



Canadian Artificial Intelligence

Intelligence Artificielle au Canada

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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

AI Applications at Canadian Railways by Grant Buckler

New Alberta Robotics and AI Centre

**Stephen Regoczei on
the Banff Workshop on Knowledge Acquisition**

Book Reviews

Intelligent Information Systems

Machine Interpretation of Line Drawings

On Knowledge Base Management Systems

**Utilisation de l'IA par les chemins de fer canadiens
par Grant Buckler**

Nouveau centre de robotique et d'IA en Alberta

**Stephen Regoczei nous parle de
l'atelier en acquisition de connaissances
ayant eu lieu à Banff**

Critiques de livres

Systèmes d'information intelligents

Interprétation automatisée de compositions de lignes

Au sujet des systèmes de gestion de connaissances



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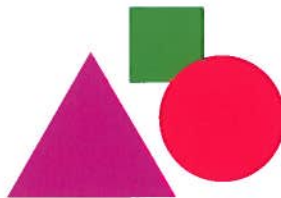
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Canadian Society for Computational Studies of Intelligence

Founded 1973

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

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

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

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

Fondée 1973

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

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

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

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Canadian Artificial Intelligence

Founded in 1974 as *CSCSI/SCEIO Newsletter*

[En français, page 9]

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

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

- Articles of general interest.
- Descriptions of current research and courses.
- Reports of recent conferences and workshops.
- Announcements of forthcoming activities.
- Calls for papers.
- Book reviews (and books for review).
- Announcements of new AI companies and products.

Intelligence Artificielle au Canada

Opinions, counterpoints, polemic, controversy.
Abstracts of recent publications, theses, and technical reports.

Humour, cartoons, artwork.
Advertisements (rates upon request).
Anything else concerned with AI.

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

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

Staying in Touch

Dick Peacocke
President, CSCSI/SCEIO

This magazine has become a major asset of our society. It replaced the previous newsletter in 1984, and now comes out regularly each quarter. Each time you receive a new issue it's interesting to see what *they* have written. But who are *they*?

The diverse contents and attractive layout of the magazine may fool you into thinking that the magazine has been prepared by a team of professional journalists. While some of the production is now being done professionally, almost all the copy is submitted by society members. So *they* is *us*. If we wish to continue producing a quality quarterly that delivers reliable and authoritative information on AI in this country, we need high-quality submissions of all the kinds of material the magazine regularly prints: articles of general interest (especially opinions and polemic), descriptions of current research and courses, reports of recent conferences and workshops, announcements of forthcoming activities, book reviews, announcements of new AI companies and products, abstracts of recent publications, theses, and technical reports, humour, cartoons, and artwork. And, of course, advertisements for your company, its products, or your job openings.

There is plenty of scope for you! It really doesn't take too much time to write a short piece. Academic, research, industrial, commercial, and of course government, news and viewpoints are all welcome. If you are doing something in AI you want the rest of the Canadian AI community to know about, this is the place to make it known.

One thing that we do not currently do as a society is produce a membership directory. It would certainly help put people in touch with one another, particularly if it were organized by location. And perhaps have a summary of interests for each member. It could even be produced as a special issue of this magazine.

If you have any comments on this idea, positive or negative, or other suggestions, please contact me or any of the executive. Our addresses are on page 4.

Avis important au sujet de l'adhésion et des abonnements

La CSCSI/SCEIO, l'éditeur de *I. A. au Canada* est une branche de l'ACI, l'Association Canadienne d'Informatique. De ce fait, tout renouvellement passe par l'ACI. L'adhésion à la CSCSI/SCEIO coûte 25\$ pour les membres réguliers et 15\$ pour les étudiants. Si vous êtes également membre de l'ACI, vous bénéficiez d'un rabais supplémentaire de 10\$. Si vous recevez *Intelligence informatique* en passant par la CSCSI/SCEIO, votre facture sera de 16\$.

Apparemment, des erreurs se sont produites en 1986 et en 1987 pour les renouvellements. Certains qui se sont abonnés à *Intelligence informatique* en 1985 n'ont pas été facturés pour 1986 ou pour le renouvellement de 1987, alors que d'autres qui l'ont été n'ont pas vu la revue. De plus, certains rabais pour étudiants ont été omis.

Si vous avez de tels problèmes, veuillez écrire ou téléphoner à Lynn Keays à l'ACI, 243 College Street, 5th floor, Toronto, Ontario M5T 2Y1; 416-593-4040 (pas de frais virés s.v.p.). Lynn mettra les choses au clair. Si vos dossiers indiquent que vous n'avez pas payé pour *Intelligence informatique* en 1986 ou 1987, mais que vous avez l'intention de continuer votre abonnement, veuillez immédiatement envoyer le paiement. Afin de recevoir les numéros appropriés, veuillez spécifier clairement à quelle(s) année(s) se rapportent votre paiement.

L'échéance pour le numéro
d'juillet est le 15 mai.

Deadline for the
July issue
is 15 May.

Important Notice Regarding Membership and Subscriptions

Because CSCSI/SCEIO, the publisher of *Canadian A.I.*, is a subgroup of CIPS, the Canadian Information Processing Society, all renewal invoices appear on CIPS stationery. You will be billed for CSCSI/SCEIO membership at the rate of \$^{CDN}25 if you are not also a member of CIPS and \$15 if you are; students receive an extra \$10 discount. If you subscribe to *Computational Intelligence* through CSCSI/SCEIO, this will also appear on your invoice (\$16).

There have apparently been some errors in renewal notices, both in 1986 and 1987. Some people who subscribed to *Computational Intelligence* in 1985 were not billed for renewals, and some who were still did not receive the journal. In addition, some student discounts were not applied.

If you have any problems with your membership, please write or phone Lynn Keays at CIPS, 243 College Street, 5th floor, Toronto, Ontario M5T 2Y1; 416-593-4040 (no collect calls please). Lynn will straighten things out for you. If your records show that you didn't pay for *Computational Intelligence* in 1986 or 1987, but you meant to, please send payment now.

Letters to the editor

Turing Test Extended

Dear Editor,

I have been in contact with a group of engineers who claim to have produced AI software that can receive and send mail with pertinent response to questions within the received mail.

Problem: How can one tell if there is indeed a piece of software or hardware on the other end of the electronic mail link?

Any assistance you might provide would be greatly appreciated. I am deeply concerned with having my leg pulled electronically by a giggling gaggle of engineers.

Bradshaw Lupton
Massachusetts Institute of Technology

This problem takes the Turing test for AI one step further. Instead of a computer pretending to be a human, a human is pretending to be a computer pretending to be a human.

I don't see any way you can tell for sure whether a mail correspondent is a real machine or someone pretending to be, if that person is clever enough. You can try to catch a person out by asking a question that the machine could not answer, and hope the person is caught. For example, if you ask "What does it feel like to be a computer?", any answer that implies that the question was "deeply" understood probably came from a human:

Readers are invited to submit their own suggestions for trick questions. — Editor.

Update

Catalogue of AI Tools becomes Catalogue of AI Techniques

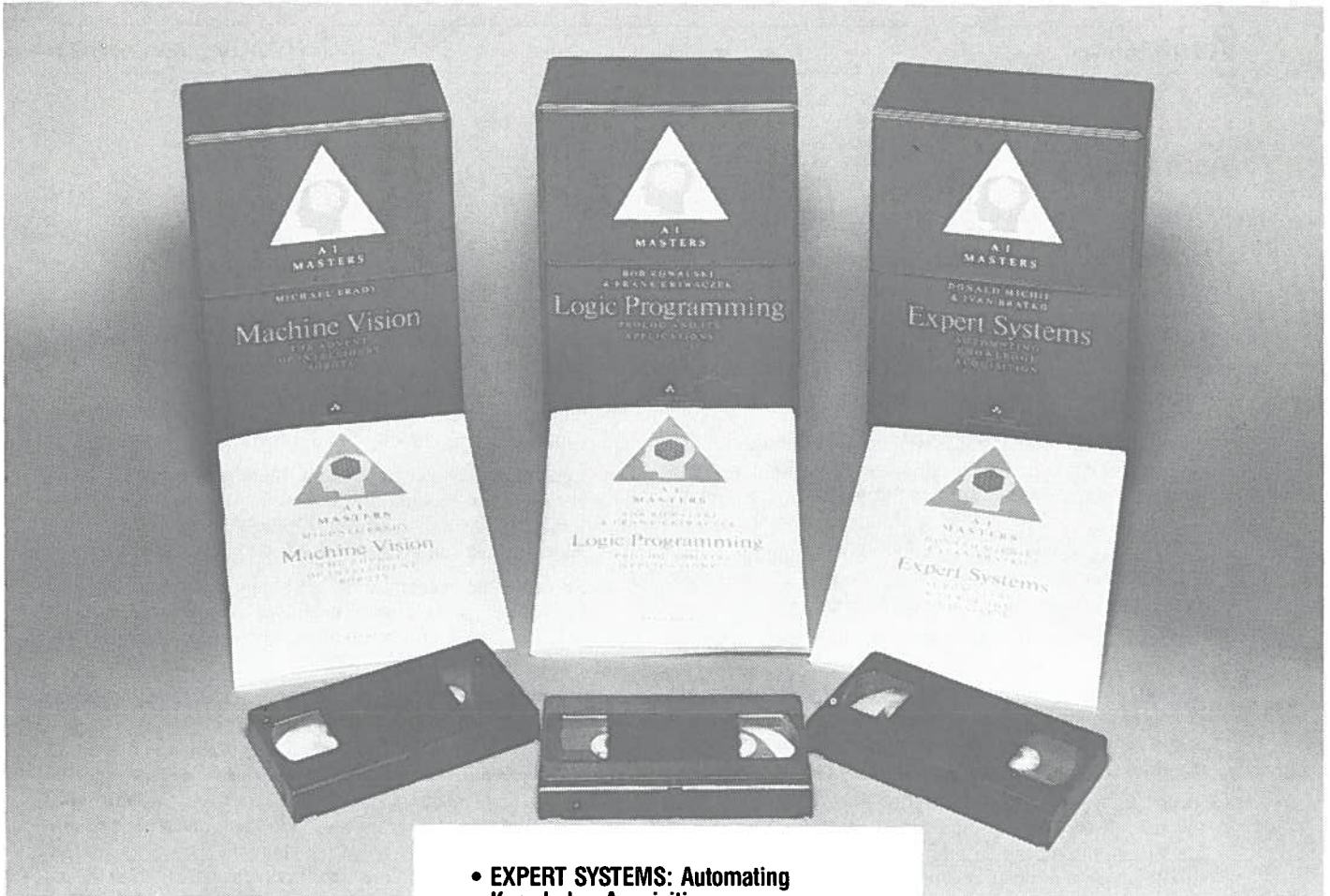
Some extensive revisions have been made to the goals and plans of the *Catalogue of Artificial Intelligence Tools*, which Alan Bundy described in the January 1987 issue of *Canadian A.I.*. These are reflected in the new title, *The Catalogue of Artificial Intelligence Techniques*.

The original version of the catalogue contained, as well as AI techniques, descriptions of portable AI software, such as expert systems shells and knowledge representation systems. Unfortunately, it was found impossible to maintain a comprehensive coverage of either all or only the best such software. New systems are being introduced too frequently and it is too large an editorial job to discover all of them, to evaluate them and to decide what to include. It would also have required a much more frequent reprinting of the catalogue than either the publishers, editors or readers could afford. Also, expert systems shells threatened to swamp the other entries. The *Catalogue's* editors have, therefore, decided to omit software entries from future editions and rename the catalogue to reflect this. The only exception to this is programming languages, for which provide generic entries will be provided. Any software entries sent to the *Catalogue* will be passed on to Graeme Publishing Company, which publishes a directory of AI vendors and products.

The *Catalogue's* definition of AI techniques and format for submission of entries has not changed from those given in the January issue.

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Résumé

Message du président, 5

La qualité de cette revue dépend avant tout des articles envoyés par nos collaborateurs à savoir les membres de la CSCSI/SCEIO. Nous encourageons votre participation. De plus, la société considère la création d'un répertoire de ses membres afin que tous puissent se connaître plus facilement. Qu'en pensez-vous?

Lettre à l'éditeur, 6

Voici qu'il existe à présent un programme qui répond au courrier électronique. Bradshaw Lupton se demande donc comment l'on peut savoir si c'est un humain ou une machine qui s'occupe de votre message!

Mise à jour, 6

Le catalogue des utilitaires en IA s'est métamorphosé en catalogue des techniques en IA et s'intéresse maintenant au matériel et aux langages de programmation.

Le groupe de travail canadien pour la standardisation de Prolog, 10

Le groupe de travail canadien pour la standardisation de Prolog a entrepris en décembre une étude visant à proposer des solutions aux divers problèmes de standardisation identifiés tant au plan international qu'au niveau local.

Le prix "Computers and Thought" en 1987, 10

Johan de Kleer, un canadien travaillant présentement aux Etats-Unis, a remporté le prix "Computers and Thought" en 1987 pour son travail touchant au raisonnement qualitatif, au maintien de la vérité logique, à la propagation de contraintes, et au contrôle explicite du raisonnement. Il n'y a pas de prix d'excellence en recherche cette année.

Rapport final de la table ronde au sujet d'une politique nationale en ce qui a trait à la technologie, 11

Les auteurs de ce rapport ne mâchent pas leurs mots pour demander aux gouvernements fédéral et provinciaux d'adopter une politique d'ensemble à long terme en matière de science et de technologie.

Réponse du gouvernement fédéral, 12

En guise de réponse à ce rapport, le gouvernement fédéral a créé un conseil consultatif national qui travaillera à huit clos.

Troisième réunion annuelle de la société canadienne pour la recherche sur les systèmes de cinquième génération, 12

La société canadienne pour la recherche sur les systèmes de cinquième génération tiendra sa troisième réunion annuelle au Château Laurier, à Ottawa, les 23 et 24 avril, 1987.

Nouvelles Express en IA, 13

- *Lisp Pointers* est un nouveau mensuel au sujet de Lisp.
- Peter Davies forme la compagnie Expert Solutions pour le développement en IA.
- La CATA et le département fédéral d'expansion régionale parrainent un atelier de deux jours au sujet d'associations stratégiques entre compagnies pour la mise en marché, la recherche, et le développement. Cet atelier aura lieu au Château Laurier, les 14 et 15 avril, 1987.
- Ceux qui se lancent en IA et qui cherchent des fonds, sont invités à la réunion de l'Association canadienne des sociétés d'investissement en capital de risque au Hilton Harbour Castle, à Toronto, les 14 et 15 mai, 1987.
- Le centre de recherche en intelligence informatique de l'université McGill offre un cours en robotique industrielle du 11 au 13 mai, et un atelier en programmation de robots, les 14 et 15 mai 1987.

Les chemins de fer et l'intelligence artificielle (*Grant Buckler*), 16

Le Canadien Pacifique et le Canadien National en sont à développer des systèmes experts touchant à divers aspects du fonctionnement d'un chemin de fer. En utilisant l'environnement Exsys, le Canadien Pacifique a produit un système pour l'entretien des locomotives. Quant au Canadien National, il emploie l'environnement Insight 2 pour construire un système mesurant l'usure des roues de locomotives. Le CP projette également un système aidant à la réparation des 13,000 radios portatives utilisées par ses employés, et le CN, un système pour les contrôles thermiques placés sur les voies principales. Ces contrôles vérifient la température de certaines parties des essieux afin d'empêcher des incendies pouvant entraîner des déraillements tel celui qui occasionna l'évacuation de Mississauga, en Ontario, en 1979.

Entretien Indes/Canada au sujet de l'IA et de la sémiotique (*Gord McCalla*), 18

Un atelier interdisciplinaire portant sur la représentation du sens commun en IA a eu lieu du 5 au 9 janvier 1987 à l'Institut Central des Langues Indiennes à Mysore aux Indes.

Acquisition de connaissances pour les systèmes cognitifs (*Stephen Regoczei*), 20

Le premier atelier en acquisition de connaissances pour les systèmes cognitifs prenait place à Banff, en Alberta, du 3 au 7 novembre 1986.

Interfaces intelligentes et systèmes experts appliqués
(James Bradford), 25

Rapport au sujet de la recherche qui se fait à l'université Brock en deux domaines d'application des systèmes experts. Un premier système utilisant l'approche question/réponse conseille les étudiants quant à leur choix de cours. Le deuxième projet consiste en un système expert permettant l'analyse de protocoles de réseaux.

L'IA au département d'informatique de l'université de l'Alberta (Renée Elio), 27

Au cours des dernières années la recherche interdisciplinaire a pris son essor à l'université de l'Alberta. Cet article résume ce qui se passe au département d'informatique qui gère plusieurs laboratoires spécialisés. Le laboratoire en robotique possède un robot Heathkit ET-18 qui peut présentement accomplir de simples tâches de recherche, de préhension, et de déplacement, qu'il analyse lui-même. Le laboratoire d'intelligence artificielle s'intéresse à l'apprentissage cognitif ainsi qu'au raisonnement et à la simulation. Celui en systèmes distribués, aux algorithmes de recherche sur arborescences, et celui en langages de programmation, aux langages, aux environnements de programmation, et aux utilitaires pour la construction de compilateurs.

Centre en intelligence informatique et en robotique de l'Alberta, (Terry Caelli), 30

L'université de l'Alberta a créé un centre en intelligence informatique et en robotique visant à intégrer les divers aspects interdisciplinaires de ces domaines. Le centre s'intéresse principalement à l'intelligence informatique, à la vision informatisée, à la robotique, et à la production intégrée.

Bande dessinée (P.S. Mueller), 31

Critiques de livres, 32

- *Systèmes d'information intelligents* par Roy Davies (éditeur), compte rendu par C.C. Gotlieb.

- *Interprétation automatisée de compositions de lignes* par Kokichi Sugihara, compte rendu par Alan Mackworth.

- *Au sujet des systèmes de gestion de connaissances* par Michael L. Brodie et John Mylopoulos (éditeurs), compte rendu par Patrick Saint-Dizier.

- Comptes-rendus express.

- Livres reçus.

- Résumés d'*Intelligence informatique*, 3(1), février 1987.

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Applied AI Systems, 19

Outils de construction rapide de prototypes pour l'IA: Le Lisp, Gold Common Lisp, Micro-Prolog et APES, l'ensemble de développement de systèmes de connaissance Arity, et l'interface en langage naturel Q&A de Symantec.

Xerox Canada, Inc., 22

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

Heurix Computer Research Inc., 26

Consultants pour les applications de l'IA.

Canadian Artificial Intelligence Products, 43

Touchant à toutes les facettes des systèmes experts.

Applied AI Systems, 44

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

Intelligence Artificielle au Canada

Fondée en 1974 en tant que *CSCSI/SCEIO Newsletter*

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

L'*Intelligence artificielle 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.
- Des requêtes d'articles.
- Des critiques de livres (ainsi que des livres à critiquer).
- L'annonce de nouvelles compagnies en IA et de leurs produits.
- Des opinions, des répliques, tout ce qui est polémique.
- Des résumés de publications récentes, de thèses et de rapports techniques.

Canadian Artificial Intelligence

Des trucs humoristiques ou artistiques, des bandes dessinées.

Des annonces (s'enquérir des frais).

Tout autre matériel touchant à l'IA.

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

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

AI News

Canadian Working Group on Prolog Standardization

Stan Szpakowicz
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The Canadian Working Group on Prolog Standardization met for the first time in Ottawa in December. The group, of which I am chairman, is organized by the Committee on Programming Languages of the Canadian Standards Association.

The group was created partly in response to international standardization activities, principally in Britain and France. Even though the very idea of Prolog standardization may seem premature to some, it is advisable that the Canadian Prolog community be prepared to voice its opinion.

About 30 people have expressed an interest in the group, and six have declared their wish to participate actively. No structure has yet been proposed for the group, but it will probably follow that of its British counterpart.

Discussion at the December meeting on what the scope of the group should be included the following points:

- To work out a position on the international standardization effort to date.
- To propose solutions to some of those problems which have been identified internationally and in Canada; with Logicware being the largest Canadian-based Prolog developer, it is not unlikely that such solutions could be influenced by the MPROLOG experience.
- To make the issues not yet resolved by the European groups clearly visible and propose our own input; this should ensure that standardization will not be premature.

I presented at the meeting an overview, based on the materials received from the BSI (British Standards Institution) group, of the current state of affairs in Prolog standardization. Many technical points of varying importance have been raised in this presentation and in the ensuing discussion. Two major concerns have been voiced during the initial meeting.

1. We believe the language should be kept small, and separate from the development tools. Error treatment and debugging facilities, for example, should

not be part of the standard, but instead there should be recommendations to be implemented in the form of a library package. Similarly, mathematical functions (trigonometric, hyperbolic, etc.) or screen-handling routines could be recommended but not required by the standard.

2. The logical origin of Prolog may be an impending factor in learning the language by programmers without the appropriate background. It may be that replacing the terminology inherited from theorem-proving by another, appealing to the intuitions from the data-processing paradigm, and therefore possibly more 'programmer-friendly', could make Prolog easier to master.

Anyone interested in these issues is welcome to join the group, or to send their ideas and concerns directly to me. □

Johan de Kleer Wins Computers and Thought Award

The winner of the 1987 Computers and Thought Award is Dr Johan de Kleer, a Canadian now working in the U.S.

The Award is in recognition of his fundamental contributions to artificial intelligence research in the areas of qualitative reasoning, truth maintenance, constraint propagation, and explicit control of reasoning.

Dr de Kleer grew up in Canada, and completed his Bachelor's degree at the University of British Columbia, where he worked with Prof. Ray Reiter. In 1973, he went to MIT, from which he obtained both his MSc and PhD degrees. Since 1979, he has been with the Xerox Palo Alto Research Center. He is well-known for his work on the AMORD reasoning system and assumption-based truth-maintenance systems. Most of an issue of *Artificial Intelligence* last year was given over to a series of three papers by Dr de Kleer on the latter topic.

The Computers and Thought Lecture is given at each International Joint Conference on Artificial Intelligence by an outstanding young scientist in the field of artificial intelligence. The Award carries with it a certificate and the sum of \$^{US}2,000 plus travel and subsistence expenses for the IJCAI. The Lecture is one evening during the Conference, and the public is invited to attend. This year's conference will be held in Milan, 23–28 August.

The Lectureship was established with royalties received from the book *Computers and Thought*, edited by Feigenbaum and Feldman; it is currently supported by income from IJCAI funds. Nominations for the 1987 award were invited from all in the artificial intelligence international community. The award selection committee was the union of the Programme, Conference, and Advisory Committees of IJCAI-87 and the Board of Trustees of IJCAI, with nominees excluded.

The previous award, in 1985, was also won by a Canadian, Hector Levesque of the University of Toronto. Other past recipients have been Terry Winograd (1971), Patrick Winston (1973), Chuck Rieger (1975), Douglas Lenat (1977), David Marr (1979), Gerald Sussman (1981), and Tom Mitchell (1983).

The committee decided that the Research Excellence Award will not be made this year. This Award is given in recognition of an Artificial Intelligence scientist who has carried out a program of research of consistently high quality yielding several substantial results. The first recipient was John McCarthy in 1985. In the opinion of the Awards Committee, none of the nominated candidates reached the high standard required. (Several members of the Committee afterwards suggested candidates that, in their opinion, did reach the required standard, but who had not been nominated.) □

CATA National Technology Policy Roundtable Final Report

The Canadian Advanced Technology Association has released its final report and the recommendations of the *National Technology Policy Roundtable*.

The strongly worded report urges the federal and provincial governments to adopt a comprehensive, long-term strategy to make science and technology the "cornerstones of national economic renewal and employment growth".

The Roundtable involved over 220 leaders from government, educational institutions, labour, the investment community, and the high technology industry in a year-long process to develop a national strategy to draw on the power inherent in scientific and technological advance to create wealth and jobs for Canadians.

"Nations that lag in the new international race for technology leadership", the report argues, "will have increasing difficulty creating income and employment opportunities for their citizens." Yet, the report concludes, Canada is lagging well behind other industrialized nations.

As a result of 15 to 20 years of policy neglect, the report says, Canada's science and technological capability is approximately half the comparable level achieved by major competitor countries: we are not investing sufficiently in science and technological education; we employ roughly half the scientists and engineers; we do roughly half the R&D; our advanced-technology industry base accounts for roughly half the share of national GNP; our established industrial sectors are adjusting more slowly to the use of advanced technologies; and we have no national strategy to stay with the front runners.

If these shortcomings are not remedied, the report predicts, the nation could quickly slip into a state of economic disarray that would place our present standard of living at risk.

Six-Point Strategy Proposed

A six-point strategy, together with detailed policy recommendations is set out in the report.

- The starting point is the development of appropriate people skills through increased emphasis on meeting the educational requirements of a knowledge and technology intensive society. The report contains a number of recommendations for curriculum reform and for strengthening the links between the educational system and industry. It also calls for a national symposium to address the problem of underfunding in the educational system, particularly as it applies to science and technology at the university level.
- Second, decision-making guidelines and specific policy recommendations are presented to expand and rationalize national research and development efforts. If acted upon, these proposals could see Canada's overall R&D activity double, thus bringing total expenditures more in line with the performance of competitor countries. Highest priority in the allocation of R&D effort, the report states, must be targeted on increasing the level of applied research by and for industry.
- The third strategic thrust is designed to significantly expand the advanced technology industry based in Canada. Proposals for achieving this objective include support for freer trade; cooperative, private sector and government supported market initiatives, and stronger investment incentives, including more favourable tax treatment for pre-production market development costs.
- Fourth, the report tables proposals to accelerate the pace of technology diffusion in order to enhance the competitive position of established industrial sectors. Recommendations are table for overcoming cultural and business constraints to technological adaptation and for addressing the particular problems faced by small companies.
- Fifth, the report states that societies most likely to achieve a leadership position are those that place a human face on technological innovation by facilitating work force adjustment. The report urges continued support for existing training initiatives and social programs that encourage employee adaptation to technological advance.
- Finally, the report argues that science and technology must become part of the public culture. This is unlikely to happen without broad political commitment to the achievement of national science and technology goals. Thus, the report urges the establishment of a strong science and technology voice

in the highest councils of each level of government. It proposes a management framework to facilitate national decision making and public consultation to review performance.

Roy Woodbridge, President of CATA, said in a press release that "There is a unanimous consensus within the advanced technology community in Canada, that we have to now accord the same kind of national priority to building science and technology-based industrial strength that we accorded the war effort in the 1940s and the creation of our social welfare system over the last three decades."

"The Roundtable report provides a blueprint for building long-term, national economic strength. It is now up to the federal and provincial governments to incorporate these ideas in a National Science and Technology Strategy. This will require financial rather than rhetorical support for science and technology development".

CATA is the national industry association representing the interests of Canada's advanced technology community. Membership comprises advanced technology companies having production or R&D capability, located in Canada, as well as research, financial, and academic institutions and companies or individuals concerned with the performance of the sector.

CATA recently announced an alliance with CIPS, CSCSI's parent organization, to address the many issues, from national technology policy to copyright infringement, that are of concern to both groups. □

Government's Latest Technology Policy Formation Moves

In response to repeated criticisms of its handling of policy issues in science and technology (*see previous article*), the federal government has created a National Advisory Board on Science and Technology, which held its first meeting in Ottawa in mid-February. The Prime Minister, Mr Mulroney, chaired the meeting.

The Board is to make policy recommendations to the government. Its deliberations will be confidential. The Board's members include the President of the University of Waterloo, Dr Douglas Wright, recent Nobel Prize winner, Professor John Polanyi of the University of Toronto, and Fraser Mustard, Head of the Canadian Institute for Advanced Research, which has a large AI research program. Frank Oberle, the Minister for Science and Technology is Deputy Chairman.

It remains to be seen whether the Board will have a significant effect on the government's actions in support for science and technology in Canada. Mr Mulroney said in a speech at the University of Waterloo on 4 March that the federal cabinet is working on a new science and technology strategy, components of which will be announced in the next few months. In

particular, an agreement will soon be signed with the provinces concerning investment in science and technology, he said.

There were also hints that another tax incentive scheme to encourage research and development would be forthcoming. □

Fifth Generation Society Third National Meeting and Workshop

Nick Cercone
President, CSFGR/SCRSCG

The Canadian Society for Fifth Generation Research / Société canadienne pour la recherche sur les systèmes de cinquième génération (CSFGR/SCRSCG) will conduct its Third National Meeting in Ottawa at the Chateau Laurier on Thursday 23 April and Friday 24 April 1987.

This meeting will be a combination workshop and business meeting. The 1½-day workshop preceding the business meeting is intended to bring together industry, government, and university researchers, administrators, and project directors in an effort to inventory Canada's current Fifth Generation computing strengths and ongoing efforts, and to make each group aware of the needs of the others.

To fulfil the Society's mandate, as discussed at the first two national meetings, the Society is asking representatives from industry and government to make short presentations introducing the fifth generation and related computing research in which their organization is engaged. Speakers are also asked to help guide the Society's future activities by reporting which expertise in this area their organization would like to see better developed in Canada during the short, intermediate, and long-term future.

The focus on industry speakers and government speakers is in marked contrast to the first two meetings which emphasized academic efforts, many of which were chronicled in the publication "Toward a Canadian Fifth Generation Research Plan", authored by the initial CSFGR/SCRSCG Steering Committee.

Preliminary Schedule Of Speakers

Although the program is not finalized at this time, the following organizations have tentatively agreed to make a brief presentation during the workshop: Bell-Northern Research, Digital Equipment Corp., IBM Laboratories, Spar Aerospace, Canadian Pacific, Intelligent Systems Corp., Applied AI Systems, Western Expert Systems Technologies, Cognos, Interact, International Artificial Intelligence, MacDonald Dettweiler & Associates, and the Canadian Institute of Advanced Research.

Also, the following agencies have tentatively agreed to make presentations: Natural Sciences and Engineering Research Council, Ministry of State for Science and Technology, National Research Council (3 groups: Intelligent Systems, Associate Committee on Artificial Intelligence, Research Journals), B.C. Advanced Systems Foundation, Alberta Research Council, Department of Communications (CRC).

Attendance at the Third National Meeting is expected to approximate 120 participants. A block of 40 rooms has been reserved for out-of-towners at the Chateau Laurier for the nights of 22-23 April. If you require accommodation, please telephone Carol Murchison, CSFGR/SCRSCG administrative assistant at 604-721-7219. (Leave a message if necessary.) □

New Lisp Newsletter

Lisp Pointers is a new bimonthly newsletter, to start in March, covering all aspects of Lisp.

Included will be articles, implementation summaries, opinion columns, and information on the latest action on the standardization front. Contributions are solicited.

Lisp Pointers is being funded by "companies who care about the future of Lisp". However, the editorial content of the newsletter will not be influenced by these companies nor will the companies be responsible for the material in *Lisp Pointers*. Until such time as it is affiliated with a more formal organization, subscriptions to *Lisp Pointers* will be free.

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New Expert Systems and Development Company

Peter Davies, formerly of INEX, has started his own company, to be known as Expert Solutions. The company will do development, consulting, and research in expert systems and other AI applications. Dr Davies may be reached at:

Expert Solutions
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Toronto, Ontario
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Making Money Meet Research and Development

Strategic partnering between companies, for research, development, and marketing, are becoming increasingly common, especially in the high-tech industries. The Canadian Advanced Technology Association believes that creating more such arrangements could "open new horizons" for Canadian firms.

To this end, CATA and the federal Department of Regional Industrial Expansion are sponsoring a two-day workshop on the topic, to be held 14-15 April in Ottawa at the Chateau Laurier Hotel. The meeting promises to include opportunities for meetings between executives from large Canadian corporations and Canadian high-tech companies.

For more information, call CATA at 613-236-6550.

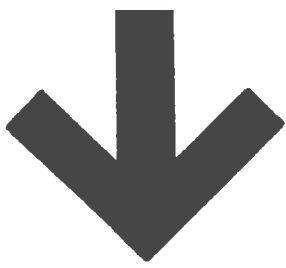
Venture Capital

AI start-ups looking for capital may find the place to start looking is the meeting of the Association of Canadian Venture Capital Companies, which is meeting in Toronto, 14-15 May, at the Hilton Harbour Castle.

Conference features include the 'Venture Marketplace', and well as over twenty talks and sessions. For more information, contact the organizers, JPdL Conventions, at 416-595-5111 in Toronto, or 514-287-1070 in Montréal. □

Robotics courses

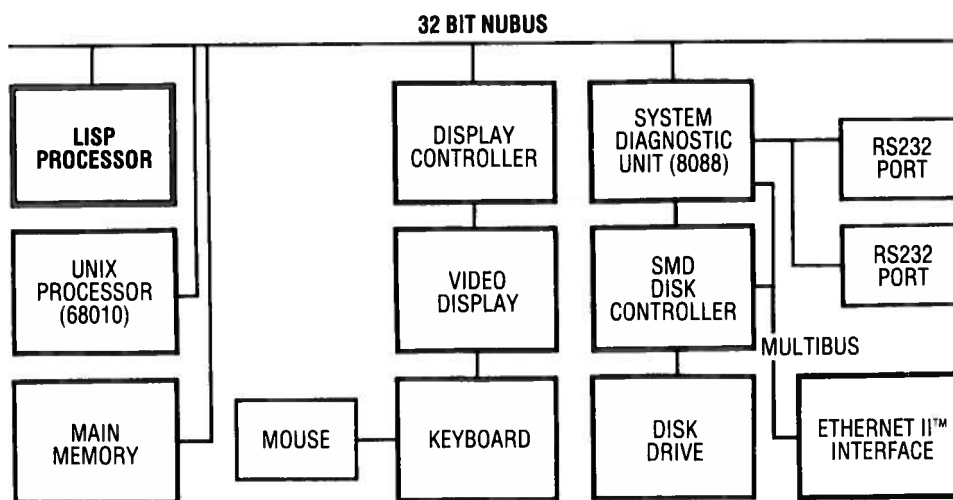
The McGill University Research Centre for Intelligent Machines is holding two events on robotics next month. The first is a course on industrial robotics, will be held 11-13 May; the second is a workshop on robot programming, and will follow on 14-15 May. For more details, call Lorna McFadden, 514-392-5426.



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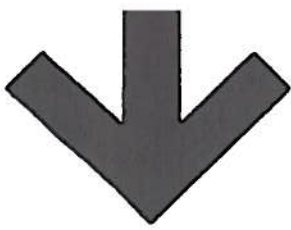


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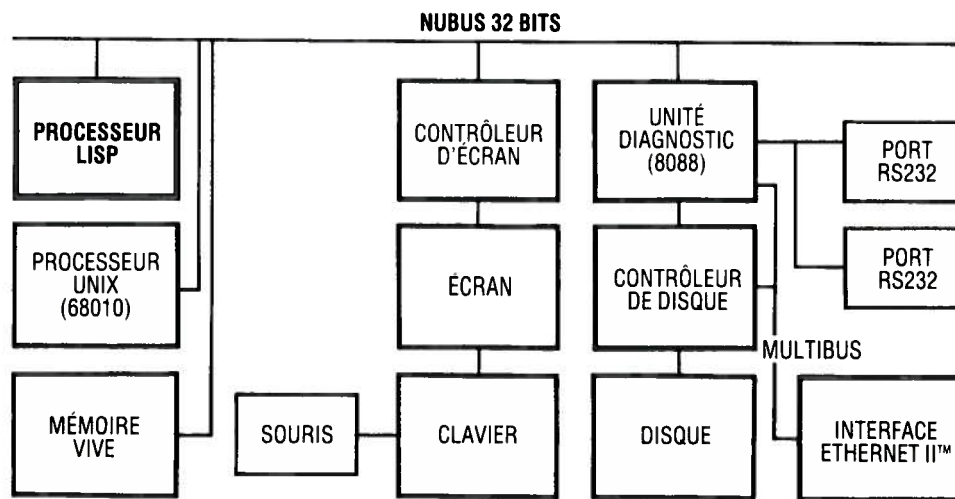
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Railways and Artificial Intelligence

Grant Buckler

Both Canadian National and Canadian Pacific are developing expert systems to help them in various aspects of running a railway. Although neither company has expert systems in day-to-day use yet, several projects are in various stages of development, ranging from planning to operating trials.

Canadian Pacific has developed a system to help with locomotive maintenance. When an engine completes a run it goes into the shop for inspection. One regular procedure is to take a sample of lubricating oil and test it for impurities. Different elements in the oil can indicate where problems may be developing, explains Peter Bedoukian, director of the technical computer and communications department at CP. Water in the oil, for example, usually points to a leak in the cooling system.

Traditionally, human experts have provided the know-how to spot problems. However, there are too few such people, and because of staff turnover the railway is concerned about analyses being done by untrained people. An expert system that runs on an IBM Personal Computer provides this expertise, Bedoukian says, and has the added advantages of being available 24 hours a day and providing consistent analysis across the country.

Exsys and Aion

Canadian Pacific developed the system using Exsys expert system shell software, but is planning to convert to another package, Aion, from the company of the same name in San Jose, California. To create the knowledge base, CP interviewed its own experts as well as specialists at General Motors, the locomotive manufacturer, and at suppliers of lubricating oil.

Canadian National is interested in a similar system. The railway has two options, says Norma Welch, who heads CN's artificial intelligence group in Montreal: develop its own system or approach CP about purchasing the system developed there. Canadian National is interested in a similar system, says Norma Welch, who heads CN's artificial intelligence group in Montreal, as part of the company's Information Systems Department.

Insight 2

Meanwhile, Canadian National has been working on an expert system to help in another area of locomotive maintenance: wheel size analysis. Locomotive wheels wear down over time, and at a certain point the wheels must be replaced.

There are definite rules about when a wheel must be replaced, Welch says, but there are also rules of thumb about adjusting the wheels to prolong their lives. Using the Insight 2 expert system shell and dBase II database management software, CN is developing a system to make decisions about wheel changes.

In the longer term, Welch says, this system will also be able to build up historical data about wheel wear, which may lead to better maintenance planning.

Canadian Pacific is also working on an expert system to help assign people to jobs. Bedoukian explains that many factors, including skills, experience and agreements with labour unions, must be taken into account in assigning people to jobs and to specific trains. The crew selection system, under development for the past three to four months, will first handle job reassignments, Bedoukian says. Assigning crews to individual trains will come later.

Another CP project is an expert system to aid in repairing the more than 13,000 portable radios used by railway employees. Canadian Pacific uses about 50 different models from half a dozen suppliers, Bedoukian says. So far, his department has developed a personal computer expert system that can diagnose 70 per cent of the problems with one popular model, all from visual and auditory checks.

Canadian Pacific's computer department is working on a "very experimental" expert system to help recover from computer failures. This is a very complex process, Bedoukian explains, and needs to be done quickly because the railway depends on its computers.

An expert system has the advantage that it doesn't feel pressure the way a human expert does. "Even our experts on how to do it make mistakes", Bedoukian says. "There's a lot of pressure happening at the time — we have very high uptime requirements and there's a lot of pressure to do it fast".

Hot Boxes

Canadian National is also considering an expert system to monitor hot box detectors along its main lines. These detectors, placed at intervals along the tracks, check the temperature of journals — parts of the axles of rolling stock — which sometimes overheat and burn out, causing derailments like the one that forced the evacuation of part of Mississauga, Ontario, in 1979.

Currently, hot box detectors are monitored by operators at central sites, who watch readings coming in from the detectors and can order that a train be stopped if there are signs of trouble. An expert system could be constructed to interpret the data and perform the same function.

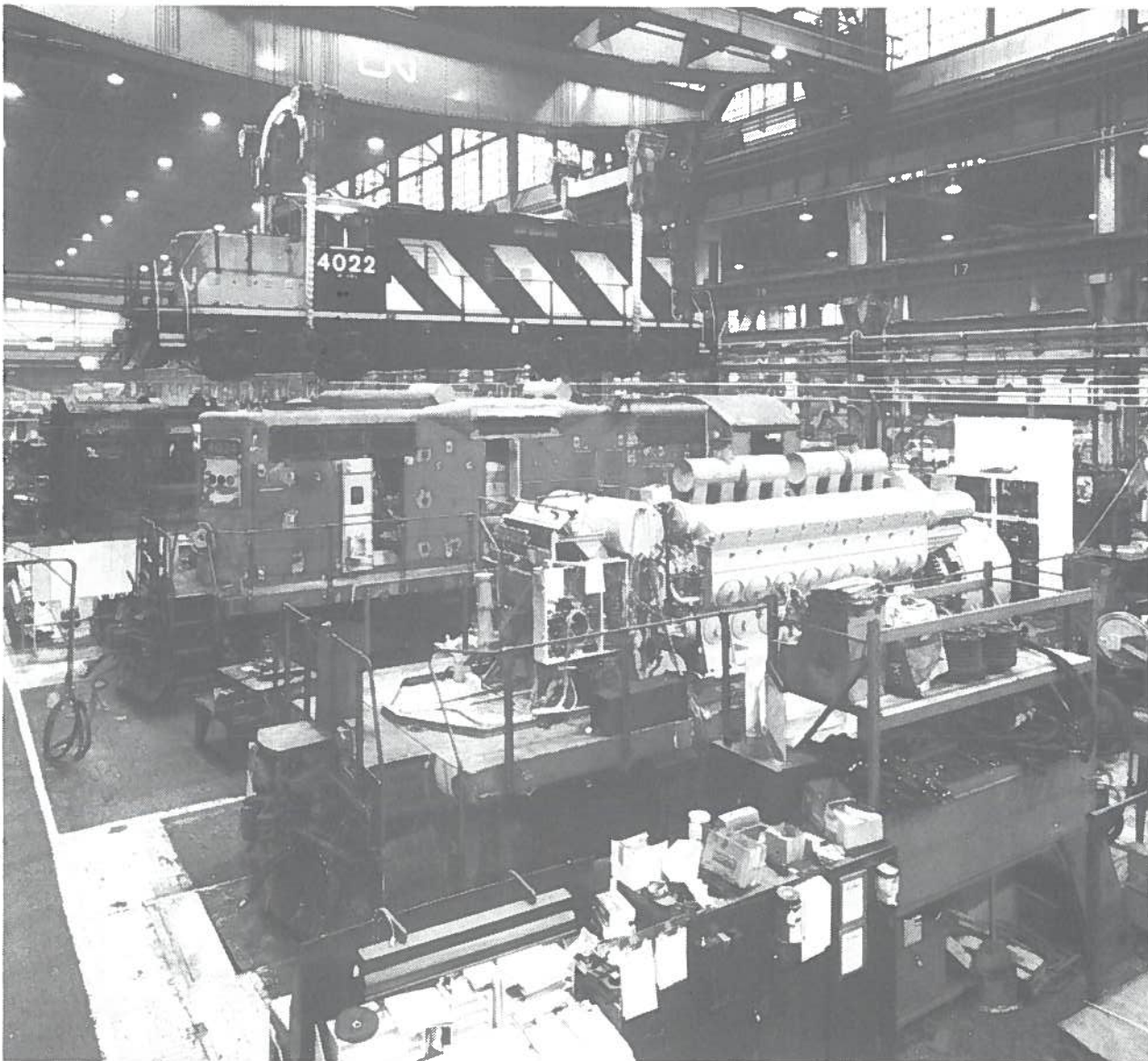
Canadian National's AI group is a year and a half old, Welch says. The initial focus is on learning about

artificial intelligence and identifying ways it can be used. Welch describes her group as partly a "resource centre" for the rest of the company, providing advice to those interesting in putting artificial intelligence to work.

Canadian Pacific started working on AI at about the same time: the lubricating oil expert system, its first project, was started about 18 months ago.



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



CANADIAN NATIONAL

AI-based programs will be used in maintaining Canadian locomotive fleets. Plans include systems for wheel maintenance, lube oil analysis, and trouble-shooting.

India/Canada AI and Semiotics Colloquium

Gord McCalla
Department of Computational Science
University of Saskatchewan
Saskatoon, Saskatchewan

From January 5 to January 9, 1987, an interdisciplinary workshop was held at the Central Institute of Indian Languages in Mysore, India, to discuss "The Challenge of Commonsense Knowledge Representation in Artificial Intelligence". Entitled the Indo-Canadian Colloquium on Information, Signs, and Meaning, the workshop brought together a number of Canadian and Indian researchers from areas such as artificial intelligence, anthropology, linguistics, sociology, semiotics, and neurolinguistics to try to find common ground about commonsense.

Among the papers discussed were "Expert Systems and Commonsense" by R. Narasimhan of the Tata Institute of Fundamental Research in Bombay; "Knowledge Representation: What Is It?" by N. Cercone, currently at the University of Victoria; "Some Uncommon Sense About Commonsense" by A. Kelkar of Deccan College in Pune; "Contributions of Semiotics to the Issue of Commonsense Knowledge Representation" by P. Bouissac of Victoria College at the University of Toronto; "Commonsense and the Interpretation of Human Phenomena" by J.-C. Gardin, this year at CNRS in Paris; "Knowledge Representation Issues in Automated Tutoring" by G. McCalla of the University of Saskatchewan; "Markovian Connotation Models for the Exploration of Commonsense Knowledge" by P. Miranda of Laval University; "From Meaning to Text: Semantic Representation in the Meaning Text Linguistic Theory" by I. Mel'čuk of l'Université de Montréal; "Neurolinguistics: From Static Representational Structures to Dynamic Processes" by J. L. Nespoulous; "Biology of Natural Language" by A. R. Lecours of Centre Hospitalier de la Reine Marie in Montreal; and a concluding paper by S. Ramani of the Tata Institute in Bombay.

The papers were accompanied by lots of discussion, both impromptu and from formal discussants (many of whom were drawn from various Indian research laboratories and universities). While no unified theory of

commonsense knowledge was produced, the participants did begin to understand each other's viewpoints, and the groundwork may have been laid for future interdisciplinary, international collaboration. Currently, many of the papers are being revamped to take into account the discussions in India, and it is hoped a Post-Proceedings will be produced, co-edited by Hans Dua of the Central Institute of Indian Languages and myself.

The week in Mysore was interesting beyond just the workshop. The hospitality was extremely warm as was the weather (sunny, dry, and highs of around 28 to 30 degrees). Not only were we chauffeured around wherever we wanted to go (a necessity given the chaos on Indian roads), but we were also taken on several tours to local highlights. Mysore is an ancient capital, and contains a number of opulent palaces, old temples, and beautiful gardens, in addition to a thriving and crowded market where all manner of exotic goods can be bought or haggled over. Three of the nights were consumed by extravagant dinner parties, where we all (or most of us at least!) continued our love affair with Indian cuisine. I would like to express my thanks to everybody involved in the workshop, in particular to Paul Bouissac and D. P. Pattanayak (Director of the C.I.I.L.) who organized the workshop; to Hans Dua, M. Ganesan, and the rest of the people at the C.I.I.L. for all their efforts to make our stay more pleasant; and to S. Ramani and his colleagues at the Tata Institute for their hospitality while I was in Bombay.

I think everybody enjoyed the workshop and the chance to meet colleagues from both India and Canada. It is ironic that it is sometimes necessary to travel half-way around the world in order to meet fellow Canadians who are studying intelligence from a slightly different perspective than yourself. □

Gord McCalla's winter vacation would have been a dead loss for us all if he hadn't remembered to bring the conference agenda home with him.

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Knowledge Acquisition for Knowledge-Based Systems

Stephen Regoczei
Trent University

The first Workshop on Knowledge Acquisition for Knowledge-Based Systems was sponsored by the American Association for Artificial Intelligence and held at Banff, Alberta, 3–7 November, 1986. The two chief organizers of the workshop, John Boose of Boeing Computer Services, Seattle, and Brian Gaines of the University of Calgary, deserve special thanks for having the courage and initiative to bring a most diverse and vocal group together under the heading of knowledge acquisition. The week-long workshop was held at the Banff Centre, with spectacular scenery and freshly fallen snow provided at no extra charge.

Officially, we were to be divided into seven smaller working groups:

- Cognition and Expertise with Bill Clancy
- Knowledge Acquisition
- Software According to Carnegie-Mellon and John McDermott (officially dubbed Interactive Interview Tools I)
- AQUINAS Knowledge Acquisition Software with John Boose (officially called Interactive Interview Tools II)
- Analysis of Knowledge Structures with Gavriel Salvendy
- Learning with Ryszard Michalski
- Knowledge Acquisition Methodology and Training, and Reasoning with Uncertainty with Brian Gaines and Ross Quinlan.

There was an almost total unanimity that this was not how the group wanted itself to be divided up. The more than fifty participants eventually did break into self-organized working groups that met during Thursday afternoon and reported back Friday on what they perceived to be the state of the art.

The Monday plenary sessions provided the overview that enabled the participants from different backgrounds, perspectives, and “cultures” to orient themselves somewhat. Brian Gaines started with an almost

encyclopaedic summary of the knowledge-based activities of the human species. Humanity was characterised as a “distributed anticipatory system — a coordinated collection of autonomous systems whose primary function is the anticipation of the future”. Although the terminology of this description is based on general systems theory and George Kelly’s theory of personal constructs, one could make a connection with — and a translation into — mental models, or Newell’s goal-based definition of knowledge, or Roy Hagman’s language-as-technology, and the basic cogniting functions described by Gaines as “drawing distinctions” and “clustering” were operationally meaningful enough to make sense to the software builders.

Bill Clancy’s summary of the papers in the Cognition and Expertise group introduced the basic, contentious issues of the workshop. Is the thorough understanding of cognition a necessary prerequisite for further work in knowledge acquisition (KA)? Can we really build automatic KA software without understanding the basic issues about expertise? Clancy pointed out the dubious status of the tacit assumption, casually adopted by people in AI, that the mind is like an expert system and debriefing the expert is something like producing a core dump. He warned against taking the knowledge base (KB) as the “representation” of the expert’s knowledge. He emphasized that the knowledge in the KB is constructed cooperatively as part of a joint venture between analyst and expert. The KB is genuinely a creative, participatory product — a publicly examinable, first-time result of a formalization process. The expert working alone does not “have” the knowledge for the analyst to “acquire”. In that sense, the “acquisition” part of KA is a misnomer.

Such doubts and misgivings were really of no significance to John McDermott of Carnegie-Mellon University. If KA is difficult and problematic, then let us build software to make the knowledge engineer’s job easier. In any given specific case, the construction of useful software is a software building job. What is the problem? Let us build the software. Where is this KA “bottleneck” that Feigenbaum is supposed to have invented? If Feigenbaum put knowledge in a bottle, let’s get it out of there! His seemingly cavalier attitude was backed up by some impressive software examples: MOLE, a tenacious KA tool, TKAW, an intelligent workbench and KNACK for report-driven KA, representing the work of a large team from Carnegie-Mellon and the

Carnegie Group.

John Boose of Boeing Computer Services represented a software building school with a very different philosophy. AQUINAS, a successor of ARISTOTLE and an enlarged version of ETS, is a comprehensive KA software package with a broad range of capabilities, such as eliciting distinctions, decomposing problems, combining information from multiple sources, dealing with uncertainty, and testing and extending the KB. The main point is that AQUINAS has a clearly specified architecture based on a comprehensive set of theories. For example, the elicitation of distinctions is implemented using the repertory grid techniques that are based on George Kelly's theory of personal constructs. Similar design strategies are followed for cluster analysis, multiple scaling, uncertainty tools, and for combining knowledge from several different experts, as clearly described by Jeff Bradshaw, a member of the Boeing team. AQUINAS has a natural language dialog manager, which was presented by Cathy Kitto; it uses standard database techniques.

The "architecture first" school of software construction was also represented by KRITON, described by Joachim Diederich of West Germany, and KSS1/KITTEN by Mildred Shaw and Brian Gaines of Calgary, who take a philosophical approach based on a systems view of human-computer interaction and personal constructs psychology, and implement a philosophical view in working software.

The industrial engineering approach, coupled with George Kelly's theory of personal constructs, as elaborated by Boose, Gaines, Shaw and Salvendy, was a new perspective to those whose background includes Newell's knowledge level, Ericsson and Simon's protocol analysis, garden-variety AI and cognitive science, and traditional, straight-from-the-shoulder software engineering.

Towards the end of the workshop, Marianne LaFrance of Boston College gently reminded us that when it comes to the widespread, industrial implementation of "real" working systems, the actual, practical KA activity is a people business. The social interaction between analyst and expert has its pitfalls. For example, the veteran, highly respected expert may feel offended by the interrogation conducted under the direction of a relatively naive knowledge engineer. LaFrance uses what she calls the KA Grid to train analysts at DEC in the subtle practice of interviewing skills and other related issues in social psychology.

The use of natural language as a key component in real-life, industrial KA was recognized in papers by Jim Kornell of General Research Corporation, Cathy Kitto of Boeing, Regoczei and Plantinga of the University of Toronto, and by Marianne LaFrance, who considered it a crucial part of the social interaction. In her KA Grid, she recognizes metaphors, stories, and other so-called "non-standard" ways of communicating information. Jim Kornell originally submitted a software paper to the

workshop on YAKYAK (Yet Another Kit for Your Acquisition of Knowledge), but actually presented an insightful analysis of the difference between formal and narrative thought. Narrative thought is exemplified by analogies and stories. Knowledge acquisition tools such as MOLE and ETS fail to support the kind of reasoning used by experts in narrative domains.

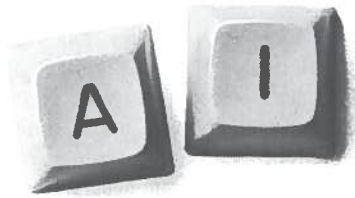
The creation of a new subdiscipline such as KA is both an exciting and an unsettling process. Much was learned from work of hitherto unsuspected diversity. Is there work in KA not uncovered by the first workshop? If so, we hope that papers will be submitted to the second one, which is scheduled for 19-23 October, 1987, in Banff. Deadline for abstracts: 15 April, 1987. Send them to:

John Boose,
Advanced Technology Center,
Boeing Computer Services,
P.O. Box 24366,
Seattle, Washington,
98008, U.S.A. □

Stephen Regoczei is an assistant professor at Trent University. He has a long background in knowledge acquisition for system specification, and is presently working on the formalization of mental models.

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The keys to Artificial Intelligence are at Xerox.

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

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- Interactive user interface
- Ability to mix interpreted and compiled code
- Multiprocessing capacity
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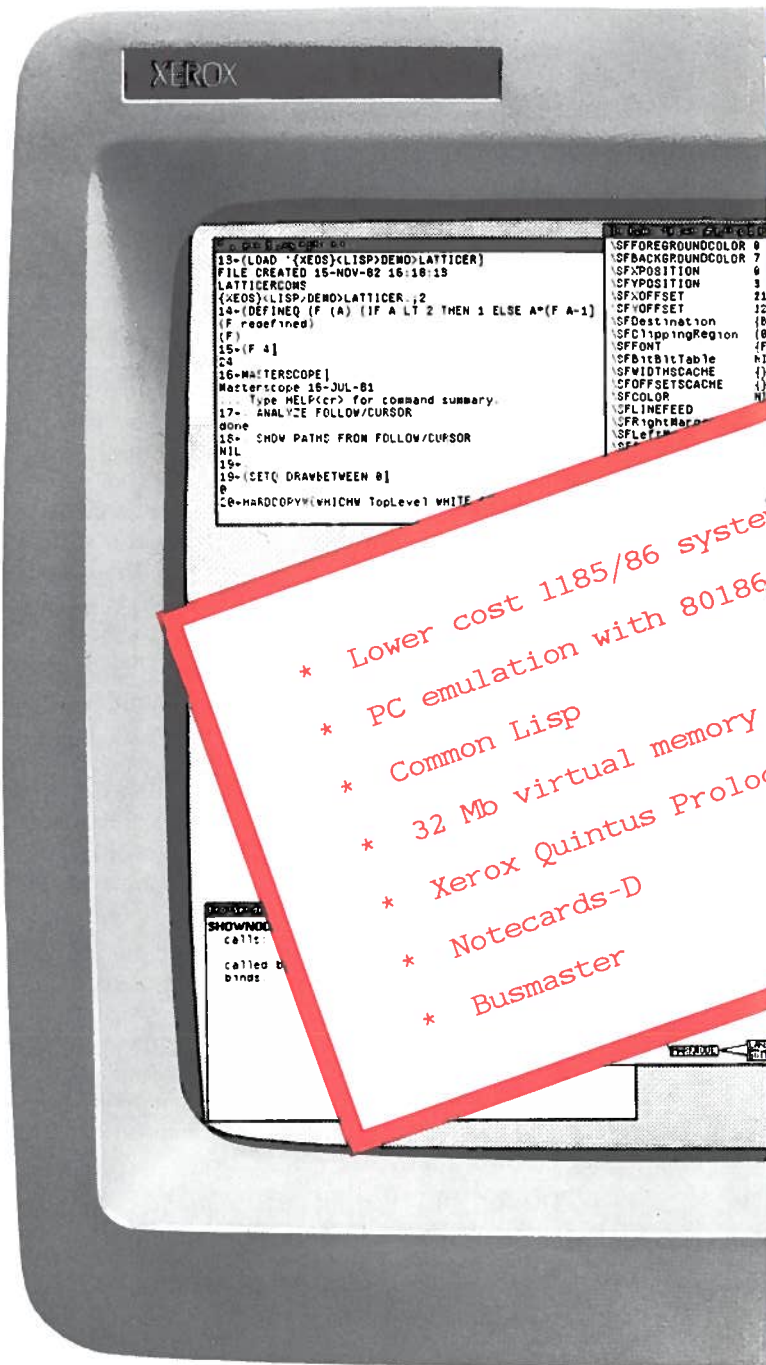
Power Tools for Programmers

1. Display Editor and Inspector

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

2. Programmer's Assistant

The Programmer's Assistant provides an intelligent assistant and bookkeeper that frees the programmer from much mundane detail. The Programmer's Assistant includes an error analysis capability and also monitors and records all user inputs. For example, a history is kept of the commands typed, their side-effects, and the results. Thus, one can request that a previous command or sequence of commands be repeated, modified and then repeated, or even undone (which undoes all the changes it may have caused). Also

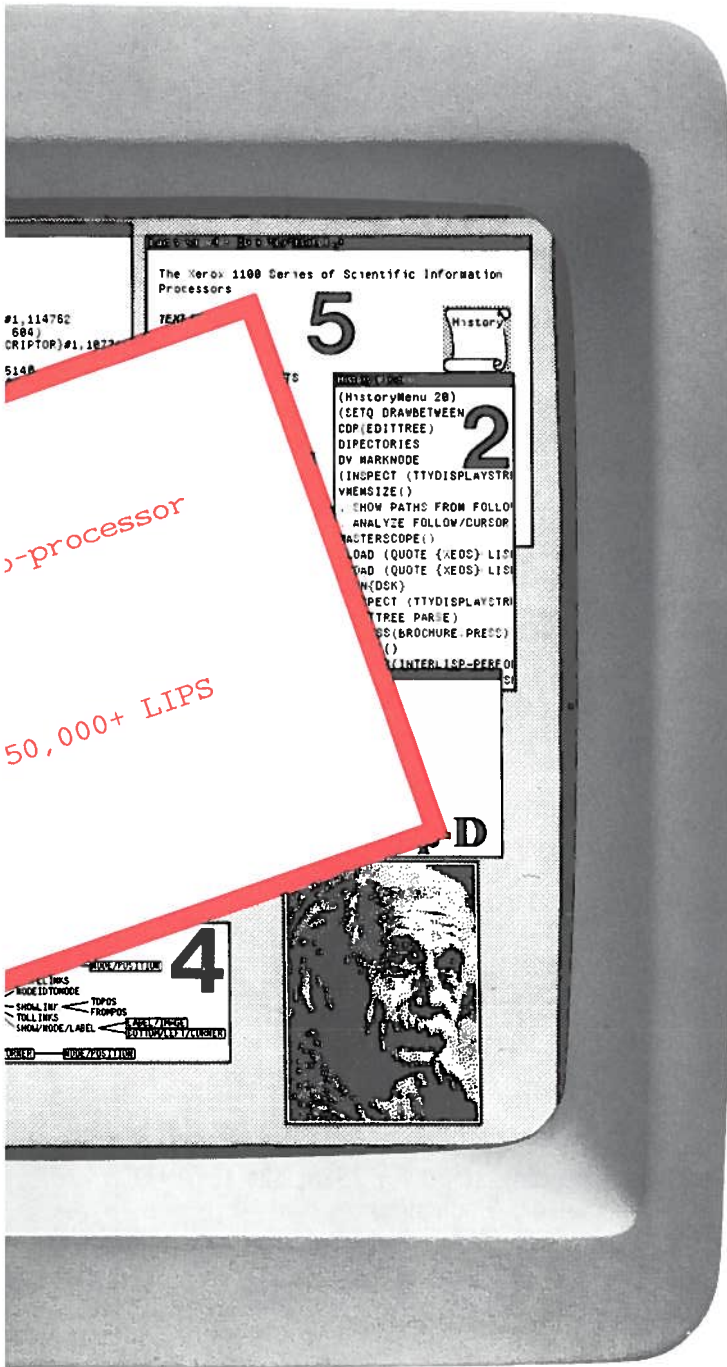


provided is a spelling corrector that automatically corrects spelling mistakes using information from the local context. To simplify file management for the programmer, Interlisp-D automatically keeps track of where in the file system each object is stored and which ones have been modified. In response to a simple request, the system can therefore save the user's state, updating all changed files automatically. The Programmer's Assistant provides a programming environment which cooperates in the development of programs allowing the user to concentrate on higher level design issues.

3. Debugging Tools

Debugging tools allow the user to break and trace

XEROX



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

5. A Professional Workstation

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

6. Knowledge Programming System (Optional)

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

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

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

4. Program Analysis

The Masterscope facility can analyze a user's program and use that information to answer questions, display

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Intelligent User Interfaces and Applied Expert Systems

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Brock is currently engaged in a number of projects in the area of applied artificial intelligence. Our research is divided into two categories: Intelligent User Interfaces under Dr James Bradford and Expert Systems Applications under Dr Jerzy Barchanski.

The work on User Interfaces is primarily concerned with identifying, characterizing, and responding intelligently to user error. We currently have two projects related to Intelligent User Interfaces: the Advisor project, which is an experiment with spontaneous help systems for commercial software, and the Representation project, which is a theoretical study of human/computer interaction.

Brock is also applying expert systems in two areas. The first application is a question-and-answer system to advise students on curriculum planning. The second is an expert system to test and diagnose problems with network protocols.

Interfaces

The Advisor project focuses on the algorithms and methodology necessary to offer spontaneous advice to users running commercial third-party software on IBM microcomputers. The impact of spontaneous advice on user productivity and satisfaction will also be evaluated in a series of field trials. The work will be performed in three phases.

Phase 1 will involve the creation of a user interface monitoring tool, The Brock Probe. The Brock Probe will run as a background process on an IBM PC/XT. It will monitor the keyboard buffer, the mouse port, and screen memory. Selected commercial software will be run as the foreground process.

Phase 2 will use the Brock Probe to evaluate user interaction with one or more pieces of commercial software. The data will be analysed to reveal the most

frequent conceptual problems users encounter with each piece of software.

Phase 3 will introduce an active help system (a system that monitors and analyses user interaction and takes the initiative when help is required). The impact of an active help system on user productivity with commonly available software will be measured and evaluated.

The Representation project is an investigation of some of the properties of human/computer interaction. The approach is to adopt a symbolic representation of the interaction process and to examine the properties predicted by the representation.

Sequences of commands are represented by strings of symbols. The set of symbols together with the concatenation operator define a well-known mathematical object (a semigroup). The concept of distance applies to semigroups and this can be used to detect and correct user errors in much the same way as error detection/correction can be applied to binary codes.

The work shows promise of establishing that there exists a restricted class of user interfaces for which it is always possible to distinguish between typographical and conceptual errors. Further work is needed to create a practical technology based on this class of interface. This may lead to a new way of producing intelligent responses to user error.

Applied Expert Systems

The Expert Student Advisor Project aims to develop an expert system able to advise students about which courses they should take to attain a desired degree. The system will consider the background of the student (for example, in the course domain, the courses taken), the background of the domain (for example, the courses currently offered), and queries from a student (for example "Should I take COSC 322").

Brock already encourages its computer science students to pre-register through interactive terminals. It is hoped that the Expert Student Advisor will assist our students with this process. In addition, the use of an expert system as a standard utility will give us valuable feedback on the methodology and tools required to maintain an expert system in production use.

The Protocol Diagnosis project will produce a knowledge-based communications protocol testing and

diagnosis system. The emphasis is on fault location in a malfunctioning network where the faults arise from problems with the protocol implementation. Thus the expert system is used as a tool for protocol analysis.

The project will investigate two approaches for diagnostic expert systems. The first is based on the knowledge of a human expert, and the second on the formal specifications of a protocol. To increase the efficiency of diagnostic testing, a set of formal specifications derived from the stepwise refinement process will be used.

The two kinds of expert system will be integrated into a closely coupled system. A major focus of this research will be the investigation of ways to facilitate interaction between expert systems based on different paradigms. □

Student Volunteers Needed for AAAI-87 Conference

AAAI-87, the 1987 conference of the American Association for Artificial Intelligence, will be held 13-17 July 1987 in Seattle, Washington. Student volunteers are needed to help with local arrangements and staffing of the conference. To be eligible for a volunteer position,

an individual must be an undergraduate or graduate student at a college or university.

This is an excellent opportunity for students to participate in the conference. Volunteers receive free registration at AAAI-87, conference proceedings, a "Staff" T-shirt, and are invited to the volunteer party. More importantly, they become more involved and meet students and researchers with similar interests.

Volunteer responsibilities are varied, including conference preparation, registration, staffing of sessions and tutorials and organizational tasks. Each volunteer will be assigned twelve hours of work.

If you are interested in participating in AAAI-87 as a student volunteer, apply to:

Richard Feifer
Center for the Study of Evaluation
145 Moore Hall
UCLA
Los Angeles, California 90024
feifer@locus.ucla.edu

Include your name, electronic address (if any), postal address, phone number, dates available, student affiliation, and advisor's name. □

The diagram illustrates the flow of knowledge and the components of an expert system. On the left, a stylized head icon is labeled 'EXPERT'. A box labeled 'KNOWLEDGE' is connected to the expert by a double-headed arrow. Below the expert is the logo for 'HEURIX Computer Research Inc.' with contact information: 'P.O. Box 40, Station "L" Toronto, Ontario Canada M6E 4Y4 Tel. 416-654-9414'. A central computer monitor icon is connected to the 'KNOWLEDGE' box by a double-headed arrow. Below the monitor are three boxes: 'ACQUISITION', 'ENGINEERING', and 'INFERENCE'. Arrows point from 'ACQUISITION' and 'ENGINEERING' to 'INFERENCE'. To the right of 'INFERENCE' are three stacked boxes: 'FORMALISM', 'REPRESENTATION', and 'INFERENCE'. Arrows point from 'ENGINEERING' to 'FORMALISM', 'REPRESENTATION', and 'INFERENCE'.

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AI at the University of Alberta Computer Science Department

Renée Elio
Department of Computer Science
University of Alberta

In the past few years, interdisciplinary research in artificial intelligence and robotics has been growing at the University of Alberta. New faculty appointments in Computing Science, Electrical Engineering, and Chemical Engineering have broadened the scope of AI activities to include new applied interests as well as new basic research areas. In April 1986, this activity coalesced into a single research institute, the Alberta Centre for Machine Intelligence and Robotics, formed by faculty from Computing Science, Psychology, Engineering, and Applied Sciences in Medicine (see the following article).

One of the institute's primary goals is to provide a focal point for research and development activities in these areas at the University. This article gives an update of the activities within the Department of Computing Science.

Facilities for AI Research

The Department has its own research computing facility, including programming, engineering, and operating staff. The computer equipment consists of a time-sharing network of four VAX 11/780 processors and approximately 30 SUN workstations, all running under a UNIX operating system. In addition to these general facilities, the Department has established a number of special-purpose laboratories to support particular research areas. The following labs are associated with AI research projects.

Robotics Research

The Robotics Research Laboratory features a Heathkit ET-18 (HERO) robot, which is mobile and has an arm with a gripper, ultrasound ranging, and a speech synthesizer. A hardware link to a VAX 11/780 allows high-level control of the robot via a LISP-like command language. Stereo vision hardware and an M68000 for vision processing are being installed on the robot. The robot is currently able to perform simple seek-grasp-move tasks, commenting on its actions while doing so.

Stereo vision hardware and a processor for vision planning are being installed. The robot serves as a vehicle for research in computer vision and planning, which is particularly important for applications in which robots must achieve goals in a dynamic, unpredictable environment.

There are plans to acquire a second robot with better carrying capacity and motor control than the ET-18 robot, to support research on a wider range of goal-directed activities. The two robots together will make it possible to do research on cooperative planning and action.

AI Research

The AI Research Laboratory currently contains three Xerox 1186 workstations and a laser printer. The workstations are connect to the department's VAX network via an Ethernet. In addition to Interlisp-D, Prolog, and Smalltalk, the workstations also run production system languages such as OPS and PRISM (also available on the Department's UNIX system). Most of the work underway in this lab focuses on machine learning topics as well as qualitative reasoning and simulation.

Distributed Systems Research

The Distributed Systems Research Laboratory contains an experimental facility consisting of a network of interconnected MC68000's along with the software necessary to implement simple message-passing communication. Currently, most of the emphasis is on distributed tree-searching algorithms, specifically parallel alpha-beta search of game trees. Two chess programs have been parallelized to run on the distributed computer facility. One is intended as a high-performance vehicle while the other is used to investigate various aspects of parallel algorithm development. Other applications being explored for distributed implementation include branch and bound algorithms, graphics algorithms, and parallel implementation of a theorem-proving system and of certain animation techniques.

Programming Languages Research

The Programming Languages Research Laboratory provides the Programming Languages Group with computer systems for research involving programming languages, programming environments, and compiler generation tools.

The laboratory currently contains SUN workstations, an IBM PC, a Lisa microcomputer, Macintosh microcomputers, and access to the department VAX network. These systems support Ada, C, Lisp, Pascal, Modula-2, and Smalltalk-80. The programming environments that are also supported include Smalltalk-80, Cornell, and Guide.

Faculty Research

The Computing Science faculty currently involved in AI projects include the following:

- Renée Elio: learning, qualitative simulation and reasoning, cognitive models, expert systems
- Tony Marsland: tree-searching algorithms and distributed computation
- Jeff Pelletier: cross-appointment in Philosophy: automatic theorem proving, computational linguistics, and formal language theory
- Jonathan Schaeffer: searching algorithms, heuristic knowledge, distributed computing, and computer chess
- Len Schubert: natural language understanding, knowledge representation and organization, inference in language understanding and question answering, algorithms for picture analysis and spatial reasoning, robotics and planning
- Jia You: logic programming.

Other faculty, such as Duane Szafron (programming languages and environments) and Tamer Ozsu (database systems), are investigating problems that bridge issues in their primary research areas and topics in AI. Several of these projects are described in more detail below.

Two interdepartmental research groups have been active for several years. The Logic Grammar Study Group studies a variety of issues concerning computational linguistics, such as parsing, intensional logic, natural language formal grammars, formal semantics, propositional attitudes, vagueness, tense and modal logics, scope phenomena, and the like. The group was formed in 1983 by Len Schubert and Jeff Pelletier. Its continuing members include Bernard Linksy (Philosophy), Matthew Dryer (Linguistics), and several lecturers and graduate students from Linguistics, Philosophy, and Computing Science.

The group studies recently published articles in the above-mentioned areas, as well as being a forum for the participants to present their own work and to propose and carry out collaborative projects.

The Image Processing/Computational Vision Seminar was organized by Wayne Davis (Computing Science), Terry Caelli (Psychology), and Zoly Koles (Applied Sciences in Medicine).

It meets monthly to discuss ongoing research in the area of human and machine vision and image

processing. Papers are presented by invited speakers and discussion of recent developments within the group constitute the normal agenda. An important theme of this group's interests is image processing and vision problems in medical applications, such as the detection of tumors in breast mammograms (Caelli and Davis). Regular attendees include a number of researchers and staff from Applied Medicine and the Cross Cancer Institute.

Inference and Language Understanding

Len Schubert and Sven Hurum are working to extend a natural language system developed by Schubert and Pelletier to handle quantifier scope ambiguities. Quantifiers such as "some" and "every" and other logical operators such as "and", "or", "not", and "sometimes" interact with each other giving rise to various types of ambiguity. A program has been written to generate the different possible scope orderings of these operators using heuristics to select the best scope orderings.

Jeff Pelletier is developing a natural language system that implements a Generalized Phrase Structure Grammar with morphological rules, features, and meta-rules. The underlying parser is a left-corner parser and the output is a fully reduced semantic representation of the natural language input in intensional logic. A post-processor converts this intensional logic output to an approximation in first-order logic with identity. This can be used as input to an automatic theorem proving system (described below) and will produce formal proofs of arguments entered in English.

From the viewpoint of formal linguistics, Schubert and Pelletier have also investigated such topics as the syntax and semantics of mass nouns, generics, base plurals, and habituals. The account given is viewed as an alternative to such computer-oriented accounts as "default logics" and "circumscription". They have also independently been working on a formal semantics for vague terms.

Over the past few years, an automatic theorem proving system called THINKER has been developed by Jeff Pelletier and several students. THINKER is a natural-deduction-style theorem-proving system for first-order predicate logic with identity. It is being used currently for comparison purposes to evaluate other theorem proving systems, and as an aid in discovering why people find certain logic problems difficult. Planned future research with THINKER has to do with using the proofs generated to supply a robotic planning system with a high-level course of actions and producing proofs of problems presented in natural language. Jonathan Schaeffer is also directing work on a parallel version of THINKER in the Distributed Systems Laboratory. Jia You is collaborating with Duane Szafron on topics in question and answering systems. Such systems often require special inferencing abilities within certain theories other than the theory of equality. For example,

theories about taxonomies, colour, time, and parts are often required.

Szafron and You are investigating special fast inferencing mechanisms for these theories that could be incorporated into a general inferencing system like Prolog. This should result in a system with better overall performance for dealing with AI problems than the general inferencing mechanism provided by Prolog alone. Szafron's other work in knowledge-based systems focuses on development environments that support multiple-knowledge representations and multiple-inferencing mechanisms.

Knowledge Representation, Organization, and Reasoning Research

In the area of management of uncertainty, Fahiem Bacchus and Len Schubert are looking at issues that have both applied and theoretical importance. Although one of the specific aims of this research is to deal with the typical diagnosis problems addressed by expert systems, a more general point of view is taken. The assumption of this work is that the specialized reasoning performed by, for example, medical experts is very similar to the ordinary reasoning that people perform in their day-to-day problem solving. Specifically, the research addresses the problem of representing the wide range of uncertain knowledge that people possess and reasoning with this knowledge.

A formal logic has been developed that can express a larger set of uncertain knowledge than was previously possible. Ongoing research is aimed at developing a practical scheme for reasoning with knowledge expressed in this logical formalism.

Sean Cormack and Renée Elio are developing a scheme that supports qualitative simulation of physical processes like "liquid flow" in simple physical systems, such as some configurations of containers, connecting pipes, and pumps.

The goal is separate knowledge about processes from knowledge about the structure of the system in which the processes are operating; however, the representation must support reasoning about situations in which structural features influence processes and vice versa. This work is related to several ideas from Forbus's qualitative process theory.

Some problems in the area of knowledge representation, retrieval, and maintenance that are critical in expert systems research have been investigated in a different context in database systems. Tamer Ozsu and Ajit Singh are focusing on those issues of large, shared knowledge-based systems that have significant similarity with issues generally studied within database systems research. Some of these issues include (a) design of data structures for inferencing as well as powerful query processing and updates on large stores of rules and facts; (b) algorithms for consistency and completeness constraints management (at syntactic level only);

(c) development of protocols for sharing knowledge among various agents in a safe and reliable manner.

Robotics and Planning Research

The research in robotics and planning is aimed at the development of a more sophisticated goal-directed planning system. Jim Borynec and Len Schubert have described a first-order logical planning language that allows the statement and solution of robot planning problems. This has been done by adding an explicit time domain to the semantics of normal logic that permits the description of facts and actions that occur over time.

In addition, they have a bidirectional planning algorithm which creates plans suitable for execution on the Kato-Heron robot system. The algorithm works by positing actions forward in time from a set of initial conditions and backwards from a set of goal conditions. The plan is finished when a series of actions (*i.e.*, a plan) is found that, together with the initial conditions, prove that the goal conditions must hold. The algorithm essentially conducts a search across the space of possible actions in a heuristic best-first manner.

Search Algorithms

Schaeffer and Marsland are involved in a number of projects in this area. First, work is being done on improving minimax search. This includes modifications of and enhancements to the alpha-beta algorithm. A new class of algorithms based on minimal window searches is being investigated. Their performance is comparable to SSS*, without the space problems of SSS*.

A second research project explores several alternatives to depth constrained alpha-beta, including Berliner's B* algorithm. Most of the work, however, has been concentrated on MacAllesters's Conspiracy Numbers algorithm, an exciting new minimax search procedure that builds trees to variable depths in an application-independent manner. The algorithm selectively expands nodes in the tree trying to narrow the range of plausible minimax values at the root of the search tree. It does so by computing the conspiracy number for each possible root value; the minimum number of terminal nodes that must change their score to cause the root to change to that value. Research under way includes theoretical and experimental performance of the algorithm.

Schaeffer is also investigating a variety of search algorithms for improving their parallel performance. Current projects include parallel alpha-beta search (implemented in a chess program) and parallel and-or tree search (for the THINKER program). The alpha-beta work was used in Schaeffer's chess program, Phoenix, and helped it tie for first place in the recent World Computer Chess Championships using 20 SUN workstations.

Learning Research

Several graduate students working with Renee Elio are involved in learning projects. Larry Watanabe and Elio developed a learning system called LAIR, which investigates constructive induction for one kind of learning: incremental learning of conjunctive concept descriptions by example. Constructive induction (also called constructive generalization) introduces features into the emerging concept description that were not explicitly present in any of the examples the learning system has encountered. These new features are derived from knowledge about a few remembered examples and prior knowledge about the domain. LAIR is an initial investigation of two unresolved issues in constructive generalization, namely when to do it and how to control it.

Another research project in the area of learning concerns knowledge reorganization as a function of experience and, in particular, models that can account for expert-novice differences on some tasks. Peternela Scharf and Renee Elio are investigating mechanisms that transform knowledge from a "novice-like" organization to an "expert-like" organization. The working definition of novice- and expert-like organizations comes from cognitive psychology studies on problem solving by novices and experts in physics. The mechanisms they are exploring and extending are based on ideas from Kolodner's EMOP framework for dynamic memory maintenance.

Jonathan Schaeffer has formed a research group to investigate and build systems based on Holland's genetic learning algorithms. The knowledge of the system is contained in messages that, anthropomorphically, can live, prosper, mate, and die. The mating of two messages results in their knowledge combining to possibly form one more general piece of knowledge. Frequently used knowledge grows stronger and can mate more often, while infrequently used knowledge grows weaker and eventually may die. In some sense, this community of messages forms an "ecosystem". The project has three major components: isolating application dependencies, exploiting the inherent parallelism, and constructing a useful interface to capture expert knowledge. □

Research in Alberta II

The Alberta Centre for Machine Intelligence and Robotics

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Recently, the University of Alberta has created a Centre for Machine Intelligence and Robotics (ACMIR) aimed at integrating the multi-disciplinary interests in this area across departments, faculties and, to some extent, the province. The Centre has some funding for administration, production of technical reports, and the support of some visiting speakers, but at this stage, the research funding is provided through individual grants.

As part of the diversification strategy for the province, the Centre is negotiating for funding with the provincial government to create infrastructure, equipment and space, to allow more research to be undertaken. At this stage, the Centre has four main areas:

Intelligent Machines — Drs. *Renée Elio and Len Schubert*.

This group is concerned with problems associated with the development of expert system technologies and with ongoing research in the area of natural language representation.

Computer Vision — Drs. *Caelli, Davis, and Koles*. These researchers are concerned with a variety of issues related to computational vision and image processing. This group is interested in issues from image restoration, image encoding and transmission and two and three-dimensional pattern recognition.

Robotics and Control — Drs. *Gourishankar and Fisher*. This group is concerned with applications of control and expert systems to areas varying from pure robotics to control of chemical plants. The emphases of the group are on integrating both low-level control systems with more high-level knowledge representations of such problems.

Integrative Manufacturing — Drs. *Sprague and Toogood*. This group is concerned with in-process control and integrative manufacturing, where optimization of

production systems are considered both from control and high-level knowledge representational systems.

Common to all members of ACMIR, which now includes in excess of 20 staff, faculty and students, is the commitment to applications where possible. At present, a number of application areas are being pursued, varying from the applications of computational vision and image processing to improvement of medical x-rays, the development of expert systems for weather forecasting, beef classification and the control of petrochemical plants.

One of the aims of the Centre is to supply the academic knowledge often required by new developing industries within Edmonton and the province. Of equal importance is the ability of such units to facilitate research over faculties and departments. Our graduate students come from Psychology to Mechanical, Electrical and Chemical Engineering, Applied Sciences in Medicine, and Computer Science. With the co-

operation of department chairmen we have been able to locate students with the appropriate group to facilitate interaction.

Technical reports are now available and for further information, please contact the author. □

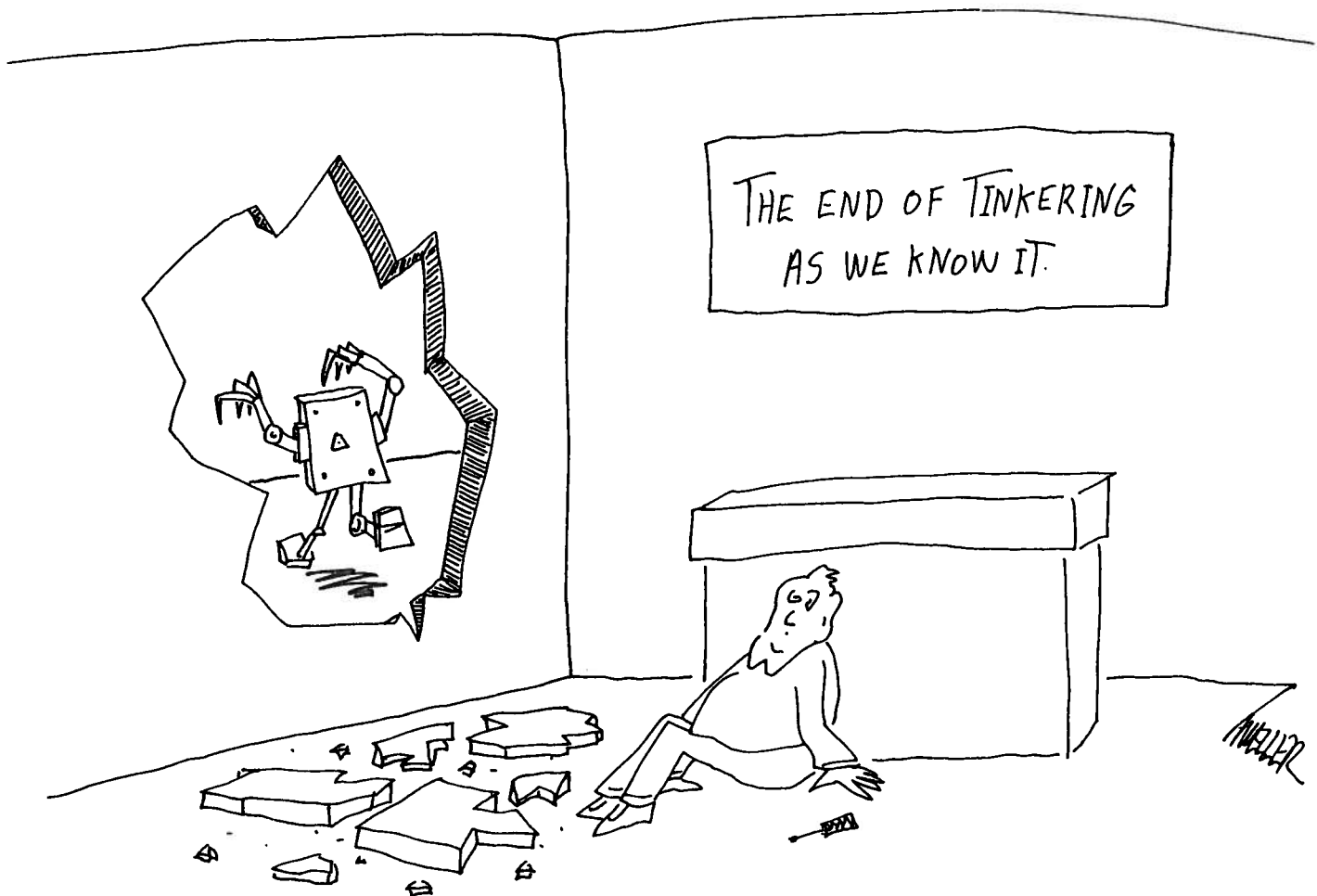
Terry Caelli is Killam Professor at the University of Alberta.

New Bindings

Marlene Jones from the University of Waterloo to the Alberta Research Council.

Daniel Delmas from Ecole Polytechnique de Montréal to Cognitech (Paris). Dr Delmas is known to many members as one of the organizers of last year's highly successful Canadian AI conference in Montréal. Cognitech is a leading European company in the study, development, and transfer of expert systems and AI technology.

P. S. Mueller



Book Reviews and Publishing News

Intelligent information systems: Progress and prospects

Roy Davies (editor)
[University of Exeter]

(Ellis Horwood series in artificial intelligence)
Chichester: Ellis Horwood; Distributed in
Canada by John Wiley
Hardbound, ISBN 0-85213-896-0; 300 pp.;
\$CDN82.95

Reviewed by
C.C. Gottlieb
University of Toronto

In spite of some faults, this book comes off very well in its goal of indicating to librarians and information scientists why and how the techniques of artificial intelligence are, or will be, relevant to their activities.

The organization into five parts (Database Creation and Cataloguing, Information Retrieval, User Referral and User Modelling, Cognitive Science and Information Science, Lessons of History) is good. The editor (who is also the author of two of the chapters, including the last) does an excellent job in his short introduction to each section. The systems chosen provide convincing demonstrations of the perhaps limited accomplishments, but yet considerable promise, that artificial intelligence and natural language have in searching and querying information systems. Chapter seven in Part III, "Users are individuals: Individualizing user models" by Elaine Rich, is a fascinating description of building "stereotypes" of readers in order to suggest books of fiction that they might be interested in. The last chapter, which contains biographical accounts of those who, throughout history, have been concerned with organizing and mechanizing the structure of knowledge, is concise, interesting, and highly informative.

There are some criticisms. There is more detail on some of the programs than many readers will care to know about. The book is not successful in showing that cognitive science will be useful, although this is also one of the goals given in the preface. Perhaps the two chapters selected by the editor on this subject are not representative of the discipline, but they are full of generalizations and empty of ideas. And last, in these days of good spelling checkers for manuscripts, the disconcertingly large number of typographical errors is

inexcusable.

For those working in AI, the book is a highly credible application; for those working in library and information science, it is a must, tempered by the almost prohibitive price. □

C.C. Gottlieb is Professor Emeritus of Computer Science and of Library and Information Science at the University of Toronto. He is one of the founders of CIPS, and is a Fellow of the Royal Society of Canada.

Machine interpretation of line drawings

Kokichi Sugihara
[University of Tokyo]

(The MIT Press series in artificial intelligence)
Cambridge, MA: MIT Press, 1986, x+233 pp
Hardbound, ISBN 0-262-19254-3, \$US30.00

Reviewed by
Alan Mackworth
University of British Columbia

"Let's visit the blocks world, encore une fois."

Over the last twenty years, the interpretation of line drawings as polyhedral scenes has been a focus for many theoretical and practical AI projects. In the first decade a flurry of interesting new ideas and results emerged and then most researchers moved on. These results and the general exodus gave the erroneous impression to most bystanders that the major problems had been solved. Kokichi Sugihara spent most of the second decade solving many of the important theoretical and practical problems that had been left unsolved. This book is an excellent summary of his results.

The book is organized around a four-module procedure for interpreting line drawings as polyhedral scenes. Each module is introduced in sequence along with examples, the appropriate mathematical apparatus and historical references. Module one is the traditional Huffman-Clowes labelling algorithm. Module two takes the proposed labellings (not all of which may be realizable) and determines their geometric feasibility by reducing the problem to determining the existence of a feasible solution to a linear programming problem. Module three allows tolerance in the definition of geometric feasibility by removing redundant constraints and "correcting" the original line drawing. Module four allows the use of additional information sources

such as 3-D range finding, surface shading, and texture to pick a unique scene interpretation from the infinite number of possible scenes in the equivalence class of interpretations.

There were at least four main open issues at the end of the first decade. First, procedures such as Huffman-Clowes labelling and gradient space reasoning applied necessary but not sufficient tests for realizability. Second, it was not clear how to characterize the degrees of freedom in the equivalence class. Third, the computational complexity of the problems and their algorithms was not understood. Fourth, it was not known how to apply these results to "real" images, integrating these methods with other shape-from-X methods and coping with noisy data. Sugihara has contributed substantially to the solution of each of these problems. They are all essentially solved now. (That is a satisfying statement to make in a field as confused as AI!)

This is not the place to indulge in a detailed technical review. The book is well written; it is clear and well organized. The treatment is unified, careful and scholarly; previous contributions are mostly well referenced. The elements of new mathematical theories, such as matroid theory and network flow theory, are introduced where necessary so the work is self-contained for the mathematically literate reader.

The old bugaboo questions aimed at all blocks world researchers: "So what?" "Do people do it that way?" "Is it useful?" "Does it generalize?" must be asked. The author claims little psychological relevance, coining a new slogan, "we learn what to do from the human visual system, whereas we decide how to do it from an engineering point of view". The techniques will not work on images of teacups or clouds. But the underlying methodology does apply generally. This is a clear demonstration of the power of characterizing the equivalence class of scenes in terms of constraints from the image imposed on the degrees of freedom of the scene and, furthermore, of finding a unique scene by minimizing some functional over the equivalence class. Finally, the last chapter on rigidity of structures is a delightful development of the analogy between the duality principle behind gradient space structures and the corresponding duality principle behind force diagrams of rod and pin structures. These ideas will generalize far beyond the blocks world as we design and build large spaceframe structures on earth and beyond.

Every vision researcher should study this book. I do not recommend it to others for casual, easy reading, but someone willing to do some work to appreciate elegant applications of new mathematics would enjoy its intrinsic merits. □

Alan Mackworth is a professor of computer science at the University of British Columbia and a Fellow of the Canadian Institute for Advanced Research. He is the author of many well-known papers on computer vision.

**On Knowledge Base Management Systems:
Integrating Artificial Intelligence
and Database Technologies**

*Michael L. Brodie and John Mylopoulos, editors
[Computer Corporation of America and
University of Toronto, respectively]*

(Topics in Information Systems)
New York and Berlin:
Springer-Verlag, 1986, xxi+660 pp.
ISBN 0-387-96382-0, hardbound, 8.00

*Reviewed by
Patrick Saint-Dizier
Simon Fraser University*

This book is a collection of papers written during the year immediately following the Islamorada Workshop on Large-Scale Knowledge-Based Systems held in 1985. The goal of this workshop was first to make people from AI and database research meet and have detailed technical discussions. The book presents the two main, relevant directions that can be dealt with in a workshop of this kind:

1. State of the art, *i.e.*, identifying actual and potential areas of collaboration and integration of the two fields, the Knowledge Base Management System (KBMS for short) being used as the axis of the discussion.

2. Future directions, *i.e.*, identifying relevant potential research frameworks and related research technologies.

The topics covered in this book are not new and the idea that AI and databases have something to do together was already in the air in the early seventies. Since that time, several good books were written, hundreds of industrial projects have been carried out and at least six or seven conferences and workshops were held. This clearly indicates that AI, KBMS, and databases have something to do together, for instance in the following fields: data models, languages, concurrency, maintenance and integrity of data, security, control structures, user front-ends, and so on.

The book includes 40 articles (some of which were written by the same authors), divided into seven parts and an epilogue. Each of the eight parts ends with a discussion reflecting questions, positions, and suggestions made during the session. Some papers are very short (just three or four pages) and are rather position papers briefly (and sometimes superficially) presented. Other papers are more elaborated and closer to research papers, although at least half of them are rather a survey of a project, of an idea or an approach than a formal research paper. The book is well documented, with a common bibliography of approximately 250 to 300 references.

The book starts with four articles about KBMS, presenting different points of view and levels in KBMS. The system Krypton is presented as an illustration by

Hector Levesque and Ron Brachman in a very stimulating article. Problems of organization and architecture are also addressed.

The second part presents knowledge bases versus databases. David Israel expresses a certain general scepticism about a possible marriage of these two fields. Next, knowledge is opposed to data in a short note by Gio Wiederhold. A more constructive approach for enhancements of existing systems and coupling of independent ones is proposed by Yannis Vassiliou. He however rejects technology integration which may never lead to a practically acceptable solution.

The third part is devoted to one of the most complex problems in AI: retrieval, inference, and reasoning. Israel presents in a short note why and how systems should reason. This is followed by a good, detailed paper about logic and databases systems by Jeff Ullman. Answering negative queries is addressed, and some elements of a unified approach for building powerful KBMSs is proposed. A second paper by the same author surveys query optimization using capture rules.

In part four, on extending database management systems, solutions are proposed for integrating AI concepts into traditional database systems. Several aspects of databases and logic are addressed for instance to improve integrity constraints (Alex Borgida, Tom Mitchell, and Keith Williamson). Part five, Extending Knowledge-Based Systems, is somewhat parallel to the previous part. A good survey of the problem is presented by Peter Szolovits, in which rule-based and frame-based methods are compared. Then, Bonnie Webber presents a very important complement to KBMS: natural-language interfaces. Basic concepts and methods for natural language analysis and interpretation as well as generation are discussed.

A second paper by the same author focuses on questions, answers, and responses. A response is an answer to a question, plus additional information or actions salient to the answer, or information or actions instead of the answer when the latter cannot be given for various reasons. A response thus appears to be more cooperative than an answer, and I feel that cooperativity is a crucial aspect of database interrogation. This particular article is very well developed and addresses many fundamental, unsolved problems. Next, some aspects of learning are presented by Mitchell, arguing the important role played by machine learning. Finally, the role of databases in KBMS is explored by Mark Fox and John McDermott.

The next part, Knowledge-Based System Design Issues, addresses some conceptual modelling aspects of information systems. The logic of requirements modelling language is proposed by Sol Greenspan, Alex Borgida, and John Mylopoulos. Part seven deals with the numerous efforts spent in advanced hardware design research for KBMS. Part eight is an epilogue containing

concluding remarks and wishes for the forthcoming years.

In conclusion, I feel this book and the workshop from which it is issued provides a good overview of current research in both fields of databases and KBMS systems, including some already existing or potential common research frameworks. A large part of this book could also be used as a textbook for graduate courses. To end this review, I regret that the Ilamorada workshop was exclusively for North-American scientists and that a separate workshop was organized by and for Europeans. Why this form of exclusion and segregation? Has it to do with a certain form of narcissism? □

Patrick Saint-Dizier is a researcher in natural language understanding and knowledge representation at INRIA, France. This year he is on leave at Simon Fraser University, Burnaby, B.C.

Brief Reviews

Is man a robot?

Geoff L. Simons

[National Computing Centre, U.K.]

Chichester: John Wiley & Sons, 1986,
xvi+316 pp.; Hardbound,
ISBN 0-471-91106-2, \$^{CDN}38.95

The short answer is "yes", and so is woman. This is not so much an AI book as a book that applies an AI style of thinking to other issues. From the blurb: "This book suggests that there is a sense in which man *can* be viewed as a robot — as an engineered anatomy. It is argued that the specifically human characteristics of emotion, free will, moral responsibility, creativity, and ethical awareness can be accommodated by the doctrine of robotic man; and moreover, that this is not a dehumanizing analysis of human nature. Only in such a way can we develop a philosophy that is truly humanistic." — *G.H.*

Intelligence: The eye, the brain, and the computer

Martin A. Fischler and Oscar Firschein
[SRI International]

Reading, MA: Addison-Wesley, 1987,
xiv+331 pp.; Hardbound,
ISBN 0-201-12001-1

A study of intelligence, both human and machine, emphasizing the relationship between the two and the relationship between perception and cognition. Although sloppily edited, it is a good book, and could be used as a text in an AI or cognitive science course. —*G.H. and L.F.*

*Canadian A. I. invites
letters to the editor
on any AI topic.*

Books received

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

Artificial intelligence and its applications (Selected papers from the AISB85 conference)

A.G. Cohn and J.R. Thomas (editors)
[University of Warwick]

Chichester: John Wiley, 1986, xiii+291 pp.
Distributed in Canada by John Wiley and Sons Canada Ltd Hardbound,
ISBN 0-471-91175-5, \$^{CDN}64.95

†Robotics research: The third international symposium (Proceedings of the symposium held in Gouvieux, France, October 1985)

Olivier Faugeras and George Girault (editors)

(The MIT Press series in artificial intelligence)
Cambridge, MA: MIT Press, 1986, xi+410 pp
Hardbound, ISBN 0-262-06101-5, \$^{US}50.00

†Artificial intelligence and statistics

William A. Gale (editor)
[AT&T Bell Laboratories]

Reading, MA: Addison-Wesley, 1986
Hardbound, ISBN 0-201-11569, xiv+418 pp., \$39.95

Prolog

François Giannesini; Henry Kanoui; Robert Pasero; and Michel van Caneghem
[Groupe intelligence artificielle, Université de Aix-Marseilles]

(International computer science series)
Wokingham, England: Addison-Wesley, 1986,
xi+260pp; Paperback, ISBN 0-201-12911-6,
24.95

Designing the user interface: Strategies for effective human-computer interaction

Ben Shneiderman
[University of Maryland]

Reading, MA: Addison-Wesley, 1987, xv+448 pp.
Hardbound, ISBN 0-201-16505-8, \$29.95

***Artificial Intelligence: An applications-oriented approach**

Daniel Schutzer
[Citibank]

New York: Van Nostrand Reinhold, 1987,
ix+294 pp.
Distributed in Canada by Gage
Hardbound, ISBN 0-442-28034-3, \$^{CDN}61.15

†Expert systems: Tools, techniques, and applications

Philip Klahr and Donald A. Waterman (editors)
[The Rand Corporation]
Reading, MA: Addison-Wesley, 1986, vi+441 pp
Hardbound, ISBN 0-201-14186-8, \$35.95

A Prolog primer

Jean B. Rogers
[University of Texas at Austin]

Reading, MA: Addison-Wesley, 1986 (corrected reprinting), xii+223pp
Paperback, ISBN 0-201-06467-7, \$19.95

The T programming language: A dialect of Lisp

Stephen Slade
[Yale University]

Englewood Cliff, NJ: Prentice-Hall, 1987,
xiv+425 pp.
Paperbound, ISBN 0-13-881905-X, \$^{US}21.33

Robotics and AI: An introduction to applied machine intelligence

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

Englewood Cliffs, NJ: Prentice-Hall, 1987,
x+373 pp.; Hardbound, ISBN 0-13-782269-3,
\$^{US}39.95

New journal

Computer speech and language

Edited by Frank Fallside and Steven Levinson
[University of Cambridge and AT&T Bell Labs]

London: Academic Press; Issue 1(1), March 1986
ISSN 0885-2308

Four issues per volume, except two issues only in vol 1, 1986. Subscriptions (from 1987; 1986 rates are half price): Personal: 30.00 pounds in the U.K., \$50.00 elsewhere; Institutional: 60.00 pounds in the U.K., \$97.50 elsewhere

Abstracts of papers in Computational Intelligence, 3(1), February 1987

Meaning Representation in Montague Grammar and Situation Semantics

Robin Cooper

This paper compares certain aspects of situation semantics and Montague grammar and points out some issues related to natural language programming. It provides an introduction to certain basic concepts of situation semantics and makes some tentative claims about possible advantages of situation semantics.

An Architecture for a Self-Improving Instructional Planner for Intelligent Tutoring Systems

*Stuart A. Macmillan and
Derek H. Sleeman*

Every intelligent tutoring system (ITS) embodies some mechanism for deciding what to do next at each point during and instructional session. We refer to this function as instructional planning. In this paper we describe a generic system architecture for a Self-Improving Instructional Planner (SIIP) that dynamically creates instructional plans, requests execution of these plans, replans, and improves its planning behaviour based on a student's responses to tutoring. Like human instructional planners, SIIP must respond to individual students in several ways. It must seek to resolve ambiguities in diagnosis, it must determine what, if any, feedback to provide, and it must consult the syllabus of skills to be learned to determine what to teach next. The multitude and complexity of the various activities argue for the need to treat the entire process as a planning problem. An instructional planner must develop a plan in light of changing data and control the execution and dynamic refinement of the instructional plan.

LIY: Learn-It-Yourself Software Interfaces

F.A. Martin

An increasing number of people are becoming users of unfamiliar software. They can be genuinely 'new' computer users or part of a growing group who are transferring skills and knowledge from a familiar product such as a word processor to a functionally similar but different, unfamiliar one. The problem for users in this position is that they do not have access to training courses to teach them how to use such software and are usually forced to rely on text-based documentation. LIY is a method for producing computer-based tutorials to teach the user of a software product. This paper describes how LIY is, in turn:

- A method for application system design which recognises the need for tutorial design – A task analysis and user interface specification provide information structures, which are passed to the tutorial designer.
- A support environment for the tutorial designer – In addition to prompting for courseware for nodes in the task analysis, LIY provides a ready-made rule base for constraining the degree of learner control available while the tutorial is in use. The designer is able to tailor this rule-base for a specific tutorial.
- A tutorial delivery environment – The tutorial adapts to individual learners and offers a degree of learner control.

Automatic Programming Debugging for Intelligent Tutoring Systems

William R. Murray

Program debugging is an important part of the domain expertise required for intelligent tutoring systems that teach programming languages. This article explores the process by which student programs can be automatically debugged in order to increase the instructional capabilities of these systems. The research presented provides a methodology and implementation for the diagnosis and correction of nontrivial recursive programs. In this approach, recursive programs are debugged by repairing induction proofs in the Boyer-Moore

Logic. The induction proofs constructed and debugged assert the computational equivalence of student programs to correct exemplar solutions. Exemplar solutions not only specify correct implementations but also provide correct code to replace buggy student code. Bugs in student code are repaired with heuristics that attempt to minimize the scope of repair. The automated debugging of student code is greatly complicated by the tremendous variability that arises in student solutions to nontrivial tasks. This variability can be coped with, and debugging performance improved, by explicit reasoning about computational semantics during the debugging process. This article supports these claims by discussing the design, implementation, and evaluation of Talus, an automatic debugger for LISP programs and by examining related work in automated program debugging. Talus relies on its abilities to reason about computational semantics to perform algorithm recognition, infer code teleology and to automatically detect and correct nonsyntactic errors in student programs written in a restricted, but nontrivial, subset of LISP. Solutions can vary significantly in algorithm, functional decomposition, role of variables, data flow, control flow, values returned by functions, LISP primitives used, and identifiers used. Solutions can consist of multiple functions, each containing multiple bugs. Empirical evaluation demonstrates that Talus achieves high performance in debugging widely varying student solutions to challenging tasks.

Representing Complex Knowledge in an Intelligent Machine Tutor

Beverly P. Woolf

Knowledge representation remains a serious issue for researchers of intelligent tutoring systems. Two areas of knowledge representation that are particularly difficult are domain and teaching knowledge. This article discusses and gives example solutions to these knowledge engineering issues and also addresses issues that relate to up-scaling existing intelligent tutoring technology to practical levels so that tutoring systems can be brought up into the real world.

Upcoming in Volume 3

During publication of Volume 3, **Computational Intelligence** will introduce a new section, *Taking Issue*, with an outstanding contribution debating logical approaches to artificial intelligence. This first *Taking Issue* is edited by Hector Levesque, and will be on the relevance of logic to AI, a topic hotly debated from the very beginnings of the field.

Subscription information

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Recent AI Technical Reports

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

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University of British Columbia

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

Department of Computer Science
University of British Columbia
Vancouver, B.C. CANADA V6T 1W5

A Schema and Constraint-based Representation to Understanding Natural Language

Eliza Kuttner

Technical Report 87-2

This thesis attempts to represent the syntax and semantics of English sentences using a schema and constraint-based approach. In this approach, syntactic and semantic knowledge are represented by schemata and are processed in parallel by network consistency techniques and an augmented version of Earley's context-free parsing algorithm. A sentence's syntax and semantics are disambiguated incrementally as the interpretation proceeds left to right, word by word. Each word and recognized grammatical constituent provides additional information that helps to guide the interpretation process.

It is desirable to attempt to apply network consistency techniques and schema-knowledge representations on understanding natural language since the former has been proven to be quite efficient and the latter provides modularity in representing knowledge. In addition, this approach is appealing because it can cope with ambiguities in an efficient manner. Multiple interpretations are retained if ambiguity exists as indicated by the words processed so far. However, incorrect interpretations are eliminated as soon as their inappropriateness is discovered. Thus, backtracking search which is known to be inefficient is avoided.

Shape Analysis

R.J. Woodham

Technical Report 86-12

This report is a pre-print of an article to appear in *Encyclopedia of Artificial Intelligence* S. Shapiro (ed.), John Wiley & Sons, New York, NY (1987).

In a general-purpose vision system, the mapping from signal input to final shape description is too complex to be treated as a function in a single representation. Shape

analysis requires many levels of intermediate representation. Each level of representation must consider both the processes that derive the representation and the processes that compute with the representation. At the level of the signal, one deals with descriptions that can be derived directly from the image. This leads initially to representations for the 2D shape of image patterns. Interpreting image properties as scene properties leads to representations for the visible surfaces in the scene. Finally, recognition of distinct objects and their spatial arrangement requires representations for 3D shape that are independent of viewpoint. This report surveys work at these three levels of representation: 2D shape, visible surfaces, and 3D shape.

Analytic Method for Radiometric Correction of Satellite Multispectral Scanner Data

R.J. Woodham and M.H. Gray

Technical Report 87-1

The problem of radiometric correction of multispectral scanner data is posed as the problem of determining an intrinsic reflectance factor characteristic of the surface material being imaged and invariant to topography, position of the sun, atmosphere and position of the viewer. A scene radiance equation for remote sensing is derived based on an idealized physical model of image formation. The scene radiance equation is more complex for rugged terrain than for flat terrain since it must model slope, aspect, and elevation dependent effects. Scene radiance is determined by the bidirectional reflectance distribution function (BRDF) of the surface material and the distribution of light sources. The sun is treated as a collimated source and the sky is treated as a uniform hemispherical source. The atmosphere is treated as an optically thin, horizontally uniform layer. The limits of this approach are reviewed using results obtained with Landsat MSS images and a digital terrain model (DTM) of a test site near St Mary Lake, British Columbia, Canada.

New results, based on regression analysis, are described for the St Mary Lake site. Previous work is extended to take advantage of explicit forest cover data and to consider numeric models of sky radiance. The calculation of sky irradiance now takes occlusion by adjacent terrain into account. The results for St Mary Lake suggest that the cosine of the incident solar angle and elevation are the two most important correction terms. Skylight and inter-reflection from adjacent terrain, however, also are significant.

On the Visual Discrimination of Self-Similar Random Textures

R.A. Rensink

Technical Report 86-16

This work examines several issues relating to self-similar random textures.

1. Relations are established between the covariance functions and power spectra of stationary n -dimensional self-similar random fields. These determine the conditions under which such fields are stochastic fractals or self-similar noises.

2. The discriminability of self-similar Gaussian line textures is empirically determined. Results show that the similarity parameter H and the scaling ratio h influence discriminability, but are insufficient to completely characterize perceived texture.

3. The empirical results are analyzed, and found to be compatible with the hypothesis that texture perception is mediated by the spatial-frequency channels putatively involved in form vision.

Adequacy Criteria for Visual Knowledge Representation

Alan K. Mackworth

The proper study of artificial intelligence is the design of computational systems that represent, use and acquire knowledge to perceive, reason, communicate and act. Under that definition knowledge representation is the heart of artificial intelligence. Past and future success in building systems for vision, problem solving, planning and language depends critically on progress in knowledge representation. Workers in the field have been prolific in proposing and exploiting a variety of knowledge representation schemes such as grammars, semantic nets, programs, logics, schemas, rules, constraints and neural nets. However, as we explore in the world of knowledge representation we need navigational tools: the analogs of chart, compass, log and sextant. In this paper a framework for evaluating knowledge representation schemes is presented.

□ □ □ □ □

University of Toronto

The following reports may be obtained by writing to:

Marina Haloulos
Department of Computer Science
University of Toronto
Toronto, Ontario, Canada M5S 1A4.

Implementing a Taxis Compiler

*Brian A. Nixon, K. Lawrence Chung,
David Lauzon, Alex Borgida, John Mylopoulos,
and Martin Stanley*

January 1987

The features of a compiler for the Taxis design language are described and discussed. Taxis offers an entity-based framework for designing interactive information systems and supports generalization, classification, and aggregation as abstraction mechanisms. Its features include multiple inheritance of attributes, IS-A hierarchies of transactions, metaclasses, typed attributes, a procedural exception-handling mechanism, an iteration construct based on the abstraction mechanisms supported, semantic integrity constraints, including time-dependent ones, and communicating Petri net-like processes (called scripts). Developing a compiler for the language involved tackling the problem of efficiently representing and accessing a large collection of entities, performing (static) type checking and representing IS-A hierarchies of transactions. The compiler has also been designed to deal with semantic integrity constraints and scripts, though these features have not yet been implemented.

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University of Waterloo

Copies of the following papers and reports may be ordered from:

Sue DeAngelis
Department of Computer Science

University of Waterloo
Waterloo, Ontario, N2L 3G1.

There is a nominal charge.

Spreadsheets with Incremental Queries as a User Interface for Logic Programming

M.H. van Emden, M. Ohki, A. Takeuchi

Research Report CS-85-43

We believe that currently marketed programs leave unexploited much of the potential of the spreadsheet interface. The purpose of our work is to obtain suggestions for wider application of this interface by showing how to obtain its main features as a subset of logic programming. Our work is based on two observations. The first is that spreadsheets would be a useful enhancement to interactive languages such as APL and Basic. Although Prolog is also an interactive language, this interface cannot be used in the same direct way. Hence our second observation: the usual query mechanism of Prolog does not provide the kind of interaction this application requires. But it can be provided by the Incremental Query, a new query mechanism for Prolog. The two observations together yield the spreadsheet as a display of the state of the substitution of an incremental query in Prolog. Recalculation of dependent cells is achieved by automatic modification of the query in response to a new increment that would make it unsolvable without the modification.

A Hierarchical Module Structure for WUP Programs

Chris Baird

Department of Computer Science Research
Report CS-85-49

Modular programming, decomposing programs into smaller components or modules, is a software engineering technique for managing the complexity of large software projects. Several imperative programming languages, including Modula-2 and Ada, have incorporated the concept of module in their design. Logic programming languages, if they are to be used for writing large programs, must also provide features for modular programming.

The work reported here was intended to provide a new system of organising Waterloo UNIX Prolog (WUP) modules which would eliminate existing shortcomings. This paper describes a hierarchical module structure for WUP that is statically derived from the UNIX file structure. The module structure of a program may also be dynamically configured by the programmer. This implementation of modules in WUP is compared to that in other logic programming systems.

Equational Logic Programming

M. H. van Emden and K. Yukawa

Department of Computer Science Research
Report CS-86-05

This paper is a contribution to the amalgamation of logic programming (as embodied in Prolog) and functional programming (as embodied in languages like SASL, KRC, Hope, or in dialects of Lisp like Lispkit Lisp or Scheme). We investigate how equational rewriting, which we assume is an adequate model for functional programming, can be performed within the context of logic programming. The equational program

plus the standard theory of equality (reflexivity, symmetry, transitivity, and substitutivity) is our standard of correctness: we regard it as a logic specification from which the result of any evaluation must be a logical consequence. Although the standard theory of equality plus the equations formally qualify as a Prolog program, their use as such is computationally infeasible. To obtain feasible evaluations conforming to our standard of correctness, we investigate two approaches: the interpretational one and the compilational one. In the interpretational approach we use as logic program the equations themselves, but replace the standard axioms of equality by suitably chosen logical consequences having the property that the Prolog interpreter mimics equational rewriting without search. In the compilation approach we obtain an efficient Prolog program by translating the equations to a set of Horn clauses not involving equality and discarding the equality axioms altogether. We prove correctness for both approaches.

AP: An Assertional Programming System

Mantis H.M. Cheng and Keitaro Yukawa

Research Report CS-86-11

We combine functional programming and logic programming by adding a suitable equality theory and defining functions using equations. This approach has the advantage that the semantics of logic programming is retained and the semantics of functional programming can be given in terms of logical consequence. The idea of this approach is based on an idea by van Emden and Yukawa [report CS-86-05].

Studying Arguments to Gain Insight into Discourse Structure

Robin Cohen

[from *Pre-Acts of the Invitational Workshop on the Structure of Multi-modal Dialogue Including Voice*, 1986]

In constructing a computational model to comprehend discourse one task to be solved is how to interpret one uninterrupted set of utterances from a conversant. The problem is to determine how the propositions connect together into some coherent, purposeful sub-dialogue. We have developed a computational model to analyze arguments — one-way dialogue, where the speaker tries to convince the hearer of a particular point of view. The patient listener simply tries to recognize the structure of the argument that is felt to be what the speaker intends to be understood. The model produces as output a representation of the argument that indicates the claim and evidence relationships between the underlying propositions. We claim that this first step of comprehending the input is necessary for the overall model of a conversant, and requires a careful specification.

In order to address the larger concerns of this workshop, we first outline the model for analyzing arguments. We then consider two specific questions raised by the overview to the workshop:

1. What kinds of protocols to communication exist (and can be processed in a computational model)?
2. Is there a grammar for dialogues?

Finally, we draw on some specific characteristics of our model to suggest extensions for handling the larger class of two-person free-form dialogue.

An Adaptive Technique for Improving the Efficiency of Planners

J.A.N.A. Trudel and R. Goebel

Research Report CS-86-24

We describe a planning program called “Madame”, which is based on D.H.D. Warren’s WARPLAN modified to use Kowalski’s representation for dynamic worlds. The modified WARPLAN uses a network data structure, called the “spider”, to store goal states generated during the planners use. The spider is retained over multiple invocations of Madame, and is used to provide possible subplans for subsequent planning requests.

Experimental results are presented that show that the spider gives improvement in terms of the time required to produce plans for a collection of randomly generated queries. We also study the usefulness of the spider as it increases in size.

We discuss the spider, the implementation that uses it, and various heuristic strategies for retaining and using subplans stored in the spider.

An Implementation of a Computational Model for the Analysis of Arguments — An Introduction to the First Attempt

T. J. Smedley

Research Report CS-86-26

This paper presents a description of a first attempt at a Prolog implementation of a computational model for the analysis of arguments. The implementation of the model is based on the papers and thesis by Robin Cohen. The three different algorithms for the different models have been implemented: pre-order, post-order and hybrid. The implementation does not include an intelligent evidence oracle, as this is beyond the scope of a first attempt. Some examples are given, demonstrating that the algorithms do construct the argument trees as claimed in the papers.

Exhuming the Criticism of the Logician

R. Goebel

Research Report CS-86-33

McDermott has recently explained his fundamental philosophical shift on the methodology of artificial intelligence, and has further suggested that this shift is both necessary and inevitable. This shift results from a perception that a trend towards over-formalization has detached the real problems from the research results. McDermott’s criticism is an enlightened exhumation of the criticisms of the seventies, and explains new ways in which the logical methodology can be abused. I argue that McDermott’s criticism should not discourage the use of logic, but force a timely re-examination of its fundamental role in AI.

Theory Preference Based on Persistence

S.D. Goodwin and R. Goebel

Research Report CS-86-34

A recent paper by Hanks and McDermott calls into question the value of logic in AI. The paper describes how representing even simple default reasoning problems can give rise to multiple consistent yet conflicting solutions. The problem they describe is not due to any deficiency of the reasoning

system, but is merely the result of a weak set of axioms. Since strengthening the axioms to eliminate unwanted models is a nontrivial problem (equivalent to the frame problem), our approach is to supplement the axioms with a preference criterion which restricts the models (just as strengthening would), but which is easier to specify. The preference criterion we propose is intended to reflect what McCarthy has called "...the common sense law of inertia." Our formalization of this concept is based on a heuristic measure of *persistence*. We describe a planning framework in which a theory formation system uses frame default schemas to generate descriptions of situations. We show how the notion of persistence can be used to distinguish multiple competing situation descriptions and thereby determine whether the goal is predicted by the preferred situation description.

A Model for User-Specific Explanations from Expert Systems

P. G. van Beek

Research Report CS-86-42 [M.Math Thesis]

In this thesis we present a computational model for generating non-misleading, user-specific explanations from expert systems. Ideally an expert system should, as an aid in formulating cooperative responses, both maintain a model of the user from the ongoing dialogue and possess knowledge of a user's expectations of cooperative expert behaviour. Our model focuses on how knowledge of the user's goals, plans, and preferences should influence a response. Included are two important specifications: what information about the user is needed plus an algorithm for using that information to compute user-specific responses. The explanation model may be seen as extending the work of Joshi, Webber, and Weischedel to include user-specific goals and to specify the algorithm independent of domain.

The algorithm, together with the model of the user, present a general method of computing the responses enumerated by Joshi et al. They also allow us to generate helpful responses that address a particular user's preferences and goals and to recognize cases where a direct, correct response may violate the user's expectations of cooperative expert behaviour and thus mislead or confuse the user. This involves, among other things, the ability to: provide a correct, direct answer to a query; explain the failure of a query; compute better alternatives to a user's plan as expressed in a query; and recognize when a direct response should be modified and make the appropriate modification.

While we focus in this thesis on explanations in the context of expert advice-giving systems, we feel the approach is applicable to a broad range of question types and to expert system explanation generation in general.

The Fifth Generation: Making Computers Easier to Use?

R. Goebel

Research Report CS-86-43

When it began in 1982, Japan's Fifth Generation Computer Systems project caught the imagination of the computing world. Responses of all kinds, including criticism, praise, and initiation of competing and cooperative projects, have combined in a kind of Fifth Generation "hysteria" that has touched most of the world computing community.

Here we examine the motivation and foundation of the Fifth Generation project, and argue that the ultimate goal is really to make computers easier to use. The argument is based on the use of logic programming and its role in the development of *rational systems*. It suggests that the AI revolution anticipated by some will actually be a subtle, almost undetectable infusion of "rational" programming practices into the most common of everyday software.

Activities

Forthcoming Conferences, and Calls for Papers

Canadian Conferences

Office Knowledge: Representation, Management and Utilization

17-19 August, 1987

University of Toronto
Toronto, Ontario

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

Extended abstracts, in English, of four to eight double-spaced pages are invited. Accepted submissions will appear as submitted in special issue of the WG8.4 newsletter and will be made available to workshop participants. Four copies of each submission should be sent by 15 April 1987 to:

Dr Winfried Lamersdorf
IBM European Network Centre
Tiergartenstrasse 15
Postfach 10 30 68
D-6900 Heidelberg
WEST GERMANY

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IEEE ELECTRONICOM '87

28-30 September, 1987

Metro Toronto Convention Centre
Toronto, Ontario

This conference, sponsored by the Canadian Region of the Institute of Electrical and Electronics Engineers, is divided into a seminar program and a workshop program. The seminars will showcase proven systems and services. The following topics will be considered: engineering applications for

personal computers; computer assisted engineering; computer aided design and computer aided manufacturing; standards and quality control; the smart house; integrated services digital network; the integrated office.

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

For further information, contact:

ELECTRONICOM '87
1450 Don Mills Road
Don Mills, Ontario M3B 2X7

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U. S. Conferences

Workshop on Spatial Reasoning and Multi-Sensor Fusion

5-7 October 1987

Pheasant Run Resort
St Charles, Illinois

Spatial reasoning is central to the interaction of an intelligent robot with its environment. This workshop, which is sponsored by AAAI, will focus on such problems as integrating incoming information through the various sensors, and correlating perceived information with stored world knowledge.

For more information, contact

Su-shing Chen
Department of Computer Science
University of North Carolina
Charlotte, NC, USA 28223

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Third International Conference on Artificial Intelligence and Education

8-10 May, 1987

University of Pittsburgh
Pittsburgh, PA

This conference, which is being organized by the Learning Research and Development Center of the University of Pittsburgh, will bring together researchers working on intelligent tutoring systems and education researchers. The conference will focus on how the application of artificial intelligence to education can go beyond the analysis and representation of subject-matter content.

For more information, contact

Jane Parlett
811 LRDC
University of Pittsburgh
Pittsburgh, PA, USA 15260

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Second International Symposium on Methodologies for Intelligent Systems

14-17 October 1987

Hilton Hotel at University Place
Charlotte, NC

This symposium, which is being sponsored by several institutions including the University of North Carolina, is intended to attract those who are actively engaged in both theoretical and practical aspects of intelligent systems. The goal is to provide a platform for a useful exchange between theoreticians and practitioners, and to foster the cross-fertilization of ideas. For further information, contact

Dr Keh-hsun Chen
ISMIS 87
Computer Science Department
UNC-Charlotte
Charlotte, NC, USA 28223

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Expert Systems and the Leading Edge in Production Planning and Control

10-13 May 1987

Omni Hotel at Charleston Place
Charleston, SC

A conference, sponsored by AAAI and the Operations Management Association, on expert systems applications in manufacturing. For more information, contact

Libby Schropshier
Conference Coordinator
Institute of Information Management
College of Business Administration
University of South Carolina
Columbia, SC, USA 29208

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1987 Workshop on Computer Architecture for Pattern Analysis and Machine Intelligence

5-7 October 1987

Seattle, Washington

CAPAMI-87 will focus on new architectures and associated algorithms designed for artificial intelligence applications. The emphasis of the program will be the presentation of significant new contributions plus panel and discussion sessions in which attendees can actively compare and contrast their methods. Papers will be reviewed by the Program Committee. No parallel sessions are planned.

Topics include: computer vision and image processing architectures; architectures for inference engines and rule-based systems; knowledge-based machines and systems; neural network-based architectures; VLSI and systolic implementations; parallel algorithms for AI problems on these architectures; parallel matching and reasoning algorithms.

Authors should submit four copies of a complete paper by 15 April 1987 to:

Charles R. Dyer
Department of Computer Science
University of Wisconsin
1210 W. Dayton St.
Madison, WI, USA 53706

Authors will be notified of the acceptance of their papers by 1 June 1987. Final camera-ready papers are due by 15 July 1987.

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Outside North America

Second International Conference on Artificial Intelligence and the Sea

18-19 June 1987

Marseilles, France

The objectives of this second ORIA conference are to show, through real applications, that actual developments in artificial intelligence and especially in the area of expert systems are out of laboratories. They are now in the industrial world, particularly in sea-linked businesses, such as shipbuilding, fishing and harbours installations.

Communications on the state of the art and different tools available will be followed by conferences on the present applications.

For more information, contact
Viviane Bernadac
IIRIAM/CMCI
2 rue Henri Barbusse
13241 Marseille Cedex 1
FRANCE

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European Conference on Artificial Intelligence in Medicine

31 August to 3 September 1987

Marseilles, France

Following proposals at the International Conference on Artificial Intelligence in Medicine, Pavia, November 1985 the European Society for Artificial Intelligence in Medicine (AIME) has been established to foster fundamental and applied research in artificial intelligence and symbolic information processing techniques for medical care and medical research. AIME also wishes to assist industry in identifying high-quality medical products that exploit these techniques.

A major AIME activity will be a biannual series of international conferences, the next of which will be in Marseilles, France, following the International Conference on Artificial Intelligence in Milan, August 1987. For more information, contact

Viviane Bernadac - AIME 87
IIRIAM
2 rue Henri Barbusse
13241 Marseille Cedex 1
FRANCE

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12th IMACS World Congress '88 Second-Generation Expert Systems: Reasoning With Heuristics and Deep Knowledge

18-22 July 1988

Paris, France

Papers are invited on expert systems reasoning with deep knowledge, or on any aspect of deep reasoning. Topics to be covered at the conference include: model-based reasoning; qualitative physics; multilevel and multimodel reasoning; reasoning from structure, behaviour and function; and causal reasoning.

Submit three copies of a 1000-word abstract by 1 August 1987. Papers will be accepted on the basis of submitted abstracts. Notifications of acceptance will be mailed by 1 December 1987.

Submissions and inquiries about the Second Generation Expert System Session should be sent to the Session Chairman:

Jean-Marc David
IMACS '88
Laboratoires de Marcoussis
Computer Science Division
Route de Nozay
91460 Marcoussis
FRANCE

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European Conference on Speech Technology

September 1987

Edinburgh
Scotland

This conference will present the latest research, development and applications in speech technology. For further information, contact

Secretariat
European Conference on Speech Technology
CEP Consultants Ltd
26 Albany Street
Edinburgh EH1 3QH, UK

or send requests for further information by E-mail to

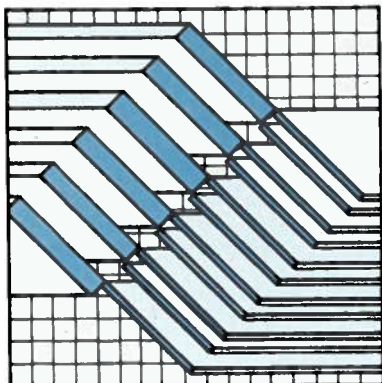
JANET: ecst@uk.ac.ed.eusip

ARPA: ecst%ed.eusip@ucl-cs.arpa

UUCP: ...{decvax,ihnp4,seismo}!mcvax!ukc!eusip!ecst

Guidelines for electronic submissions

Canadian A.I. prefers submissions to be made by network mail when possible, to eliminate the need for retyping. However, please do not send text that has been through a document formatter; extra embedded spaces and hyphenated line breaks just have to be edited out again before typesetting. The best thing to send is plain typing or *troff* source (preferably with *-me* macros).



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- Speed data entry with programmability, macros, lookup tables, mass updates, data validation, initial values, custom Help screens and calculated fields.
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| Evaluation | Name | Position | 1 |
|------------|------------------|------------------------|-------------|
| 7 | Guy Mary | Regional Sales Manager | \$56,000.00 |
| | Kelly Colin | Outside | \$33,600.00 |
| | Wilson Ann | Regional Sales Manager | \$56,640.00 |
| | Jacobson Will | Regional Sales Manager | \$61,600.00 |
| 8 | Turlledge Nina | Sales Manager | \$49,450.00 |
| | Dean Sarah | Sales Administrator | \$25,300.00 |
| 9 | Johnson Nick | National Sales Manager | \$70,000.00 |
| | Sanquinetti Tony | Outside | \$02,600.00 |

EMPLOYEE.DTF
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