadian private sector AI usage to obtain further dollar commitments that in turn support AI suppliers; and
- while multiple procurements to a few firms should foster strong companies, the broad range of AI applications suggests there is merit in triggering the development of numerous supplier firms.

It is concluded, therefore, that a substantial number of AI applications exist in government and that they can generate real benefit in terms of productivity, decision-making support and enhanced service. These applications should be pursued as part of an overall strategy within each department, and the experience from the initial applications should be shared on an interdepartmental basis. In parallel with this application development process, the government should establish specific procurement strategies and policies to promote the growth of domestic suppliers. AI technology, properly applied, can result in benefits that are a large multiple of the original cost.

Annual Meeting of the CIAR AIR Group

by Russell Greiner

Réunion Annuelle du CIAR

RÉSUMÉ: Le CIAR, l'Institut Canadien de Recherche Avancée, est une corporation privée à but non lucratif s'intéressant aux ressources tant intellectuelles que financières requises par toute recherche à long terme d'importance nationale. Son premier et plus gros mandat porte sur l'Intelligence Artificielle et la Robotique (AIR). La réunion annuelle de 1987 comprenait des mini-cours et des présentations d'articles techniques. Il y a aussi eu une discussion générale au sujet de l'avenir du programme AIR.

Mont Ste. Marie, Quebec
23-26 October 1987

The Canadian Institute of Advanced Research (CIAR) is an institute without walls; it is a private, non-profit corporation established to focus resources, both intellectual and financial, on areas of long-term research important to Canada's future. Its first and largest program is in Artificial Intelligence and Robotics (AIR). This three-year-old program involves over thirty fellows, associates and scholars, whose research interests range from AI theory (focusing on knowledge representation and reasoning) and applications (ranging from expert system design to natural language processing and image understanding systems) to robotics (ranging from prosthetic devices to machines for moving trees) to

Russ Greiner is a research associate in the Department of Computer Science, University of Toronto.

psychology, neuroscience and systems theory. Despite their varied fields, these researchers share a recognized excellence: each is acknowledged as a world-class figure in his or her area.

. The CIAR sponsors various activities to further the interactions of its members. I was privileged to attend the group's 1987 retreat which this report summarizes.

Communication is, of course, one of the main goals of these gatherings. It is also quite a challenge, given the researchers' diverse backgrounds. To rectify this situation, several of the sessions were mini-tutorials. Two prominent System Theorists presented a three-hour tutorial on their field: George Zames (McGill) spoke first on "Feedback Hierarchies, Complexity and Systems Theory", followed by Peter Caines's (McGill) presentation "On the Theory of Adaptive Systems". These introductory lectures were followed by a session on applications of systems theory – Ian Hunter's (McGill) presentation of "Neuromuscular Control: Systems Theory Approach" and Peter Lawrence's (UBC) description of "The Teleoperation System". There was also an open discussion (led by Peter Caines, Ray Reiter (U of T) and the author) on ways of combining Systems Theory and Logic.

In another session, two of the researchers who founded the "Logic and Database" sub-discipline presented an excellent overview of this area: first John Mylopoulos (U of T) on "Knowledge Representation and Databases", then Wolfgang Bibel (UBC) on "AI, Logic and Databases".

Several other sessions focused on controversial issues: Geoff Hinton (U of T) and Hector Levesque (U of T) presented their respective interesting (and amusing) views on Connectionism. This followed Mark Seidenberg's (McGill) description of a real application of a connection system, "A Distributed Developmental Model of Word Recognition".

There was also a general discussion session officially titled "Should one study high-level or low-level vision?", which focused on an attempt to define and distinguish these two levels. This session received active participation from John Tsotsos (U of T), Robert Woodham (UBC), Alan Mackworth (UBC), Martin Levine (McGill), and Roger Browse (Queen's). The session was surrounded by several vision papers: David Lowe's (UBC) "Model-based Visual Recognition and Motion Tracking", Patrick Cavanagh's (U de Montreal) "Image Coding" and Allan Jepson's (U of T) "Towards Self-organizing Feature Maps".

Rounding out these technical papers were a pair of open discussions on the current and future state of CIAR's AIR program, from both the CIAR officials and the researchers themselves.

This retreat was very well planned. Many aspects – the tutorials, the small number of attendees and the free time, augmented with often rainy weather promoted interaction and communication among the members of this group. This gathering also furthered specific interests of several attendees – e.g., one of my personal interests is in investigating ways of merging AI (especially Machine Learning) and Control Theory techniques.

For more information about CIAR, please contact Jim Wentzell, 434 University Avenue, Suite 502, Toronto, Ontario M5G 1R6; (416)963-1380.

L'échéance pour le numéro d'avril est le 15 fèvrier

Programming Intelligent Robots

by John H. Andreae

La programmation de robots intelligents

RÉSUMÉ: Le Dr. Andreae présente ses idées sur comment des robots pourraient se comporter intelligemment dans des environnements imprévus. Il suggère qu'il sera impossible de donner aux robots les aptitudes et connaissances nécessaires à un comportement adéquat dans des environnements imprévus en les programmant et qu'il est impossible de formaliser l'intelligence et le langage, ceux-ci étant des conséquences dynamiques et changeantes de l'apprentissage. Les robots devront apprendre comme des bébés, avec peu de connaissances au départ, mais une grande capacité d'apprentissage.

Robots have a long way to go before the man in the street will consider them to be intelligent and friendly; most robots at the present time are little more than flexible machine tools fixed to a factory floor. Of course, research is proceeding apace to give robots handy manipulators, sophisticated vision, mobility, touch and so on. At the same time, people are writing programs to make robots carry out intricate tasks using their newly developed facilities. With programming languages developed especially for them, there is no doubt that the programming of robots will enable them to make plans and take decisions in complicated situations.

Mobility will make a big difference to robots. I don't mean the ability to move about within a constrained area where everything can be nicely laid out so that the programmer of a robot will know what it is going to encounter. It is when robots can explore our world that the difficulties will arise. It will not then be possible to program a robot with all the knowledge it might need of the real world around it, a world frequently full of surprises. To be intelligent in the real world, these advanced robots will need something more than programs to tell them what they should do. They will have to learn about the world and what to do in it.

Machine learning is a thriving research field, and a great deal of interesting work is going into efforts to give computers the ability to learn. There is a popular adage, dubbed Martin's Law, which is often quoted in the context of machine learning. It goes like this: "You can't learn anything unless you almost know it already"; or in another version, "For an organism to learn anything, it must already know a lot." Ideas like this tend to drive research in a particular direction, whether they are well founded or not. Notice that the first version I gave of Martin's Law was ambiguous and, instead of meaning what the second version states clearly, it could have meant that learning has to be incremental. Things must be learned a little at a time, so that just before you learn something completely you must nearly know it. That would be a harmless interpretation. The problem with the interpretation corresponding to the second version is that it encourages the idea that you have to fill a computer with knowledge before it can learn. This leads to the development of systems which behave in very clever ways but hardly learn anything at all.

Of course, we know that we humans are intelligent and we know that we learn to become intelligent. Few of us would consider that babies start with much knowledge, even though we accept that a baby is equipped with a remarkable body that it will learn to use as competently as we do. Isn't it strange that Martin's Law is so widely accepted? In the 1950s and the early 1960s it was considered quite reasonable to talk about learning machines being primed with the minimum of knowledge, but during the past two decades it has become a heresy amongst researchers in artificial intelligence (AI) to talk about systems that learn from a *tabula rasa*. Now, there are signs that the orthodoxy is weakening and the alternative views are being taken seriously. The current interest in connectionist systems is an example.

The AI research community has had good reasons for its attitude to unprimed learning systems. It is basic to the scientific approach that one should first understand how something works and then try to construct a formal model (i.e., mathematical model) of it. In computer science, of which AI is a branch, this amounts to formalizing processes before programming them. It is only in computer science that formal systems are constructed. The main thrust of AI research has been to understand the processes of intelligence by formalizing them, so that they can be programmed. Problem solving, language understanding and other aspects of intelligence have been subjected to intense research with the aim of formalizing them.

Some people have been expressing doubts about the possibility of formalizing language and intelligence. Of course, formal models will always provide an important part of the understanding of anything, including human characteristics, but we will have to take an engineering approach to the reproduction of language and intelligence. The job of science is to understand things. The job of engineering is to build things. Progress in engineering follows the sequence: build things, understand them better, build better things, and so on. In engineering, the formal systems of mathematics and computer science are never more than approximate

John Andreae obtained his B.Sc(ENG) in 1948 and Ph.D. in 1953 from Imperial College, London University. He started designing learning machines in 1961 at the Standard Telecommunication Laboratories, Harlow, Essex. Since 1966 he has been a professor in the Department of Electrical and Electronic Engineering, University of Canterbury, Christchurch, New Zealand. John Andreae was a Visiting Professor at the University of Calgary for the fall of '87.

models of what is being constructed. No one would dream of building a mathematical or computer model of a bridge or telephone exchange and expect to have a real one as a result! This is what is happening in AI. Formal models of intelligence and language are being treated as the real thing, instead of as approximate models of unformalizable human characteristics.

Now is the time to draw together the three points made above: (1) it will not be possible to program robots with the skills and knowledge needed to enable them to cope with complicated tasks in unexpected environments; (2) intelligence and language understanding are not formalizable, but are the dynamic and changing consequences of learning; and (3) robots will have to learn like babies, not in accordance with Martin's Law.

It is not the purpose of this article to extol the particular virtues of my approach to the design of unprimed learning systems. Other approaches may prove superior, and there is a real need for more research to discover and evaluate new methods. However, if a learning system is designed for a robot body, then we can expect the designer to take into account the facilities available in that robot body, but not to provide the skills and knowledge which the robot will require for future tasks in unexpected environments. It will be a long time before robots of this calibre are seen in the company of men and women, but not as long if we recognize the limitations of programming intelligence now.

Lisp Machines vs General Purpose Workstations: MIPS are not the whole story

by Ken Gamble

Machines Lisp vs postes de travail d'usage général:
les MIPS ne disent pas toute l'histoire

RÉSUMÉ: Les machine Lisp ont un rôle qui ne peut pas nécessairement être rempli par les postes de travail d'usage général. Dans son article de l'édition précédente de l'IA au Canada, Grant Buckler adopte une attitude de "soit l'un soit l'autre", qui omet d'examiner la possibilité de rôles différents pour les machines Lisp et les postes de travail d'usage général. Des outils de développement intégrés et de nouvelles configurations de matériel continueront de donner aux machines Lisp un rôle unique et en expansion dans l'informatique contemporaine.

Lisp machines have a role that cannot necessarily be filled by general purpose workstations. In his article in the last *Canadian AI* magazine Grant Buckler's either/or attitude towards Lisp machines and workstations failed to address the possibility of different roles for Lisp machines and general purpose workstations. Integrated development tools, expanding hardware configurations and software integration with other hardware will allow Lisp machines to retain a significant role in modern computing.

Mr. Buckler's article addressed the increased speed of general purpose workstation hardware, but speed of execution is a moot point if the underlying software development tools are inadequate. When asked why I like programming Lisp machines, I don't say it is because the machines run Lisp programs well or fast, or that they are "good for AI". Rather, Lisp machines have integrated tools which provide a powerful software development environment and it is these tools that set them away and above any other programming environment.

Ken Gamble works at the Alberta Research Council as an Associate Researcher. His background is in expert systems and current interest is in process planning.

A typical example of a Lisp machine development tool is the Symbolics Genera full screen debugger. This tool provides a comprehensive display of the debugging context, including the program stack. It displays the values of the arguments and local variables of the current stack frame, as well as the associated Lisp code with surrounding comments.

If this were all the Genera debugger provided, it would still be well ahead of the current terminal-based debuggers found in most general purpose workstation Lisp environments. However, Genera provides more. The contents of any object in the display can be inspected simply by clicking on it with the mouse. The program stack is scrollable, so moving around in the stack is simple and logical. Most importantly, however, the source definition for any object with source code can be edited simply by selecting the edit icon and clicking on the object.

While software development tools are "simply software" that can be implemented in any Lisp environment, they aren't yet available in most general purpose Lisp implementations. The software to provide truly integrated development environments in general purpose workstations on the scale provided in current Lisp machines has not yet been developed, and Lisp

machine companies are constantly extending the capabilities of their existing tools and creating new tools. See the new Symbolics Genera interface development facilities as an example.

Another assumption in discussions about the relative merit of workstations and Lisp machines is that Lisp machines are "just good for AI". While they are undoubtedly well designed for working in Lisp, most have Prolog implementations, some have C, Ada and Pascal and even Fortran. Most Lisp machines provide access to the same development tools provided to Lisp when working in these other languages. Symbolics has indicated that their source code debugger will soon provide source code error listings for all languages they deliver.

In addition to the Lisp machine hardware improvements mentioned in Graeme Hirst's companion article in the last issue of *Canadian AI*, Symbolics has added the option of a 386 co-processor. This will allow Symbolics Lisp machines to run UNIX and MS-DOS. As well, a system called VP/ix will run UNIX and multiple MS-DOS sessions on the Symbolics in standard Genera windows. Thus Symbolics machines will provide a full UNIX multi-user system with remote login from networked machines.

Another dimension of Symbolics' integration with 386 machines is the software development system CLOE. CLOE allows development, on the Symbolics, of Common Lisp software that will run on any 386 machine under UNIX System V. The CLOE system consists of three parts: a development system on the Symbolics, an application generator, and a runtime environment on a 386. The software development occurs on the Symbolics in the normal Lisp machine environment, giving access to Genera development tools. The application can then be fine tuned and run on a 386.

Workstation companies are also recognizing the capabilities of these machines, as evidenced by efforts to integrate Lisp machine software and hardware into workstations. Sun has become an OEM for the Symbolics Lisp Ivory chip and has developed a technological alliance with XEROX to integrate some of XEROX's office system and develoment tools running on the XEROX 6085/1186 into their Sun/4's.

There is a lot of power and capability in Lisp machine environments that will require an extensive effort by general purpose workstations to match, and the Lisp machine companies are not waiting for them to catch up. Either through expansion or integration, Lisp machine technology will continue to exist for the foreseeable future.

Applied AI Research and Development at NRC

by J.W. Brahan

Recherche et développement de l'IA appliquée au CNR.

RÉSUMÉ: Le Laboratoire de systèmes intelligents du Conseil national de recherche a récemment mis en oeuvre un programme de recherche et développement dans le domaine général de l'intelligence artificielle appliquée. Le programme est concentré sur les systèmes à base de connaissances. Une première application vise au développement d'un système intelligent d'aide à la décision pour utilisation dans les systèmes interactifs. Une deuxième application vise à l'intégration de la technologie des bases de connaissances dans le développement d'un système d'information de génie pour la fabrication intégrée par ordinateur. Une troisième activité examine l'application de la technologie des systèmes experts au contrôle de bon fonctionnement des moteurs. Une quatrième activité étudie l'apprentissage par découvertes à partir de données médicales. Un projet "stratégique" général a pour objectif de développer une méthodologie flexible et des outils de support pour la création de systèmes impliquant la représentation, l'acquisition, et l'application des connaissances.

The Laboratory for Intelligent Systems of the National Research Council's Division of Electrical Engineering has recently initiated a program of research and development in the general area of applied artificial intelligence with a specific focus on knowledge-based systems. The work is under way in the Information Technology Section, where the staff comes from a background in research and development of technology for computer-assisted learning and database systems. The section's research staff has been augmented by the recent transfer of a small group from the Division of Mechanical Engineering, which has a background in robotics and ergonomics. The current staffing level for the project is 15 scientific research officers supported by 6 technical and administrative staff members.

Computing facilities available to the project include a Data-General MV8000, which is linked to a network of SUN Workstations, a Symbolics 3620 and 2 LMI Lambda Lisp machines. Software, in addition to Lisp and Prolog, includes ART and several smaller shells, as well as an in-house experimental shell. A POPLOG multi-language development environment is on order for the SUN Workstations.

Initial program planning has identified several lines of activity, and preliminary work is under way. About half of the activity is to be directed towards acquisition and development of the underlying tools and methodologies for the design of knowledge-based systems. The remaining work falls in the general category of tactical applications projects which address a particular application but also contribute to the development of the underlying AI technology. Through an appropriate selection of application projects, we plan to focus our work on some of the basic issues of knowledge-based systems technology. The following is a brief summary of the tactical application projects currently under way.

An "Intelligent Advisor" Project has as its objective the development of a support facility that can be used with an interactive computer-based system to provide the user with advice specifically tailored to the user's immediate goals and knowledge of the system. The Advisor will be capable of providing a structured tutorial for the neophyte or, operating in a background mode, it can monitor user interaction with the system and provide meaningful responses to requests for help. Between these two modes, we hope to provide a mode wherein the Advisor monitors the user interaction, identifies user goals and actively interjects advice as appropriate. While the objective of the project is the development of a general advisor framework, it must be demonstrated in context. The demonstration topic that has been selected is database design methodology, specifically the conceptual design phase. The Advisor project is being carried out in collaboration with Laval University and Price Waterhouse in Canada and the University of Leeds in the UK.

A second application project is concerned with the integration of knowledge-based technology in the development of an Engineering Information System, which addresses the needs for information-processing and decision-making support in computer-integrated manufacturing. This project includes the design of an expert database system that will permit the storage of both data and knowledge. It will implement a high-level query facility that retrieves data and incorporates a capacity for manipulating these data by means of production rules and frames. The expert database system will also include an integrated model-management system to assist the user in encoding knowledge about the problem domain.

In a third activity, the application of expert systems technology to monitor the health of engines is being investigated. This project is currently in the feasibility study phase, with immediate goals being a demonstration of the technology in a pilot application and identification of resource requirements for a full-scale working system. The topic selected for the pilot is rotor balancing; this has been implemented using the ART development system.

The fourth application activity involves support of the Division's Medical Engineering Section in a study of

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discovery learning from medical data. This project, undertaken in collaboration with the Ottawa Civic Hospital and Carleton University, is also at the feasibility study phase. Current topics being addressed include identification of holotypes, conceptual clustering and automated knowledge acquisition.

The application projects are supported by a general "strategic" project in knowledge-based systems technology, which has the objective of developing and demonstrating a flexible methodology and supporting tools for the creation of systems that provide for the representation, acquisition and application of knowledge. This project includes a general investigation of automated knowledge acquisition techniques and qualitative modelling. A knowledge-processing shell has been developed. The basic representation scheme is rule-based and the system allows for meta-knowledge, forward and backward chaining, consistency checking, mechanisms for optimization and the capability to interactively define and access new processes. The shell is currently being applied to the development of an expert system for medical device risk management for the Bureau of Radiation and Medical Devices, Health and Welfare Canada.

In addition to the program of work in the Information Technology Section, there are several projects under way in other groups within NRC where the focus is on particular applications, and the AI technology is being used as a means of achieving the primary objective. In the Laboratory for Intelligent Systems, for example, the Computing Technology Section is applying AI technology to problems in sensory interpretation and recognition, decision strategies in intelligent control and task planning in their work on intelligent robotics. In the Institute for Research on Construction, knowledge-based systems are being developed for building operation and maintenance. In the Industrial Materials Research Institute, AI technology is being applied to parts design, to production problem diagnosis, and to the capture of practical rules through use of production systems. In the National Aeronautical Establishment, work is under way in the area of speech synthesis and speech recognition.

Within the program, we place a high value on interactions with AI researchers from other centres and on establishing collaborative undertakings with other research organizations, both academic and commercial. Thus we welcome inquiries regarding short-term visiting research appointments and opportunities for academic staff on sabbatical.

Research in Biological and Computational Vision at the University of Toronto

by John K. Tsotsos

La recherche en vision biologique et computationnelle à l'Université de Toronto

RÉSUMÉ: La recherche en vision biologique et computationnelle à l'Université de Toronto est une activité multi-disciplinaire impliquant plusieurs départements, qui est affiliée à des activités similaires à l'Université York. En 1983, une coopération sérieuse a pris naissance entre les départements d'informatique, psychologie, et physiologie, et un groupe informel, RBCV (pour Research in Biological and Computational Vision), fut formé. Une série de rapports techniques fut lancée au printemps 1984 et à ce jour, 20 rapports ont été produits, impliquant des auteurs et co-auteurs des trois départements; ce qui reflète bien le degré de travail coopératif multi-disciplinaire.

La philosophie de recherche qui guide le groupe est simple: pour obtenir des résultats profonds et significatifs, on doit prendre au serieux l'hypothèse que le traitement humain de l'information visuelle peut être effectivement modélisé computationnellement. Ceci veux dire que: 1) toutes les observations biologiques appropriées devraient être prises en considération; 2) tous les outils computationels appropriés devraient mis à profit, pas seulement les mathématiques classiques; 3) que l'on poursuive concurremment les macro-théories ("visions globales") et les micro-théories (analyses détaillées de composantes individuelles) de façon complémentaire et coopérative; et 4) que les théories produites ne soient pas seulement compatibles avec les observations connues, mais quelles aient aussi un impact prédictif sur l'expérimentaion des chercheurs en sciences biologiques, de manière à fermer la boucle de motivation biologique.

Une activité secondaire du groupe est celle de l'informatique expérimentale, c'est à dire, l'implémentation et la mise à l'essai des théories, et l'applications de nos résultats à des problèmes pratiques.

L'article décrit brièvement quelques 20 projets mis en oeuvre par le groupe.

Overview

Research in Biological and Computational Vision at the University of Toronto is an inter-disciplinary activity, spanning several departments and affiliated with activities at York University. The first instance of computational vision research at the University of Toronto was the 1973 M.Sc. thesis of Nicholas Roussopoulos titled "Abstracting Descriptions from Simple Line Drawings". This work attempted to heuristically decompose closed line curve drawings of simple shapes into meaningful segments, following up on previous work by Guzman. In 1975, Norman Badler completed a Ph.D. thesis titled "Temporal Scene Analysis:

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Conceptual Descriptions of Object Movements". This is considered the first serious work on high-level motion understanding. The 1980 Ph.D. thesis by John Tsotsos titled "A Framework for Visual Motion Understanding" continued the research begun by Badler and provided both a "big picture" framework for motion understanding systems, as well as demonstrating the concepts with a successful implementation in a rich dynamic domain. These theses were supervised by John Mylopoulos, who also is the "father" of the Artificial Intelligence Group at the university.

A formal vision research group in the Department of Computer Science was begun by Tsotsos in 1980, but biological vision research was ongoing for many years in other departments within the university, primarily in Psychology and Physiology. In 1983, serious cooperation developed between the departments and the informal group RBCV emerged. At that time, the faculty members involved were A.D. Jepson and J.K. Tsotsos, both from Computer Science, P.E. Hallett from Physiology, and P. Kolers from Psychology. There were approximately six graduate students in the Department of Computer Science working on vision. Since then, the group has grown significantly in number and in research activity. Additional faculty are H. Kwan (Physiology), G. Moraglia (Psychology), R. Reiter and E. Milios (Computer Science), G. Hinton (Computer Science and Psychology), and most recently, D.M. Regan (Ophthalmology at the University of Toronto and Psychology at York University). Recent graduates R. Gershon and M. Jenkin, who have remained in Toronto, are also research members. Sadly, Paul Kolers passed away in 1986.

A technical report series was launched in the spring of 1984 and at this writing 20 reports have been produced, involving authors and co-authors from all three departments; this reflects the level of cooperative inter-disciplinary work. The technical reports are primarily pre-prints of papers that have later appeared as refereed conference or journal publications. The graduate student population is about 15 now, primarily students in Computer Science, but also including students from several other departments. Several graduate students have been and are co-supervised across departments.

The group organizes and participates in a number of activities. Peter Hallett organizes the University Lectures in Vision, held yearly and made possible in part by a grant from CAE (Electronics) Ltd. Montreal. The general theme is to organize a day of lectures and activities around the research interest of a key invitee in biological and computational vision. The 1986 invitee was J.J. Kulikowski, of the University of Manchester, focusing on "Early Form and Motion"; the 1987 invitee was A. Burgess, of the University of British Columbia, with the focus being "Noise and Disorder in Vision". In 1988, the invitee will be F.M. DeMonasterio, who will focus on "Colour Vision". The group also organizes the vision seminars within the Department of Computer Science and runs a bi-weekly vision discussion series.

The research philosophy that guides the group is a simple one: to achieve deep and meaningful results, one must take seriously the hypothesis that human visual information processing can indeed be modeled computationally. This means that: 1) all appropriate biological observations should be carefully considered; 2) all appropriate computational tools are brought to bear on the problem and not just classical mathematics; 3) that both macro-theories ("big picture") and micro-theories (detailed analysis is of individual components) are pursued in parallel, in a complementary and cooperative manner; and, 4) that theories produced must not only model the known observations but also have a predictive impact on the experimentation of biological scientists, thus closing the biological motivation loop. A secondary activity of the group is that of experimental computer science, i.e., implementing theories and testing them appropriately, and application of vision results to practical problems.

Research Members

Research members are: Ron Gershon, Expert Systems Center, Allied-Signal Canada; Peter E. Hallett, Physiology, U of T; Geoffrey E. Hinton, Comp. Sc. and Psychology, U of T; Michael R.M. Jenkin, Computer Science, York U.; Allan D. Jepson, Comp. Sc., U of T; Hon Kwan, Physiology, U of T; Evangelos Milios, Comp. Sc., U of T; Giampaolo Moraglia, Psychology, U of T; David M. Regan, Ophthalmology at U of T, and Psychology at York U.; Raymond Reiter, Comp. Sc., U of T; John K. Tsotsos, Comp. Sc., U of T.

Research Projects

1. Early Motion Sensing and Measurement

N. Lobo (Ph.D. student), J. Tsotsos

In order for early motion measurements to be useful, they have to be quite accurate. The computations that recover structure and 3-D motion are highly sensitive to noise. Gradient techniques and spatio-temporal filter methods for computing 2-D velocity degrade when motion occurs over high-contrast textured backgrounds, when there is divergence in the velocity field and when illumination effects cause the luminance to vary for reasons other than the local translation of a patch. Token-matching schemes may overcome some of these problems but suffer from the perplexing dilemma of choosing an appropriate token. Some of these problems will be studied.

2. Intermediate Representations for Images

D. Fleet (Ph.D. student), A. Jepson

Previous work concerned the early extraction of visual information. The concern was that richer image information should be extracted without the need for early interpretation or overly restrictive assumptions, such as those inherent in (then) current techniques for motion extraction.

This work evolved from a closer look at spatio-temporal properties of centre-surround mechanisms in retinal processing. Attention then focused on the construction of efficient (and simple) filters for the extraction of orientation and velocity information based on Fourier analysis and information theory. The work continues now with the construction of families of filters

for rich image encodings and the consequences of various hypothetical constraints on such representations. Current interests also include segmentation and shape representation. Questions include what constitutes good form and how such a concept might facilitate figure/ground distinctions and efficient shape encodings.

3. *Models of Image Structure and Primitive Features*

M. Langer (M.Sc. student), A. Jepson

The first step in any vision system is the gathering of sensory data in raw pixel form. The fact that the world is highly structured implies that images of the world will also be structured. Any analysis of an image should take advantage of this structure. In particular, since the second step in a vision system is the coding of the image in terms of a set of primitives, these primitives should be chosen with the image structure in mind. One problem then is to form and test a model of image structure. Once this is done, one is able to discuss the efficiency of different image coding schemes with respect to the model. Then, by imposing heuristical constraints that a coding scheme should satisfy, it is possible to compare the efficiency of different schemes. The expectation is that for commonly accepted constraints, such as spatially localized and scale invariant encoding, the most efficient coding schemes will be similar to the ones found in biological systems.

4. *Early Chromatic Processing*

A. Jepson, P. Hallett

An information theoretic approach is used to study the functional organization of chromatic processing up to the LGN. There are implications for the choice of spectral sensitivities of the sensors, for algorithms for colour constancy, and for the utilization of simple opponent chromatic units. The eventual goal is to obtain an understanding of the design of the chromatic pathways in terms of a few organizational principles.

5. *Visual Stereoscopic Computation*

M. Jenkin, J. Tsotsos, A. Jepson

When we look out on the world, our eyes see views separated by only a few centimetres. This slight difference, and slight differences in ocular orientation, encodes the three-dimensional position of objects in the environment. Models for resolving these slight differences (stereopsis) have been proposed by computer vision and psychology researchers. Current models lack both the robustness and sophistication of biological systems. In this thesis, the task of stereopsis will be investigated. The researchers argue against the main tenements of classical stereopsis algorithms, proposing that stereopsis is a spatio-temporal process. They argue against the extraction of complex monocular features such as zero-crossings, against the use of inhibitory surface constraints and against the use of global stereopsis to produce a unique retinotopic depth map.

A new method for measuring structure from binocular presentations is developed that relates disparity to the local phase difference from band-pass versions of the input images. This disparity measurement produces a dense, robust measurement of structure in space without performing complex token extraction or correspondence. The spatial and temporal properties of the disparity measurement technique are investigated and extensions to the detectors are considered to allow for the construction of detectors tuned to surfaces with particular three-dimensional orientations and to specific three-dimensional trajectories.

Finally, the researchers investigate how the raw disparity measurements should be integrated into a description of the environment. They identify two classes of false targets and propose different techniques for identifying and dealing with them. Rather than construct a unique retinotopic depth map, they argue for the use of an object based representation and show that even a very simple model-based representation can be used to simplify the global stereopsis problem.

6. *Extracting Egomotion and Environmental Layout from Image Sequences*

J. Barron (Ph.D. student), A. Jepson, J. Tsotsos

This thesis concerns the computation of motion and structure from noisy image velocity or from noisy local image velocity information (the Taylor series coefficients of the image velocity field). The two main algorithms developed reconstruct the observer motion and environmental layout (3-D depth information) from time-varying monocular and binocular image sequences. The two algorithms are "unified": the binocular algorithm reduces to the monocular algorithm if the spatio-temporal baselines are unknown and the left and right image sequences coincide. These algorithms exhibit some novel features—for example, the use of temporal information and the removal of the need to compute point-to-point correspondence in individual image sequences or between stereo image pairs. An extensive error analysis investigates the sensitivity of the motion and structure calculation for various types of input error that includes best, random and worst case error as well as error in the image velocity means and differences. The researchers demonstrate that increasing the spatio-temporal distribution of image velocities using a least squares formulation of the algorithms and scaling the Jacobian matrix (among other things) reduces the error amplification. Other results include the presence of dual solutions, the presence of multiple (non-dual) solutions, the effect of violating the algorithms' underlying assumptions, the relationship between error in image velocities and their corresponding Taylor series coefficients and the effect of using normal (versus full) image velocity fields. In the binocular case the researchers also investigate the effect of varying the spatio-temporal baseline and of parallel versus convergent/divergent stereo setups.

7. *Self-Organizing Feature Maps*

A. Jepson. M. Langer (M.Sc. student), D. Fleet (Ph.D. student)

This is an integrative project extending and unifying the results of the previously listed projects. The goal is to

obtain realizable unsupervised learning rules for image feature maps based on information theoretic principles.

8. *The REx Robot Rover Project*

E. Milios (project leader)

The goal of this project is to design an image understanding system in which to integrate much of the research being conducted by the U of T vision group. The problem area is the task of navigating a camera-equipped robot successfully 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 occur.

Much of the research required is in the design of representation and reasoning mechanisms that extend the state of the art in high-level vision. In particular, it is necessary to address the problem of identifying partially occluded objects and to increase the generality of object representations to model motion characteristics and resulting shape and position changes in a general manner. 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).

As the system matures, it is expected that the work of additional department members may be integrated. Experimentation will be facilitated by modularity and careful documentation. Greg Dudek, Mike Jenkin, Howie Marcus, Evangelos Milios and David Wilkes are currently building a working prototype that addresses all stages of the computation 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.

9. *Process-Based Shape Theories*

E. Milios

Milios is currently working on computational implementations of process-based shape theories suitable for describing growth or evolution of amorphous shapes. His research is motivated by the recent emergence of psychological theories that view shape as an outcome of deformation processes that introduce curvature extrema and inflection points and by the fact that current shape matching methods either work on polygonal/polyhedral approximations or search for exact matching between smoothly curved shapes. His approach is based on higher-order polynomial shape modeling and segmentation and attempts to match segments at multiple abstraction levels using curvature-based representations. Shape matching is viewed not only as establishing correspondences between segments of two shapes, but also as the explanation of their differences by means of curvature processes. This research has potential application to the automatic interpretation of spatiotemporal satellite imagery for weather forecasting and to the description of growth of biological phenomena.

10. *The Logic of Depiction*

R. Reiter, A. Mackworth (University of British Columbia)

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

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

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

11. *Finite Automata Models for Cortical Texture*

M. Hofmann (Ph.D. student in Zoology), P. Hallett, A. Jepson

The main focus of interest is the area of pattern and texture discrimination and segregation. The research is composed of two parts. A psychophysical study using human observers will test the ability of subjects to discriminate patterns. The particular class of patterns used in this study are composed of superimposed sine-wave gratings of different orientations. The spatial frequency, orientations and relative phases of the patterns can be varied to produce a wide range of patterns.

The second part of the research is the construction of a computer simulation based on known physiology of the visual system. The purpose of the model is to try to simulate the visual system's ability to discriminate and segregate textures and patterns. The results of the simulation will be compared with the results from human observers given similar input patterns.

12. *Evaluating Blood Perfusion from Retinal Images of Diabetes Patients*

G. Crookall (M.Sc. student), C. Francis (clinical clerk in the Dept. of Medicine), A. Kurusek (Dept. of Ophthalmology, Toronto General Hospital), J. Tsotsos

This project will develop a vision system to quantify and identify patterns of anomalous blood perfusion from images of the human retina. In diabetes, blood perfusion in the retina is affected, leading to the potential for partial or total blindness in the affected eye. Some observable

problems include localized changes in colour, localized changes in image texture of the retina, changes in the pattern of arteries, and changes in the size and elasticity of arteries. Combinations of anomalies have specific meaning as well. The patterns and characteristics of those anomalies and their changes during the time course of the disease are currently topics of active clinical research. It is difficult, however, to quantify texture or size changes by observation alone. Therefore, a research tool is required to assist with the automatic and objective evaluation of retinal images. The types of anomalies will be catalogued and appropriate techniques developed for extracting image features and temporal feature changes and then matching features to anomalies believed to be manifestations of specific disease stages. This research tool will permit clinicians to pose hypotheses about disease progress and effects on the retina and will provide the quantitative analyses necessary to compare hypotheses. The control structure will be based on that used in the ALVEN system developed by Tsotsos for evaluation of the dynamic performance of the human left ventricle from X-ray images.

13. Hierarchical Time-Varying Cooperative Computation

E. Shavit (M.Sc. student), J. Tsotsos

In Tsotsos's 1980 Ph.D. thesis, a time-varying, hierarchical relaxation labeling process was presented. It performed very well in that application. Although an empirical study of the process was conducted (it seemed too difficult to analyze analytically at the time because it was cast in the old-style relaxation formalism) and many properties were demonstrated, such as convergence and compatibility settings related to the semantics of hierarchy organization, there were several issues remaining. The foremost issue is that of characterizing the computation, i.e., what exactly is this large system computing? The current project will attempt to reformulate the computation as an optimization problem and address this question from an energy minimization point of view. Note that all previous relaxation algorithms make a critical assumption that does not hold in a time-varying domain—namely, that an initial solution is available as a starting point that is "close" to the desired solution. In a domain whose input is time-varying and where the structure over which the computation is being performed is also time-varying, this assumption is violated much of the time. The previous formulation dealt with this problem by using an executive controller to continually tune and adjust the system's parameters. It is expected that such a solution will still be necessary; moreover it is desirable because other research (Tsotsos's complexity level analysis of vision) has shown that exactly such an "attentive" component is a necessary one for human vision.

14. The Use of Curvature in Model Based Vision

G. Dudek (Ph.D. student), J. Tsotsos

The use of surface shape as an aid to object recognition is being studied. The particular measurable quantity proposed for use as a shape indicator is local surface curvature. It has been demonstrated that in a constrained environment local surface curvature estimates can be obtained from surface shading gradations. Unfortunately, the accuracy of the recovered parameters has proven inadequate for the the true surface shape except in the most elementary conditions. Non-Lambertian surfaces or nearby light sources are among the factors that can lead to corruption of the results. The goal of the present research is to use local curvature estimates to classify patches of the surface using a quadric surface model. Furthermore, by carrying out this classification at the multiple scales at which curvature changes manifest themselves, different types of co-occurring surface structure should manifest themselves explicitly. The curvature information is explicitly available in the gradient of the difference of Gaussians of the image. Using this inherently multi-scale representation, the surface may be classified on a local basis. Once this local classification is performed, the measurements must be organized to describe the surface in terms of patches of varying size. It is hoped that topological laws can be used to aid in this process. Finally, these surface patches at multiple scales are to be linked together into a coherent representation of the object in 2-1/2D. Although this representation will not fully capture surface shape, it should capture the major structural features. An object recognition process based on this representation is now being planned. It should embody aspects of the Grimson/Lozano-Perez style constrained matching algorithm at each scale, while capitalizing on the multi-scale nature of the representation by using a coarse-to-fine matching paradigm.

15. Associative Computation in Vision

D. Wilkes (Ph.D. student), J. Tsotsos

The researchers are interested in the development of parallel architectures for vision. Work in parallel distributed implementations of various filtering, association and constraint satisfaction tasks suggests the plausibility of a complete vision architecture based on such implementations and their extensions. Important ideas to be incorporated in such an architecture are the use of attention, 2D perceptual cues and representation of objects in terms of sequences (or, more generally, graphs) of cue areas separated by arcs representing the displacement from one cue area to the next. It is desired to achieve reliable initial object recognition without resorting to depth or surface orientation reconstruction. The proposed architecture draws on the vision models of Triesman, Tsotsos and Lowe. Parallel computation of "feature maps", using simple filtering operations, provides cues for initial bottom-up direction of attention to cue areas in the image data. Model elements detected in the cue areas influence direction of attention by prompting, e.g., edge-following jumps of attention. Cues also prompt associative retrieval of object models, which then provide a top-down influence on attention. Image to object-based coordinate transformation is determined concurrently by matching of cue pairs in the image and object model to each other. Problems to be solved are primarily concerned with object representation. Reliable cues must be combined in a way that allows the expression of 3D spatial information and associative

model retrieval based on a small number of cues with their relative image positions. Extensive use of statistical inference, based on prior experience of the system, will be incorporated.

16. Analyzing Vision at the Complexity Level

J. Tsotsos

"Grand theories" of perception are easy prey for criticism, criticism that in one important sense is unfair at this point in the development of this discipline. There is no test that can be applied to a grand theory in order to determine whether or not fundamental considerations are satisfied. The researcher's work proposes that satisfaction of the space and time complexity constraints be one of the elements of the test that new theories of visual perception must pass. This ongoing research attempts to tie many biological observations of human and primate vision systems with the thread of complexity satisfaction, a novel approach to this problem. The goal is to develop some of the key design principles for visual systems, to discover the constraints on visual system architectures that permit space and time complexity satisfaction, and to produce a theory with predictive impact, both anatomic and psychological. Much of the motivation for this research comes from the psychology community. Neisser, for example, claimed that a visual theory based solely on spatial parallelism was doomed to failure because the brain was not large enough. This is why attention was required. Although true, this statement does not lead to any useful constraints on visual system architectures, but it hints at the important complexity issues that to this point have not been adequately addressed.

Computational complexity issues are broad and pervasive in the development of a theory of perception based on the premise that human visual perception can be modeled computationally. Since complexity theory is a major contribution of computer science, its use is natural within the computational paradigm. It is further hypothesized that evolution, where guided by basic design principles, tended to prefer system designs with lower computational complexity. If these hypotheses are true, then complexity analysis should reveal basic insights into the structure and performance of human vision. The serious consideration of computational complexity is claimed to be critical in the computational modeling of perception, and indeed, in the computational modeling of any aspect of intelligence. One of the key problems with AI is that the solutions proposed are so fragile with respect to "scaling up" with problem size. In particular, parallel solutions, such as those proposed by the connectionist community, although motivated by complexity considerations, typically fail to demonstrate the computational sufficiency of their approaches. It is also interesting to note that the application of complexity analysis in order to uncover basic limits of the information processing capacity of the visual system did not appear at all in the overview of a large number of techniques and approaches to discovering the limits of perception in *Limits in Perception* (edited by van Doorn, van de Grind & Koenderink, 1984).

There are three major results that are derived using space and time complexity analysis, a technique that may be one of the most important contributions of computer science with theoretical implications for a wide range of sciences. First, a set of architectural constraints is presented that satisfies the space complexity of the human visual system and the time complexity of pre-attentive vision. These constraints are derived using two guiding principles claimed to be critical in the development of any theory of perception. The first is that analysis at the "complexity level" is necessary to ensure that the basic space and performance measures observed in human vision are satisfied by a proposed system architecture. Then, the "maximum power/minimum cost principle" ranks the many architectures that satisfy the complexity level analysis and allows the choice of the best one. The best architecture chosen using this principle is completely compatible with the known architecture of the human visual system, and in addition, leads to several anatomical predictions. Secondly, within this architecture, a new explanation for visual search performance is proposed that differs in important ways from Treisman's account and is accompanied by several predictions. The key result regarding this explanation is that pre-attentive vision is shown to be just a special case of visual information processing and not a processing stage distinct from attentive vision. Thirdly, the inherent computational limits of this bottom-up architecture are exposed and thus provide a computational justification for the necessity of attentive processing in visual theories, something that has been debated in the computer vision community and is counter to Marrs's view of vision.

17.Visual Search Performance in Humans

R. Zemel (M.Sc. student), J. Tsotsos, G. Moraglia

There are a number of key implications on visual search performance in Tsotsos's complexity level theory. A number of experiments may be devised to test each prediction, and the psychology experimentation is being done under the guidance of Moraglia. Possible hypotheses include: map activation is not the only mechanism active for pop-out displays; an increase in the number of active maps leads to an increase in response time for pop-out displays; strength of response can order candidates for the match-to-target process; non-distractor elements in a conjunction display have no effect; serial search is required to identify and count more than one target in a pop-out display; no spatial relations pop-out; as the number of targets increases, so does the response time.

18. Learning through Amplification of Correlations and Fluctuations in a Modular and Hierarchical Neuronal Network

T. Yeap (Ph.D. student in EE), H. Kwan, J. Tsotsos, S. Zaky (EE)

Recent progress in the study of brain and VLSI technology has led to growing interest in research on massively parallel architectures. These machines use many simple processing elements (PE) connected to each other. A weight is assigned to each connection, and the machine is programmed by adjusting these weights. Two well-known examples are the Boltzmann machine and Backward Error Propagation Machine, and much work

has been done on learning algorithms for such networks. However, an implicit assumption in past work has been that an initial value for the recognition or learning task is available that is close to the equilibrium state of the network. This is a useful assumption, valid in many tasks; however, in recognition of a time-varying domain, it is often violated (in vision, for example, when a moving object stops). This thesis examines the possibility of learning and recognition in a network that may operate both near to and far from equilibrium. It shares many characteristics with Boltzmann architectures; differently, however the PE considered is an analog computation unit. It has an analog integrator, a threshold unit and a differential positive feedback loop. As a result, the circuit model is sensitive to change or fluctuation in the network. With the ability to amplify fluctuation, the whole network is very unstable, and thus it is very easy for the system to go into a state of chaos, which is a common process far from equilibrium. It has been hypothesized that nature achieved order through the use of a competition process between neurons, and such a competitive mechanism is included in this design.

The learning algorithm is based on the study of self-organization in non-equilibrium systems done by Prigogine. According to Prigogine, most natural systems that are capable of self-organization have the property of operating far from equilibrium. Order is achieved through the ability of the system to amplify fluctuations and correlations. Learning in a network is studied by incorporating fluctuation, correlation and competition as a process of adjusting the weights of the connections between PEs. Several theories on self-organization in non-equilibrium systems are currently being studied.

For a large network performing a complex task, long computation time is required to settle to a unique solution. To reduce the computation time, task partitioning is crucial. Units may thus be organized hierarchically.

19. Auditory and Visual Psychophysics and Electrophysiology

D.M. Regan

Regan is involved in a number of research areas: 1) experimental visual psychophysics and mathematical modeling for form from motion, stereopsis, motion in depth and colour—a well-equipped vision laboratory including eye-movement recording is available; 2) auditory psychophysics and modeling: FM/AM channels and neural processing of speech—a sound-insulated room is avaiable; 3) visual, auditory and inter-modality magnetic and electrical recording from the human brain, using a 7-channel SQUID neuromagnetometer in a magnetically shielded room; 4) studies of visual and auditory disorders via psychophysical and evoked brain potential and neuromagnetic investigations; 5) applications of psychophysics to hand-eye coordination in aviation and space with opportunities to work with flight simulators and high-performance jet aircraft.

20. Pre-attentive and Attentive Vision

G. Moraglia

Current research focuses on the issues related to the preattentive-attentive dichotomy in human spatial vision. This dichotomy is explored within the context of experimental tasks involving search, detection and recognition of visual signals in noisy backgrounds. The aim of this research is to contribute to the development of alternative theoretical accounts of this dichotomy. Allied concerns include the modeling of human performance in close experimental analogs of real-life pattern recognition tasks.

21. Visual Information Processing

G.Hinton

Hinton has worked on connectionist models of viewpoint-invariant shape recognition and on general models of relaxation search in massively parallel networks. He is currently interested in the issue of what frames of reference are used for human vision and motor control, and is trying to devise efficient connectionist methods of performing coordinate transformations between different reference frames (e.g., between retino-centric and object-based reference frames.) He is also interested in the application of unsupervised connectionist learning procedures to the task of constructing a hierarchy of representations in early vision.

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- DEC VAX 11/780
- single-cell recording facilities for primates
- computer-driven 4-field monocular tachistoscope
- computer-driven 2-field binocular tachistoscope
- 7-channel SQUID neuromagnetometer with shielded room
- eye movement recording equipment

Research in Biological and Computational Vision Publication List

The reports are available upon request from: RBCV Technical Report, Secretary, Department of Computer Science, 10 Kings College Rd., University of Toronto, Toronto, Ontario, Canada, M5S 1A4. Several of the abstracts have been published in the October 1987 issue of this magazine.

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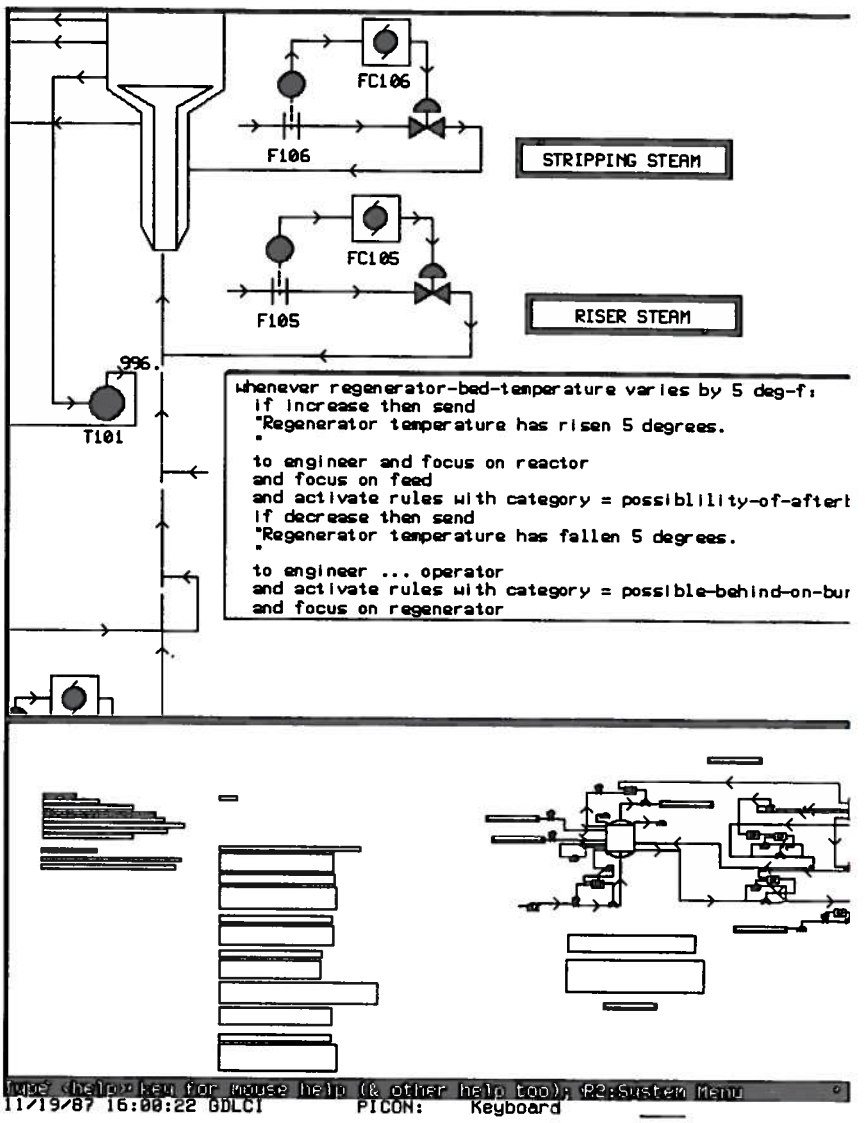

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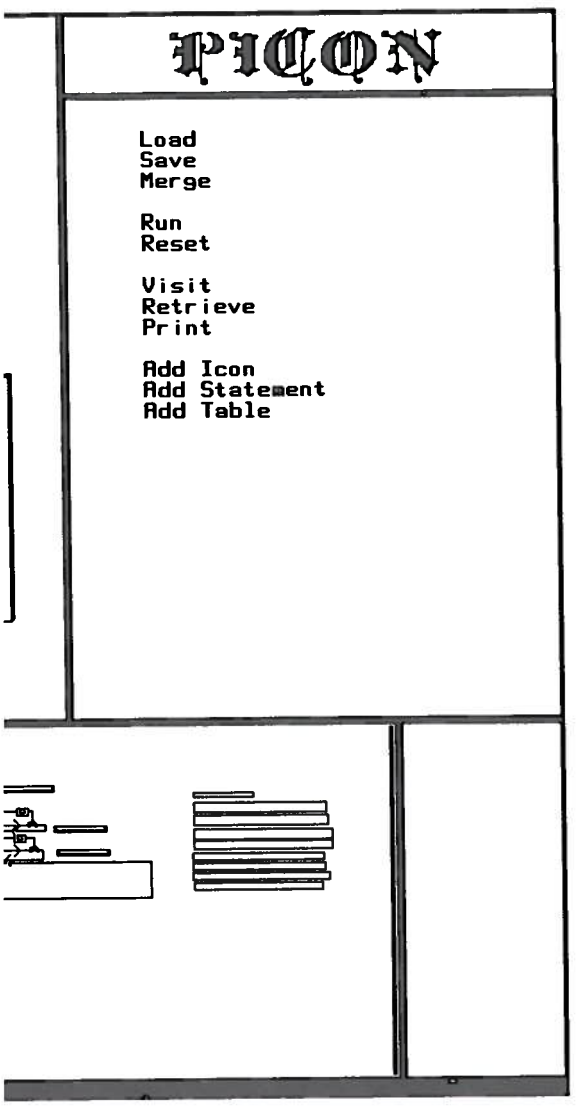

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International Conference on Intelligent Tutoring Systems:
The state of the art

June 1-3, 1988 Montréal, Canada

Conference General Chairperson
Claude Frasson
Département d'informatique
et de recherce opérationnelle
Université de Montréal
C.P. 6128, Sacc. "A"
Montréal, Canada
H3C 3J7

Organizing Committee General Chairperson
Jan Gecsei
Université de Montréal

Program Committee Chairpersons
Gregor V. Bochmann
Université de Montréal

Marlene Jones
Alberta Research Council

The goal of the conference is to discuss the *state of the art* in Intelligent Tutoring Systems. It will feature invited presentations, panels, tutorials and submitted contributions.

Invited speakers are:

Jeff Bonar
John Seely Brown
John Self
Elliot Soloway
Pat Suppes
Phil Winne
Beverly Woolf
Masoud Yazdani

Conference topics include:

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

Second International Conference on Human-Computer Interaction

by Chris Stang

La Deuxième conférence internationale sur le dialogue homme-machine

RÉSUMÉ: Près de 350 personnes provenant de 16 pays différents ont donné des communications. Parmi les faits saillants de la conférence, on compte les ateliers de deux jours donnés par le Dr. Ben Schniederman et le Dr. Brian Shackel qui ont précédé les présentations. Certains détails sur l'atelier du Dr. Schneiderman apparaissent dans cet article.

10 - 14 August 1987, Honolulu, Hawaii

Yes, that's right. Hawaii! Can you think of a better place for a conference on humans interacting and trying to make life easier for computer users (or programmers, for that matter)? Well, neither could I. So when it came to the opportunity to take on this immense burden of luxury and relaxation, I did not hesitate for a second before replying, "Sure, I'll go!" Yet, there was a catch. I had to attend this conference and it was not the one being held daily from 9 a.m. to 6 p.m. on the beach. I managed to persevere and attend a full program of presentations and workshops anyway.

The conference had a very impressive list of presenters from 16 countries. Presenters included Gavriel Salvendy, Ben Schneiderman, Brian Shackel, and Elliot Soloway. There were 368 scheduled presentations and a handful of workshops. Approximately 700 people attended, with experience in all levels of computer design and use. The participants included academics, government researchers, and private industry computer system designers and researchers.

The actual conference (August 12-14) was preceded by two days of workshops. These two parallel workshops were given by Dr. Brian Shackel on "Usability Engineering" and by Dr. Ben Schneiderman on "Designing the User Interface". I attended Schneiderman's workshop and was very impressed by his presentation style and breadth of knowledge in the area of user interfaces. His presentation summarized his recently published book, *Designing the User Interface* which provides a wide range of guidelines and suggestions. Schneiderman backs many of his suggestions by research studies. Among his special areas of interest is direct manipulation, which is the up and coming technique of graphically representing objects and actions. This design technique greatly aids a computer user's concentration on the task being solved. Some of the suggested guidelines include:

- In all parts of interface design, the interface should allow the user to concentrate on the task and not on the computer (the computer should be "invisible").
- In menu selection, use task-oriented menu structure and selection items, as well as short-cuts for experienced users.
- In form fill-in, use neat, concise screen display with optional fields prefilled.
- The user group should assist in the design of the interface guidelines, test a prototype of the interface, and suggest changes to it.
- Use experimentation techniques with a selected group of users to test the system interface. Both quantitative and qualitative results should be gathered from these tests.
- Eliminate error messages where possible. Either take away the error situation, or make it obvious that an action cannot be carried out so that the message is not needed.
- On-line help should be designed for all levels of users, detailed explanations for novice users, and short messages for more experienced users.
- Help should be designed around the objects and actions of the task, rather than on the objects and actions of the computer (e.g., a screen of help on a form field rather than on an entire screen of fields).
- In preparing documentation, start early in the system development, and have a professional writer or copy editor assist in the writing of the user's manual.

Most attendees left the workshop feeling they had learned a great deal in terms of designing human computer interfaces. For me, this was definitely the most educational part of the conference.

The actual conference started with plenary presentations given by key conference speakers in the early morning of each day. This was followed by six parallel presentations later in the morning and again in the afternoon, with two-hour workshops in the evenings. The first plenary presentation on Wednesday was given by Gavriel Salvendy, the conference chairperson and chief organizer from Purdue University, and by Masamitsu Oshima, the honorary chairperson from Japan. To kick off the conference, they covered trends and directions in human-computer interaction. The Thursday morning plenary presentation had Hans-Jorg Bullinger from West Germany talk on Software Engineering and Elliot Soloway from Yale University giving a very spirited performance on "Programming-in-the-Large: A Cognitive Perspective". Friday's plenary presentations were given by Brian Shackel on designing

At the time of the conference, Chris Stang held the position of Programmer/Analyst with Shell Canada Limited; Chris's attendance at the conference was financed by Shell. Chris is currently an AI programmer at the Alberta Research Council.

electronic journals and Ben Schneiderman on developing electronic encyclopedias. Both of these presenters concentrated their discussions on the user aspects of their work and genuinely tried to make the most usable system they could.

The parallel presentations formed the bulk of the presentations with a two-hour morning session and a two-hour afternoon session each of the three days. Each session contained six groups of presentations running in parallel with 6-8 presenters giving a talk in each group. For each group there was a topic to which all presentations were to relate within the human-computer interaction field. The topics of presentation included Interface Design, Expert Systems, Ergonomics, Hardware Innovations, Software Design and Use, Human Factors, and Graphics. Unfortunately, many of the presentations did not stick to the theme of human-computer interaction and only discussed their own area of work (which in itself was usually quite good). Nevertheless, there were some excellent presentations given by people who performed experiments on particular interface questions with a selected group of users. These came up with some very outstanding results which formed the basis of many of the guidelines that the key presenters tried to communicate.

Essentially, human-computer interaction is in its childhood stages. With many more computer research labs and academic centres taking an active role in experimenting to develop better human-computer interfaces, this child is growing up rather quickly. This is bound to happen as the users, who generally pay for the systems they use, are realizing that it pays to buy a system that is easier to use. The un-written theme of the conference seemed to be "If a great computer system cannot be used by its users, then it's useless!"

2nd Natural Language Understanding and Logic Programming Workshop (NLULP)

by Patrick Saint-Dizier

Le deuxième Colloque sur la compréhension des langues naturelles et la programation logique

RÉSUMÉ: Environ 70 participants de 10 pays assistèrent aux diverses communications et discussions. Les discussions se concentrèrent sur les applications de la programmation logique aux problèmes de traitement des langues naturelles; les sujets furent divisés entre syntaxe, sémantique, et pragmatique.

17 - 19 August 1987, Simon Fraser University, Vancouver, BC

About 70 participants from 10 countries attended the various talks and discussions. The atmosphere was particularly friendly and cooperative. Sponsored by SFU, the Canadian CRSNG/NSERC, AAAI and the French INRIA, the final proceedings will be published soon by North Holland Publishing Co.

Let us define more precisely what is generally meant by Natural Language Understanding and Logic Programming. In the light of some talks and discussions, it turns out that this term refers to works where Logic Programming (in particular, Prolog) is viewed as a convenient implementation framework and as a clear (and sometimes simple) formal framework for describing linguistic phenomena. However, as pointed out in several talks, it appears that the current logic programming languages do not have all the tools and theoretical framework that most linguists and computational linguists need. This is the reason several contributions attempted to assess the explanatory coverage and power of various logic programming languages with respect to natural language. In this range of ideas, practical as well as formal extensions have been proposed.

Although the NLULP community is still small, interest in this approach is rapidly increasing. This is mainly due, I feel, to three major contributions to the field of logic programming:

1. the publication of several clear and relevant books and articles on the theoretical foundations of logic programming;
2. the edition of a number of very good books on programming in Prolog;
3. the commercialization of large and efficient Prolog interpreters and compilers available on many types of machines.

These remarks suggest that an open field of research still exists in the merger of logic programming and natural language understanding (in its broadest sense). Another point is that about half of the speakers and half of the audience came from companies. This clearly indicates the high interest of the industrial community in this approach.

The first day of the workshop was devoted to syntax. Apart from a paper presenting comparisons between current implementations of grammar formalisms, the two main contribution areas were compiler design for natural language grammar systems and the improvement of current logic-based grammar formalisms.

The second day was devoted to semantics. The high quality of the papers presented in this area shows that natural language semantics in logic programming is no longer a neglected area. These contributions explored connections and relations between Montague semantics, conceptual graphs and Kamp's discourse representation structures. The results indicate that this area is promising; however, it certainly requires efforts of mutual understanding between semanticists and logic programmers.

The third day was devoted to pragmatics. A number of

Patrick Saint-Dizier is a researcher at INRIA France; he is currently visiting the School of Computing Science, SFU.

topics were addressed, such as: disambiguation of word senses, using integrity constraints to provide cooperative responses, and problems of interpretation of questions. An interesting point which emerged was the intimate connection between pragmatics and deductive databases.

Four panel sessions were held: Linguistic Theories and Logic Programming, What Is Logic Grammar?, Semantics and Pragmatics in Logic Programming, and Applications (industrial or academic). Problems, general and technical, stimulated controversial discussions which often lasted until late evening.

Everyone felt the workshop to be very useful and rewarding; the workshop program is listed below. The next one is already planned and will be held in two years in Europe.

Syntax

Constraint Analysis on Japanese Modification, R. Sugimura, H.Miyoshi (Japan)

Parsing with Explicit Representations of Syntactic Constraints, E. Stabler (Canada)

Contextual Discontinuous Grammars, P. Saint-Dizier (France)

A Dynamic Translator for Rule Pruning in Restriction Grammars, J. Dowding, L. Hirschman (USA)

Comparison of Logic Programming Based NL Parsing Systems, R. Sugimura, T. Okunishi, Y. Matsumoto, N. Tamura, T. Kamiwaki, H. Tanaka (Japan).

Compilers

Towards Functional Logic Grammars, M. Boyer (Canada)

P-PATR: A Compiler for Unification-Based Grammars, S. B. Hirsh (USA).

Semantics

Computational Semantic Introduction, G. Koch (Denmark)

Data Semantics in Logic Programming Framework, S. Akama and M. Kawamori (Japan)

Comparatives in Logic Programming: Two Viewpoints, A. Banks, M. Rayner (Sweden).

Integrating Conceptual Graphs and Logic in a NLU System, M. T. Pazienza, P. Velardi (Italy)

Sylog: A DRT System in Prolog, C. SEDOGBO (France)

Graphs in Logic Programming for Natural Language Analysis, H. Beringer (France).

Miscellaneous

A Rule-based System for the Morphological and Morphosyntactic Analysis of the Italian Language, M. Russo (Italy)

Towards a Theory of Natural Language Generation: The Connection between Syntax, Context and Semantics, C. Brown (Canada)

Pragmatics

Using Common Sense Knowledge to Disambiguate Word Senses, K. Dahlgren (USA)

Greater Cooperation between Database and User: Integrity Constraints Provide an Answer, A. Gal, J. Minker (USA)

Epistemic Reasoning, Logic Programming and the Interpretation of Questions, M. Rayner, S. Janson (Sweden)

AAAI Workshop on Spatial Reasoning and Multi-Sensor Fusion

by Roy Eagleson, U. of Western Ontario,
and Evangelos Milios, U. of Toronto

Atelier de l'AAAI sur le raisonnement spatial et la fusion multi-capteurs

RÉSUMÉ: Un atelier sur le domaine relativement nouveau du raisonnement spatial et de la fusion multi-capteurs a eu lieu sous la commandite de l'AAAI. Des communications furent données dans les domaines suivants: raisonnement spatial et représentation spatiale, fusion multi-capteurs, représentation des formes 2D-3D pour la reconnaissance, détection active, et modèles concernant ces sujets.

5 - 7 October 1987, St. Charles, Illinois

Perceptual Robotics is a term being used to describe new studies of how an intelligent system might base its actions on perceived representations of the world. Sensory inputs may take the form of changing visual images, haptic perceptions based on touch sensors, or any combination of inputs across a wide range of sensory modalities: e.g., acoustical, proprioceptive, or depth maps from range data. At the AAAI-sponsored workshop on "Spatial Reasoning and Multi-Sensor Fusion", participants showed a wide range of approaches to this new field. Workshop sessions included frameworks for spatial reasoning, computer vision, shape analysis, spatial databases, multi-sensor fusion, natural systems and geometrical approaches, mobile autonomous systems, and natural language processing related to spatial reasoning. This article is not a critical or exhaustive review of the workshop or its content; rather, it is a pointer to some of the dominant themes we saw emerging from the presentations, papers, and discussion sessions. We chose to review a selection of papers which, taken together, convey some of the flavour of the workshop.

Session comments were provided by Takeo Kanade, Tod Levitt, Jake Aggarwal, Ram Nevatia, Dana Ballard, Tom Strat, Linda Shapiro, Ruzena Bajcsy, Tom Henderson, Victor Raskin, and Ben Kuipers.

The organizers of the workshop, Professors Avi Kak and Su-shing Chen, are to be commended for its format and content, which promoted close interaction among the participants and lively discussion. The papers of each session were reviewed by a well-known researcher in that field and authors were given the opportunity to respond to this critique and then present their own viewpoint. In addition to informal discussions over meals, groups met after dinner on both evenings for round-table discussions on topics such as multi-sensor fusion, shape analysis, autonomous land vehicles, frameworks for reasoning, and spatial reasoning. At the end of the workshop, the discussion leaders of each sub-group summarized the particular issues.

After the technical sessions and the reports on the round-table discussions, Tom Garvey of SRI organized a panel discussion on the state of the art and open research issues in the area. The panelists were Martin Fischler, Linda Shapiro, Dana Ballard, and Ben Kuipers. The fields of spatial reasoning and multi-sensor fusion are still in their infancy. Researchers work mainly with simplified microworlds and narrow application domains. Consequently, results are generally either theoretical treatments with no practical demonstration, or systems carefully engineered for specific applications. Criticisms of the current research practices included: the lack of appropriate standards for evaluating the quality of the research in the area; the need to look more into other fields such as cognitive science, psychology, neural, and brain sciences; and the need to test research proposals more extensively by implementing working systems.

Summary of the Dominant Themes

"Multi-sensor Fusion" includes two separate problems: how to integrate measurements from arrays of identical sensors, and how to combine information from different modalities into a single representation.When integrating multiple measurements from spatially distributed sensors, there is a registration problem. Features found by different sensors which are due to the same physical object or event must be correctly associated with each other, as in the stereo-pair correspondence. Here, it is necessary to have a good characterization of the measurement noise and the propagation of uncertainty. In addition, measurements which are sampled over time have the temporal correspondence problem–i.e., how to establish the identity of an object while tracking it from one sample to the next. To make matters worse, the correspondence problem can usually be solved only at a few sparse locations, thus calling for interpolation on the rest of the data. In order to combine sensory measures from different modalities, a great deal of consideration must be given to the design of a good representational framework. Not only is it more difficult to solve a correspondence problem across modalities, but it is not clear what measures or semantic interpretations should be made explicit by the representation. Martin Fischler pointed out a serious lack in the development of representations that would allow you to encode some notion of desires, purposes, and intentions. Some initial efforts in this direction seem to be very task-dependent. Unless a system is capable of retaining and transforming between a large number of these "representational structures", it may be necessary that it be able to generate them dynamically, based on the system's goals, its proposed actions, and the measurements available. While it is not clear how these measurement problems should be approached, "Spatial Reasoning" addresses how a robotic system can carry out its actions in order to achieve specified goals. Representations of space generally also encode representations of objects, and reasoning about action is employed to estimate the changes in the world that will be caused by these interactions. Spatial Reasoning is an umbrella term that can be applied to locations, object shapes, or their interactions. The computations involved can also be done at many different levels: numeric computations on the measurement data, qualitative reasoning, or symbolic manipulation. Again, solutions which are proposed initially seem to show a great deal of task dependence.

Brief Reviews of Selected Papers

The presented papers can be classified into the following categories: multi-sensor fusion, spatial representation and reasoning; 2D and 3D shape representation for recognition; active sensing or combined planning and perception; frameworks for spatial reasoning and multisensor fusion.

Multi-Sensor Fusion

There was discussion about exactly where the problem lies and whether the existing mathematics is sufficient to solve it. In one sense, multi-sensor fusion deals with inconsistencies in sensor measurements, implying the need for uncertainty management. In another sense, multi-sensor fusion deals with the combination of sparse measurements from different sensors into a coherent explanation, implying the need for constraint satisfaction. Bajcsy called for more exhaustive testing of theories and techniques. Henderson raised the question of appropriate tools for the designer of multi-sensor fusion systems. Rodger and Browse (Queen's) presented the design and partial implementation of a sensor fusion system that works in the domain of polyhedral objects. Their system is independent of the type of sensors, as long as sensors yield information about the assumed visual features, which in their case are straight line segments, corresponding to polyhedral edges. Computation of the support of hypotheses across sensors and features is achieved via an intersection operator. Hu and Stockman (Michigan State U.) use two different modalities, light striping and image intensity, and their fusion rules are specific to these sensors. Rules are being used by a labeling process, which applies five types of labels (extremum, blade, fold, shadow, mark) to segmented contours found in the input data. Durrant-Whyte (Oxford) views a multi-sensor system as a team of decision makers and proposes a theoretical framework that combines multi-bayesian decision theory with team theory. In order to simplify the mathematics, he assumes independence of sensor observations, an assumption of limited generality. Duncan, Gindi and Narendra (Yale) perform relaxation-like segmentation of multi-sensor scenes using learning automata. They suggest switching between sensors in order to obtain optimal results, but they assume complementary spatial noise in the two sensors–i.e., locations where one sensor is noisy, the other is clean, and vice versa.

Spatial Representation and Reasoning

Current research is directed towards path planning and collision avoidance in 3D and dynamic domains, the

use of landmarks for segmenting space, and natural language user interfaces that understand spatial relationships. Levitt, Lawton, Chelberg, Nelson and Dye (Advanced Decision Systems) partition space using straight-line segments connecting distinct landmarks and suggest use of such partitioning for qualitative self-localization of a mobile robot. They are in the process of coupling this space representation scheme with visual landmark recognition. Meng (Texas Instruments) proposes the use of layered Voronoi diagrams for representing free space and planning collision-free paths in 3D, while Bose, Meng and Rajinikanth (Texas Instruments) combine this representation with assumption-based truth maintenance and a dependency network to plan paths in dynamic situations and with incomplete knowledge. Aubry and Hayward (McGill) proposed a hierarchical representation of free space using tetrahedra. They investigate the use of Delauney triangulation and sparse graphs for obtaining such a tetrahedral decomposition of space. Their paper is also a good survey of the path planning and collision avoidance research. Chubb (U.S. Army Center for Signals Warfare) reported on a new algorithm for finding straight line optimal paths in discrete binary space (where each spatial array element is classified as either free space or obstacle) and compares its properties with the standard A* heuristic search algorithm for solving the same problem. Miller and Slack (Virginia Tech) addressed path planning and navigation in dynamic domains using a rectilinear grid as their space representation. Dynamic situations are represented by time-dependent states of individual nodes on the grid, while legal paths are found via a spreading search. Grids are organized hierarchically to achieve efficiency in search. Nirenburg and Raskin (CMU and Purdue) and Retz-Schmidt (U. of Saarbruecken) addressed issues of how to deal with space in natural language processing for building user interfaces that understand spatial relationships.

Shape Representation

J. Aggarwal, R. Nevatia and L. Shapiro each gave their own overview of important open issues in the field. An open question is: What are appropriate models for shape and how can they be learned? Other problems are noisy input, noisy models, the scale problem (What is the scale of the features of interest?), the partial information problem (e.g., sparse data, occlusion). Nevatia cited among the requirements for a good shape representation local support and stability (small changes in the object result in small changes in the representation). He drew a distinction between segmented and non-segmented representations. Shapiro posed the question whether there exists a unified mathematical formalism for shape recognition. He also raised the queries: When is a model-based approach useful? Are there generic models for objects? Arbab (IBM) presented a method for identifying an object among a set of known objects using projections of parallel laser light planes. Various constraints are discovered from the 3D models. Recognition is achieved via tree search similar to that proposed by Grimson and Lozano-Perez. Leyton (Rutgers) presented a formalism for describing shape based on processes that act upon it and introduce or modify curvature extrema of the shape. Such formalism can form the basis for describing changes in a natural entity such as an embryo, tumor or cloud. Rao, Nevatia and Medioni (USC) presented an overview of issues in shape representation, summarized several segmented and non-segmented approaches and briefly described ongoing work on generalized cones. Kishon and Wolfson (Courant Institute) presented an algorithm for finding the longest common subcurve of two 3D curves. The algorithm works by representing curves as sequences of local, rotationally and translationally invariant shape signatures. The specific signature used by the algorithm is the magnitude of the tangent vector at each point of the curve. Magee and Nathan (U. of Wyoming, U. of Colorado) described a system that selects new viewpoints to locate disambiguating features in 3D shape recognition. Selection of new viewpoints is based on the partial model matches found. The method has been tested on simulated data. Tsai, Silverman and Lavin (IBM) presented a method for locating polyhedra in space with 6 degrees of freedom using a light stripe sensor. A tree search is used similar to that of Grimson and Lozano-Perez that is based on edge intervals, a representation that facilitates the search for all the ways three line segments of fixed length can fall between the edges of a polyhedron.

Active Sensing

The term active sensing is used to denote the process by which the camera characteristics and position are actively modified to improve perception. There is growing psychophysical evidence that human and animal vision is active. Guided by such evidence and mathematical analyses that attempt to demonstrate that many ill-posed vision problems may become well-posed under active sensing, the active approach enjoys increasing popularity. Ballard (U. of Rochester) pointed to the rapid saccadic eye movements that we make while viewing the world, even while viewing a still photograph. Added to this is the notion that we can gain a rich impression of shape while observing its dynamic movement in space, or by moving ourselves about an object. The flow field of the visual image generated by either of these motions contains information which can be used to generate a depth map. Ballard also pointed to methods for encoding spatial relations and performing hand-eye coordination which use active vision, especially eye movements. His group is in the process of experimenting with a stereo camera pair with movement capability similar to human eye movement. Hager and Mintz (U. of Pennsylvania) introduced a system which claims to be "able to choose the number and placement of views needed to gather requested information while contending with noise processes, quantization and limitations of sensor scope." In order to actively select where and which measurements are to be taken, they propose a decision theoretic framework, which weighs the value of some piece of information against the cost of taking that measurement. The authors assume that the robot is dealing with a known object and then using information about that object when attempting to take a measurement, for example, of position. However, perception may be very dependent on object knowledge and on explicit representation of important object features within the catalog of known objects. Kuipers and Byun (U. of Texas at Austin) represent space by a topological model, whose nodes represent distinctively recognizable places (landmarks) and whose arcs represent travel paths connecting them. Landmarks are defined as places that maximize a set of distinctiveness measures. This allows them to use hill-climbing search to identify a landmark when the robot is in its

neighbourhood. Travel paths are defined by local control strategies that the robot can use to follow the path. Their paper shows examples of map-learning and navigation using ideal simulations of sonar data.

Frameworks for Spatial Reasoning and Multi-Sensor Fusion

Andress and Kak (Purdue) described on-going work on a computer vision system designed to use world knowledge for expectation-driven vision. The system combines a multilevel blackboard with the Dempster-Shafer formalism for inexact reasoning. Walker, Herman and Kanade (CMU) presented a frame-based system for 3D model-based recognition. Their system allows the representation of composite objects and geometric relationships and constraints. Weymouth (U. Michigan Ann Arbor) presented an extension of the blackboard-based design for vision to the recognition of dynamic scenes. In this case, knowledge sources have the extra task of tracking changing elements over time.

Summary

Spatial reasoning and multi-sensor fusion are two different facets of the problem of building perceptually guided robots. A lot of effort is being expended on each of them separately, while relatively less research is performed on their integration. However, advances in sensor and computer technologies are making it easier to experiment with real problems, as Ballard observed; therefore, it is reasonable to expect in the near future, more progress in the integration issues associated with perceptually guided robotics.

The proceedings of the workshop, entitled "Spatial Reasoning and Multi-Sensor Fusion: Proceedings of the 1987 Workshop", edited by Avi Kakand Su-shing Chen, is available through Morgan Kaufmann Publishers, Inc., 95 First Street, Los Altos, California 94022, USA.

The Second Workshop on AI in Environmental Science

by Max Kranse

Deuxième colloque sur l'IA et les sciences de l'environnement

RÉSUMÉ: Le Deuxième colloque sur l'IA et les sciences de l'environnement a eu lieu à Boulder, Colorado du 15 au 17 septembre 1987. Environ 80 personnes assistèrent aux discussions sur les applications de l'IA dans les domaines de l'environnement, incluant la météorologie, l'hydrologie, l'écologie, l'astronomie, la physique, et la psychologie.

15 - 17 September 1987, Boulder, Colorado

The Second Workshop on Artificial Intelligence in Environmental Science, sponsored and organized by the NOAA Environmental Research Laboratories, was held at the Clarion Hotel in Boulder, Colorado. With about 80 attendees, the workshop was small enough to allow easy interaction among participants, yet large enough to offer presentations from a wide variety of disciplines and working environments. The disciplines represented included computer science, meteorology, hydrology, ecology, astronomy, physics and psychology. Working environments included government agencies and research laboratories, industry, universities and the military.

The first session of the workshop included three 45-minute tutorial presentations aimed at providing or reinforcing a common working vocabulary of terms and concepts: Chris Fields of New Mexico State U. spoke on "AI Approaches"; William Gevarter of NASA/Ames Research Center gave a review of "AI Tools"; William Moninger of NOAA Environmental Sciences Group (the workshop organizer) reviewed "AI Applications So Far". During a lunch-time talk entitled "Understanding and Eliciting Expert Judgement", Gary Klein presented his practical experience in developing efficient methods of gathering and organizing the knowledge of domain experts.

Max Kranse is an AI researcher employed by MacDonald Dettwiler and Associates. He holds a B.Sc. in Psychology and an M.Sc. in Computer Science.

The afternoon included eight presentations devoted to demonstrable AI systems. (Due to the number of presentations, each was limited to 10 minutes, with another 10 minutes for questions and comments from the audience.) Although most of the systems discussed were applied to meteorology, other applications included an expert system for assisting in decisions concerning land disposal of hazardous wastes and another for managing the response to spills of dangerous materials. Among the meteorological applications were systems for tracking cloud masses from GOES satellite water vapor images and an Environment Canada system for the computer generation of worded weather forecasts presented by Carr McLeod of the Atmospheric Environment Service.

The next session was devoted to nine presentations: five were on "Systems Under Development" and four were on "Knowledge Engineering Strategies". All of the talks in the first category were about applications to meteorology, including SWIFT, a system for predicting severe weather (currently under development for Canada's Atmospheric Environment Service by MacDonald Dettwiler and the Alberta Research Council's Advanced Technology Department). Other applications included a fog and haze prediction system (being developed by Martin Marietta Corporation for use by the U.S. Navy) and a system for automated understanding of meteorological satellite imagery (being developed by The Analytic Sciences Corporation).

The "Knowledge Engineering Strategies" section included: a presentation from a psychologist studying individual differences in severe weather forecasting; a

presentation on the automatic generation of knowledge structures; and a description of a system under development for NASA which will use scenario-based reasoning to predict severe weather at Cape Kennedy in support of the U.S. space program. Finally, Peter Zwack, of the University of Quebec at Montreal, described the architecture of the knowledge base for a system under development, SCAPIN. SCAPIN will incorporate knowledge of the physical principles underlying the formation of low clouds in order to forecast them.

Although the next session was entitled "Software Engineering", the presentations were primarily descriptions of more applications of knowledge-based systems to various areas of environmental science. One exception was a discussion by Chris Fields of the potential for coupling symbolic and numerical computing in weather prediction systems. The other talks described systems for performing conceptual clustering in environmental data sets and an approach to qualitative modeling in biological science.

The theme of the final presentation session was "Data Analysis and Educational Applications". Kenneth Young of the University of Arizona gave one of the most interesting talks, describing a hybrid perceptron/neural net software system which he developed at home on a 386-based micro. This system predicts summer rainfall for Tucson far more accurately than the local forecasters. The system also revealed the local predictive importance of a set of factors (winds at very high levels of the atmosphere) which no one had previously suspected of having much significance for Tucson rainfall forecasts.

The final morning was devoted to three panel discussions which addressed the future of AI in environmental education/research/forecasting. Each panel had a judicious mixture of academics, industry people and operational users. After several hours of spirited discussion of the present state of AI and where it could, should or may go in the future, we all went home stimulated, better informed, and impressed with the scenic beauty of Boulder.

Although a majority of the knowledge-based systems described were rule-based, it became evident that there is a growing dissatisfaction with the limitations that this form of KBS imposes. Further, there is a great interest in other types of software systems which incorporate representation schemes such as objects or neural networks. This seems like a natural progression as more difficult applications are undertaken, ones which require a greater degree of "deep" knowledge as opposed to "surface" rules.

Canada was well represented at the workshop, especially in terms of the work being undertaken here. Although only three of the systems described were Canadian, I felt that they were some of the more ambitious and interesting at the conference. The workshop ended with the announcement of the High Plains Severe Storm Shootout. Everyone is invited to pit their computer-based severe storm forecasting system against the elements (and other competitors) in 1989. The competition will be conducted in real time, with the aim of predicting severe storms on the east slope of the Colorado Rockies. Real time data sets collected by PROFS in 1985 and 1987 will be made available so that systems can be tuned to the local Colorado conditions before the beginning of the Shootout. For Shootout information, contact: William R. Moninger, NOAA Environmental Research Laboratories, 325 Broadway, Boulder, Colorado 80303.

IJCAI'87: International Joint Conference on Artificial Intelligence

by Renato De Mori

IJCAI'87: La Conférence internationalle conjointe sur l'intelligence artificielle

RÉSUMÉ: Avec plus de 2500 participants, la dixième Conférence internationale conjointe sur l'intelligence artificielle a été la plus grande conférence sur l'IA jamais tenue en Europe. Une liste des sujets des sessions (en anglais) apparaitre sur la page suivante. Le Canada fut bien représenté à IJCAI avec des communications dans plusieurs catégories. Un fait saillant de la conférence fut la communication donnée par le gagnant du prix Ordinateur et Pensée, Johan De Kleer. Il y eut aussi un séminaire d'une journée sur ESPRIT. Les succès atteints et les domaines de concentration futurs furent discutés. La prochaine Conférence internationale conjointe sur l'IA aura lieu à Détroit en 1989.

23 - 28 August 1987, Milan, Italy

The tenth International Joint Conference on Artificial Intelligence was the greatest AI conference held in Europe, with more than 2500 in attendance. The technical program had two tracks: science and engineering. The science papers stressed the computational principles which underlie cognition and perception in both mankind and machine. The engineering presentations focused on the pragmatic issues encountered when applying these computational principles.

Renato De Mori is a professor at McGill University and is affiliated with CRIM. He is also the Vice-President of CSCSI.

Twelve tutorials were offered in parallel with the engineering papers:

- Expert Systems (B. Buchanan)
- Person-Machine Interaction Using Speech (R. De Mori)
- Introduction to Robotics (R. Dillmann)
- Knowledge-Based Tutoring (W. Clancey)
- Introduction to Artificial Intelligence and Its Application to Manufacturing Problems (M. Fox)
- Machine Learning (R. Michalski)
- Man-Machine Dialogues (J. Allen)
- Robot Programming (M. Gini)
- Evaluation of Expert Systems: Examples and Principles (E.Soloway and D. Littman)

- Uncertainty Management in Expert Systems (J. Pearl)
- Computer Vision (A. Rosenfeld)
- Towards the Deductive Synthesis of Software (R. Waldinger)

The technical program, prepared by the Program Chairman, J. McDermott, included topics shown in the table that follows this article. These topics are compared with those of other important conferences held in 1987.

Papers on Knowledge Acquisition mostly focused on explanation-based learning. There were two papers from Canada: one by J. Delgrande (SFU) and another by L. Watanabe and R. Elio (U of A). Most of the papers on Architectures and Languages were from Europe and were related to extensions of PROLOG. Papers on Cognitive Modeling were mostly from the U.S. and dealt with various aspects of educational systems. A large variety of papers on Knowledge Representation was presented, varying from fundamental theoretical issues on non-monotonic logic to practical applications to automation and business. There were two Canadian papers by J. Delgrande (SFU) and G. Lakemeyer (U of T.). Papers on Natural Language covered various aspects of syntax and semantic interpretation in English, Japanese and Italian. A number of papers were presented in the area of Perception. Three papers on Vision were presented by J. Tsotsos, J. Barron and R. Gershon et al. (U of T.). Another paper on Vision was presented by I. Mulder (Dalhousie). On the topic of speech, a paper was presented by R. De Mori (McGill). Reasoning was another area covered by a variety of contributions among which were those by D. Poole (U of Waterloo) and T. Marsland (U of A). Vision and Motion were the main subjects in the Robotics sections. Interesting invited talks were given by: D. Sleeman on Intelligent Tutoring Machines; O. Fangeras on 3-D Vision; G. Gazdar on Grammar Formalism; D. B. Lenat on AI versus Common Sense; H. Aiso on Architectures; B. Chandrasekaran on AI and Information Processing. Johan de Kleer delivered a very interesting Computer and Thought lecture.

More than fifty companies exhibited their products or applications. Most were from Europe, some from Asia and very few from North America.

A one-day seminar on the ESPRIT project reviewed the work done to date in AI. The major achievements have been in the following areas:

- Knowledge acquisition
- Knowledge representation
- Shells and languages (OMEGA, Prolog III)
- Speech and vision
- Architectures
- Integrated sensor robot-based system
- VLSI design tools

Interesting proposals for future projects in the European Community are as follows:

- Simulation action
- Basic research in adaptive intelligence in neural computer (BRAIN) (possibility of using GAAS technology)
- EUROTRA multiple machine translation
- Concerted action project (COST 13) for basic research in AI
- ISPRA Joint Research Centre
  - Knowledge representation and reasoning
  - Knowledge simulation cooperation (fractal actor model of negotiation)
  - Management of very large knowledge base
  - Coupling symbolic and numerical computation
  - Intelligent simulation environment
  - Analogical representation and naive physics
  - Media to support a new generation of user interfaces

The conference was well organized, by M. Somalvico and his colleagues, and well chaired by A. Bundy.

The next IJCAI will be in Detroit in 1989. The general Chairman will be W. Bibel (UBC) and the program chairman will be N. Shridatan (FMC).

Topics Covered in Recent AI Conferences

	IJCAI'87	AAAI'87	IEEE CAIA-87
1.	Architecture and Languages	Architectures	Software and Tools
2.	Cognitive Modeling	Cognitive Modeling	Explanation-based Learning
3.	Knowledge Acquisition	Machine Learning and KA	Knowledge Acqusition
4.	Knowledge Representation	Knowledge Representation	Knowledge Representation
5.	Natural Language	Natural Language	
6.	Perception	Vision and Speech	
7.	Reasoning	Automated Reasoning	
8.	Robotics	Robotics	6/8 Robotics and Perception
9.		AI and Education	
10.		Planning	Design and Planning
11.		Default Reasoning	Default Reasoning
12.		Engineering Problem solving	
13.		Expert Systems	Case Studies
14.			Search
15.			Uncertainty

Conference '88

CSCSI '88
Graphics Interface '88
Vision Interface '88

The Convention Centre

Edmonton, Alberta

6 - 10 June 1988

Important Dates

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

For General Information:

Wayne A. Davis, *General Chairman*
Department of Computing Science
University of Alberta
Edmonton, Alberta T6G 2H1
Tel: 403-432-3976

CSCSI '88
Canadian Artificial Intelligence Conference

Edmonton Convention Centre

6-10 June 1988

In Conjunction With

Graphics Interface '88 & Vision Interface '88

CSCSI '88 is the seventh biennial conference on Artificial Intelligence.

Conference Program

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

Invited Speakers

Wolfgang Bible, U.B.C., Geoffrey Hinton, University of Toronto, Renato de Mori, McGill, David Lowe, U.B.C., David Etherington, Bell Labs, NJ, Charles Morgan, University of Victoria

Program Committee

Nick Cercone & Robert Woodham, *Program Chairmen*

James Allen, Bill Bregar, Roger Browse, Terry Caelli, Veronica Dahl, Jim Delgrande, Renato de Mori, David Etherington, Randy Goebel, Bill Havens, Alan Jepson, Marlene Jones, James Little, Alan Mackworth, Gordon McCalla, John Mylopoulos, Peter Patel-Schneider, Dick Peacocke, Pavid Poole, Larry Rendell, Len Schubert, & Steve Tanimoto.

Sponsored by: Canadian Society for Computational Studies of Intelligence

Vision Interface '88

Edmonton Convention Centre

6-10 June 1988

In Conjunction With

Graphics Interface '88, CSCSI '88

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

Conference Program

- Model-Based Vision Systems
- Knowledge Representation for Vision
- Models of Human Perception
- Image Understanding
- Special Purpose Architectures
- 3D Vision
- Text Understanding & Verification
- Industrial Applications
- Biomedical Applications
- Remote Sensing Applications
- Motion Representation & Analysis
- Speech Recognition & Synthesis
- Texture & Segmentation
- Object Recognition
- Computational Geometry
- Image Processing
- Robot Vision
- Interactive Systems
- Feature Selection & Pattern Analysis

Invited Speakers

Karl Doetch, NRC, Ottawa, Ontario; Joseph Mundy, General Elec., Schenectady
R.C. Gonzalez, Univ. of Tennessee, Tenn; Theo Pavlidis, SUNNY, Stony Brook,

Program Committee

T. Kasvand & A. Krzyzak, *Co-Chairmen*
Terry Caelli, Luc Devroye, Karl Doetch, Jacques Domey, Morris Goldberg, David Goodenough, Richard Gordon, Bernard Kurz, Martin Levine, Alan Mackworth, James Middleton, Rajean Plamondon, Ching Suen, John Tsotsos, & Andrew Wong.

Sponsored by: Canadian Image Processing & Pattern Recognition Society

Graphics Interface '88

Edmonton Convention Centre

6-10 June 1988

In Conjunction With

Vision Interface '88 & CSCSI '88

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.

Conference Program

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

Invited Speakers

James Blinn, JPL, California
Kelly Booth, Waterloo, Ontario
Aaron Marcus, A. Marcus Assoc., California
Rob Pike, Bell Labs, New Jersey
Bill Reeves, Pixar, California

Program Committee

Darwyn R. Peachey, *Program Chairman*, Brian Barskey, Frank Crow, Tom Duff, Alain Fournier, Mark Green, Przemyslaw Prusinkiewicz, Peter Tanner, Daniel Thalmann, Colin Ware, & Marceli Wein.

Electronic Theatre - Mark Green, *Electronic Theatre Chairman*

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 presented at the 1988 conference. This material will represent new techniques, the artistic applications of computer graphics, and/or a historical perspective of the field.

Sponsored by: Canadian Man-Computer Communications Society

Book Reviews

edited by Graeme Hirst

The robot's dilemma: The frame problem in artificial intelligence

Pylyshyn, Zenon W. (editor)
[University of Western Ontario]

(Theoretical issues in cognitive science)
Norwood, NJ: Ablex Publishing Corp, 1987, xi+156 pp
Hardbound, ISBN 0-89391-371-5, US$29.50

Reviewed by
Peter Patel-Schneider
Schlumberger Palo Alto Research

The frame problem continues to fuel a great deal of discussion among AI practitioners and critics, as amply demonstrated in this collection of previously unpublished (except for one) papers by Lars-Erik Janlert, Daniel C. Dennett, Clark Glymour, John Haugeland, Hubert L. and Stuart E. Dreyfus, Drew McDermott, Patrick J. Hayes and Jerry A. Fodor. This entertaining collection of non-technical and philosophical papers contains widely diverging views on whether the frame problem is solvable, on whether it needs to be solved and on whether it is damaging to AI.

The violent divergence in the conclusions reached by the different authors is partly due to their differing outlooks—the authors include vocal critics as well as vocal proponents of AI. However, a major source of the differences in the conclusions is the lack of agreement on the definition of the frame problem—which is variously defined as the problem of representing the metaphysical fact that actions leave most primitive facts undisturbed, the problem of inferring efficiently that a fact is still true, the problem of making only relevant inferences and knowing when to stop inferring, or the whole problem of building an intelligent robot.

Just about the only common view in the collection is that the frame problem (whatever it may be) is a result of using a representation that does not correspond well enough with the real world. However, this observation is used variously to argue for representations which intrinsically contain a metaphysics of the common-sense world, to argue that the basic premises of AI are mistaken, to argue for a theory of human expertise based on holistic similarity recognition, to argue that no recent AI systems use representations with these problems, or to argue that the frame problem is the same as the problem of building an intelligent robot.

The disagreement over the nature of the frame problem renders the collections less focused than it could be. (A more focused, but also more technical and less philosophical, collection is *The Frame Problem in Artificial Intelligence: Proceedings of the 1987 Conference*, published by Morgan Kaufmann.) However, there is quite a bit of discussion of the differences in definition between authors, as well as discussion of the differences in conclusions, so this collection is not as disjointed as the preceding comments may indicate. In fact, there is a flavour of philosophical debate in this book—even including heated comments. (A real debate between some of the authors could, if handled well, be very interesting.)

The book suffers from poor editing and proofreading; there are passages that are hard to read and should have been edited—for example, on a single page, italics, boldface, and uppercase are all used for emphasis; there are also a large number of typographical errors—some humourous, some mystifying, some annoying, some benign, some serious. I expect a better job of editing and proofreading in a book that costs about Cdn$0.25 per page. Also, I would have preferred more originality; some of the papers are little more than rehashes of the author's or authors' previously made points, with some small application of them to the frame problem or some related AI problem.

Nevertheless, I recommend this collection as a source of a good introduction to the frame problem (by Janlert), as well as a source of the current views of several prominent AI researchers and critics on the frame problem and related AI problems.

Peter F. Patel-Schneider received his doctorate in knowledge representation from the University of Toronto.

Expert systems for business

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

Reading, MA: Addison-Wesley, 1987, xvi+446 pp
Paperback, ISBN 0-201-07179-7, Cdn$32.95

Reviewed by
Cao Lieu Nguyen
Université du Québec à Montréal

This is not a book on how to build expert systems for business applications. The author declares its goal is to "assist the business-oriented lay person in learning about the realities of what AI and expert systems can reliably deliver by explaining actual applications and developments". However, I found the book fairly well organized and sufficiently documented for any person who wants a good introduction to various expert system applications for management and business.

The book contains 17 papers from 31 contributors, 12 of whom are non-scholars from the business community. Except one from Greece, all the authors are from the U.S. This is not a collection of selected published papers; most of the papers were written specially for the book. They are organized into five parts: Building an Expert System Capability, Expert Support System, Expert Systems, Integrating Expert Systems into the Business Environment, and Next-Generation Technology. Each part begins with an introductory text which explains its main ideas and introduces the contributing papers. This

increases the coherence of the book. Another good idea of the editor's is to add a short summary of each paper, which increases the readability of the book.

Part I consists of three papers which define expert systems, examine the potential applications for business, and explain how to manage an expert systems project. Part II contains four papers describing support systems to increase the user's capability in such fields as accounting, military procurement, and weapons acquisition planning. Part III contains two papers on applications in production planning and resource allocation. Part IV contains five papers on integrating expert systems into various business environments: spreadsheets in ledger books, database systems, project management, and decision support systems. Part V contains three papers which examine progress on AI approaches in modeling for management support, automated analogical reasoning, and expert systems support for innovation process.

Most of the contributing papers are well written and interesting. In particular, there are four brief survey papers which give an overview on expert systems applications on management, accounting, modeling creativity for management, and analogical reasoning. One of the most valuable features of the book is to offer to business people, in a low-cost format, information on practical issues and actual experiences relating to expert systems applications in business and management fields.

A few of the papers are not quite well written, particularly numbers 5 and 14. Paper number 5, "Fuzzy Knowledge in Rule-Based Systems", has a two-page introduction where its four authors give a lengthy discussion on "linguistic variables" and "fuzzy production rules", but neglect to mention the objective and the topic of their paper. In addition, after this introduction, the authors describe five different expert systems and then terminate the paper with a 13-line conclusion somehow unrelated to the described systems; they do not give any synthesis or any comparison of five systems. In paper number 14, "Computer-Based Intelligence Support: An Integrated Expert Systems and Decision Support Systems Approach", the two authors often use well-known terms in rather ambiguous situations. For example, under the subtitle "Knowledge Base Management Systems (KBMS)" they discuss briefly not KBMS but database management systems (DBMS) and then give a long description of relational, hierarchical, and network models as "knowledge representation schemes".

The major part of the book contains descriptions of a great number of expert systems; for example, there are a total of at least twelve expert systems described in papers number 5 and 15 (all of them are unknown to me). Hence, in addition to each lengthy description, I would prefer to read a table which summarizes main features of each expert system. (And the feature I would look for at first will be whether the described expert system is only projected or already implemented and tested.) In addition, a more detailed index would be useful to readers. The present index has only about 200 entries.

Cao Lieu Nguyen is on the faculty of the Département de mathématiques et d'informatique, Université du Québec à Montréal. His research interests include AI in business and natural language database interfaces.

Neural networks: implementing associative memory models in neurocomputers

Miller, Richard K.

Madison, GA: SEAI Technical Publications, 1987
Looseleaf binder, ISBN 0-89671-088-2, US$485.00
243 pp

Reviewed by
Geoffrey Hinton and Yann Le Cun
University of Toronto

Judging by the extraordinary price, this document is aimed at executives who want a quick summary of the technological potential of neural networks. If they believe what they read here, they may be seriously misled.

The Executive Summary boldly tells us that before Hopfield's 1982 paper, neural models of associative memory were based on a linear approach. The author has obviously failed to grasp that the interesting thing about Hopfield's paper was its use of a simple energy function for describing the behaviour of a neural network. Its actual performance is rather poor compared with earlier non-linear associative memories, such as the "associative net" developed at Edinburgh in the late 1960s. The summary repeats wild exaggerations from the popular press without quotation marks or any other acknowledgement. We are told, for example, that "In a few hours, the machine can accomplish the language skills of a 6-year old child". It is hard to believe that the document could get any worse. Read on.

Chapter 1 is entitled "Introduction to Neural Nets" and it reads remarkably like a sales brochure for Hecht-Nielsen Neurocomputer Corporation. We were impressed by the unqualified assertion that neurocomputers provide capabilities such as continuous speech recognition, image pattern recognition, adaptive robot movement control, etc. We have been labouring under the assumption that current neural models can solve some interesting toy problems in these areas and that there are only a few carefully selected subtasks where an existing neural model does as well as the best conventional methods. It is not until the end of the chapter that all is revealed: It was not written by the book's author—it was provided by Hecht-Nielsen Neurocomputer Corporation.

Chapter 2 reveals the author's own grasp of the subject matter: "Associative memory is believed to be the way the neuron system of the brain works. This concept does not use numbers, but stores data in a kind of symbolic form, whereby an almost infinite combination of patterns is theoretically available." Later on we learn that "biological neuron speed is no faster than an ordinary desktop computer".

Chapter 3 describes various models and includes some quite reasonable criticisms of Hopfield's associative net and of Boltzmann machines. Unfortunately, the chapter fails to explain many ideas of central importance such as the difference between iterative and "one-shot" training procedures or the reasons why "hidden units" are necessary. Also, the section called "Mathematical Foundations" is rather thin, containing only one equation.

Chapter 4 is devoted to the implementation of neural networks. The difference between "neurocomputers" and add-on boards that accelerate floating point operations is not clearly stated, and some important

analog or hybrid machines are not mentioned. Some VLSI implementations of associative memories are described, but there is no clear statement of the fact that no practical implementation of these chips is envisioned in the near future. A substantial part of the chapter is devoted to optical processors, but there is little attempt to make the information intelligible to the non-expert. There is no explanation of the basic principles, but we are told that "compensation for phase nonuniformities . . . can be achieved by phase conjugation in degenerate four-wave mixing configurations". The last part of the chapter is speculative even by neural network standards, since it concerns implementation using a technology that does not yet exist: "molecular electronics".

The remaining two chapters survey the companies and research groups in the field. There appears to be no attempt at evaluation. Each company or group is described in its own words, or in a précis of them. There is wide variation in the degree of detail. Important start-ups like Synaptics (which includes Carver Mead and Frederico Faggin) receive very brief descriptions, whilst other companies have long descriptions that mention, for example, the "attractive 24-inch-wide" processor. The major connectionist group at Rochester receives the same amount of space as Francis Pettit, whose "Pettit Machine" will work in the following way: "The active element will be a pulse-transponder with light quanta in 'clouds' carrying whole images and correlating these with vast sets of dynamic images. This work depends on . . . the development of a new, non-Aristotelian mathematics." At least one group that did not provide text is summarized by picking a single paper and reproducing half of the abstract (with a few words changed and no acknowledgement of the source). Nevertheless, these two chapters are the most useful part of the document because they contain names and addresses and bring together information not previously collected in one place.

In summary, this document is of little value as an introduction to the ideas in the field, and the author's uncritical acceptance of exaggerated claims is liable to lead to unrealistic expectations. Fortunately, the extremely high price should limit the damage that will be done to the serious researchers in the field.

Geoffrey Hinton is a leading researcher in the field of neural networks. He is a Professor in the Departments of Computer Science and Psychology at the University of Toronto, and is a fellow of the Canadian Institute of Advanced Research. His colleague, Yann Le Cun, is a Research Associate in the Department of Computer Science, University of Toronto.

Books Received

Books listed below that are marked ‡ will be reviewed in a future issue; reviewers are still sought for those marked with an asterisk. Readers who wish to review books for the magazine should write, outlining their qualifications, to the book review editor, Graeme Hirst, Department of Computer Science, University of Toronto, Toronto, Ontario, Canada M5S 1A4. Obviously, we cannot promise the availability of books in anyone's exact area of interest.

Authors and publishers who wish their books to be considered for review in *Canadian AI* should send a copy to the book review editor at the address above. All books received will be listed, but not all can be reviewed.

‡ **Artificial intelligence and tutoring systems: Computational and cognitive approaches to the communication of knowledge.** *Wenger, Etienne* [University of California, Irvine]. Los Altos, CA: Morgan Kaufmann Publishers, 1987, *xxiii*+486 pp, hardbound, ISBN 0-934613-26-5, US$32.95.

‡ **Automated reasoning: 33 basic research problems.** *Wos, Larry* [Argonne National Laboratory]. Englewood Cliffs, NJ: Prentice Hall, 1988, xiii+319 pp, paperback, ISBN 0-13-054522-X, US$12.00.

Consciousness and the computational mind (Explorations in cognitive science.) *Jackendoff, Ray* [Department of Linguistics, Brandeis University]. Cambridge, MA: The MIT Press, Bradford Books, 1987, xvi+356 pp, hardbound, ISBN 0-262-10037-1, US$27.50.

Efficient parsing for natural language: A fast algorithm for practical systems. *Tomita, Masaru* [Carnegie Mellon University]. (The Kluwer international series in engineering and computer science; natural language processing and machine translation.) Boston: Kluwer Academic Publishers, 1986, xviii+201 pp, hardbound, ISBN 0-89838-202-5, US$39.95.

‡ **Logical foundations of artificial intelligence.** *Genesereth, Michael R., and Nilsson, Nils J.* [Stanford University]. Los Altos, CA: Morgan Kaufmann Publishers, 1987, xviii+405 pp, hardbound, ISBN 0-934613-31-1, Cdn$36.95.

Logics of time and computation. *Goldblatt, Robert* [Department of Pure Mathematics, Victoria University of Wellington]. (CSLI lecture notes 7) Center for the Study of Language and Information, Stanford University, 1987, ix+131 pp. Distributed by the University of Chicago Press, hardbound, ISBN 0-937073-11-3, US$24.95; paperback, ISBN 0-937073-12-1, US$11.95.

Meaning and cognitive structure: Issues in the computational theory of mind. *Pylyshyn, Zenon W and Demopoulos, William (editors)* [University of Western Ontario]. (Theoretical issues in cognitive science.) Norwood, NJ: Ablex Publishing Corp, 1986, xi+264 pp, hardbound, ISBN 0-89391-372-3, Cdn$39.50.

Natural language and voice processing: An assessment of technology and applications. *Walker, Terri C., and Miller, Richard K.* Madison, GA: SEAI Technical Publications, 1987, 260 pp. Looseleaf binder, ISBN 0-89671-083-1, US$285.00.

Natural language generation: New results in artificial intelligence, psychology and linguistics. *Kempen, Gerard (editor)* [Department of Experimental Psychology, University of Nijmegen]. (NATO Advanced Science Institutes Series E: Applied Sciences, number 135.) Dordrecht: Martinus Nijhoff Publishers (distributed by Kluwer Academic Publishers), 1987, xiv+466 pp, hardbound, ISBN 90-247-3558-0, US$79.50.

A natural language interface for computer-aided design. *Samad, Tariq* [Carnegie-Mellon University].

(The Kluwer international series in engineering and computer science; natural language processing and machine translation.) Boston: Kluwer Academic Publishers, 1986, ix+188 pp, hardbound, ISBN 0-89838-222-X, US$38.95.

Natural language understanding. *Allen, James Frederick* [University of Rochester]. Menlo Park, CA: Benjamin/Cummings, 1987, xvi+574 pp, hardbound, ISBN 0-8053-0330-8, Cdn$50.

Prolog and natural-language analysis. *Pereira, Fernando C.N., and Shieber, Stuart M.* [SRI International]. (CSLI lecture notes 10.) Center for the Study of Language and Information, Stanford University, 1987, viii+260 pp. Distributed by the University of Chicago Press. Hardbound, ISBN 0-937073-17-2, US$28.95; paperback, ISBN 0-937073-18-0, US$13.95.

Prolog for programmers. *Kluzniak, Feliks and Szpakowicz, Stanislaw, with a contribution by Bien, Janusz S.* [Warsaw University and University of Ottawa]. (APIC studies in data processing 24.) London: Academic Press, 1985, xii+306 pp. Includes floppy disk with Toy Prolog for IBM PC. Hardbound, ISBN 0-12-416520-6; paperback, ISBN 0-12-416521-4, US$24.95.

Computational Intelligence

Abstracts for 3(4) November1987
Special Issue on Machine Learning
Guest Editor: Larry Rendell

A Discussion of a Report by Ehud Shapiro
Ranan B. Banerji
Saint Joseph's University
Philadelphia, Pennsylvania

The paper is an annotated summary of Ehud Shapiro's report "The Induction of Theories from Facts". In the view of this author, Shapiro's work forms a very good foundation for work in the field of learning. It gives a clear definition of the term *learning* in a way which is both intuitively acceptable and renders learning algorithms amenable to precise analysis. It also establishes a paradigm for learning algorithms which is precise enough that it can serve as a benchmark for future development as well as for the analysis of presently available algorithms.

Learning to Control a Dynamic Physical System
Margaret E. Connell
Paul E. Utgoff
Department of Computer and Information Science
University of Massachusetts
Amherst, Massachusetts

This paper presents an approach to learning to control a dynamic physical system. The approach has been implemented in a program named CART and applied to a simple physical system studied previously by several researchers. Experiments illustrate that a control method is learned in about 16 trials, an improvement over previous learning programs.

A Computational Theory of Motor Learning
Wayne Iba
Pat Langley
Department of Information and Computer Science
University of California, Irvine

In this paper we present a computational theory of human motor performance and learning. The theory is implemented as a running AI system called MAGGIE. Given a description of a desired movement as input, the system generates simulated motor behaviour as output. The theory states that skills are encoded as *motor schemas*, which specify the positions of a limb at selected points in time. Moreover, there exist two natural representations for such knowledge: *viewer-centered* schemas describe visually perceived behavior, while *joint-centered* schemas are used to generate behaviour.When the model acts upon these two representational formats, they have quite different behavioural characteristics. MAGGIE performs the desired movement within a feedback control paradigm, monitoring for errors and correcting them when it detects them. Learning involves improving the joint-centered schema over multiple practice trials; this reduces the need for monitoring. The model accounts for a number of well-documented motor phenomena, including the speed-accuracy trade-off and the gradual improvement in performance with practice. It also makes several testable predictions. We close with a discussion of the theory's strengths and weaknesses and directions for future research.

Inductive Ambiguity and the Limits of Artificial Intelligence
Satosi Watanabe
University of Hawaii
Honolulu, Hawaii

Most artificial intelligence (AI) systems are based fundamentally on deduction. Such systems usually rely on a number of deductive heuristics. We can justify this reliance only when we can assume that the logical lattice of propositions is closed. In particular, this restriction forces us to concede that deductive AI systems cannot be capable of performing activities such as abduction and inductive evaluation, which are at the heart of scientific activity. To illustrate, we will look at diagnostic practices in medicine and compare the inductive-scientific and deductive-technological processes. Deductive AI systems can help us only with the latter type of analysis.

Subscription Information

Computational Intelligence is published by the National Research Council and is sponsored by CSCSI/SCEIO. Non-institutional CSCSI/SCEIO members may subscribe for Cdn$16, half the regular price, by using a copy of the all-purpose order form on page 48.

Technical Reports

University of Saskatchewan

The Practical Use of Artificial Intelligence in Automated Tutoring: Current Status and Impediments to Progress
Gordon I. McCalla and Jim E. Greer
ARIES Laboratory Research Report # 87 - 2
(Laboratory for Advanced Research in Intelligent Educational Systems)
Department of Computational Science
University of Saskatchewan
Saskatoon, Canada

This paper summarizes the current trends in artificial intelligence (AI) applications and research into computer assisted instruction (CAI). Increasingly sophisticated intelligent CAI systems are being developed, making use of new technologies and new AI techniques. The six major components of an intelligent CAI system are identified: 1) the domain knowledge component, 2) the teaching expert component, 3) the communication component, 4) the student knowledge component, 5) the system learning component, and 6) the system control component. Each component is described in some detail, with emphasis on the current state of the art, future potential, and perceived impediments to further development. The need for cooperative research and development activities among educators, computer scientists and cognitive scientists is emphasized, and immediate practical implications for educators are discussed.

Note: This paper was presented at the Conference on Cognition and Literacy for a Changing Society, The University of Saskatchewan College of Education 60th Anniversary Conference, Oct. 30, 1987.

Finding Language Errors and Program Equivalence in an Automated Programming Advisor
Xueming Huang
ARIES Laboratory Research Report # 87 - 3
(Laboratory for Advanced Research in Intelligent Educational Systems)
Department of Computational Science
University of Saskatchewan
Saskatoon, Canada
(M.Sc. Thesis presented to the College of Graduate Studies, University of Saskatchewan)

A program has three conceptual levels: task, strategy and implementation. The process of developing a program is a process of using a specific programming language to implement a chosen strategy which can solve the given task. Several types of bugs could arise in this process, including strategy bugs and language bugs as well as their mixtures.

Although many automatic debugging systems have dealt with non-syntactic language errors, they either only work on programs using a determined strategy or try to use plans at one conceptual level to catch bugs at several conceptual levels. The former is limited in practice, while the latter would generate wrong explanations for bugs at different levels from the plans. This thesis describes a new approach to solve this problem—using an independent language expert to detect language errors and determine program equivalence. The language expert will cooperate with other components of an automatic debugging system, the SCENT advisor, to achieve high performance in finding bugs at various levels.

A combination of knowledge-based and program verification techniques has been used in the language expert. This combination enables the language expert to have good debugging and reasoning abilities, high efficiency and generality.

Knowledge-based debugging has been implemented by a debugging graph which is intended to recognize common program constructs and common bugs which frequently appear in students' programs. Empirical studies on performance of this implemented part of the language expert show that it has achieved high performance in detecting and identifying language errors.

Ordering information

Requests for any of the aforenamed publications should be addressed to: Gord McCalla, Department of Computational Science, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, S7N OWO.

Deadline for the April issue is 15 February

Upcoming Conferences

In Canada

International Conference on Intelligent Tutoring Systems
1 - 3 June 1988, Montreal Quebec.
See announcement on page 26 for details.

Artificial Intelligence '88
Vision Interface '88
Graphics Interface '88
6 - 10 June 1988, Edmonton Alberta
See announcements on pages 35-38 for details.

Professionals and Social Responsibility: Conflict or Conference?
16 - 18 March 1988, U. of Waterloo, Ontario
Topics include: professional codes: their historical development; ethical codes in engineering/practice; women as scientists: their rights and obligations; global peace as a professional concern; international campaigns for human rights, beyond professional ethics.
Contact: U. of Waterloo, Centre for Society, Technology, and Values, PAS 2061, Waterloo, Ontario N2L 3G1; (519) 885-1211, Ext. 6215.

16th Annual Conference of the Canadian Association for Information Science
12 - 14 May 1988, Ottawa, Ontario
Contact: David Holmes, c/o CAIS 88, P.O. Box 38, Station B, Ottawa, Ontario, K1P 6C3; (613) 564-4074

3rd AAAI Workshop on Knowledge Acquisition for Knowledge-Based Systems
7-11 November 1988, Banff, Alberta
Topics include: Transfer/modeling of expertise; Learning systems; Extracting and modeling of knowledge; Integration of Knowledge Acquisition (KA) techniques and systems; KA methodology and training; Validation of KA techniques (the role of KA techniques in validating Knowledge-Based systems).
Submission deadline: May 15, 1988. Submission material: 5 copies of an abstract (4 - 8 pages) or a full-length paper (to 20 pages). There will be a best student paper award.
Contact: John Boose, Advanced Technology Center, Boeing Computer Services, 7L-64 (via US mail:) PO Box 24346, Seattle, Washington, USA 98124 (206) 865-3253. (via express mail:) Bldg 33.07 2760 160th Ave. SE Bellevue, Washington, USA 98008. Brian Gaines, Dept. of Comp. Sci., U. of Calgary, 2500 University Dr. NW, Calgary, Alberta T2N 1N4 (403) 220-5901.

In the United States

2nd Conference on Applied Natural Language Processing
9 - 12 February 1988, Austin, Texas
Focus: the application of natural language processing techniques to real-world problems.
Topics include: Human-machine interfaces; Speech input and output; Information retrieval; Text generation; Machine translation; Office automation; Writing aids; Computer-aided instruction; Tools for natural-language processing; Applications to medical, legal, or other professional areas.
Contact: Bruce Ballard, AT&T Bell Laboratories, 3C-440A, Murray Hill, NJ 07974; (201) 582-5440.
NET: *allegra*!bwb@ucbvax.berkeley.edu.

2nd Conference on Theoretical Aspects of Reasoning about Knowledge
6 - 9 March 1988, Monterey, California
Focus: to bring together researchers from philosophy, linguistics, economics, and computer science to further theoretical understanding of reasoning about knowledge.
Topics include: Semantic models for knowledge and belief; Resource-bounded reasoning; Minimal knowledge proof systems; Analyzing distributed systems via knowledge; Knowledge acquisition and learning; Knowledge and commonsense reasoning; Knowledge, planning, and action; Knowledge in economic models.
Contact: Moshe Y. Vardi, IBM Research, Almaden Research Center K53-802, 650 Harry Rd., San Jose, CA 95120-6099; (408) 927-1784.
NET: vardi@ibm.com, vardi@almvma.bitnet.

4th IEEE Conference on AI Applications
14 - 18 March 1988, San Diego, California
Focus: the application of techniques to real-world problems.
Contact: CAIA-88, The Computer Society of the IEEE 1730 Massachusetts Avenue NW, Washington, DC 20036-1903; (202) 371-0101.

AAAI Spring Symposium Series
22 - 24 March 1988, Stanford U., California
AAAI offers 5 mini-symposia. The format of each will be a series of panel discussions in which position papers are presented and debated. Symposium titles: Computer Games; How Can Slow Components Think So Fast?; Explanation-based Learning; AI in Medicine; Physical and Biological Approaches to Computational Vision.
Contact: 1988 Symposium Series, AAAI, 445 Burgess Drive, Menlo Park, CA 94025-3496.

Conference on Office Information Systems
23 - 25 March 1988, Palo Alto, California
Focus: intelligent processing of information in organizations. Topics include: Object-oriented and intelligent databases; Planning systems; Distributed AI; User models.
Contact: Conference on Office Information Systems, Dr. Robert Allen, 2A-367, Bell Communications Research, Morristown, NJ 07960.

AAAI Workshop on Architectures for Intelligent Interfaces: Elements and Prototypes
29 March - 1 April 1988, Monterey, California
Focus: to explore ways in which techniques can be used to provide the adaptability and reasoning capabilities required for a more intelligent human-machine interaction. Topics include: Models (user, system, task); Channels of communication; Planning; Interface-building tools.
Contact: Joseph Sullivan, Lockheed Center, 2710 Sand Hill Rd., Menlo Park, CA 94025; (415) 354-5200.
NET: wiley!joe@lll-lcc.arpa.

2nd International Conference on Expert Database Systems
25 - 27 April 1988, Tysons Corner, Virginia
Focus: theoretical and practical issues in making database systems more intelligent and supportive of applications. Topics include: Theory of knowledge bases; Object-oriented systems; Reasoning on knowledge and databases; Knowledge management; Distributed knowledge and databases; Intelligent database interfaces; Natural language interaction.
Contact: Larry Kerschberg, Dept. of Information Systems and Systems Eng., George Mason U., 4400 University Drive, Fairfax, VA 22030.

2nd International Conference on Expert Systems and the Leading Edge in Production Planning and Control
3 - 5 May 1988, Charleston, South Carolina
Focus: Bridging the gap between the leading edge in production planning and control and expert systems development. Topics include: Process or product design; Production control; Logistics; Scheduling; Integrated production planning; Maintenance.
Contact: Michael Oliff, Dept of Management Science, College of Business Administration, U. of South Carolina, Columbia, SC 29208.

8th Workshop on Distributed AI
22 - 25 May 1988, Lake Arrowhead, California
Topics include: Describing, decomposing, allocating problems among a collection of intelligent agents; Assuring coherent, coordinated interaction among intelligent agents; Reasoning about other agents, the world, and the state of the coordinated process; Recognizing and resolving disparities in viewpoints, representations, knowledge, goals, etc.; Problems of language and communication; Epistemological problems such as joint concept formation, mutual knowledge; Practical architectures for building and interacting with intelligent agents.
Submission deadline: Feb. 15, 1988; Submission material: extended abstract, 5-7 double-spaced pages.
Contact: Les Gasser, Distributed AI Group, Comp. Sci. Dept., U. of Southern California, Los Angeles, CA. 90089-0782 (213) 743-7794 .

AI and Advanced Computer Technology Conference/Exhibition
4 - 6 May 1988, Long Beach, California
The 24 technical sessions will be covered in 6 tracks consisting of the following topics: Languages; Expert Systems; Learning; Computers; Applications; Engineering and Manufacturing.
Contact: Tower Conference Management Co., 331 W. Wesley St., Wheaton, IL. 60187.

9th International Conference on Automated Deduction
23 - 26 May 1988, Argonne, Illinois (near Chicago)
Topics include: Theorem-proving; Logic programming; Unification; Deductive databases; Term rewriting; Automatic theorem-proving for non-standard logics; Program verification; Inference systems.
Contact: Ewing Lusk, CADE-9, Mathematics and Comp. Sci. Division, Argonne National Laboratory, Argonne, IL 60439.

26th Annual Meeting of the Association for Computational Linguistics
7 - 10 June 1988, Buffalo, New York
Topics include: Computational linguistics; Phonetics, phonology, and morphology; Interpreting and generating spoken and written language; Models of language; Machine translation aids; Natural language interfaces; Message understanding systems.
Submission deadline: Jan. 4, 1988. Submission material: 12 copies of extended abstract, max 8 double-spaced pages.
Contact: Jerry Hobbs, ACL88 Program Chair, AI Center, SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025; (415) 859-2229.
NET: hobbs@warbucks.ai.sri.com.

Symposium on the Engineering of Computer-Based Medical Systems
8 - 10 June 1988, Minneapolis, Minnesota
Focus: to explore the full range of issues and problems that emerge from the process of engineering computer-based medical systems. Topics include: Expert Systems; Networking and communication; Software QA (validity, standards); Reliability (modeling, design, fault tolerance); Regulatory issues; Medical imaging and graphics.
Contact: Dr. Bart Galle, Continuing Medical Education, Box 202 UMHC, 420 Delaware St. SE, Minneapolis, MN 55455; (612) 626-5525.

5th International Conference on Machine Learning
12 - 15 June 1988, Ann Arbor, Michigan
Focus: to bring together researchers from all areas of machine learning.
Submission deadline: Jan 15, 1988. Submission material: 4 copies of paper, in required format. Contact: Machine Learning Conference, Cognitive Science and Machine Intelligence Laboratory, The U. of Michigan, 904 Monroe

St., Ann Arbor, MI 48109-1234.
NET: ml88@csmil.umich.edu.

2nd International Conference on Theoretical and Methodological Issues in Machine Translation of Natural Language

12 - 14 June 1988, Pittsburgh, Pennsylvania

Topics include: Machine-aided translation; Automatic analysis and generation of natural language texts; Structure of lexicons and grammars; Research tools and Methodologies; Theory of translation.
Submission deadline: Feb. 1, 1988. Submission material: extended abstracts max. 1500 words.
Contact: Cerise Josephs, Center for Machine Translation, Carnegie-Mellon U., Pittsburgh, PA 15213; (412)268-6591.
NET: cerise@nl.cs.cmu.edu.ARPA.

5th ACM Conference on Lisp and Functional Programming

25 - 27 July 1988, Snowbird, Utah

Focus: the theory, design, and implementation of programming languages and systems that support symbolic computation. Topics include: Programming language concepts and facilities; Implementation methods; Machine architectures; Semantic foundations; Programming logics; Program development environments; Applications of symbolic computation.
Submission deadline: Jan. 22, 1988. Submission material: 11 copies of tech summary, max. 3000 words.
Contact: Robert Cartwright, Rice U. Dept of Comp. Sci., P. O. Box 1892, Houston, TX 77251-1892; (713) 527-4834.
NET: cork@rice.edu.

ASME International Computers in Engineering Conference

31 July - 3 August 1988, San Francisco, California

Focus: real-world applications of expert systems and AI.
Topics include: CAD/CAM; Computer simulation; AI; Robotics; Interactive graphics; Finite element techniques; Microprocessors; Computers in education.
Contact: Edward Patton, US Army Ballistic Research Lab, Aberdeen Proving Grounds, MD 21005; (301) 278-6805.

3rd International Conference on Applications of AI in Engineering

8 -12 August 1988, Stanford U., California

Topics include: Representation in design; Problem solving in diagnosis/evaluation; Constraint reasoning in process control and planning; Robotics learning; Tutoring qualitative models; Sensing and interpretation tools; User interfaces.
Submission deadline: Jan. 15, 1988. Submission material: Full papers with abstracts, max. 8000 words. Contact: John Gero, Technical Chair, AIE88, Dept. of Architectural Science, The U. of Sydney, NSW 2006 Australia; Phone: 61-2-692-2328.
UUCP: uunet!munnari!archsci.su.oz!john.

AAAI 4th Workshop on Uncertainty in AI

19 - 21 August 1988, St. Paul, Minnesota
(preceding the AAAI Conference)

Topics include: Applications: results, implementation problems and experiences, analyses of the experiences of end users; Knowledge engineering under uncertainty; Control of uncertain reasoning processes; Different uncertainty calculi; Revision of beliefs in an uncertain environment; Robotics; Planning; Development of standard test cases.
Submission deadline: Mar. 31, 1988. Submission material: 4 copies of full papers.
Contact: Ross Shachter, Center for Health Policy, 125 Old Chemistry Building, Duke U., Durham, NC 27706; (919) 684-4424.
NET: shachter@sumex-aim.stanford.edu.

DIAC-88: Directions and Implications of Advanced Computing

21 August 1988, St. Paul, Minnesota

The adoption of current computing technology, and of technologies that seem likely to emerge in the near future, will have a significant impact on the military, on financial affairs, on privacy and civil liberty, on the medical and educational professions, and on commerce and business. Focus: to consider these influences in a social, economic, and political context as well as a technical one. Topics include: Ethical issues in computing research; Sources and effects of research funding; Responsible software development; AI and the conduct of war; Limits to the automation of war; Automated defense systems; Computerized voting; Civil liberties; Risks of the new technology; Resource modeling; Arbitration and conflict resolution; Software safety.
Submission deadline: Apr. 1, 1988. Submission material: 4 copies of complete papers, max. 6000 words.
Contact: Nancy Leveson, ICS Department, U. of California, Irvine, CA 92717; (714) 856-5517.
Sponsored by Computer Professionals for Social Responsibility, P.O. Box 717, Palo Alto, CA 94301.

AAAI-88: 7th National Conference on AI

22 - 26 August 1988, St. Paul, Minnesota

Topics include: AI and education; Automated reasoning; Cognitive modeling; Common sense reasoning; Expert systems; Impacts of technology; Knowledge acquisition; Knowledge representation; Machine architecture and computer languages for AI; Machine learning; Natural language; Robotics; User interfaces; Perception and signal understanding.
Submission deadline: Mar. 8, 1988. Submission material: 6 copies of complete paper.
Contact: AAAI-88, American Association for Artificial Intelligence, 445 Burgess Dr., Menlo Park, CA 94025-3496.

International Neural Network Society Annual Meeting

6 - 10 September 1988, Boston, Massachusetts

INNS is an association of scientists, engineers, students, and others seeking to advance our understanding of the modeling of behavioural and brain processes, and the application of neural modeling concepts to technological problems.
Submission deadline: Mar. 31, 1988. Submission material: abstracts must be typed on the INNS abstract form in camera-ready format.
Contact: Neural Networks, AT&T Bell Labs, Room 4G-323, Holmdel, NJ 07733.

Outside North America

Avignon 88–Expert Systems and Applications
30 May - 3 June 1988, Avignon, France

The main conference will be accompanied by specialized conferences: Expert Systems and Maintenance; Expert Systems in Medicine and Biology; AI and Defense. Tutorials will supplement the technical conference, on May 30 - 31. An exhibition will feature commercially available software/hardware products and prototypes. An Expert's Fair will provide a meeting place for knowledge base experts and interested companies. Topics include: Finance, banking, economics; Business admin, office automation; CAM, robotics, QA; CAD, CAT, engineering; Security, software engineering; Decision support systems.
Submission deadline: Jan. 11, 1988. Submission material: 6 copies of papers, max. 20 pages.
Contact: Jean-Claude Rault EC2 269-287, rue de la Garenne, 92000, Nanterre, France.
Phone: (33.1) 47 80 70 00.

ACM-SIGIR
11th International Conference on Research and Development in Information Retrieval
13 - 15 June 1988, Grenoble, France

Focus: the theory, methodology, implementation and applications of information retrieval. Topics include: Retrieval system modeling; Information retrieval and AI; Evaluation techniques; Natural language processing; Information retrieval and database management; User interfaces.
Submission deadline: Jan. 15, 1988. Submission material: 4 copies of full papers (max. 25 pages), or extended abstracts (max. 10 pages).
Contact: Gerard Salton, Cornell U. Dept. of Comp. Sci., 4130 Upson Hall, Ithaca, N.Y. 14853 - 7501, USA.
NET: siri@imag.UUCP.

1st Australian Knowledge Engineering Congress
15 - 17 November 1988, Melbourne, Australia

Topics include: Expert Systems case studies; Knowledge Engineering methodologies; Design and use of conceptual schemas; Natural Language Interfaces; Evaluation of tools and expert systems; Role of consultants in KE; Design of Intelligent tutors; Knowledge Source Systems.
Submission deadline: "as soon as possible". Submission material: A preliminary indication of interest in offering a paper, management of specific streams and/or tutorial presentations.
Contact: G. Garner, Deakin U., Victoria 3217, Australia.
NET: brian@aragorn.oz.

IAPR Workshop on Computer Vision
Special Hardware and Industrial Applications
12 - 14 October 1988, Tokyo, Japan
(This workshop will be held in advance of)
9th International Conference on Pattern Recognition (ICPR)
17 - 20 October 1988, Beijing, China

Topics include: Special hardware and industrial applications; High speed image processor; VLSI image signal processor chip; PC-based low-cost image analysis system; Special-purpose PRIP machine; Intelligent sensor; Visual inspection; Robot vision; Engineering automation for documents and line drawings; New imaging techniques; 3-D information usage.
Submission deadline: May 15, 1988. Submission material: 2 copies of a 400 word summary.
Contact: Mikio Takagi, Institute of Industrial Science, U. of Tokyo, 7-22-1, Roppongi, Minato-ku, Tokyo 106.
CSNET: takagi%iis.u-tokyo.junet@relay.cs.net.

Editors' Note:
Please let us know which of the upcoming conferences you want to see reported in *Canadian AI*. We already know that we want reports on CSCSI '88, ITS '88, the AAAI gatherings, DIAC, and the 3rd Conf. on Knowledge Acquisition. Care to volunteer? We would like to arrange for reports in advance of conferences, so please do not postpone contacting us. Many thanks to those who contributed material for this issue.

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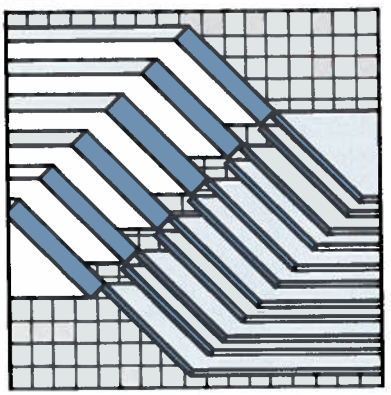

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