Canadian Artificial Intelligence

Intelligence Artificielle au Canada

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September 1986   **No. 9 (New series)**

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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.

President/Président: Dick Peacocke, Bell-Northern Research, Box 3511, Station C, Ottawa, Ont K1Y 4H7. Phone: 613-727-2629. UUCP: . . . !bnr-di!dick
Vice-President/Vice-Président: Renato De Mori, School of Computer Science, McGill University, Montréal, Qué H3A 2K6. Phone: 514-392-8274. UUCP: . . . !musocs!renato
Secretary/Secrétaire: Bill Havens, Department of Computer Science, University of British Columbia, Vancouver, BC V6T 1W5. Phone: 604-228-6450. CSNET, CDNNET: havens@ubc
Treasurer/Trésorier: Randy Goebel, Department of Computer Science, University of Waterloo, Waterloo, Ont N2L 3G1. Phone: 519-888-4439. CDNNET: rggoebel@water UUCP: . . . !watmath!water!rggoebel

Canadian Artificial Intelligence

Intelligence Artificielle au Canada

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.

Opinions, counterpoints, polemic, controversy.
Abstracts of recent publications, theses, and technical reports.
Humour, cartoons, artwork.
Advertisements (rates upon request).
Anything else concerned with AI.

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

Canadian A.I. is published in March, June, September, and December. Material for publication is due on the 15th of the preceding month.

Treasurer's report 1986

Randy Goebel
Treasurer, CSCSI/SCEIO

Treasurer's reports have typically consisted of a single page of revenue and expenses (*e.g.,* see the report in *Canadian A. I.,* December 1985). However, there have been quite a few changes in CSCSI/SCEIO's financial picture recently, so I feel that I should augment the traditional ledger sheet with some additional information. But first the ledger:

CSCSI/SCEIO
Consolidated Financial Statement
1 April 1985 to 31 March 1986

Balance forward	**13,746.87**
Savings account	6,210.96
Current account	3,939.25
CIPS account	3,596.66
85—86 Revenue	**19,352.07**
Fees (including *CI* subscriptions)	7,877.00
Proceedings sales	4,431.17
Canadian A. I. advertising	6,865.86
Interest	178.04
85—86 Expenses	**27,314.48**
TANLU workshop advance	2,000.00
1986 conference advance	2,000.00
CIPS proceedings handling	832.97
CIPS administration	3,540.00
NRC *CI* journal	2,432.00
Canadian A. I. production	16,509.51
85—86 Net loss	**7,960.41**
Balance forward	**5,786.46**
Current account	2,057.42
Savings account	1,389.00
CIPS	2,340.04

In addition to the regular yearly budget statement, several other items of business have been completed since the end of March of this year.

Richard Rosenberg has submitted the final budget of the TANLU Workshop held at Dalhousie in May of 1985, and was able to report a net profit of $5,035. It seems that the number of registrants was larger than anticipated, so that meeting was a financial as well as academic success.

A preliminary closing budget for the 1986 CSCSI/SCEIO conference in Montreal has been submitted. This was the most financially successful conference in our history; I have already received approximately $15,000 from the conference chairman, Renato DeMori, with a few thousand more expected after final expenses have been tallied.

While the last two meetings have been financial successes, our budget is not all as rosy as one might think. In fact you all probably noticed that the final tally for the 85—86 fiscal year reported a net loss. This is partly because the final budget of the TANLU workshop is not included.

Note that, however, our *Canadian Artificial Intelligence* magazine has become a regular and major expense item of our budget. Its production is relatively costly for a society such as ours, but everyone seems to agree that Graeme Hirst's superb editing job brought our newsletter "out of the closet," and should continue. Therefore we have had to agree to increase membership dues.

The last increase in membership dues was in January 1985, when they rose to the lofty sum of $20 for regular members, and $10 for students. Note that, as we are a special interest group affiliated with CIPS, CIPS members pay $5 less in each category. Note also that CIPS maintains our membership records, handles membership dues, *Computational Intelligence* subscriptions, and sale and mailing of proceedings, so there has typically been a $10 CIPS surcharge, levied once per year, for each of our non-CIPS members.

All this means that we will be revising our membership rates as of 1 September 1986. The new rates will be $25 for regular members, and $15 for students, with a $10 discount for CIPS members. The $16 rate for *Computational Intelligence* will remain the same.

Our membership has grown to over 900, from 650 in September 1985, and 283 in March 1984.

Another potential increase in revenue is our new agreement with Morgan Kaufmann Publishers of Los Altos, California to serve as the central distribution agent outside of Canada for our conference proceedings (see page 11). We hope that having our proceedings distributed with the other major AI publications will achieve a wider distribution of our conference proceedings, and produce more revenue for our society.

The anticipated extra revenue will provide us with the stable budget that we require to continue to produce the magazine, which is the flagship of our society. In addition, we hope to create a larger financial base from which to launch conferences and workshops. □

Editor's notes

Changes afoot

Graeme Hirst
Editor

This is my last issue as volunteer editor and general staff of this magazine. With the start of the school year, my teaching commitments (which are what I get paid for) make it impossible for me to spare sufficient time to continue to produce the magazine as I have for the previous two years.

As this issue goes to press, the Society's executive is busy plotting schemes for the continued production of the magazine. One possibility is another volunteer editor; a second is using some of the Society's conference profits (see the

Joanne Mager

treasurer's report above) to have a professional paid assistant take over much of the work. The next issue will have full details.

□   □   □   □   □

This issue is also the last for Joanne Mager, who has often, in her position as secretary to the AI group in the University of Toronto Computer Science Department, voluntarily assisted me in entering submissions that arrive on paper and in many other clerical tasks. Joanne is leaving the University for marriage and Saskatoon. The Society and I are grateful to her for her contributions. □

AI Limericks

Henry Kautz
University of Rochester

If you're dull as a napkin, don't sigh;
Make your name as a "deep" sort of guy.
  You just have to crib, see
  Any old book by Kripke
And publish in AAAI.

□   □   □

A hacker who studied ontology
Was famed for his sense of frivolity.
  When his program inferred
  That Clyde is a bird
He blamed not his code but zoology.

□   □   □

If your thesis is utterly vacuous
Use first-order predicate calculus.
  With sufficient formality
  The sheerist banality
Will be hailed by the critics: "Miraculous!"

If your thesis is quite indefensible
Reach for semantics intensional.
  Your committee will stammer
  Over Montague grammar
Not admitting it's incomprehensible.

In the December issue

● Takashi Gomi reports on the European AI conference.

● Paul Bassett discusses AI as a science of ambiguity and partial information.

Deadline for submissions for the December issue is 15 November.

RAPID PROTOTYPING TOOLS FOR AI

Le_Lisp

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

GCLISP NEW PRODUCTS

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

- 286 Developer ($1675)
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- Halo Graphics ($350)

LPA MICRO-PROLOG/APES KIT

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scientific and educational applications. Refined syntax gives
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Several thousand copies sold throughout the world. $1073 (PC
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ARITY KNOWLEDGE SYSTEM DEVELOPMENT PACK

A new generation AI prototyping tool for PCs. A Prolog
interpreter/compiler, a rule/frame-based Expert Systems shell
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Natural Language interface for popular database systems
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during the past 9 months. $495.

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

Applied AI Systems, Inc.
P.O. Box 13550
KANATA, Ontario
Canada K2K 1X6

Telephone: (613) 592-0084

Résumé

complications introduites par les croyances des agents durant la compréhension des énonciations.

Ainsi, le groupe s'intéresse plus à la compréhension complète de longs textes sans restrictions sur le contenu ou la forme, plutôt qu'aux interfaces avec l'usager ou autres systèmes de traitement de phrases individuelles. Cette orientation est particulièrement appropriée pour la recherche en traduction automatique, en traitement de longs documents pour la recherche conceptuelle (conceptual retrieval), et en acquisition de connaissances par la lecture.

Le groupe travaille présentement sur les projets suivants:
* La détection et représentation des ambiguïtés d'intension et description (Brenda Fawcett, Diane Horton).
* Les croyances et présuppositions (Diane Horton).
* L'interpretation sémantique et la résolution de l'ambiguïté (Graeme Hirst). * Les modèles deux-étapes de l'analyse syntactique (Susan McRoy). * Une interprétation computationnelle de la sémantique situationnelle (Yves Lespérance). * La compréhension des métaphores (Ed Plantinga). * L'analyse syntactique des langages non-configurationnels (Barbara Brunson). * Un modèle des processus de mémoire pour la compréhension de textes (Jean-Pierre Corriveau). * La recherche conceptuelle de l'information légale (Judy Dick). * Les modèles mentaux individuels et la compréhension du langage (Stephen Regoczei).

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* *Vision Robotique* par Bertholt K.P. Horn, compte rendu par Colin Archibald; * *Raisonnement sur la Connaissance* par Joseph Halpern, compte rendu par Patrick Saint-Dizier. * Nouveau journal: *Abstracts in Artificial Intelligence.* * Résumés d'*Intelligence Informatique*, 2(3), août 1986.

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Intelligence Artificielle au Canada

Canadian Artificial Intelligence

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.
Des trucs humoristiques ou artistiques, des bandes dessinées.
Des annonces (s'enquérir des frais).
Tout autre matériel touchant à l'IA.
Veuillez expédier vos contributions, soit sur papier ou par courrier électronique, à l'éditeur dont l'adresse apparait à la page 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* apparait en mars, juin, septembre et décembre. Le matériel pour un numéro doit nous parvenir le 15 du mois précédant sa parution.

AI News

Dalhousie Business School AI grant from Sperry

The Dalhousie University School of Business Administration has been granted a Sperry / Texas Instruments Explorer Lisp machine and a copy of the IntelliCorp KEE expert system development environment. The grant, worth $202,000, was part of a world-wide AI grant program by Sperry Inc.

The equipment will be used for research in expert systems in business administration, a facet of the School's Courseware Development Project directed by Dr Andrew Peacock. The equipment will help foster cooperation between the University and industry.

The first project under way is an expert system for the management of foreign debts. The system is being developed by Alice Ireland, in association with some large utility companies.

Other projects planned are the development of an expert estimator for bidding in custom one-off R&D projects (Dr Michael Martin), intelligent computer-aided instruction (Dr Donald Sheridan), and expert systems in auditing.

The coordinator of the research projects is Dr Michael Dempster.

The AI project is one part of the Courseware Development Project, which aims to involve computers in all aspects of teaching and research at the School.

Morgan Kaufmann Distributes CSCSI/SCEIO Proceedings

Morgan Kaufmann Publishers of Los Altos, California, has arranged with CSCSI/SCEIO to be the distributor outside Canada of CSCSI/SCEIO conference proceedings, starting with the proceedings of the recent Canadian AI conference in Montreal.

Morgan Kaufmann is well known as a publisher specializing in AI and computer science material. It also distributes the proceedings of the International Joint Conferences on Artificial Intelligence and the conferences of the American Association for Artificial Intelligence, among others.

Canadian residents (and non-Canadian members of CSCSI/SCEIO) will continue to be able to buy CSCSI/SCEIO proceedings though CIPS using the order form on the inside back cover of *Canadian A. I.*, at a price somewhat lower than that to be charged by Morgan Kaufmann.

MOSST Offers Matching Grant to CIAR

The federal Ministry of State for Science and Technology (MOSST) has agreed to match dollar for dollar funds raised by the Canadian Institute for Advanced Research for the next four years, up to a maximum of $7 million.

The CIAR, through its AI and robotics program, is the leading private sponsor of AI research in Canada (see *Canadian A. I.*, September and December 1984).

Xerox Sets Up AI Support Group

Xerox Canada Inc has set up an AI support group in its Toronto headquarters. The group, which will have close ties with the Xerox Palo Alto Research Center in California, is run by Neal Kelly. Initial staff include Bob Gannon and Bryan Kramer.

Logicware joins Nexa Group

Logicware Inc, the Toronto-based vendor of MPROLOG and the TWAICE expert-system builder, has been acquired by the Nexa Group through International Artificial Intelligence Inc (IAI), a subsidiary it owns jointly with Allied-Signal Canada Inc.

Nexa Corporation is a Canadian management and investment company which specializes in information technology. It provides start-up capital, management expertise, and administrative help. Among its subsidiaries are several other Canadian AI companies held through IAI: Canadian Artificial Intelligence Products Corporation, Inference Canada Inc, and Symbolics Canada Inc. Allied-Signal is a large company with interests in electronics, aerospace, and the automotive industry.

Logicware has relocated at the same Mississauga address as several other Nexa companies. Ian MacLachlan, vice-president of marketing, said that the change of ownership will put Logicware in an even better position to help its clients create successful AI applications.

Logicware was previously a subsidiary of G&B Automated Equipment Ltd, which received preferred shares in Nexa's Canadian AI Products Corp.

Guide sur l'IA au Québec

L'intelligence artificielle au Québec: Références utiles est un répertoire de références sur les activités d'AI dans la province. Le guide couvre les groupes de recherche universitaires et gouvernementaux, les institutions privées, et les cours d'I.

Le guide est publié par le Ministère des Communications du Québec. Des copies peuvent être obtenues en écrivant á:

Yves Hudon
Ministère des Communications des Québec
Direction générale des politiques
Secteur du logiciel
580, Grande-Allée est, suite 440
Québec, PQ G1R 2K2
Téléphone: 418-643-1903

Guide to AI In Quebec

L'intelligence artificielle au Québec: Références utiles is a compilation of AI activities in the province. The guide includes university and government research groups, private companies, and AI courses.

The guide is published by the Quebec Ministry of Communications. Copies are available by writing to the address above.

B.C. Advanced Systems Institute Gets Go-Ahead

AI will feature strongly in the new British Columbia Advanced Systems Institute that the Federal and B.C. Columbia governments are jointly setting up. The institute will be a centre for research and education in AI, robotics, microelectronics, and related fields.

The institute is expected to draw affiliates from B.C. universities as well as having its own staff. It is being established by the B.C. Advanced Systems Foundation, which is presently setting up a Scientific Advisory Board. Dr David Brousson has been appointed interim director of the foundation.

INPUT/OUTPUT Magazine on Peaceful High Tech

INPUT/OUTPUT is an impressive quarterly magazine published by the Initiative for the Peaceful Use of Technology (INPUT). It publishes articles concerning the impact of technology, especially computer technology, on society.

The Spring 1986 issue features three articles on computer communications and networking, including a description of AlterNET, a local Ottawa project to promote communication among groups working for peace, social and economic development, and other compatible goals. There is also an article on why David Parnas quit the SDI computing panel.

The magazine costs $10 for four issues, and is available from:

INPUT
PO Box 248, Station B
Ottawa, Ont K1P 6C4
Phone: 613-230-6678

INPUT is presently considering reconstituting itself as CEPSR, Computer and Engineering Professionals for Social Responsibility, along the lines of the American organization CPSR.

AAAI 1986 Conference Large and Daunting

The 1986 Conference of the American Association for Artificial Intelligence, held in Philadelphia last month, was large and perhaps a little frightening. AI has become a powerful and attractive bandwagon.

Over 5200 people registered for the five-day conference, which, experimentally, was divided into a two-day science section (AI theory) and a two-day engineering section (AI applications), bridged by a day of plenary sessions and a three-day trade show.

The trade show and the tutorials rather than the technical papers are clearly becoming the main attractions of AAAI conferences. There

were over 100 exhibitors, many with large and expensive displays. Many new companies offering expert system shells and the like are springing up, and many more publishers are starting AI lines. Of the major mainframe manufacturers, only DEC, IBM, and Sperry were represented, with the traditional AI workstation manufacturers — Symbolics, Lisp Machine Inc, Texas Instruments, Xerox, and Sun — dominating the hardware displays.

A new feature of the exhibition was a number of booths offered free of charge to non-profit university and research institute groups to show their work. One Canadian group was represented, Queen's University, featuring the Q'Nial language for AI.

At least seven "executive newsletters" on AI were being offered. These are generally small, advertising-free monthlies with subscriptions in the $\$^{US}200-400$ range.

The technical papers were generally of a high quality, as selection was highly competitive. The conference proceedings are published as a two-volume set, and are available for $\$^{US}55$ ($\$^{US}40$ for AAAI members) from Morgan Kaufmann Publishers. In addition there were many invited talks surveying various subfields of AI.

The Publisher's Prize for the best conference paper was won in the science section by Steve Hanks and Drew McDermott of Yale University for their paper "Default reasoning, non-monotonic logics, and the frame problem", and in the engineering section by Mark Shirley of the MIT AI Lab for "Generating tests by exploiting designed behavior".

Call for Nominations for IJCAI Awards

The IJCAI Award for Research Excellence

The IJCAI Award for Research Excellence is given at each International Joint Conference on Artificial Intelligence, to a scientist who has carried out a program of research of consistently high quality yielding several substantial results. If the research program has been carried out collaboratively the award may be made jointly to the research team. The first recipient of this award was John McCarthy in 1985.

The Award carries with it a certificate and the sum of $\$^{US}1,000$ plus travel and living expenses for the IJCAI. The researcher(s) will be invited to deliver an address on the nature and significance of the results achieved and write a paper for the conference proceedings. Primarily, however, the award carries the honour of having one's work selected by one's peers as an exemplar of sustained research in the maturing science of Artificial Intelligence.

We hereby call for nominations for The IJCAI Award for Research Excellence to be made at IJCAI-87 in Milan. The section below on selection procedures for IJCAI Awards provides the relevant details.

The Computers and Thought Award

The Computers and Thought Lecture is given at each International Joint Conference on Artificial Intelligence by an outstanding young scientist in the field of AI. The Award carries with it a certificate and the sum of $\$^{US}1,000$ plus travel and subsistence expenses for the IJCAI. The Lecture is one evening during the Conference, and the public is invited to attend. The Lecturer is invited to publish the Lecture in the conference proceedings. 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.

Past recipients of this honour have been Terry Winograd (1971), Patrick Winston (1973), Chuck Rieger (1975), Douglas Lenat (1977), David Marr (1979), Gerald Sussman (1981), Tom Mitchell (1983) and Hector Levesque (1985).

Nominations are invited for The Computers and Thought Award to be made at IJCAI-87 in Milan. The section below covers the nomination procedures to be followed.

Selection Procedures for IJCAI Awards

Nominations for The Computers and Thought Award and The IJCAI Award for Research Excellence are invited from all in the AI international community. The procedures are the same for both awards.

There should be a nominator and a seconder, at least one of whom should not have been in the same institution as the nominee. The nominee must agree to be nominated. There are no other restrictions on nominees, nominators or seconders. The nominators should prepare a short submission less than 2,000 words for the voters, outlining the nominee's qualifications with respect to the criteria for the particular award.

The award selection committee is the union of the Programme, Conference, and Advisory Committees of the upcoming IJCAI and the Board of Trustees of IJCAII, with nominees excluded. Nominations should be submitted before December 1st, 1986 to the Conference Chair for IJCAI-87:

Dr Alan Bundy, IJCAI-87 Conference Chair
Department of Artificial Intelligence
University of Edinburgh
80 South Bridge
Edinburgh EH1 1HN, SCOTLAND
Phone: +44-31-225-7774 ext 242
ARPANET: bundy@rutgers.arpa
JANET: bundy@uk.ac.edinburgh

Is the Japanese Fifth Generation Project Faltering?

The following articles give two opposing perspectives on current Fifth Generation and AI research in Japan. In the first, Nick Cercone reports on his recent visit, and finds the project alive, well, and something that should be emulated in Canada. In the second, Paul Bassett is not so sure.

Japan Ploughs Ahead

Nick Cercone
Department of Computer Science
University of Victoria
Victoria, BC V8W 2Y2

In April 1986, Professor Eric Manning (University of Waterloo), Dr Dick Peacocke (Bell-Northern Research, and President of CSCSI/SCEIO), five associates of the Canadian Society for Fifth Generation Research, and I visited the Institute for New Generation Computer Technology (ICOT), two universities and five of Japan's foremost information technology companies in Tokyo.

Although the popular press has emphasized ICOT as a unique project, it is actually only one of 11 projects sponsored by Japan's Ministry of International Trade and Industry (MITI) designed to secure Japanese pre-eminence in information technology. The budgets are startling: from 1966 to 1986, MITI spent 102 billion yen* on 5 projects. From 1982 to 1991, 6 new projects (including the Fifth Generation Computer (FGC) research at ICOT), were started with a total budget of 288 billion yen.

Though the technological innovations we observed were largely based on standard techniques of computing taught in North American universities, ICOT and its collaborating companies have used their opportunity of manpower and investment effectively to exploit these technologies. Technology development and technology transfer are occurring because Japanese companies have made very large commitments to FGC. We visited NEC, Hitachi, Fujitsu, Mitsubishi, and Oki and learned that each employ more than 100 FGC researchers. ICOT and its collaborating companies have achieved an organization to effectively

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*At current rates, a billion yen is worth about $CDN111 million.

bring to bear the expertise of a very large number of very highly trained researchers.

Initial skepticism regarding the Fifth Generation project has proven unfounded, though ICOT reports that their intention to stress a number of applications areas has been reduced to stressing natural language understanding, several expert systems, and machine architectures. The FGC project has already fully met the goals of its initial three-year phase. In terms of new products, Mitsubishi is delivering 60 copies of their PSI machine — a computer-automated reasoning system necessary for development of expert systems and factory automation — to ICOT and industry and is preparing it for public sale. Also, we saw prototypes of more than a dozen artificial intelligence products for such varied applications as guidance of fishing fleets, control of trains, design of micro chips, and natural language translation.

In short, the Japanese are making major advances in the application of Fifth Generation computing systems in almost every area of economic interest to Canada. (Canadian expertise is entirely competent to undertake the work, but much more investment and manpower is necessary to build these complex systems in Canada.)

Assessment of Organization

Organizational features which we observed were the following:

Each of the five foremost Japanese computer manufacturers contributed eight researchers to ICOT; each of Hitachi, Fujitsu, NEC, Oki, and Mitsubishi has one hundred or more researchers working in-house on Fifth Generation computing; and each of the five manufacturers is developing hardware products, expert systems, and an automated Japanese-English translation package.

We estimated that about 600 researchers were working on Fifth Generation projects at ICOT and the big five corporations. Our guide, Mark Turchan, of the Tokyo University Robotics Lab, estimates that about 600 researchers are working on state-of-the-art research projects in robotics. This brings to at least 1,200 the number of highly trained researchers addressing the problems of Fifth Generation computing in Japan.

The total Japanese government funding for information systems projects was 102 billion yen in the period 1966—86; funding for the period 1982—91 will

be 288 billion yen, about triple the earlier figure. The Japanese government annual investment, although already very substantial, has been multiplied sixfold (from approximately 5.1 billion yen per year to approximately 29 billion yen per year).

Assessment of Research Progress

We now turn to the assessments of the projects.

The English-to-Japanese automated translation systems all directly applied the techniques formulated in standard North American University textbooks. Some of these techniques were pioneered by the Canadian TAUM Project, as early as 1971. Progress will be made in the Japanese Laboratories because their manpower is sufficient to build the many parts of complex systems. The output of the machine translation systems will require post-editing, but will doubtless be of substantial economic value to the companies.

In the area of expert systems, we saw a total of twelve, most of which we judge could be substantial money-earners, both applied for greater efficiency within the Corporations and as products for sale. Again progress could be due to a task force sufficiently large to realistically undertake the tremendous volume of work necessary to implement the techniques which have already been formulated.

We also identified at least three hardware products, alternative architectures PSI machine, PIM, and PIE, which will substantially increase the available logical inferences per second, and which will be ready for the marketplace next year. ICOT is considering also working with other nations. (Canada's alternative architecture research is comparatively underfunded and understaffed, but our hardware designs are no less likely to succeed, and succeed soon.)

We were stuck by the close similarities among the tactics followed by the companies we visited. The reason for this, we believe, is that it appears that ICOT provides intellectual leadership. ICOT makes a rather narrow selection of research topics which it investigates; a manufacturer is commissioned to build a prototype of each project. Generally, however, most of the companies choose to build prototypes for most of the products — at their own expense. Thus the whole strategy is ICOT-driven. This means, first, that ICOT is under powerful pressure to produce short term, tangible, exploitable results. Progress on basic research may occur when hardware and software techniques already taught at North American Universities are applied in a sufficiently broad context, in sufficiently large applications to reveal inherent limitations. Sufficiently many highly trained researchers are already available to ICOT to solve these problems as they arise. Only well-informed understanding of the fundamental nature of the problems will ensure that the best solutions are used. The entire Japanese national effort appears to be extremely vulnerable to decisions made by ICOT. In contrast, external consultation, as practised in North America, offers a reservoir of advice on how well the implementations appear to be progressing.

Comments on Japanese Fifth Generation Efforts

We focus our comments around several questions which occurred to many of us during this trip:

- What are the differences between the Fifth Generation research efforts in Japan and those in the West (primarily North America)?
- What are the Japanese motivations for the current state of affairs in their Fifth Generation efforts?
- What happens after ICOT (in 1992)?

We consider several differences between the Japanese and Western approaches to Fifth Generation research:

Duration: Western approaches, especially in AI, have had a long history and what appears to be a rosy future for achievement. In contrast, the Japanese effort has virtually no past and an indefinite future after ICOT is terminated in 1992.

Number of researchers: Throughout the universities and state-of-the-art corporate R&D laboratories, North America leads the way in sheer numbers of research workers. The Japanese effort is focused, primarily through government sponsored megaprojects, corporate collaboration and some university involvement.

Sources of funds: Western funding is broadly based through government agencies (for example, NSF, NSERC, NRC, ONR, DoD, etc.), private funds (CSLI, CIAR, etc.), and corporations. Most Japanese

Senior ICOT officials with Professors Cercone and Manning

funding efforts are MITI-sponsored initially, and later transferred to corporations.

Research community: Western approaches are multi-faceted, broadly based, multiple schools of thought and robust. The Japanese effort is highly focused and directed through ICOT and member companies.

Researcher/industry interaction: The North American model is the entrepreneurial model. Expertise is provided through consulting, research contracts, and private high-technology startups. Japanese interactions are more intimate since all researchers loyalities are to the company employing them.

The ICOT Fifth Generation effort is now apparently concerned with short- to intermediate-term goals. Due to the corporate affiliate's desire to market the initial discoveries, much of the basic research effort has given way to narrowly focused applied research and development efforts. ICOT's First laboratory is a world-class research organization headed by Dr. Koichi Furukawa. Concurrent Prologs, like guarded Horn clauses, are a speciality of his group. The remaining four labs of ICOT and the seconded researchers are now consumed with developing applications with a short-term payoff. The range of applications activities pursued by ICOT and the associated companies is initially for internal consumption. These include the translation projects, intended for the Japanese financial institutions, the controllers for ship loading and train scheduling (robotics software), the sequential inference machines, design automation tools (VLSI CAD and computer room layout expert systems), and office automation for the Japanese offices. These efforts are especially beneficial to vertically integrated businesses, reducing the cost of designing and manufacturing products and other costs associated with doing business.

The ICOT Fifth Generation effort is neither the first nor last megaproject the Japanese are pursuing in Future Information Technology. Although we cannot predict the direction MITI will take in the future, its history suggests there will be additional targeted areas of computing technology development. The more ICOT "succeeds", the more likely continued funding for ICOT-like activities will be provided.

Acknowledgements

Nick Cercone, previously Chairman of the Department of Computer Science, Simon Fraser University, is the President of the Canadian Society for Fifth Generation Research and a Past President of CSCSI/SCEIO. An extended version of this article, detailing each site visited, is available on request from Dr Cercone.

Japan Finds Itself on the Wrong Path

Paul Bassett
Netron Inc
99 St Regis Crescent North
Downsview, Ont M3J 1Y9

A hot AI topic currently is logic and theorem proving. Formal logic systems are based on first-order predicate calculus, which is 'universal' notation for representing knowledge unambiguously. Algorithms have been developed which permit system to derive new facts from old, based on proving theorems. The language Prolog is actually a general purpose problem description language which solves problems by proving corresponding theorems.

In Japan, a bold initiative has been seized, to the astonishment of the rest of the world. Given the advent of cheap VLSI hardware technology, and the expectation that Prolog-like systems can handle 'knowledge reasoning' (as opposed to mere information or data processing), Japan has formulated its so-called Fifth Generation computer project. This means trying to build computers whose processing elements can carry out logical inferences directly. Since all theorem-proving algorithms must search through a combinatorial explosion of possibilities, otherwise impractical problems might become feasible by the use of such hardware. The performance of such machines will be measured in million logical inferences per second (mega-lips).

Reportedly, the Japanese have suffered a major setback with the abandonment of 'Delta', their parallel inference engine. It apparently has been gathering dust since last September. This news comes from Dr Derek Paddon, a senior lecturer at Bristol University, who recently returned from a year's sabbatical in Japan in the architecture department of Keio University's electrical engineering department. The head of this lab is Professor Aiso, one of the key figures in the management of ICOT, the Institute for New Generation Computer Technology.

According to Dr Paddon, the Japanese are trying to approach fundamental research as if it were development — and he doesn't think it's going to work.

Dr Paddon has been quoted as saying that because most of the ICOT research team is hardware-oriented, throwing hardware engineers into a Prolog environment for which they have had no background or interest had led to predictable results.

Japan's Fifth Generation project is faltering because its researchers have missed the basic point of AI research. They are hung up on formal logic and fail to see that AI is all about ambiguity and inconsistency: the bread and butter of natural intelligence. As a result, the Japanese are trying to surmount mathematical obstacles that are irrelevant to the goals they should be trying to achieve.

Indeed, many AI researchers have inherited their

apparent distate for inconsistency from mathematicians.

The concept of infinity suffered the same way until Georg Cantor revolutionized the entire world of mathematics by putting infinity on a sound theoretical footing. Likewise, the entire world of AI will be revolutionized when 'piecewise consistent systems' can be reconciled with that paragon of deterministic, consistent behavior — the computer.

The Japanese aren't the only guilty parties, they just have the highest profile. While more and more players try to climb onto the AI bandwagon, there is no music, just noise. Everyone is running around saying AI is the 'next big thing' while some of the basic questions just aren't being addressed.

This brings me to the heart of the dilemma. Is it possible to define what AI is really all about? Ambiguity seems to be a common issue in all the sub-fields of AI. Intelligence can be thought of as an ability to solve problems in spite of ambiguity. But what is ambiguity? Unfortunately the very notion is ambiguous, so how can one ever clear away all this fundamental fog?

Well, I propose clearing it this way. Define a Partial Information Domain (PID) to be one in which the data and/or algorithms necessary to solve problems in the domain are either incomplete, inconsistent, or both. Artificial Intelligence means designing PID problem solvers. To head off an obvious nit one could pick, games like checkers and chess are games of perfect information only in principle, not in practice. Since many universe-lifetimes are required to examine all the data (by even the most conceivably fast machines), non-trivial games are PIDs almost by definition. Similarly, practical theorem proving is really a PID problem because of its combinatorially explosive nature.

On the other hand, a payroll system is obviously a Complete Information Domain (CID). An erroneous paycheque means that there is a fault in the design of the system, not that the system made an error in judgement. Virtually all the computing done today involves CIDs. As AI matures, however, more and more of the manual programming for CIDs will be done by the machines themselves.

Until sufficient models for inconsistency are used, inferencing machines such as those under development by the Japanese will be limited to Complete Information Domain (CID) situations. The difficulty is that most real-world problems are Partial Information Domain (PID) situations.

Until they adopt this perspective, the Fifth Generation project may be best remembered for hardware architecture spin-offs rather than the dramatic advances in AI that have been predicted. □

Paul Bassett is Vice-President of Research at Netron Inc, which develops and markets automated software engineering systems based on Bassett Frame Technology, an automated process for designing, manufacturing, and maintaining software. This is the first of two articles based on Mr Bassett's address to the DECUS U.S. Symposium earlier this year.

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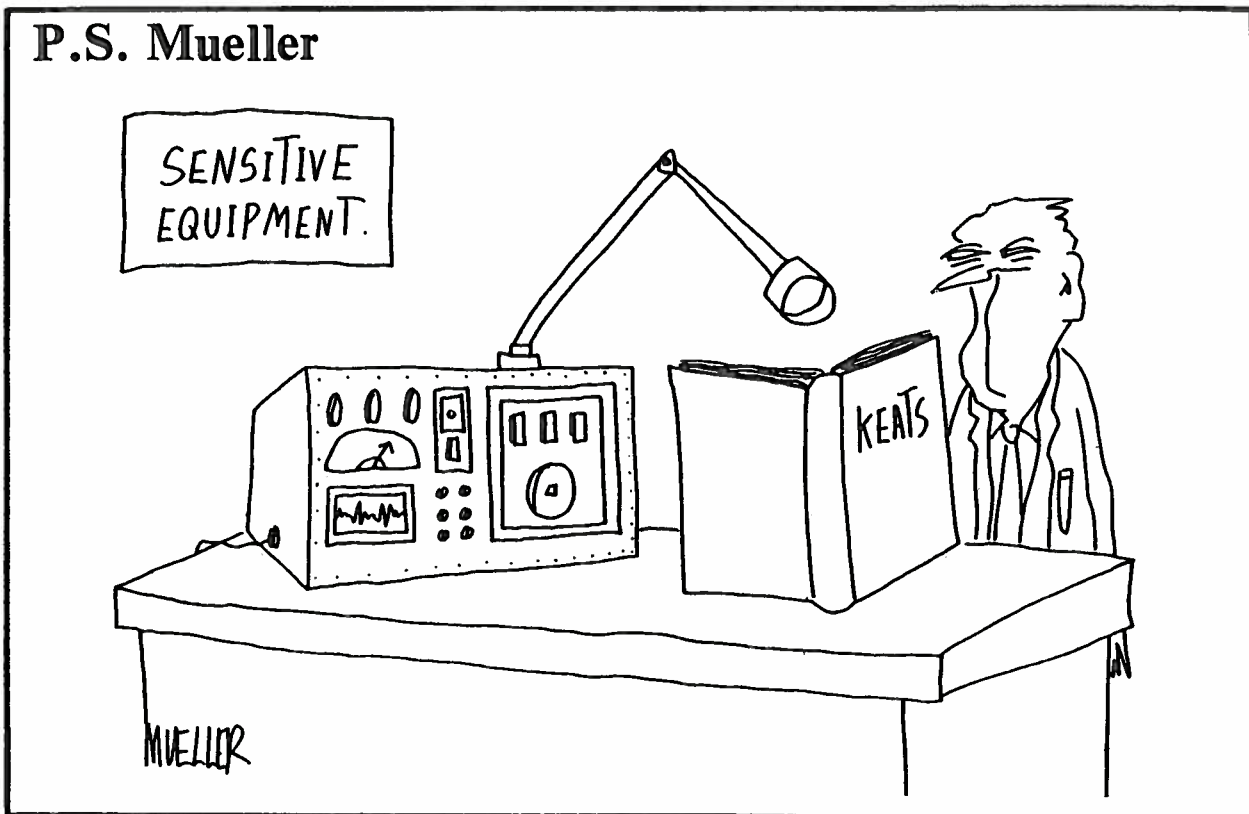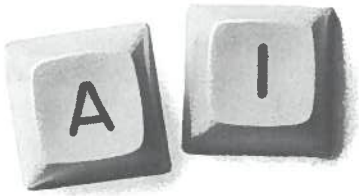
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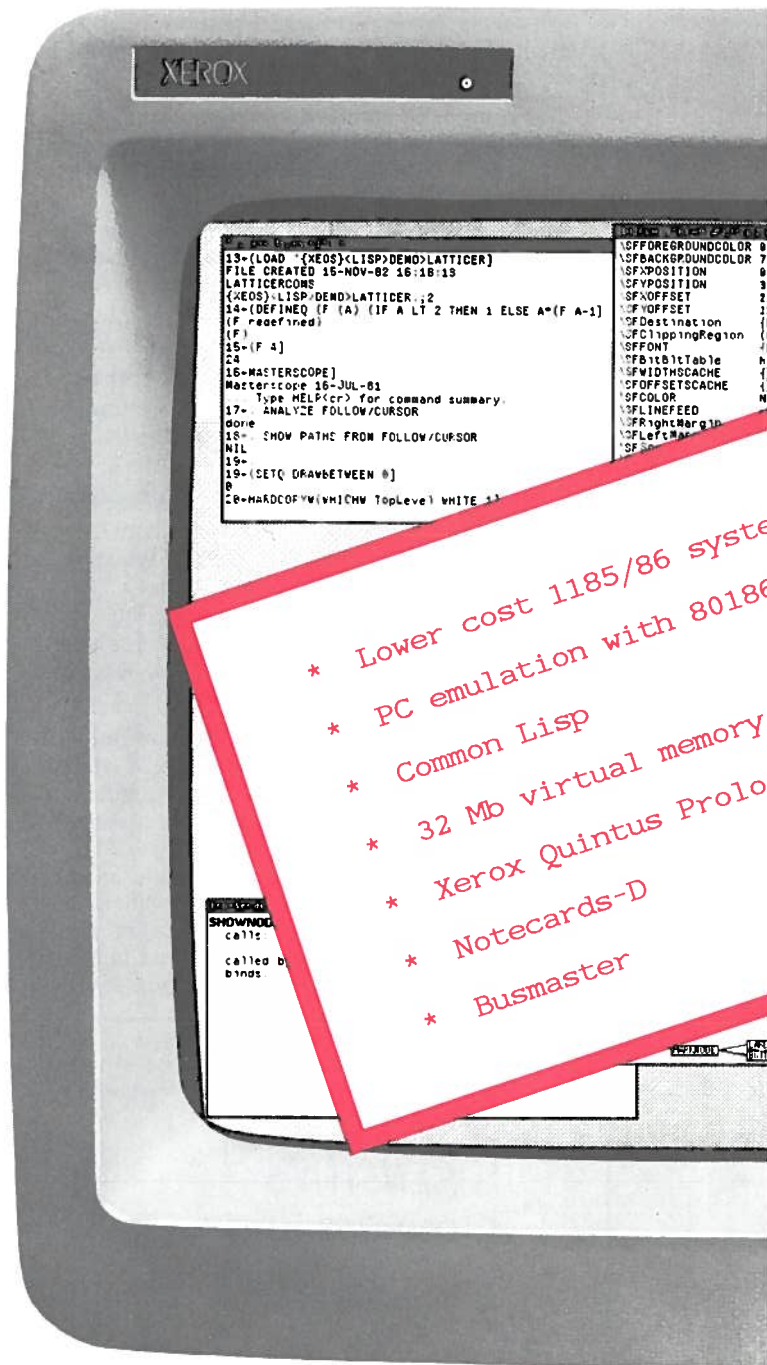
provided is a spelling corrector that automatically corrects spelling mistakes using information from the local context. To simplify file management for the programmer, Interlisp-D automatically keeps track of where in the file system each object is stored and which ones have been modified. In response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

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.

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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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Research in Natural Language Understanding at the University of Toronto

Graeme Hirst
Department of Computer Science
University of Toronto
Toronto, Ont M5S 1A4

Faculty
Graeme Hirst

Graduate students
Barbara Brunson*
Jean-Pierre Corriveau
Judy Dick‡
Chrysanne DiMarco
Diane Horton
Yves Lespérance
Susan McRoy
Charles Pilkington
Ed Plantinga

Associates
Stephen Regoczei, Trent University

Introduction

Natural language understanding is one of the research areas of the Department's artificial intelligence group. NLU research began at Toronto in the 1970s under the direction of John Mylopoulos and Ray Perrault; since 1984, the director has been Graeme Hirst. Among the group's well-known alumni are Philip Cohen (PhD 1978, now of SRI International), James Allen (PhD 1979, now of the University of Rochester, and editor of *Computational Linguistics*), and Robin Cohen (PhD 1983, now of the University of Waterloo).

The group takes an interdisciplinary view of language, and draws on research in other areas of cognitive science, such as philosophy and psychology. There is regular contact with other people at U of T in linguistics, library and

* Departments of Linguistics and Anthropology.
‡ Faculty of Library and Information Science.

information science, and computing in the linguistic humanities.

The group has full access to the equipment of the Department's artificial intelligence laboratory. This includes eight Symbolics 3640 Lisp machines, a Vax 11/780, a network of Sun workstations, and an IBM PC-AT.

Two graduate-level courses are offered in NLU: an introduction to the field, and a reading-and-discussion seminar.

Current research

Listed below are the group's current projects. Common themes and concerns running through the various projects include the following:

- Different types of ambiguity and methods for their resolution.
- Knowledge representations and semantic formalisms for language understanding.
- Psychological reality both as a strategy for designing computer methods and as an end in itself.
- The complicating effects of the beliefs of agents in understanding utterances.

Thus the group is more concerned with the complete understanding of long unrestricted text rather than with user interfaces or other single-sentence systems. This orientation is particularly suited for research in machine translation, in processing long documents for conceptual retrieval, and in knowledge acquisition by reading.

The detection and representation of ambiguities of intension and description (Brenda Fawcett, Diane Horton). [This project is sponsored by IBM Canada Ltd.] Intensional contexts are those in which the speaker refers to an underlying concept rather than any particular entity; for example, *John is looking for a unicorn* need not refer to a particular unicorn, nor need unicorns even exist for the sentence to be true. A further complication is that in certain contexts it may be ambiguous as to whether a description is to be considered that of the speaker or that of someone

else mentioned in the discourse.

Standard modal logic cannot represent some of the readings of these sentences. We have developed a formalism in which they can be represented, and plan to look at methods for selecting the intended reading.

A related problem of intensional contexts is that many standard inferences are invalid. We have used our formalism to develop rules for when substitution of equals is and is not valid.

Beliefs and presuppositions (Diane Horton). Any natural language system which is intended to understand the full meaning of an utterance must be able to handle not only the information it conveys directly, but also the indirect information such as presuppositions. Many theories have been postulated in an attempt to characterize presupposition. Most take presuppositions to be facts, without consideration of who it is that holds them to be true. We argue that such approaches make unrealistic assumptions, and propose a new view which attempts to provide a more realistic and robust account. We have developed a new definition of presupposition that takes into account the beliefs of the agents involved in a discourse, and show how it can be applied in an NLU program.

Semantic interpretation and the resolution of ambiguity (Graeme Hirst). A central problem in natural language understanding is deriving and representing the meaning of an utterance, and resolving any ambiguities in it to find the one intended.

We have developed a system that works in tandem with a conventional parser to build a representation of a sentence in a standard frame-based knowledge representation language. Unlike previous systems, partial results are always well-formed, so that separate modules for lexical, case, and structural disambiguation are able to use both the partial results and the full power of the frame system to perform their task. Much of the system is motivated by results in psycholinguistics on human language understanding.

We are continuing to look at ambiguity resolution, with our next emphasis being on situations in which syntax overrides semantic well-formedness; such situations should yield clues to the nature of the complex interaction between syntactic and semantic processes.

Two-stage models of parsing (Susan McRoy). Two-stage models of parsing, which were claimed by some to closely model the human parser, were

developed in the late 1970s and then abandoned as a result of criticism. However, much of the criticism seems to have been directed at specific details of the theory rather than the basic concept. We are looking at two-stage models in the light of the extensive research on parsing that has occurred in the last few years in the hope of making them useful in a computational system.

A computational interpretation of situation semantics (Yves Lespérance). Situation semantics is a recently developed non−truth-conditional theory of meaning that attempts to overcome the problems of traditional approaches. We are studying how it could be adapted for use in a computational system. As a first step, we are designing a logic which captures the properties of belief identified by the theory and which allows the interpretations of an interesting set of natural language utterances to be represented. This logic can then be used in the design of a procedure to support the system's reasoning over the information acquired from the input utterances and other beliefs it may have. A procedure to obtain the interpretation of an utterance on the basis of the sentence used and the system's knowledge of linguistic constraints and utterance context will also be developed. The logic will also be used to study the properties of an agent working according to the principles it formalizes.

Understanding metaphor (Ed Plantinga). Metaphor pervades language, but present-day NLU systems are almost uniformly restricted to literal language. We are considering metaphor as a problem of ambiguity, and studying methods for understanding metaphor that (as with human understanding) are part of the central language mechanism and not a black box tacked on the end.

Deterministic parsing of non-configurational languages (Barbara Brunson). Non-configurational languages include some that allow both free word order and discontinuous constituents. These pose significant problems for current theories of syntax and parsing, which have been developed with reference only to European languages (generally only English). We have developed a deterministic processing model of Warlpiri syntax that treats discontinuities through semantic association. In the course of so doing, we have parameterized and generalized many principles of Chomsky's government and binding theory of language (which could not previously account for these languages), creating a typology of languages ranging from highly

configurational to completely non-configurational. These results have significance in linguistic theory as well as computational linguistics.

A model of memory processes for text understanding (Jean-Pierre Corriveau). We are developing a reader-based framework for text understanding — that is, a schema-based model of the retrieval processes involved in the comprehension of written text. To this end, we are studying the use of headed records as a structure upon which these activation processes can operate.

Conceptual retrieval of legal information (Judy Dick). An inherent limitation of present systems for information retrieval is that the search must be based on key words rather than actual content. This limitation is especially problematic with legal information, where one often seeks a precedent by structure and form of argument rather than the domain of the facts of the case. We are developing a vocabulary and representation formalism for case reports that will permit such conceptual searches.

Individual mental models and language understanding (Stephen Regoczei). We are looking at the architecture of language processors (both people and machines) and the structure of language, especially as a knowledge-based process that depends on the mental models of the language processor as well as on the idiosyncratic and idiolectic use of language, both in generation and in understanding. We are particularly interested in understanding ill-formed input.

Recent Publications

Theses

Brunson, Barbara. *A processing model of Warlpiri syntax and implications for linguistic theory*, MSc, August 1986.

Horton, Diane. *Presupposition and agents' descriptions*, MSc, October 1986 [to appear].

Fawcett, Brenda. *The representation of ambiguity in opaque contexts*, MSc, October 1985. [Published as technical report CSRI-178]

Selman, Bart. *Rule-based processing in a connectionist system for natural language understanding*, MSc, January 1985. [Published as technical report CSRI-168]

Ali, Yawar. *Understanding adjectives*, MSc, January 1985. [Published as technical report CSRI-167]

Snarr, Vicky. *Theory and parsing of the coordinate conjunction "and"*, MSc, August 1984. [Published as technical report CSRI-171]

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Hirst, Graeme. "Why dictionaries should list case structures." Conference on Lexicology, University of

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Hirst, Graeme. "A semantic process for syntactic disambiguation." *Proceedings, Fourth National Conference on Artificial Intelligence (AAAI-84)*, Austin, August 1984, 148—152.

Hirst, Graeme. "Jumping to conclusions: Psychological reality and unreality in a word disambiguation program." *Proceedings, Sixth meeting of the Cognitive Science Society*, Boulder, June 1984, 179—182.

Books

Hirst, Graeme. *Semantic Interpretation and the Resolution of Ambiguity*. Studies in Natural Language Processing, Cambridge University Press, 1986 [to appear].

New Bindings

Nick Cercone from Simon Fraser University to University of Victoria.

Bryan Kramer from University of Toronto to Xerox Canada.

Eric Manning from University of Waterloo to University of Victoria.

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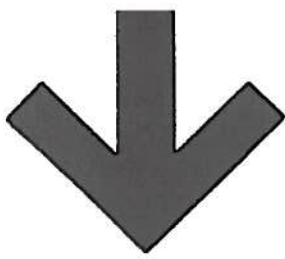
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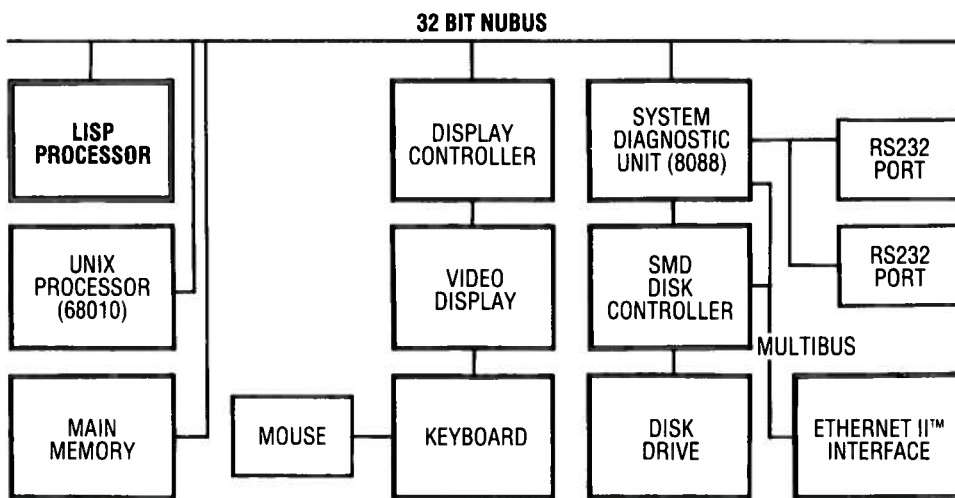
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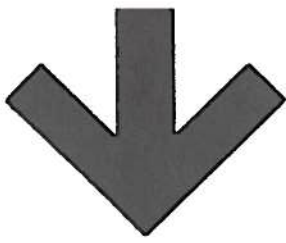
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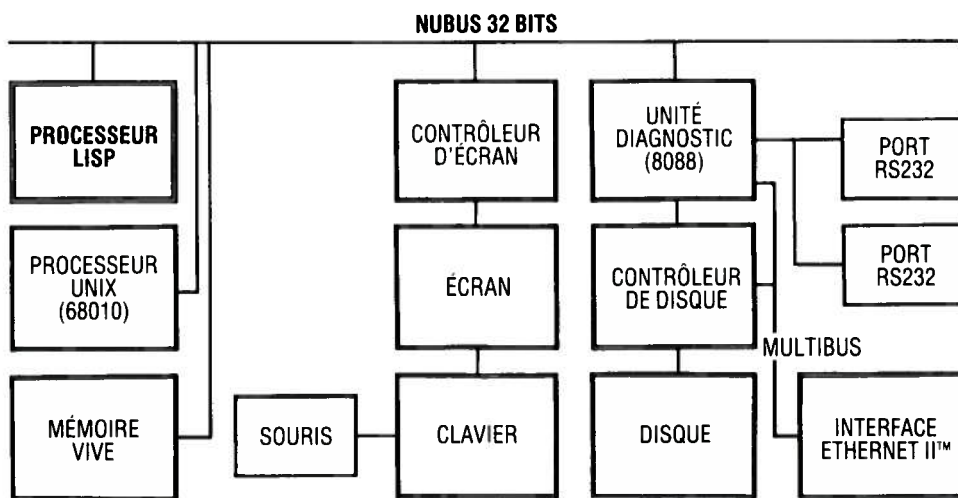
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Recent AI Technical Reports

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.

□ □ □ □ □

University of Toronto

The following reports may be obtained by writing to:

The AI group secretary
Department of Computer Science
University of Toronto
Toronto, Ont CANADA M5S 1A4.

On using causal knowledge to recognize vital signals: A study of knowledge-based interpretation of arrhythmias

Tetsutaro Shibahara

PhD Thesis, June 1986
LCM-TR86-1

A technology of knowledge-based systems has been pursued to establish a framework for the recognition of time-varying signals of a complex repetitive nature, such as electrocardiograms (ECGs).

Using a stratified knowledge base, the proposed recognition system discerns several perspectives to the phenomena of underlying entities, such as the knowledge of a causal model of the physiological mechanism and the observational knowledge of the temporality and morphology of signals emitted from physiological events, where such events are projected into the observable waveform domain. The system "reasons" observational abnormalities in the signal, by referring to the corresponding abnormalities of causal connections and events in the entity model. Projection links have been defined to represent projection in our frame-type formalism, and are used to raise hypotheses across various component KBs.
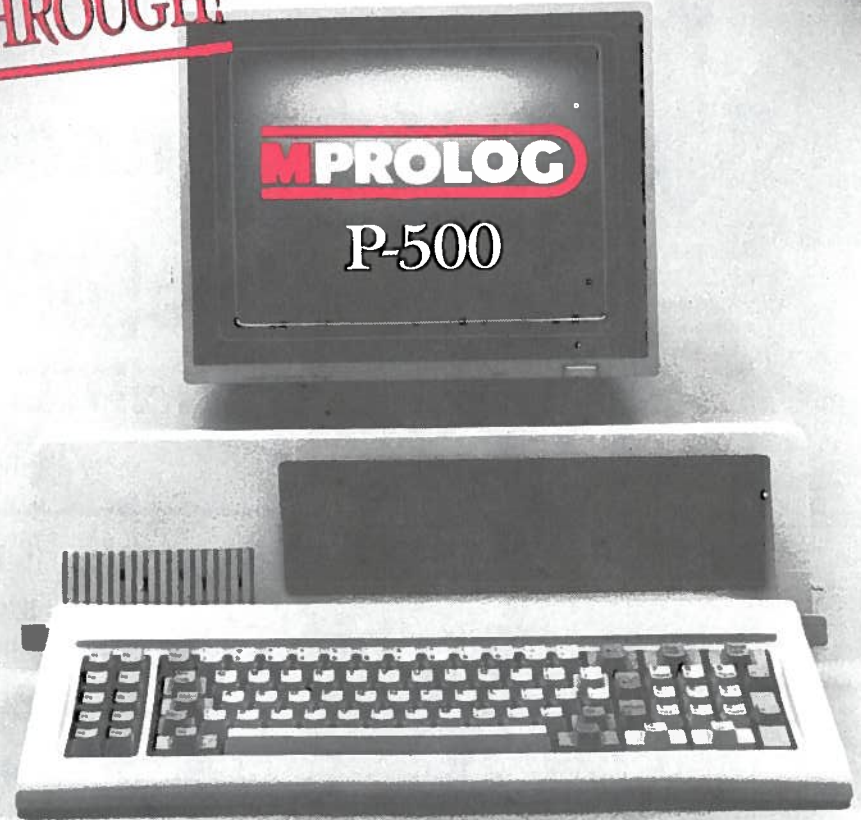
Our system also introduces causal links, and uses them extensively to represent various causal and temporal relations between concepts in the physiological event domain. The control structure uses causal links to expect unseen events from recognized events, to search for the corresponding waves in input data, and to match and calculate the degree of integrity among causally related events. The meta-knowledge representation of statistical information about events facilitates a default-reasoning mechanism and supports this expectation process, providing context-sensitive statistical information.

Our design technology has been applied to the unsolved arrhythmia problem in the ECG domain, and this prototype is called the CAA (Causal Arrhythmia Analysis) system. Our system inherits its basic control mechanisms, such as the change/focus attention mechanism with similarity links, from the ALVEN (A Left VENtricular Wall Motion Analysis) system. The CAA system, with a limited number of abnormalities, has been implemented by using the PSN (Procedural Semantic Network) knowledge-representation system. The prototype has so far demonstrated promising results, using independently sampled ECG data.

An overview of knowledge acquisition methods for expert systems

Sue Becker and Bart Selman

CSRI Technical Report CSRI-184
June 1986

In building an expert system, one of the most time-consuming tasks is knowledge acquisition. We present an overview of many of the techniques, tools and methodologies which have been developed to facilitate this process. Structured human interviewing techniques and automatic interviewing programs can be used in the early stages of expert system development, when the relevant knowledge must be extracted from domain experts. A variety of other types of tools, such as intelligent editors and graphical displays, can be employed later in the development process, when the expert knowledge must be translated into a formal knowledge representation language. We describe, in some depth, a representative sample of these knowledge acquisition systems and tools, to give the reader a good overview of the field. The best features of these systems are discussed, with the goal of determining the desirable functions of a complete knowledge-based system building tool. Finally, we discuss our current research in the area of knowledge acquisition for knowledge-based systems.

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University of Waterloo

The following reports may be obtained by writing to:

Pat Bennett
Department of Computer Science
University of Waterloo
Waterloo, Ont CANADA N2L 3G1.

Incorporating user models into expert systems for educational diagnosis

Robin Cohen and Marlene Jones

[submitted for publication]

In this paper we study a particular real-world domain, that of educational diagnosis. We argue that expert

systems for educational diagnosis require user models, and that these user models should include several components, including the user's background knowledge of both the student and the domain as well as the user's goals. We propose possible representation schemes for the user model; in particular, we focus on two schemes which have been advanced for representing student models. Finally, we discuss how the acquisition and updating of the user model can be handled, and how the user model can be employed to produce quality explanations.

The CGD project: An educational diagnostic system based on Theorist

Marlene Jones, J. McLeod, G. Robertson, J. Tubman, and B. Wasson

[submitted for publication]

The intent of the Computer-Guided Diagnosis (CGD) project is the development of an expert system to assist the user in diagnosing learning disabilities. We discuss herein the motivation for the project, the application domain including a model of educational diagnosis, as well as previous research and development regarding expert systems within this application domain. We then present specifics regarding the CGD project including the underlying educational and computational philosophies. In particular, we present the details of the implementation of the expert system in Theorist, a logic programming deduction system developed at the University of Waterloo. We argue that a Theorist-based expert system for educational diagnosis is particularly appealing because it captures the essence of what expert diagnosticians do, *i.e.*, theory formation. Combining Theorist with our philosophy of employing expertise based on clinical, rather than actuarial experience, promises to produce a system that closely resembles the ideal behaviour of an expert in the performance of an educational diagnosis. In addition to reporting on our initial experimentation with Theorist, which involved the development of an expert system for diagnosing arithmetic difficulties, we briefly discuss future research and development, as well as current related research projects.

Computational analogy

K. Wellsch and Marlene Jones

[submitted for publication]

Evidence suggests that analogy is a key component in human reasoning and learning situations. Exploiting past experience through analogies is an important aspect of "intelligent behaviour." We briefly review the research of Burstein, Gentner and Winston, and then present a particularly simple (polynomial complexity) but powerful algorithm for detecting and applying analogies. The algorithm, which is based on subtree matching, employs a hierarchical representation; we investigate the power of such a representation. The effectiveness of the algorithm is examined using two-dimensional scenes as the major test domain. The results are discussed herein along with suggestions for future research.

Expert systems for educational diagnosis: An experiment with Theorist

Marlene Jones and J. Tubman

[to appear in the *Proceedings of the 6th International Conference on Expert Systems and Their Applications*, 1986]

During the past decade many diagnostic expert systems have been developed; the majority of these are rule-based production systems. In this paper, we explore an alternative approach. First we briefly present the fundamentals of Theorist, a logic programming system that uses a uniform deductive reasoning mechanism to construct explanations of observations in terms of facts (or rules) and hypotheses (which are defaults). Secondly, we describe here a small expert system within the domain of educational diagnosis which has been implemented with Theorist. Future research plans are discussed in light of the results of this initial experimentation with Theorist.

Book Reviews
and Publishing News

Robot Vision

Bertholt Klaus Paul Horn
[MIT AI Lab]

Cambridge, MA: The MIT Press, 1986, 509 pp.
$US39.50 (cloth)

Reviewed by
Colin Archibald

"The Mathematics of Image Formation and Interpretation". This would be a more suitable title for this text book, aimed at students in their junior year up to graduate level. Although I have several criticisms, the essence of this review is favourable. In fact this book is certain to become a classic in the image-processing world. The amount of information packed into these 509 pages represents man-centuries of research in machine vision. All of your favorite topics are here, including image formation, binary images (and what to do with them), segmentation, edge detection, DFT, photometric stereo, extended Gaussian images, colour, motion, and others. The text is highly mathematical and precise. It will be very useful as a reference, especially since each chapter includes a section giving a few details of key publications on the current topic. This is infinitely more useful than a list of titles and authors.

The theme of the book is that "machine vision should be based on a thorough understanding of image formation" (p. 12). It is obviously true that to interpret a matrix of pixels, one must know the significance (possibly significances) of a pixel value. For example, a bright area in an image may represent a highly reflective surface in an image formed using visible light, but it would represent a non-dense object in an x-ray image. *Robot Vision* is predominantly dealing with mathematical models to describe image formation and interpretation using the most difficult type of image, *i.e.,* images formed using visible light in unconstrained environments. It is pointed out that the research in this area is strongly related to the work done in biological vision. Progress in this area, however, is not necessarily progress in robot vision systems. In this regard, one may be

disappointed that *Robot Vision* does nothing to bridge the widening gap between academic and industrial machine vision research.

In discussing domain representation methods, Horn points out that one must "consider the task for which the description is intended". Due consideration to the task should also be paid when designing the lighting and sensors for a robot vision system. Visible light is only useful in a very highly constrained environment where decisions based on the images are very simple. Considering any interesting task for a robot vision system will probably lead the investigator to a more constrained environment or sensor, bypassing most of the methods presented in this book for solving problems with mathematical models.

Horn does point out that this book reflects his personal preferences on what aspects of machine vision are significant and theoretically sound. This, in itself, when coming from such a successful scientist, makes this book an important contribution to the field of machine vision. □

Theoretical Aspects of
Reasoning About Knowledge:
Proceedings of the 1986 conference

Joseph Y. Halpern (editor)
[IBM Almaden Research Center, San Jose]

Los Altos, CA: Morgan Kaufmann Publishers 1986, vii+407 pp.
ISBN 0-934613-04-4 (pbk); $US18.95

Reviewed by
Patrick Saint-Dizier
Simon Fraser University
and Université de Rennes 1

Knowledge representation and reasoning about knowledge is an area of intense research ranging over different fields: AI, linguistics, philosophy, logic, and theoretical computer science. The proceedings of the First Conference on Theoretical Aspects of Reasoning About Knowledge reflect this multidisciplinary approach. Most of the papers are really very interesting, up-to-date, well-written, and provide a detailed bibliography.

In this short review, it is not possible to talk about each paper; in any case the absence of comments about a paper is an implicit judgement about its value.

Session 1 opens with an insightful overview by Halpern of reasoning about knowledge. Some threads that tie together works in diverse fields are described. Emphasis is placed on distributed systems, problems of logical omniscience, and mutual belief. This paper ends with a short list of areas for further research. The next paper (Brian Smith) focuses on varieties of self-reference, ranging from implicit relations to larger statements or circumstances in the world in which the system is embedded. The third paper (Fred Landman) raises the problem of what is the status of the objects that users talk about when they exchange information. At an intermediate level of information, partial descriptions of objects are used.

Session 2 introduces reasoning about knowledge in philosophy. In particular, several more or less advanced theories are presented (by Jaakko Hintikka) and discussed as developments of epistemic logic. Next, session 3 is devoted to reasoning in AI. The first paper (Rosenschein and Kaelbling) discusses epistemic properties of machines, whereas the two next papers deal with syntax and the treatment of knowledge. The first of these (Morgenstern) is dedicated to planning and action without complete knowledge. The strategy is to have a rough way of reasoning and to fill in details later. The other (des Rivières and Levesque) shows that any intensional operator governed by a "reasonable" modal theory can be treated syntactically in a simple and intuitive way. Both papers deal with rather complex but realistic problems.

Session 4 deals with knowledge in distributed environments. In addition, some features and properties about the logic of distributed protocols are given. In session 5, several problems are pointed out about knowledge and belief. First, some strategies are given (by Thomason) to deal with paradoxes in semantic representations. Then, a short critique (by Konolige) about superimposing some elements of the sentential approach in a possible-world framework is presented. Other papers, in session 7, propose resolution methods for specific points about knowledge and beliefs. The first paper (Geissler and Konolige) is rather intuitive, with few comparisons with related works whereas the second (Lakemeyer) is very much developed, focusing on the problem of quantifying in as it relates to logics of explicit and implicit belief. It also opens the door to many further investigations.

In the next session, some ideas about logicians that reason about themselves are presented and criticized, and, to some extent, with a real sense of humour, by Smullyan. Session 9 begins with a quite informal paper (Micali) about knowledge complexity and focuses on a very crucial point: how to extract a sufficient amount of knowledge for proving a theorem. The next paper (Mitchell and O'Donnell) proposes an alternative to Kripke models involving possible worlds, which consists of models comprising sets of "evidence" for each proposition. Evidence models vary according to classes of functions included in the models and classes of beliefs used in the definition of validity. This section ends with two prospective papers (Martins and Shapiro, and Plotkin and Stirling) about theoretical foundations for belief revision and a framework for intuitionistic modal logic. □

New AI Abstracts Journal

Abstracts in Artificial Intelligence is a new monthly current-awareness journal for AI; the first issue appeared in July. The journal covers AI publications in journals, books, and conference proceedings, and selected technical reports. For each item included, an abstract and full bibliographic information are provided. The journal is published by the Turing Institute and edited by Julia Wilkinson. Subscriptions are £200 per volume. For more information write to:

Subscriptions
The Turing Institute, Abstracts in AI
George House
36 North Hanover Street
Glasgow, SCOTLAND G1 2AD

Abstracts of papers in *Computational Intelligence*, 2(3), August 1986

Using knowledge generated in heuristic search for non-chronological backtracking

Vasant Dhar
Department of Information Systems
New York University

Problem solvers that use heuristics to guide choices often run into untenable situations that can be characterized as over-constrained. When this happens, the problem must be able to identify the right culprit from

along its heuristic choices in order to avoid a potentially explosive search. In this paper, we present a solution to this for a certain class of problems where the justifications associated with choice points involve an explicit assessment of the pros and cons of choosing each alternative relative to its competitors. We have designed a problem solver that accumulates such knowledge about the pros and cons of alternative selections at choice points during heuristic search, which it updates in light of an evolving problem situation. Whenever untenable situations arise, this preserved knowledge is used in order to determine the most appropriate backtracking point. By endowing the backtracker with access to this domain-specific knowledge, a highly contextual approach to reasoning in backtracking situations can be achieved.

Recognition algorithms for the Connection Machine™

Anita M. Flynn and John G. Harris
Artificial Intelligence Laboratory
Massachusetts Institute of Technology

This paper describes an object recognition algorithm both on a sequential machine and on a SIMD parallel processor such as the MIT Connection Machine. The problem, in the way it is presently formulated on a sequential machine, is essentially a propagation of constraints through a tree of possibilities in an attempt to prune the tree to a small number of leaves. The tree can become excessively large, however, and so implementations on massively parallel machines are sought in order to speed up the problem. Two fast parallel algorithms are described here. A static algorithm reformulates the problem by assigning every leaf in the completely expanded unpruned tree to a separate processor in the Connection Machine. Then pruning is done in nearly constant time by broadcasting constraints to the entire SIMD array. This parallel version is shown to run three to four orders of magnitude faster than the sequential version. For large recognition problems which would exceed the capacity of the machine, a dynamic algorithm is described which performs a series of loading and pruning steps, dynamically allocating and deallocating processors through the use of the Connection Machine's global router communications mechanism.

Parsing with restricted quantification: An initial demonstration

Alan M. Frisch
Cognitive Studies Programme
University of Sussex
    and
Department of Computer Science
University of Illinois

The primary goal of this paper is to illustrate how smaller deductive search spaces can be obtained by extending a logical language with restricted quantification and tailoring an interface system to this extension. The illustration examines the search spaces for a bottom-up parse of a sentence with a series of four strongly equivalent grammars. The grammars are stated in logical languages of increasing expressiveness, each restatement resulting in a more concise grammar and a smaller search space.

A secondary goal is to point out an area where further research could yield results useful to the design of efficient parsers, particularly for grammatical formalisms that rely heavily on feature systems.

An explanation shell for expert systems

Leon Sterling and Marucha Lalee
Department of Computer Engineering and Science
    and
Center for Automation and Intelligent Systems Research
Case Western Reserve University

We describe a shell for expert systems written in Prolog. The shell provides a consultation environment and a range of explanation capabilities. The design of the shell is modular, making it very easy to extend the shell with extra features required by a particular expert system. The novelty of the shell is twofold. Firstly it has a uniform design consisting of an integrated collection of meta-interpreters. Secondly, there is a new approach for explaining 'why not', when a query to the system fails.

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 edited out again before typesetting. The best thing to send is plain typing or *troff* source (preferably with − *me* macros).

Deadline for the December issue is November 15

Forthcoming Conferences, and Calls for Papers

Canadian conferences

International Conference on Computer-Assisted Learning in Post-Secondary Education

5– 7 May 1987

University of Calgary
Calgary, Alberta

For more information, write to:
 Heidi Guenter, Conference Office
 Education Tower, Room 102
 University of Calgary
 Calgary, Alberta T2N 1N4
 Phone: 403-220-4987

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U. S. Conferences

Third International Conference on Artificial Intelligence and Education

8– 10 May 1987

University of Pittsburgh
Pittsburgh, Pennsylvania

For more information and a copy of the call for papers, write to:
 Joyce Holl, 3rd Int Conf on AI and Education
 LRDC Building
 University of Pittsburgh
 Pittsburgh, PA 15260, U.S.A.
 Phone: 412-624-4881 or -4829

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1986 Ohio University Interdisciplinary Conference On Inference

9– 11 October 1986

Ohio University
Athens, Ohio

An interdisciplinary conference featuring tutorials and research papers dealing with inference (modes, mechanisms, processes, paradigms, contexts, engines) as it impacts or involves research in computer science, linguistics, mathematics, philosophy, and psychology.

Papers on second-order reasoning are encouraged. The conference / tutorial fee is $30 and includes a volume of selected papers from the conference. For more information, write to:
 OUIC 86
 Department of Computer Science
 Ohio University
 Athens, OH 45701

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The Third IEEE Conference on Artificial Intelligence Applications

22– 28 February 1987

Orlando Hyatt Regency
Orlando, Florida

This conference, sponsored by the IEEE Computer Society, is devoted to the application of artificial intelligence techniques to real-world problems. For further information, contact:
 Jan Aikins, General Chair
 Aion Corporation
 101 University Avenue
 Palo Alto, CA 94301, U.S.A.

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Fourth International Workshop on Machine Learning

22– 25 June 1987

University of California, Irvine

Recently, machine learning has emerged as a central area of research in artificial intelligence and cognitive science. This workshop is being held in order to increase communication between researchers in this growing field. of California, Irvine during June 22-25, 1987.

In order to maximize interaction at the workshop, attendance will be limited and participation will be through invitation only. If you are active in machine learning and if you are interested in receiving an invitation, we encourage you to submit a one-page summary of your recent work in the area. If you would like to present a paper at the meeting, include a title and extended abstract. You may supplement this information with recent papers on machine learning.

Invitations will be based on an informal review of the research summaries by the organizing committee. On the basis of their abstracts, some attendees will be invited to speak at the workshop and to contribute a paper to the workshop proceedings. Each participant will receive a copy of the proceedings. The organizing committee consists of: Jaime Carbonell (CMU), Rick Granger (UCI), D. F. Kibler (UCI), Pat Langley (UCI), Tom Mitchell (CMU), and Ryszard Michalski (Illinois).

The deadline for submission of research summaries is 1 February 1987. Please send summaries, along with abstracts and optional papers, to:
 Pat Langley

Department of Information & Computer Science
University of California
Irvine, CA 92717, U.S.A.
Applicants will be informed of their status two weeks after submission.

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Second International Conference on Applications of Artificial Intelligence in Engineering

4— 7 August 1987

Boston, Massachusetts

Following the success of the first international conference in Southampton, UK, the second international conference is to be held in Boston during the first week of August. The first international conference stimulated many presentations on both the tools and techniques required for the successful use of AI in engineering and many new applications. The organizing committee members anticipate that the second conference will be even more successful and encourage papers to be submitted.

The purpose of this conference is to provide an international forum for the presentation of work on the applications of AI to engineering problems. It also aims to encourage and enhance the development of this most important area of research. Authors are invited to submit a 1000-word extended abstract. This should have sufficient details, such as the type of knowledge representation, problem-solving strategies, and the implementation language used, to permit evaluation by the committee.

All abstracts should be submitted before November 1986 to:
Dr. R. Adey
Computational Mechanics Inc.
Suite 6200, 400 West Cummings Park
Woburn, MA 01801, U.S.A.
Phone: 617-933-7374

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25th Annual Meeting of the Association for Computational Linguistics

6— 9 July 1987

Stanford University
Stanford, California

Papers are invited on substantial, original, and unpublished research on all aspects of computational linguistics, theoretical or applied. Papers should describe unique work that has not been submitted elsewhere; they should emphasize completed work rather than intended work; and they should indicate clearly the state of completion of the reported results.

Authors should submit ten copies of an extended abstract not to exceed eight double-spaced pages (exclusive of references) in a font no smaller than 10 point (elite). The title page should include the title,

the name(s) of the author(s), complete addresses, a short (5 line) summary, and a specification of the topic area. Submissions that do not conform to this format will not be reviewed. Deadline: 12 January 1987. Send to:
Candy Sidner, ACL-87 Program Chair
BBN Laboratories Inc.
10 Moulton Street
Cambridge, MA 02238, U.S.A.
Phone: 617-497-3566
INTERNET: sidner@g.bbn.com

Other Activities: Special events will signal the 25th Anniversary of the ACL. The meeting will also include a program of applied tutorials and a variety of exhibits and demonstrations.

In addition, ACL-87 will be preceded and followed by the 54th LSA Institute at Stanford University, which will be cosponsored by the ACL and the AAAI. Computational linguistics will be the major focus for the Institute. The week preceding the 25th Annual Meeting will feature ten 8-hour courses that can be taken by ACL members as tutorials. For more information, contact:
Ivan Sag
Department of Linguistics
Stanford University
Stanford, CA 94305, U.S.A.
Phone: 415-723-4284
INTERNET: institute@su-csli.stanford.edu

Also, a conference on Logic and Linguistics will follow ACL-87 from 10—11 July, also at Stanford University; contact:
Rich Thomason
Linguistics Department
University of Pittsburgh
Pittsburgh, PA 15260, U.S.A
Phone: 412-624-5791
INTERNET: thomason@c.cs.cmu.edu

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Outside North America

Tenth International Joint Conference on Artificial Intelligence

23— 28 August 1987

Milan, Italy

See the Call for Papers enclosed with this issue of *Canadian A. I.*, or write to the Program Chair:
John McDermott
Department of Computer Science
Carnegie-Mellon University
Pittsburgh, PA 15213
U.S.A.

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Third Conference of the European Chapter of the Association for Computational Linguistics

1— 3 April 1987

Copenhagen University
Copenhagen, Denmark

Papers are invited on all aspects of computational linguistics. Authors should send seven copies of a 5 to 8 page double-spaced summary to the Programme Committee Chairperson by 15 November 1986.

Bente Maegaard
Institut for Anvendt og Matematisk Lingvistik
Kobenhavns Universitet
Njalsgade 96
DK-2300 Kobenhavn S, DENMARK
Phone: +45-1-542 211

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Fourth International Conference on Logic Programming

Late May 1987

University of Melbourne, Australia

The conference will consider all aspects of logic programming. Papers can be submitted under two categories: short, up to 2000 words, and long, up to 6000 words. Authors should send six copies of their manuscript, plus an extra copy of the abstract by 1 December 1986 to:

Jean-Louis Lassez, ICLP Program Chairman
IBM T.J. Watson Research Center, H1-A12
P.O. Box 218
Yorktown Heights, NY 10598, U.S.A.

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AISB-87 Conference

6— 10 April 1987

University of Edinburgh
Edinburgh, Scotland

AISB-87 will be the sixth conference held by the Society for the Study of Artificial Intelligence and the Simulation of Behaviour. The conference will feature a two-day tutorial programme, followed by three days of presentations of papers.

Authors are invited to submit papers on any subject relevant to AI and the simulation of behaviour. A prize will be awarded for the best technical paper. Papers should be typed single-spaced with a maximum of 8000 words. It is hoped that the conference Proceedings will be published as a book, and submission of a paper is assumed to indicate willingness to assign copyright in such a case. Four copies of each paper should be sent, to arrive by 1 November 1986, to the Programme Chairman:

Chris Mellish, AISB-87 Conference
Arts D Building
University of Sussex
Falmer, Brighton BN1 9QN, U.K.

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Cognitiva 87 et / and Electonic Image Electronique

18— 22 mai / May 1987

Paris, La Villette

Thèmes de Cognitiva 87, de l'IA aux biosciences: Cognition, Raisonnement et résolution de problemes, bases de connaissance, langage naturel, apprentissage, systèmes experts, modèles connexionistes, neurophysiologie.

Thèmes du 3e Colloque Image: Extraction de primitives, vidéocommunications, transmissions et codage, amélioration et restaurations, modélisation geometrique, synthèse d'images, télédétection et cartographie, imagerie biologique et médicale, création artistique.

Thèmes communs: Perception, représentation des connaissances et structures de données, communication homme-machine, robotique, réseaux et informatique distribuée, etc.

Le français et l'anglais seront les langages officielles des deux colloques. Traduction simultanée assurée.

Une proposition de communication de 1000 mots, precedée de son titre et d'un bref résumé en français et en anglais doitetre soumise avant le 15 novembre. Pour plus d'information, veillez écrive à l'adresse ci-dessous.

Topics of Cognitiva 87, from AI to the biosciences: Cognition, reasoning and problem-solving, knowledge bases, natural language, learning, expert systems, connectionist models, neurophysiology.

Topics of the Third Image Symposium: Extraction of primitives, videocommunications, transmission, encoding, image enhancement and restoration, geometric image modelling, image synthesis, remote sensing, cartography, medical and biomedical imaging, artistic design.

Common topics: Perception, knowledge representation, data structures, human-machine communication, robotics, networks and distributed processing, etc.

English and French will be the official languages, with full simultaneous translation provided.

1000-word abstracts must be submitted by 15 November. For more information, write to:

MARI 87
Secrétariat, Cognitiva 87 / EIE
Isabelle Chardonnet
CESTA
1 rue Descartes
75005 Paris, FRANCE
Phone: +33 (1) 46-34-32-98

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ARTIFICIAL INTELLIGENCE SEMINAR SERIES:
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THE WESTIN HOTEL, OTTAWA
December 2, 3, and 4, 1986

The popular seminar series in Artificial Intelligence by Applied AI Systems reports on new developments in the application of AI to practical problem solving. Up-to-date information from recent conferences, reports, and exhibitions. The seminar will be presented by active AI practitioners in both industry and academia.

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- Deep Expert Systems
- Better Explanations
- AI and Communications
- Connectionism
- Qualitative Reasoning

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Some 100 exhibitors demonstrated new AI software and hardware products, workstations, system development tools, books, and other AI products and services at the recent AAAI exhibition in Philadelphia in August 1986. A summary of observed key commercial and industrial activities will be presented:

- New Generation AI Workstations and PC-level tools
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- Expert Systems, Intelligent Interfaces, and Robots

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