CANADIAN ARTIFICIAL INTELLIGENCE

December 1985
Issue number 6

An official publication of CSCSI/SCEIO Canadian Society for Computational Studies of Intelligence/ Société canadienne pour l'étude de l'intelligence par ordinateur.

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CANADIAN ARTIFICIAL INTELLIGENCE

An official publication of the Canadian Society for Computational Studies of Intelligence / Société canadienne pour l'étude de l'intelligence par ordinateur

Number 6, December 1985

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Editor: Graeme Hirst
Assistance: Joanne Mager, Jim des Rivières
French/English translation: Jean-Pierre Corriveau, Yves Lespérance
Cover design: Cathy Ledden, University of Toronto Press
Cover logo: Kathryn Finter
Printing and Production Assistance: University of Toronto Press

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Canadian Society for Computational Studies of Intelligence

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

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

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

CSCSI/SCEIO is affiliated with the Canadian Information Processing Society and the International Joint Council on Artificial Intelligence.

CSCSI/SCEIO officers for 1984–86 are:

President:
Gordon McCalla
Department of Computational Science
University of Saskatchewan
Saskatoon, Sask S7N 0W0
Phone: 306-966-4902
UUCP: . . . !sask!kimnovax!mccalla

Vice-President:
John Tsotsos
Department of Computer Science
University of Toronto
Toronto, Ont M5S 1A4
Phone: 416-978-3619
UUCP: . . . !utcsri!utai!tsotsos

Secretary:
Michael Bauer
Department of Computer Science
University of Western Ontario
London, Ont N6A 3K7
Phone: 519-679-6048

Treasurer:
Wayne A. Davis
Department of Computing Science
University of Alberta
Edmonton, Alta T6G 2H1
Phone: 403-432-3976
UUCP: . . . !alberta!uqv-mts!sams

Canadian Artificial Intelligence Newsletter

Number 6 (New series)
December 1985

ISSN 0823-9339

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

Editor:
Graeme Hirst
Department of Computer Science
University of Toronto
Toronto, CANADA M5S 1A4
Phone: 416-978-8747
CSNET: cscsi@toronto
ARPANET: cscsi.toronto@csnet-relay
UUCP: . . . !utcsri!cscsi
(UUCP connections to allegra, cornell, decvax, decwrl, deepthot, drea, floyd, garfield, hcr, ihnp4, linus, mbcsd, mcgill-vision, musocs, qucis, sask, ubc-vision, utzoo, uw-beaver, watmath, and many others.)

The *Newsletter* 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 network, to the editor or to your local *Newsletter* representative (see list on page 3). On-line submissions are preferred, but they should not contain justification spaces or hyphenated line breaks.

The *Newsletter* is published in March, June, September, and December. Material for publication is due on the 15th of the preceding month.

Please send changes of address to:
CSCSI/SCEIO, c/o CIPS
243 College Street, 5th floor
Toronto, CANADA M5T 2Y1

Call for Nominations, and Annual General Meeting, and Treasurer's Report

En français, page suivante

Call for Nominations for CSCSI/SCEIO Executive

The CSCSI/SCEIO constitution requires that a slate of candidates be proposed for the society's next executive, to serve from 1986 to 1988. Accordingly, the following people have been approached by the present executive, and have agreed to serve in the indicated capacities:

President, Dick Peacocke, Bell-Northern Research
Vice-President, Renato De Mori, Concordia and McGill Universities
Secretary, Bill Havens, University of British Columbia
Treasurer, Randy Goebel, University of Waterloo

If no other nominations are received, these people will be elected by acclamation. If other nominations are received, a mail ballot of the membership will be carried out. The constitution requires any election to be completed by the end of February, 1986, and requires the membership to have ballots a month before that. The publication schedule of *Canadian A. I.*, combined with the Christmas rush, and inevitable delays in producing and mailing out the ballots would make this a very tight schedule to maintain. The following seems to be a more reasonable schedule:

January 31: Deadline for receipt of nominations.
February 28: Deadline for receipt of ballots by the membership.
March 31: Deadline for return of ballots.
April 15: Final tallying of election returns.

Results will be announced at the CSCSI/SCEIO meeting at the Canadian AI Conference, 21–23 May, and in the June 1986 issue of *Canadian A. I.*

Any nominee for an executive position in CSCSI/SCEIO must be a CSCSI/SCEIO member and must have agreed to let his or her name stand. People in executive positions serve for a two-year term, commencing 1 June. Nominations should be sent to:

Dr. Gordon McCalla, President, CSCSI/SCEIO
Department of Computational Science
University of Saskatchewan
Saskatoon, Saskatchewan S7N 0W0

The current executive feels that this slate of candidates is a good one, and that the individuals nominated will do an excellent job for CSCSI/SCEIO over the next two years. Nevertheless, should the membership want there to be an election, it shall be done!

Gordon McCalla,
for the current executive

1985 Annual General Meeting

The 1985 annual general meeting of CSCSI/SCEIO was held on Thursday 22 August at the International Joint Conference on Artificial Intelligence. Approximately 50 people attended.

The society's president, Gord McCalla, reported on the society's activities of the last year. These included the founding of the society-sponsored journal, *Computational Intelligence*, the new *Canadian A. I.* magazine format, the TANLU workshop, and plans for other CSCSI/SCEIO-sponsored conferences, including preparations for the 1986 Canadian AI Conference to be held in Montreal next May.

There was some discussion of plans for the Montreal conference, and members were encouraged to contribute papers. The question of whether a vendor exhibition should be held in conjunction with the conference was discussed, but not really resolved.

The treasurer's report was presented. It appears on page 7.

The two-year term of the present executive expires next May, and nominations were sought for new members. A formal call for nominations appears above.

Deadline for the March issue is 15 February.

Mises en candidature, Assemblée générale annuelle et Rapport du trésorier

In English, previous page

Mises en candidature pour l'éxécutif du CSCSI/SCEIO

La constitution du CSCSI/SCEIO exige le dépôt d'une liste provisoire de candidats pour le prochain comité éxécutif, dont le mandat ira de 1986 à 1988. Voici les mises en candidature à date, telles qu'établies par le présent comité:

Président, Dick Peacocke, Bell-Northern Research
Vice-Président, Renato De Mori, Universités Concordia et McGill
Secrétaire, Bill Havens, Université de Colombie-Britannique
Trésorier, Randy Goebel, Université de Waterloo

Si nous ne recevons pas d'autres nominations, ces candidats seront élus par acclamation. Autrement, chaque membre pourra voter par courrier. La constitution spécifie que l'élection doit être complétée à la fin de février 1986 et que les bulletins de vote doivent être reçus par les membres un mois avant. L'horaire d'impression de la *Canadian A. I.*, la surchage postale du temps des fêtes et les délais de production et d'expédition des bulletins rendent ceci très difficile. Voici un échéancier qui nous semble plus raisonnable:

31 janvier: toutes les mises en candidature doivent avoir été reçues.
28 février: tous les votants doivent avoir reçu leur bulletin de vote.
31 mars: tous les bulletins doivent avoir été retournés.
15 avril: le comptage doit être terminé.

Les résultats seront annoncés à la réunion du CSCSI/SCEIO à la conférence canadienne d'IA du 21—23 mai, ainsi que dans le numéro de juin 1986 de la *Canadian A. I.*.

Tout candidat à un poste de l'éxécutif du CSCSI/SCEIO doit être un membre du CSCSI/SCEIO et doit avoir accepté sa nomination. Le mandat est de deux ans et débute le 1er juin. Les mises en candidatures devraient être envoyées à:

Dr. Gordon McCalla, President, CSCSI/SCEIO
Department of Computational Science
University of Saskatchewan
Saskatoon, Saskatchewan S7N 0W0

Le présent comité éxécutif juge que la liste provisoire suggérée est satisfaisante et que ces candidats feront un excellent travail. Cependant, si l'électorat veut une élection, il y en aura une!

Gordon McCalla,
au nom du comité éxécutif

Assemblée générale annuelle pour 1985

L'assemblée générale annuelle du CSCSI/SCEIO pour 1985 s'est déroulée le jeudi 22 août lors de la conférence conjointe sur l'IA. Approximativement 50 personnes étaient présentes.

Le président de la société, Gord McCalla, a résumé les activités de la société au cours de la dernière année. Ceci comprend la création d'un journal subventionné par la société, *Intelligence Informatique*, le nouveau magazine *Canadian A. I.*, l'atelier TANLU, et l'étude de projets de conférences subventionnées par le CSCSI/SCEIO, y compris la conférence canadienne en IA qui aura lieu à Montréal en mai.

L'organisation de la conférence de Montréal ainsi que la possibilité d'une exposition parallèle portant sur les milieux industriel et commercial ont fait l'objet d'une discussion peu concluante. On a encouragé les participants à envoyer des articles.

Le rapport du trésorier a été déposé et apparait en page 7.

Le mandat du comité éxécutif se termine en mai et, tel qu'expliqué ci-dessus, les mises en candidatures ont commencé.

L'échéance pour le numéro de mars est le 15 février.

Treasurer's Report / Rapport du trésorier

1 April 1984 to 31 March 1985		1er avril 1984 au 31 mars 1985
Balance Forward		Solde reporté
Savings account	1,733.24	Compte d'épargnes
CIPS	4,036.64	ACI
	5,769.88	
Income		Impôt
Proceedings	5,069.73	Actes
Membership fees	5,030.70	Abonnements
BNR, donation	500.00	Don de BNR
1984 conference	3,558.44	Conférence de 1984
Interest	118.97	Intérêts
Canadian A. I. advertising	1,668.40	Publicité dans la *Canadian A. I.*
	15,946.32	
Expenses		Dépenses
Administration fee	355.00	Frais d'administration
Computational Intelligence	1,664.00	*Intelligence informatique*
Canadian A. I.	4,247.13	*Canadian A. I.*
Postage and refunds	594.00	Poste et remboursements
Reception, Ottawa	506.20	Soirée à Ottawa
Printing of report	603.00	Impression du rapport
	7,969.33	
Balance, 31 March 1985		Solde pour le 31 mars 1985
Savings account	6,210.96	Compte d'épargnes
Current account	3,939.25	Compte courant
CIPS	3,596.66	ACI
	13,746.87	

1 April 1985 to 15 August 1985		1er avril 1985 au 15 août 1985
Balance, 1 April 1985	13,746.87	Solde, 1er avril 1985
Income		Impôt
Interest	178.04	Intérêts
Canadian A. I. advertising	3,339.30	Publicité dans la *Canadian A. I.*
Expenses		Dépenses
Canadian A. I.	7,734.17	*Canadian A. I.*
Workshop advance	2,000.00	Frais avancés pour l'atelier
Balance, 16 August 1985		Solde, 16 août 1985
Savings account	1,389.00	Compte d'épargnes
Current account	2,544.08	Compte courant
CIPS	3,596.66	ACI
	7,529.74	
Major liabilities		Engagements majeurs
University of Toronto	1,975.22	Université de Toronto

Canadian
Artificial Intelligence
Numéro 6, décembre 1985

Résumé

Annonceurs

Fifth Generation Society To Be Formally Constituted

At the second national meeting of the Canadian Society for Fifth Generation Research in Ottawa on 25 October, its membership decided to formally constitute the society as a body to promote research and funding in Canada in new computing technologies. The name of the new organization has not been decided, but an executive pro tem to bootstrap the society was elected. The meeting was called to decide upon future directions for the society, which presently has no formal structure or legal status.

The society was informally created at the initial meeting in March 1984 to produce a report to the Natural Sciences and Engineering Research Council (NSERC) proposing that it fund research in fifth generation computing in Canada. This proposal, "Toward a Canadian Fifth Generation Research Plan", was published as a supplement to *Canadian Artificial Intelligence* (March 1985). NSERC's response to the proposal was friendly, but it is unable to consider committing any funds unless its new five-year plan, presently before the government (see *Canadian A.I.*, September 1985), is approved.

The recent meeting was called by the steering committee that edited the proposal. The committee's mandate to act had expired, and it was necessary to decide what to do next. About 85 people attended the meeting in the Ottawa Congress Centre; about half were from universities and half were from industry and government agencies.

The meeting was chaired by Nick Cercone, and opened with a report from Eric Manning, chairman of the steering committee, on the current status of the society and the proposal to NSERC. Dr Claude Lajeunesse, Director of Targeted Research at NSERC, then spoke on NSERC's role in the funding of research in Canada, and what NSERC can and can't do. NSERC's current priorities are to increase the number of trained researchers in Canada, and to increase the amount of funding for excellent research — possibly giving more money to fewer grantees than at present, Dr Lajeunesse said.

When the meeting turned to the question of the society's future, there was much discussion about the most suitable structure and role for the new organization. The consensus was that it should not be a professional academic (all volunteer) society in the style of CSCSI/SCEIO, with which it would substantially overlap, but rather should take more the style of an institute, which would seek to influence government and industrial policy, and would help adjudicate the scientific worthiness of research proposals.

The new society's domain should include research in new computing technologies, taking in AI, machine architecture, microelectronics, and other applicable research areas. The society should represent both industry and academia, and foster better collaboration between the two.

It was felt that it would be necessary for the society to maintain impeccable scientific credentials and a high credibility in order to influence national policy. Nick Cercone proposed that to accomplish this task, the society be governed by a board of trustees, whose members would be prominent and respected people from Canadian businesses, government, and universities. An elected executive would be responsible for day-to-day operations, and a scientific committee would keep the society's recommendations to government up to date, and judge the merits of proposed projects. Partly due to time constraints, there was no agreement about exactly how to organize this structure.

An executive pro tem was elected to refine the details and bring the society into formal existence. Those elected were:

Nick Cercone, Simon Fraser University (President)
Zenon Pylyshyn, University of Western Ontario (Vice-President)
Morven Gentleman, National Research Council (Secretary)
Lorne Bouchard, Université du Québec à Montréal (Treasurer)

It is necessary to formalize the society rapidly, and the executive is to perform its task in six months.

The executive is also to consider a name for the society. There was a general dislike of the present name, which uses the words *fifth generation* at a time when Japan is already talking about the sixth generation of computing technology. There was no consensus on a new name, however, and the old name will continue as the society's name pro tem.

Those interested in being added to the society's mailing list should write to Nick Cercone, School of Computing Science, Simon Fraser University, Burnaby, B.C. V5A 1S6. A phone number and, if applicable, electronic address, should be included. □

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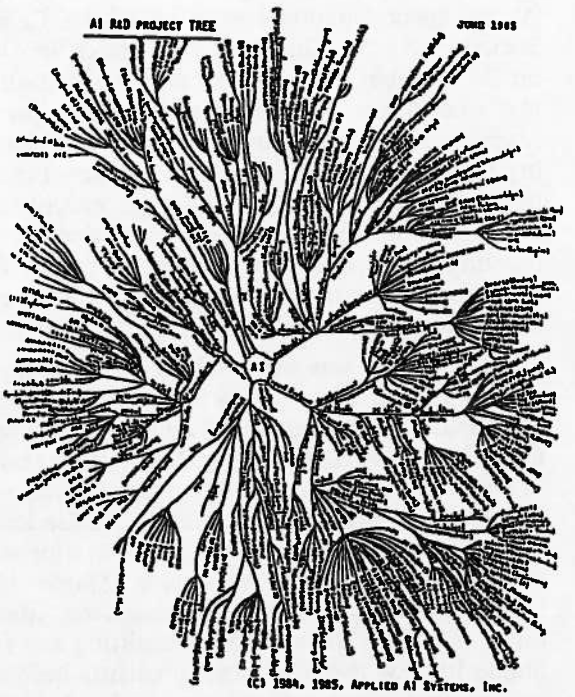

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Strong Canadian Role Possible in Machine Translation and Space Station

Two recent reports to the Canadian government have emphasized the important economic benefits to Canada that would be obtained from government support for research and development in two AI-related areas: machine translation and a Canadian role in the U.S. space station.

These reports follow an earlier proposal for substantial Canadian government funding of Fifth Generation Research in Canada (see *Canadian A.I.*, March 1985, and this issue, page 8), and come at a time when the government is considering NSERC's proposal for a major increase in the percentage of the gross national product that Canada spends on R&D (*Canadian A.I.*, September 1985).

The following articles give the details of each report.

Machine Translation Could Be Major Industry, Says Cognos Report

Canada's best opportunities in AI are in natural language processing, and, in particular, in machine translation (MT), says a report prepared by Cognos Inc. for the federal Department of Communications and the Department of the Secretary of State. The opportunities in these subfields would "enable Canada to take a world-leadership position" in critical areas of information technology still awaiting such leadership, and allow Canada to "better position itself with respect to emerging information technology thrusts from the rest of the industrialized world".

The report recommends that Canada begin a programme to develop a new generation of intelligent machine translation systems, and do so with the "utmost urgency" before the "window of opportunity" is passed. It also recommends that the MT programme serve as a focal point for the beginning of a national thrust in related areas of AI, and natural language processing in particular.

MT is particularly critical for Canada, the report said, for the following reasons:

- Canada, as a bilingual nation, requires the translation of over 750 million words a year. The automation of just 10% of this would save at least $20 million a year. The need for translation touches all corners of the economy.
- Canada already has world-class expertise in MT. TAUM-METEO, "probably the best MT system in existence", was built at the Université de Montréal.
- There will be a large international market for MT, which is only just beginning to be addressed on a large scale.

MT exceeds all other subfields of AI in its combination of high national need, existing high national expertise, potential Canadian market, and the potential for a niche in the international market, according to the report.

Government involvement is essential, the report said, to provide suitable goals and funding. The matter is "far too critical to be left solely to either the nuances of the private sector or the research bias of the academic community".

The report, titled "Machine Translation and Natural Language Processing: Opportunities for Artificial Intelligence in Canada", was prepared last year, but was released only recently. The main authors were Zenon Pylyshyn and John Shepherd. It is available in English or French* on request from David Waung, Technology and Policy Assessment Branch, Department of Communications, 300 Slater Street, Ottawa, Ontario K1A 0C8.

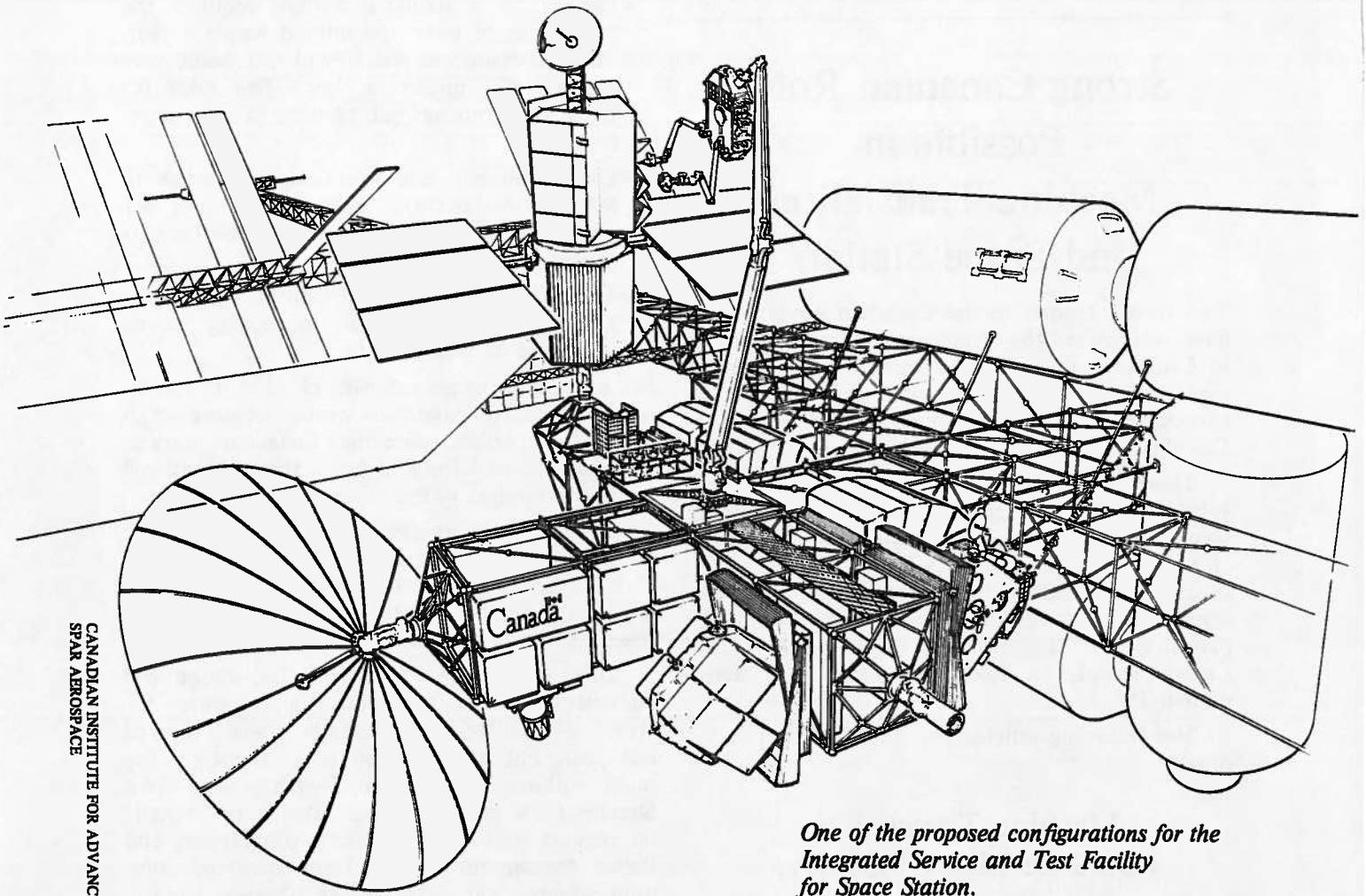
Cognos is presently preparing another report for the government on AI. To be presented to Transport Canada, it will focus on opportunities for AI in the transportation industry. It is being prepared in association with Applied AI Systems Inc.

Space Station Has Big Potential For Industrial Development, Says CIAR

The right kind of participation by Canada in the U.S. space station project would have a major technological "pull" that would be highly significant for Canadian industry, according to a report by a committee of the Canadian Institute for Advanced Research.

(Continued on next page)

*En français, "La traduction automatique et le traitement des langues naturelles: Créneaux pour l'intelligence artificielle au Canada".



CANADIAN INSTITUTE FOR ADVANCED RESEARCH / SPAR AEROSPACE

One of the proposed configurations for the Integrated Service and Test Facility for Space Station.

The space station project was announced in January 1984. Its goal is to develop a permanently manned civilian space station, known as Space Station, which would be used for the manufacture of special materials in microgravity, remote sensing, and the service and repair of satellites. It is not connected with the Strategic Defense Initiative ("Star Wars"). Several countries, including Canada, have been invited to participate in the project. Canada must tell NASA by January 1986 whether it wishes to do so, and, if so, how. If negotiations on the details, terms, and conditions were successful, there would be a formal agreement by early 1987.

The CIAR report, entitled "Canada and the Space Station", says that suitable participation in the project would include the following benefits:

- Canada's exploitable R&D base in AI and robotics, two of the key technologies in the space station, will be substantially increased.
- There would be a strong impact on the automation and robotics industries, which are strategically important for economic development.
- The Canadian space industry would be enlarged.
- The technologies developed would have important applications in areas such as energy, mining, forestry, and marine engineering.

The report warns that Canada should not participate in the project at all unless it can do so in a "meaningful, long-term way". It suggests that of the various current proposals as to how Canada can participate, the best is the construction and continuing operation and management of the station's "integrated service and test facility" (ISTF). This would be the part of the station used for servicing, repairing, and testing vehicles, satellites, and structures either attached to the space station or in the vicinity.

The proposals rejected were the construction of solar arrays to provide power for the space station, and a remote sensing facility. The solar arrays were thought not to provide adequate

long-term involvement or long-term impetus to Canadian industry. Remote sensing is extremely important to Canada for its role in natural resource management, and possibly in surveillance of Arctic areas over which Canada claims sovereignty. However, the committee thought that the remote sensing facility would, because of the space station's location, not be of great use to Canada.

The ISTF, however, would give Canada continued involvement in an integral part of the space station, and would require a major R&D effort in a broad range of technologies, including expert systems, computer architectures, robotics, sensory processing systems, and materials science. Moreover, Canada already has considerable expertise in these areas on which it can build, and the CIAR's present AI and Robotics Programme is further increasing this base, the report said.

The cost is estimated at ^{CDN}600 million over ten years, which is about 40% of Canada's current space budget. The report emphasizes that this expense should be seen as a spur for important Canadian industries, one that could give "a very handsome return on the government's investment". The U.S. clearly sees the space station project in such a way.

The importance of AI and robotics to the project is emphasized by the U.S. Congress's direction to NASA that at least 10% of the total cost of Space Station shall be spent on the development of "advanced automation and robotics technologies not in use in existing space craft".

The CIAR report also recommended that Canada establish a national space agency for the administration of all of Canada's space projects — a Canadian equivalent of NASA. Coincidentally, a report by the Science Council of Canada, released at about the same time, also made this recommendation. Responsibility for space programmes is presently shared by the Department of National Defence, the Department of Energy, Mines, and Resources, the Department of Communications, and the National Research Council, with an inter-departmental committee coordinating the activities.

Other present and planned Canadian space activities include space-based remote sensing, satellite communications, and the Canadian astronaut programme.

The CIAR's Space Station Committee was chaired by James M. Ham of the Department of Industrial Engineering, University of Toronto. Copies of the committee's report are available from CIAR, 434 University Avenue, Suite 502, Toronto M5G 1R6. □

Projects

University of Ottawa and Cognos Start Major Joint Project

Doug Skuce
Department of Computer Science
University of Ottawa

The AI group at the University of Ottawa and Cognos, Inc., of Ottawa (one of the major software companies in Canada) have recently launched a major research project. The objective is to build a prototype expert system which will provide knowledge about one of Cognos's products — a "fourth generation" report generator called QUIZ. The prototype, which should be ready in 1987, should be able to answer typical simple questions from inexperienced QUIZ users and beginner-level consultants. Because of its function, the name QUIZ Advisor has been coined for the system.

At present, Cognos allocates considerable resources to handling requests for help and advice from a large group of QUIZ users, some of whom are relatively inexperienced. Questions are normally phoned in and answered immediately, or at least within a few hours. Every question is recorded on a special sheet, with the appropriate answer. This large corpus of real questions has proven to be a valuable asset to the project.

One of the first issues confronted by the Advisor team was to define the kind of questions the system should answer, as well as what questions the Advisor will not be able to answer. This, of course, has an immediate bearing on the contents of the knowledge base. Since representing complete knowledge about QUIZ seemed to be beyond the scope of the project (the index of the QUIZ manual has approximately 1600 entries) a restriction of knowledge of the Advisor was necessary.

To limit the scope of the prototype, a two-dimensional approach is being used. A number of general question types has been defined (the most frequent being "How do I do *X*?" and "Why does *X* happen?"), and the knowledge about QUIZ has been partitioned into about 50 topics. Only certain representative question types

and topics will be covered in the prototype.

The knowledge acquisition is being aided by several software tools. A lexical analyser has been developed to acquire the necessary terminology by scanning, under human control, the QUIZ manual and the question set.

Knowledge representation is the current focus of the team. Stan Matwin is developing a hybrid frame-based notation, which will involve rules to answer certain types of questions. Doug Skuce is working on the linguistic and logical aspects of knowledge representation for the Advisor. B. Tauzovich is designing a causal representation to express cause-and-effect relationships. Tools used in the first stage of the project include PEARL, a general-purpose associative-retrieval package which permits unification between expressions, and the Prolog language, which is being used for rapid prototyping. The final prototype will be written in Common Lisp.

Total funding for the two year project is of the order of $900,000, of which approximately one half is contributed by Cognos, the remaining funds coming from the National Research Council (through the PILP programme) and NSERC. Cognos provides a project manager and ready access to QUIZ experts. One of its employees is working on a Ph.D. within the framework of the project. Three faculty members from the Department of Computer Science (Doug Skuce, Stan Matwin, and Stan Szpakowicz) are involved, along with two full time research assistants and a number of students. □

Conference Report

COMPINT Conference in Montreal Features AI and 5G

Lois Carson
Publicity and Public Relations Committee
COMPINT 85

Artificial intelligence and fifth generation computing were prominent features at the COMPINT 85 conference and exhibition held in Montreal from 10 to 12 September. The international conference, whose main theme was "computer-aided technologies", was sponsored by IEEE and ACM. Over 600 people attended.

Among the highlights of the conference was the panel on fifth generation computers where representatives from five fifth-generation projects met to discuss the research being done in each of the countries they represented. The panelists included: Clinton Kelly, of the U.S. Defense Advanced Research Projects Agency (DARPA); Eric Manning, of the University of Waterloo in Canada; Brian Oakley, of the U.K. Alvey Project; Jean-Francois Omnes, of the European ESPRIT Programme; and Toshio Yokoi, of ICOT in Japan.

The Hon. Thomas Siddon, the Minister of State for Science and Technology, officially opened the conference on 10 September. In his speech, he paid tribute to the work that had been done to attract the high-profile scientists and technicians from around the world who were participating. He stressed the benefits to Canada of international conferences of such a high calibre.

Guest speakers at COMPINT included: Professor Raj Reddy, head of the Robotics Institute at Carnegie-Mellon University; Jonathan Allen, Director of the Research Laboratory of Electronics, Massachusetts Institute of Technology; and Toshiyuki Sakai of Kyoto University, President of the International Association for Pattern Recognition.

The papers presented were collected in an 800-page proceedings. An award for best paper was presented to Thomas M. Atwood, of Mosaic Technologies, Billerica, Massachusetts, for "An object-oriented DBMS for Design Support Applications".

In addition, approximately 150 people attended pre-conference tutorials on 8 and 9 September, and the exhibition area, which featured various applications of computer-aided technologies, attracted 5,000 people over the three-day period.

In a press release, Stephen Leahey, General Chairman of COMPINT 85, said, "COMPINT 85 far exceeded our expectations, in the quality and number of papers presented. We're most pleased with the contribution this conference has made to the international transfer of technological knowledge and feel it has set the standard for future COMPINT conferences."

The next COMPINT conference will be held in Montfeal in 1987. For more information, write to COMPINT 87, P.O. Box 577, Desjardins Postal Station, Montreal, Que., CANADA H5B 1B7. □

Best Paper Award Established for Canadian AI Conference

The editorial board of the journal *Artificial Intelligence* has offered an award of $1000 for the best paper submitted to the 1986 Canadian Artificial Intelligence Conference. In addition, the winning paper will be published in the journal.

The programme committee of the conference will judge the papers.

In establishing the award for CSCSI/SCEIO, Daniel Bobrow, the editor-in-chief of *Artificial Intelligence*, said that the editorial board's intent is to encourage good writing, and to expand the circulation of high-quality papers. The board intends to also provide the award for subsequent CSCSI/SCEIO conferences.

The 1986 Canadian AI Conference will be held on 21–23 May in Montreal. Papers for the conference are due on 31 December 1985. A detailed call for papers, in both English and French, appears on page 18. Information on conference registration and accommodation will appear in the March 1986 issue of *Canadian A. I.*. □

New Bindings

Ezio Catanzariti of the University of Naples has joined the Laboratory for Computational Vision, University of British Columbia, as a Visiting Research Scientist until July, 1986. He will be working with Alan Mackworth on problems in the interpretation of 3D scenes.

Erratum: The report in "New Bindings" last issue that Mark Fox would be visiting the University of Toronto, on leave from Carnegie-Mellon University, was incorrect.

P. S. Mueller

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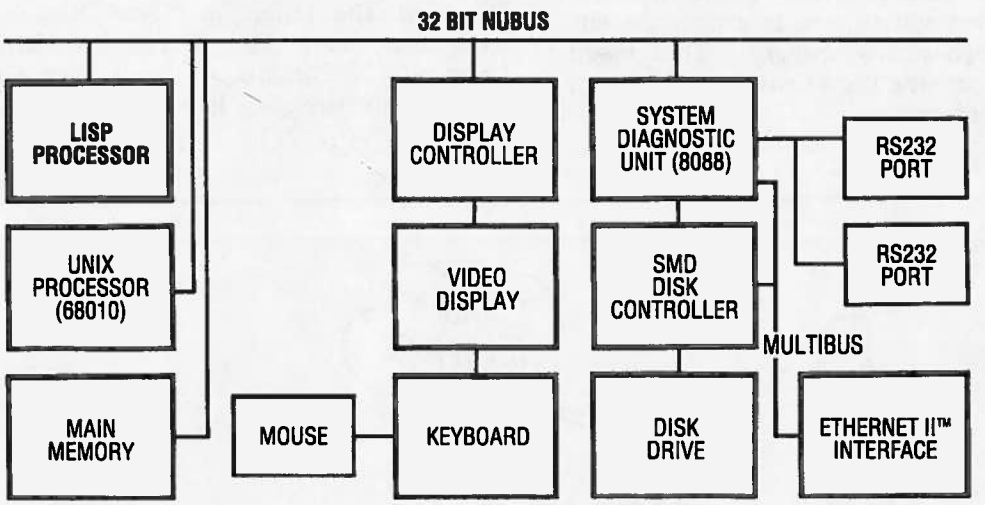

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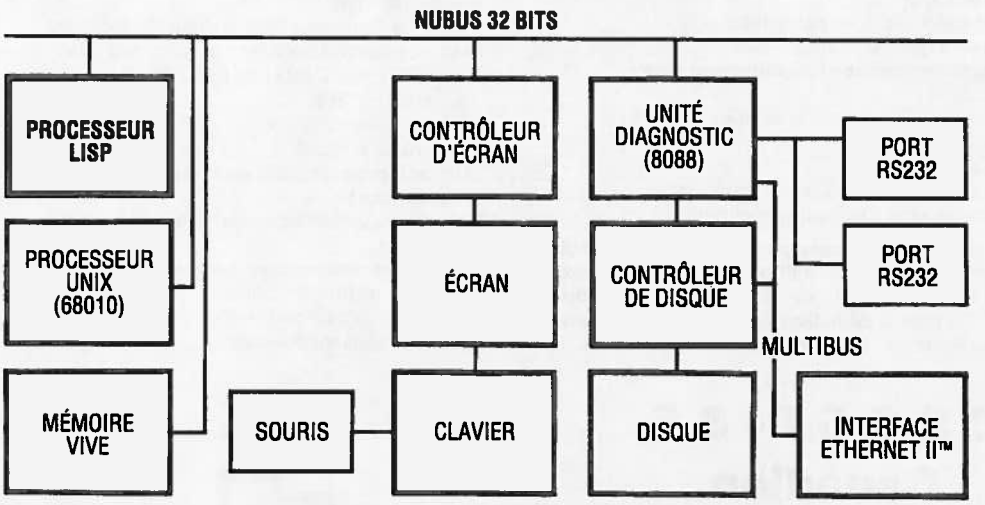

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La sixième conférence nationale de la CSCSI/SCEIO vous invite à soumettre des articles portant sur la recherche théorique et appliquée en intelligence artificielle, en particulier dans les domaines suivants:

- Représentation du savoir
- Vision artificielle
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- Planification, apprentissage et solution automatique de problèmes
- Science cognitive
- Aspects sociaux de l'intelligence artificielle
- Architectures pour l'IA, langages et outils

Tous les articles seront jugés par le comité responsable du programme. Les auteurs sont priés de ne pas dépasser 5000 mots et de préciser le domaine auquel se rapporte leur article. De plus, il est indispensable de spécifier clairement et brièvement les contributions majeures à la recherche en IA, et de fournir les références appropriées. Graphiques et illustrations doivent être impeccables.

Veuillez envoyer au président du comité responsable du programme trois exemplaires de chaque article avant le 31 décembre 1985. Nous ne pouvons malheureusement pas accepter les envois par courrier électronique. Tout article jugé satisfaisant paraîtra dans les Actes de la conférence.

Prière de vous adresser au président de la conférence ou au président du comité en charge du programme.

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- Logic Programming and Formal Reasoning
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- Computer Vision

All submissions will be fully refereed by the program committee. Authors are requested to prepare full papers of no more than 5000 words in length and specify in which area they wish their papers reviewed. All papers should contain concise clear descriptions of significant contributions to Artificial Intelligence research with proper references to the relevant literature. Figures and illustrations should be professionally drawn.

Three copies of each submitted paper must be in the hands of the Program Chairman by 31 December 1985. Electronic submissions are, unfortunately, not acceptable. All accepted papers will be published in the conference proceedings.

Correspondence should be addressed to either the General Chair or the Program Chair, as appropriate.

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INTERNET: havens@ubc.csnet

A Visiting Researcher at The Institute for New Generation Computer Technology

Randy Goebel
Logic Programming and AI Group
Department of Computer Science
University of Waterloo

From 2 to 27 September, I was a visitor at the Japanese Institute for New Generation Computer Technology (ICOT) in Minato-ku, Tokyo. My visit was not merely to observe, but to collaborate with ICOT researchers on topics of mutual interest. I was one of approximately twenty foreign researchers who have been invited during the first 3½ years of ICOT's existence.

ICOT is a government funded research centre devoted to the Fifth Generation Computer Systems (FGCS) project, which was initiated by the Japanese Ministry of International Trade and Industry in April 1982 (ICOT 1984a, 1984b). The goal of the ten-year project is the development of "knowledge information processing systems" (KIPS), suitable for the anticipated information processing tasks of the next decade. The focus is the development of hardware and software systems for acquiring, managing, and using large volumes of "knowledge". The anticipated complex information processing systems are alleged to consist of an integration of various hardware and software technologies, especially those associated with artificial intelligence and based on logic programming.

The first phase of the project has produced basic tools for use in the crucial four-year second phase (ICOT 1984b). The first "fundamental technologies" phase might be summarized as a redevelopment of current AI-related technology based on logic programming. This basic technology will be exploited in the second phase, whose results are to be combined, in the final three-year phase, into an integrated KIPS prototype.

The international reaction to the FGCS project has been dramatic. Though many have criticized everything from the logic programming basis to the detailed "legislation" of anticipated research results, there are few technology-related organizations that have escaped a twinge of fifth generation hysteria (e.g., see Feigenbaum and McCorduck 1983).

The research environment at ICOT

I had some knowledge of the research environment that I would find when I arrived, through discussions with Maarten van Emden who had visited last February. I was, nonetheless, surprised that the open office organization of the laboratories could provide such a congenial atmosphere for productive research. There were numerous informal discussions among researchers in the first laboratory. (My limited understanding of Japanese prevented me from participating in most of these.) It is important to note that most of these discussions seemed be about research issues — "GHC copy problem" sounds the same in Japanese as it does in English. There were also more formal meetings where some subset of the laboratory would move off to a meeting room to hold more lengthy discussions. This organization seemed very productive, and I speculate that the well-known Japanese talent for integrating disparate problems and solutions is a result of this kind of atmosphere.

The computing resources of the First Laboratory, and ICOT in general, seemed quite well organized. When I arrived, an account on the DEC20 system had already been created, so I could begin my work immediately. I asked about the apparent disinterest in Unix, and was told that the choice of an initial development system for ICOT was made because of the availability of Warren's DEC10 Prolog compiler.

As for the development of logic programs, I found the DEC20 Prolog very stable and productive. However, as the FGCS project has now begun its second phase, it was interesting to find that very few people seem to be using the Personal Sequential Inference machines (PSI machines) as a personal Prolog development tool. I believe that some aspects of the FGCS success will depend on exploiting the PSI machines as soon as possible.

(Continued on next page)

Collaborative research at ICOT

My research at ICOT was conducted in the First Research Laboratory, directed by Dr. Koichi Furukawa. This first of five laboratories does research on "basic software systems" for the FGCS project. Current activities of the First Lab include work on Guarded Horn Clauses (GHC, a logic programming language for parallel processing), parallel problem solving and inference, partial evaluation of logic programs, and operating systems for parallel logic programming machines.

As my research had included work on knowledge representation and parallel logic programming (Goebel 1985, Lee and Goebel 1985), I anticipated some kind of collaboration with the parallel problem solving and inference group. Dr. Furukawa set up a schedule for my first week that included discussions with members of the First Laboratory, and a lecture on my representation system, DLOG. I gave four additional lectures during my stay.

Collaborative research proposal

After completing the first two lectures, I began to consider topics for collaborative research. Of particular interest was recent work with Drs. David Poole and Romas Aleliunas of Waterloo (Poole, Aleliunas, and Goebel 1986). I had briefly described our work on the theory formation system Theorist, and explained how I believed it unified much of the research currently in progress in the First Laboratory.

In order to provide some material for concrete discussion, I prepared a proposal of possible collaborative research topics to discuss with Dr. Furukawa. Dr. Furukawa read the proposal, and suggested that I pursue the development of a version of Theorist based on definite clauses. The Theorist program developed with Poole and Aleliunas used the full clausal form of first order logic as a representation language, and thus required a full clausal theorem-prover as the deductive basis. The proposed collaboration sought to develop a simpler model of Theorist based on definite clauses. Dr. Furukawa pointed out that the classification of definite clauses into facts and integrity constraints provided the necessary concept of potentially inconsistent hypotheses, which is fundamental in the model of theory formation based on deduction. We decided that I would pursue the development of this idea, and consider its application to diagnostic reasoning.

Results of collaborative research

During my third week at ICOT, I summarized the current state of my work on the simplified version of Theorist (henceforth called Theorist-S) and its application in diagnostic reasoning. In particular, I demonstrated a working program that does diagnosis using a definite clause database partitioned into three categories of assertions: facts, integrity constraints, and possible hypotheses. In addition, the structure of the Theorist-S diagnosis system suggested that the form of MYCIN rules was actually an amalgamation of meta-level and object-level information that could be completely separated, and then automatically reassembled using Takeuchi's program for partial evaluation.

My summary of the Theorist-S program included a list of several related research topics that arose during its implementation. After discussions with Dr. Furukawa and several other members of the problem solving and inference group, I decided to spend my remaining time on a generalization of Theorist-S that would consider the use of GHC (Ueda 1985) for the parallel verification of hypotheses.

Most of my final week at ICOT was devoted to considering the possibility of exploiting parallelism in Theorist-S. My initial ideas led me to consider possible process structures for a parallel version of Theorist-S. Dr. Furukawa explained how GHC merge networks could be used to synchronize the parallel theory formation processes that I was considering. In addition, I spent an afternoon with Dr. Kuniaki Mukai discussing the relationship between his CIL programming language and my DLOG system. Both systems make extensive use of complex embedded terms whose manipulation is specified in terms of extended unification. Dr. Mukai verified my intuitions about the relationship between descriptions and the situation semantics of Barwise and Perry, and we discussed the general use of embedded terms in logic programming systems.

Prospects for success of the FGCS project

There are several ways to judge the success of ICOT and its ten-year FGCS project. The first is from the viewpoint of a non-Japanese observer, who anticipates that success in achieving the most abstract goals of the FGCS project will not only transform the way in which our civilization uses information, but will have a potentially staggering effect on the computing industry in the rest of the world. This view is the virus that has inflicted the West with Fifth Generation hysteria, and has precipitated the creation of projects like Britain's Alvey, the EEC's ESPRIT, the United States computer manufacturer's MCC, and Australia's Fifth Generation Project.

A scientific view of the FGCS project requires a careful evaluation of the possibility of achieving success in the stated goal of producing a "knowledge information processing system." There are many fundamental problems to be solved in the next phase of the FGCS project — some major ones are the development of a simple and efficient way to exploit AND parallelism, and a sound methodology for both the acquisition and delivery of knowledge. It is impossible to speculate on the timing of fundamental research breakthroughs, but I suggest that success in developing a generally useful knowledge information processing system will vitally depend on the integration as well as production of results.

The final view of the FGCS project is from the Japanese perspective, especially that of the Japanese computing research community. From this view, I believe, the project is already a great success. The classical western folk tale of the Japanese lacking in innovation and creative thinking is nowhere to be found at ICOT. Furthermore, the constant flow of manufacturers' researchers through ICOT has greatly increased the awareness of AI, and is rapidly creating a country that is filled with expertise on everything from parallel architecture to situation semantics. This kind of success is most exciting, as I believe it raises the intellectual level of the general research community which, in turn, fosters better science.

Conclusions

In general, Canadians have been among the slowest to respond to the Japanese FGCS project. The recent formation of a national interest group, tentatively called The Canadian Society for Fifth Generation Research (see this issue, page 8), is a start. This group is dominated by Canadian academics; however, it is important that Canadian industry become *actively* involved, as the short term benefits of the FGCS project will have the most effect on them.

Regardless of how the success of the FGCS project is judged, it *will* integrate the next four years' research into some form of product prototype by the early 1990s. Furthermore, the flow of information and ideas will become more restricted as the precompetitive stage ends and prototypes emerge. This is not serious for Canadian academics, who can maintain the flow of information through collegiality; however it is a more serious consideration for Canadian industry. In order to survive and maintain a niche in the world market, Canadian information technology companies have to expend resources on identifying products that can exploit the short-term results of artificial intelligence and related technologies. Technology transfer is a fine concept, but most Canadian computer science academics lack the time and the infrastructure to move their ideas from the laboratory to the marketplace. The gap between basic academic research and industrial product development has to be filled by first identifying problems that arise in consideration of new products. Only after potential products are identified can basic research results be applied to solve the problems inherent in developing and exploiting the next generation of knowledge information processing machines.

Acknowledgements

A major component of successful research is the quality of the human environment. I had the aid of many kind people who have done everything from teaching me to use the EMACS editor to pointing out that I should be careful not to ask for "the edge of a table" when I really want chopsticks. In particular, I found Hiroyuki Kusama a splendid host, who seemed to anticipate my every need and desire. Masaru Ohki endured my passion for curry, and contributed his services way beyond what I deserved. Koichi Furukawa was most empathetic about my temporary beer allergy, and taught me much about doing research. I am especially grateful to Ami Senba for teaching me a great many things about Japan, including all about Japanese baseball. And I am thankful to all the people in the First and Third Laboratories who so graciously endured the strange habits of this foreigner.

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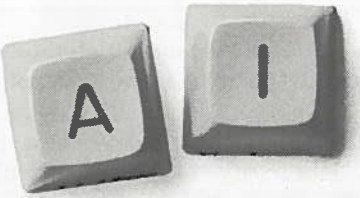

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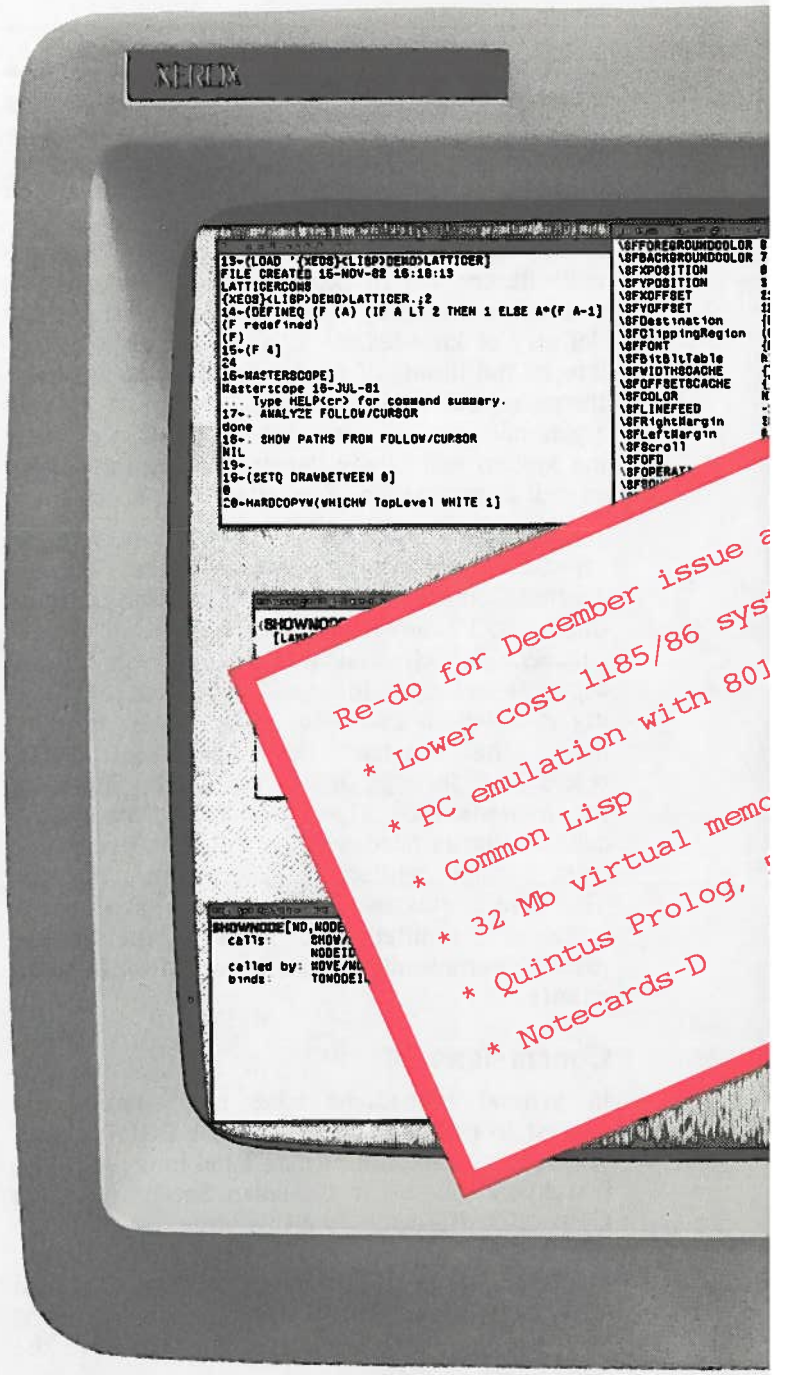

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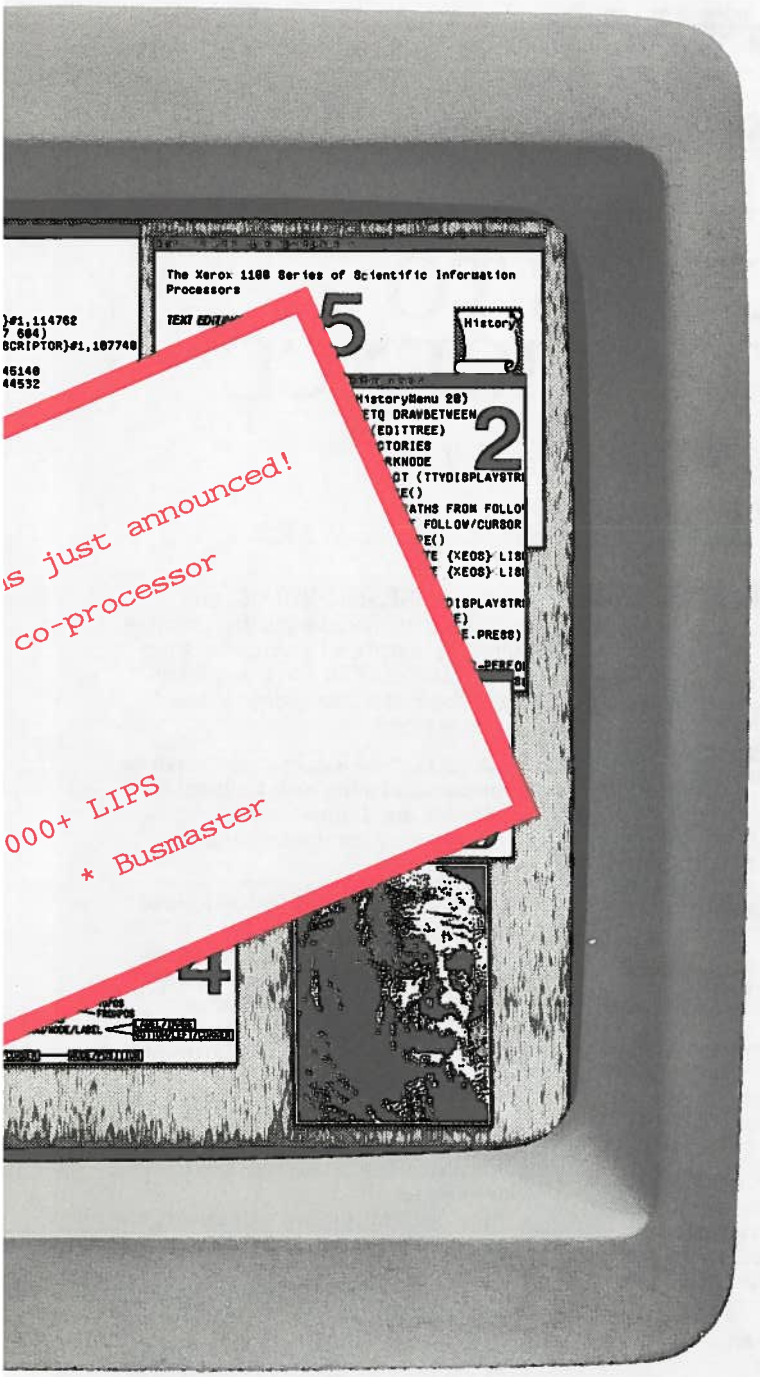

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Suite 1100
Toronto, Ontario
M5G 2H2

Directory of AI Graduate Programmes in Canadian Universities

This directory will be of interest to students seeking a suitable graduate study programme in AI in Canada, to faculty advising such students, and to people in industry and government looking for AI expertise in nearby universities.

Each entry includes graduate programmes offered, with their current enrolment, the faculty and research staff with AI interests, computing equipment available for AI research, AI courses for which graduate credit may be obtained, and whom to contact to apply for graduate admission. Each entry is in the university's language of instruction.

The information is based on responses to questionnaires mailed to a CSCSI/SCEIO member at each university. The entries are alphabetical by postal code, *i.e.*, approximately east to west.

Répertoire des programmes diplômés en IA offerts par les universités canadiennes

Ce répertoire intéressera les étudiants recherchant une université canadienne qui offre un programme diplômé qui leur convienne, en IA. Les professeurs conseillant ces étudiants, ainsi que les personnes en milieu industriel ou gouvernemental ayant besoin de l'expertise en IA d'une université avoisinante voudront également le consulter.

Chaque entrée comprend la liste des programmes offerts, le nombre d'inscriptions pour chacun de ceux-ci, le nom des professeurs et des autres chercheurs travaillant en IA, ainsi que leurs domaines d'intérêt, le matériel disponible, les cours d'IA crédités, et le nom de la personne à qui s'adresser pour faire une demande d'admission. Chaque entrée est rédigée dans la langue d'enseignement de l'université.

Les renseignements proviennent d'un questionnaire envoyé, dans chaque université, à un membre du CSCSI/SCEIO. Le répertoire suit l'ordre alphabétique des codes postaux, *i.e.*, approximativement d'est en ouest.

Dalhousie University

• Computing Science Division
Department of Mathematics, Statistics, and Computing Science
Halifax, Nova Scotia B3H 3J5

Programmes

MSc programme (current enrolment: 4 students in AI). No PhD programme.

AI faculty and staff

Jan Mulder: Vision, image understanding.
Richard Rosenberg: Natural language understanding, social issues.

Research equipment

Vax 11/750 and 11/780 running Berkeley Unix; Sun workstation.

Graduate AI courses

Computational Linguistics (Rosenberg): Introduction to natural language understanding. Review of a number of AI systems.
Computational Vision (Mulder): Introduction to image understanding, edge detection, region formation, polyhedral scenes, knowledge-based systems.

Enquiries

Prof. P. Stewart, Graduate Secretary of the Department (902-424-8855), or R. Rosenberg, Director, Computer Science Division (902-424-2572).

Université Laval

• Département d'informatique
Ste-Foy, Québec G1K 7P4

Programmes

Maîtrise (14 étudiants inscrits en IA). Le programme de doctorat est en voie développement.

Professeurs et chercheurs en IA

Martin Janta: Langue naturelle.
Ruddy Lelouche: Systèmes experts, systèmes d'apprentissage.
Bernard Moulin: Représentation de connaissances, systèmes à base de connaissainces, méthodes de conception.
Spencer Star: Apprentissage, systèmes experts appliqués à l'économie.
Minh Duc Bui: Robotique.

Matériel pour la recherche

Vax 11/780 (Common Lisp, Prolog II, OPS5); plusieurs IBM PC-ATs (Golden Common Lisp, Micro-prolog, Prolog II); plusieurs Microvaxes; quelques postes de travail Sun; de machines Lisp dans un avenir rapproché.

Cours diplômés en IA

Représentation des connaissances et modélisation conceptuelle (knowledge representation and conceptual modelling) (Lelouche et Moulin).
Conception et architecture de systèmes experts (Design and architecture of expert systems) (Lelouche et Star).
Systèmes à base de connaissances dans l'organisation (sujet spécial) (Knowledge-based systems in organizations) (Moulin).
Traitement de la langue naturelle (sujet spécial) (Natural language processing) (Janta et Moulin).
Séminaire de recherche en IA (sujet spécial) (Research seminar in AI) (Janta et Moulin).

Renseignements

Lam Locong, directeur du programme diplômé (418-656-7407 ou 656-7979), ou Bernard Moulin (418-656-5580 ou 656-7979).

McGill University

• Electrical Engineering Department
3480 University Street
Montreal, Quebec H3A 2A7
• School of Computer Science
805 Sherbrooke Street West
Montreal, Quebec H3A 2K6

Programmes

Electrical Engineering

MSc and PhD programmes.

Computer Science

MSc programme (current enrolment: 15 students in AI). PhD programme (current enrolment: 4 students in AI).

AI faculty and staff

Electrical Engineering

Martin Levine: Vision.
Steve Zucker: Vision.
L. Daneshmond: Expert systems in robotics.
V. Hayward: Expert systems in robotics.

Computer Science

Monroe Newborn: Search problems, heuristic search, game-playing programs.
Sue Whitesides: Robotics.
Godfried Toussaint: Pattern recognition.

Research equipment

Electrical Engineering

Vax 11/780; two Vax 11/750s; 4 Suns; 2 Symbolics Lisp machines; assorted image input and display devices (Grinnell, Optronix, etc.).

Computer Science

Data General multiprocessing system for work on parallel search problems; Vax 11/750 for general research.

Graduate AI courses

Electrical Engineering

Artificial Intelligence (Hayward).
Image Processing & Communication (Levine).
Computer Vision (Zucker).

Computer Science

Parallel Search Problems (Newborn).
Pattern Recognition I, II (Toussaint).
Robot Movement (Whitesides).

Enquiries

Lisa Brisbois at School of Computer Science, or Computer Vision and Robotics Lab (514-392-5387) or Department of Electrical Engineering (514-392-5415).

Other notes

Related activities on campus:
(1) McGill Center for Research in Intelligent Machines (contact P. Belanger).
(2) McGill Cognitive Science Center (contact M. Seidenberg).

Université de Montréal

• Département d'informatique et de recherche opérationnelle
• Département de psychologie
• Département de linguistique et philologie
C.P. 6128, Succ. A.
Montréal, Québec H3C 3J7

Programmes

La Faculté des études supérieures prévoit l'implantation en janvier 1986 d'un protocole d'études multidisciplinaires en intelligence artificielle qui regroupera des cours gradués provenant des départements d'informatique, de linguistique et les sciences cognitives (psychologie, éducation et communication). Ces cours favoriseront l'interdisciplinarité et la complémentarité des différentes orientations.

Présentement, il a 15 étudiants de maîtrise et 5 étudiants de doctorat qui travaillent en IA et qui pourront s'inscrire à ces programmes éventuels.

Professeurs et chercheurs en IA

Sciences Cognitives

Pat Cavanagh: Vision, perception.
S. Larochelle: Sciences cognitives, langage, mémoire.
George Baylor: Sciences cognitives, résolution de problèmes à traverse le rêve.
L. Giroux: Mémoire sémantique, communications.
A. Dufresnes: Sciences cognitives, systèmes interactifs.
Gisèle Lemoyne: Sciences cognitives, apprentissage.

Informatique

Guy Lapalme: Traitement de langue naturelle, génération de texte.
Paul Bratley: Informatique dans les humanités, représentation des connaissances.
Jean Vaucher: Systèmes experts, programmation orientée objet.
Michel Boyer: Programmation logique, traitement de la langue naturelle.

Linguistique

Richard Kittredge: Domaines restreints, génération de texte.
J. Y. Morin: Théorie du passage, analyseurs déterministes.
Igor Mel'cuk: Théorie sous-texte, lexique.

Matériel pour la recherche

Vax 11/750 au Département d'informatique; Vax 11/780 au Centre de calcul de l'Université; PDP-11 au Département de psychologie; 6 machines Xerox 1108-32 (Dandetigers); 13 stations Sun dont 1 réservée au Laboratoire Incognito plusieurs micros IBM PC et Macintosh répartis dans les départements.

Cours diplômés en IA

IFT 3132: Programmation Heuristique (Lapalme): Introduction à l'IA.
IFT 6010: Intelligence Artificielle (Bratley): Sujets spéciaux d'IA: cette année, raisonnements flous, fondements de la programmation logique, génération de texte.
PLU 6009: Cours pluridisciplinaire en IA: Collaboration de plusieurs professeurs d'informatique, linguistique et psychologie/éducation. Problématique des problèmes d'IA dans chacun des domaines d'intérêt des chercheurs.
LNG 6000: Linguistique théorique (Morin).
LNG 6020: Problèmes de lexicologie (Mel'cuk).
LNG 6200: Linguistique informatique (Kittredge).
LNG 6210: Traduction automatique: (Kittredge).
PSY 6061: Modèles des processus psychiques (Baylor).
PSY 6062: Intelligence artificielle et psychologie (Larochelle).
PSY 6063: Cybernétique: applications psychologiques (Larochelle, Baylor).
PSY 6064: Les modèles psycho-informatiques (Larochelle).

PSY 6102: Traitement d'images (Cavanagh).
PSY 6112: Les rêves en sciences cognitives (Baylor).
PSY 6182: Transformation mnémonique de l'information (Cavanagh).
EEI 6525: Représentations des notions mathématiques chez les enfants (Lemoyne).
EEI 6522: Modélisation des processus d'apprentissage (Lemoyne).

Renseignements

Guy Lapalme, Dépt. d'informatique (514-343-7220 ou 514-343-6966) ou Richard Kittredge, Dépt. linguistique (514-343-7932 ou 514-343-6220) ou George Baylor (514-343-7633 ou 514-343-6602) ou Maurice St-Jacques, Faculté des études supérieures (514-343-5891).

Université du Québec à Montréal

• Département de mathématiques et d'informatique
C. P. 8888, Succ. A
Montréal, Québec H3C 3P8

Programmes

Maîtrise (5 étudiants inscrits en IA). Aucun programme de doctorat.

Professeurs et chercheurs en IA

F. Bergeron: Calcul symbolique pour l'analyse combinatoire.
Lorne Bouchard: Langue naturelle: création et analyse de documents.
M. Bouisset: Systèmes experts pour la modélisation des données la conception de bases de données.
Simon Curry: Calcul symbolique pour la conception de systèmes intégrés à trés grande échelle (VLSI).
A. Friedman: Reconnaissancde des formes.
I. Maffezzini: Systèmes experts pour l'analyse des spécifications des exigences du logiciel.
C.L. Nguyen: Langue naturelle: préprocesseurs pour les bases de données.
C. Pichet: Systèmes experts pour l'analyse combinatoire.
E. Tropper: Systèmes experts pour l'optimisation de communications par réseau.

Matériel pour la recherche

DEC KL10; deux DEC Vax 11/750; Amdahl V8; Microvax II; IBM PCs.

Cours diplômés en IA

INF7740: Reconnaissance des formes (Friedman).
INF7840: Intelligence artificielle (Bouchard).
INF8040: Algorithmes non-numériques (Bergeron).
INF8240: Traitements des images par ordinateur (Curry).

Renseignements

Dr. Jacques Labelle, Directeur maîtrises en mathématiques (514-282-7092).

Concordia University

• Department of Computer Science
1455 de Maisonneuve Blvd. West
Montréal, Québec H3G 1M8

Programmes

MSc programme (current enrolment: 10 students in AI). PhD programme (current enrolment: 5 students in AI).

AI faculty and staff

Renato De Mori: Speech understanding (computer hearing), expert systems.
David Probst: Machine learning in large databases, architecture of very large knowledge-based systems.
Rajjan Shinghal: Search.
Ching Suen: Document recognition, image processing.

Research equipment

Vax 11/780 with OPS5, Common Lisp.

Graduate AI courses

COMP N672 Introduction to Artificial Intelligence (Shinghal).
COMP N771 Artificial Intelligence (De Mori).
COMP N772 Man-Machine Communication (Suen).
COMP N773 Seminar in Man-Machine Communication (De Mori).
COMP N776 Advanced Artificial Intelligence (Shinghal).

Enquiries

David Probst (514-848-3023) or Dr. Hon F. Li (514-848-3020) or Department of Computer Science (514-848-3000).

Other notes

The Department also has a commitment to high-level computer science research in VLSI. Although the VLSI team will require extensive CAD and database tools for its research on the design and validation of VLSI algorithms and architectures, the team has no intention, at present, of doing research in the area of knowledge-based design.

University of Ottawa

• Department of Computer Science
34 Somerset Street, East
Ottawa, Ontario K1N 9B4

Programmes

MSc programme (current enrolment: 4 students in AI). No PhD programme, but PhD students can work through Department of Electrical Engineering (current enrolment: 1 student in AI).

AI faculty and staff

Doug Skuce: Expert systems, logic programming; knowledge representation, natural language.
Stan Matwin: Expert systems, logic programming; knowledge representation, natural language.
Stan Szpakowicz: Expert systems, logic programming; knowledge representation, natural language.
T. Oren: Expert systems, software engineering, and modelling and simulation.
R. Probert: Expert systems.

Research equipment

Amdahl V8; Vax 11/750; two Sun model 130 (ordered); two Xerox model 1186 (ordered).

Graduate AI courses

CSI 5180 Introduction to AI (Skuce, Szpakowicz). Texts: Winston; Charniak.
CSI 5106 Introduction to Expert Systems (Skuce). Texts: Hayes-Roth, Waterman, and Lenat; Waterman, *A Guide to Expert Systems.*
CSI 5181 Applications of AI in Software Development.
CSI 5386 An Introduction to Natural Language Processing (Szpakowicz) Text: Harris.

Enquiries

Write to the Department at the address above.

Queen's University

• Department of Computing and Information Science
Kingston, Ontario K7L 3N6

Programmes

MSc programme (current enrolment: 7 students in AI). PhD programme (current enrolment: 1 student in AI).

AI faculty and staff

Janice Glasgow: Logic programming, expert systems.
Michael Jenkins: Logic programming, expert systems.
Roger Browse: Vision, robotics.
Z. Stachniak (visiting professor): Theorem proving.

Research equipment

Vax 11/780; Symbolics Lisp machine; IBM mainframe; personal workstations and microcomputers.

Graduate AI courses

CISC 852 Computational Vision (Browse).
CISC 856 Artificial Intelligence (Stachniak).
CISC 866 The Logic of Programming Languages (Glasgow).

Enquiries

Graduate Chairman (613-547-2711).

Brock University

• Department of Computer Science and Information Processing
St. Catherines, Ontario L2S 3A1

Programmes

No graduate programmes at present.

AI faculty and staff

Jerzy Barchanski: Knowledge engineering applied to computer network protocols diagnosis expert systems, robotics.
John Mitterer (Dept of Psychology): Computational models of human cognitive processes.

University of Toronto

• Department of Computer Science
Toronto, Ontario M5S 1A4

Programmes

MSc programme (current enrolment: 15 students in AI). PhD programme (current enrolment: 25 students in AI).

AI faculty and staff

Evangelos Milios: Knowledge-based signal processing.
Russ Greiner: Learning, knowledge acquisition, knowledge representation.
Armin Haken: Learning procedural knowledge, connectionism, complexity.
Graeme Hirst: Natural language understanding, cognitive science.
Allan Jepson: Low-level vision.
Bryan Kramer: Knowledge representation, knowledge-based systems.
Hector Levesque: Knowledge representation, logics of belief.
John Mylopoulos: Knowledge representation, AI and databases.
Ray Reiter: Knowledge representation, diagnostic reasoning.
Taro Shibahara: Knowledge-based systems, AI applications.
John Tsotsos: Vision, understanding motion, AI in medicine, expert systems.

Research equipment

Eight Symbolics 3640 Lisp machines; one Vax 11/780; three CDA colour graphics work stations; five Sun workstations; Imagen 8/300 laser printer.

Graduate AI courses

2505 Introduction to Artificial Intelligence (Tsotsos).
2530 Applications of Artificial Intelligence (Kramer and Shibahara).
2523 Introduction to Computer Vision Systems (Tsotsos).
2501 Introduction to Computational Linguistics (Hirst).
2528 Topics in Computational Linguistics (Hirst).
2532 Logic and Artificial Intelligence (Reiter).
2533 Foundations of Knowledge Representation (Levesque).
2534 Applications of Knowledge Representation (Mylopoulos).

Enquiries

Prof J. N. P. Hume, Graduate Coordinator, or Voula Vannelli, Graduate Admissions Officer (416-978-8762).

University of Waterloo

• Department of Computer Science
Waterloo, Ontario N2L 3G1

Programmes

MSc programme (current enrolment: 10 students in AI). PhD programme (current enrolment: 9 students in AI).

AI faculty and staff

Romas Aleliunas: Logic programming systems and architecture, deviant logics.
Robin Cohen: Natural language understanding, discourse understanding.
Marlene Jones: Expert systems, intelligent computer-aided instruction, machine learning.
Randy Goebel: Knowledge representation, logic programming.
David Poole: Automated reasoning, logic programming.
M. H. van Emden: Logic and functional programming.

Research equipment

Half of a Vax 11/785; several Apple Macintoshes; IBM PC-XT.

Graduate AI courses

CS 686: Introduction to AI (Cohen, Goebel, Jones, Poole): Fundamental principles of representation and reasoning.
CS 643: Functional and Logic Programming (Goebel, van Emden): Declarative programming with functions and relations.
CS 786: Knowledge representation (Goebel).
CS 786: Computational Linguistics (Cohen).
CS 786: Expert Systems (Jones).
CS 740: The Theory of Logic Programming (van Emden).
CS 760: Deviant Logics in AI (Aleliunas).

Enquiries

Graduate Secretary (519-885-1211 ext. 3112).

Other notes

All AI research is done within the department's Logic Programming and Artificial Intelligence Group, a federated group of the University of Waterloo's Institute for Computer Research. We have regular general meetings, and several special interest subgroups on common-sense reasoning, learning, and logic programming implementation.

University of Western Ontario

• Department of Computer Science
Middlesex College
London, Ontario N6A 5B7

Programmes

MSc programme (current enrolment: 6 students in AI). PhD programme in preparation.

AI faculty and staff

A. N. Abdallah: Semantics of logic programming languages.
E. W. Elcock: Logic programming, expert systems.
Bob Mercer: Logics for human reasoning.
Ed Stabler: Natural language understanding systems.
Zenon Pylyshyn: Perception, general cognitive science.

Research equipment

DEC 1091; Vax 8600; IBM 4341.

Graduate AI courses

CS551b Artificial intelligence.
CS630a Image analysis and applications.
CS650a Problem solving in AI.
PSY557 Human and machine vision.

Research equipment

Dr. I. Gargantini, Graduate Chairman.

Other notes

The Department is the focus for an interdisciplinary group on logic programming. The group includes faculty members and graduate students from Computer Science, Philosophy, and Mathematics. The group holds a bi-weekly working seminar supporting joint research.

The Centre for Cognitive Studies, under the directorship of Dr. Zenon Pylyshyn, is currently planning a tri-disciplinary undergraduate course in Cognitive Science. The three contributing disciplines are Computer Science, Philosophy, and Psychology.

University of Regina

• Department of Computer Science
Regina, Saskatchewan S4S 0A2

Programmes

MSc programme (current enrolment: 3 students in AI). No PhD programme.

AI faculty and staff

Gerard K. Rambally: Expert systems, natural language processing, AI in education.
Hazam Raafat: Vision.

Research equipment

Prolog and Lisp on Vax 11/780.

Graduate AI courses

CS 820 Artificial Intelligence (Rambally): Survey of topics in AI.
CS 890 Special Topics in AI (Rambally, Raafat): Depending on demand, this could be a class in: expert systems, natural language, knowledge representation, vision, etc.

Enquiries

Gerard Rambally (306-548-4700).

University of Saskatchewan

• Department of Computational Science
Saskatoon, Saskatchewan S7N 0W0

Programmes

MSc programme (current enrolment: 5 students in AI). PhD programme (current enrolment: 2 students in AI).

AI faculty and staff

Gord McCalla: AI applications in education, dynamic planning, natural language understanding.
Herb Yang: Image processing, motion analysis.
Tony Kusalik: Fifth generation computing, logic programming.

Research equipment

Pyramid 90X; Vax 11/750 and 11/780; four Sun workstations; two graphics terminals; DEC 2060 and DEC 8086 mainframes.

Graduate AI courses

CMPT 832: Artificial Intelligence (McCalla): Introduction to AI at the graduate level.
CMPT 872: Topics in Artificial Intelligence (McCalla, Kusalik): In-depth examination of selected topics in AI.
CMPT 879: Topics in Image Processing and Analysis (Yang): Overview of image processing and analysis, followed by a detailed look at certain image processing and pattern recognition techniques.

Enquiries

Prof. J. M. Keil, Graduate Student Correspondent, or the Dean of Graduate Studies.

University of Calgary

• Department of Computer Science
2500 University Drive N.W.
Calgary, Alberta T2N 1N4

Programmes

MSc programme (current enrolment: 8 students in AI). PhD programme (current enrolment: 2 students in AI).

AI faculty and staff

John Cleary: Logic programming, adaptation and learning.
Brian Gaines (Killam Professor): Knowledge representation, AI machine architecture.
David Hill: Pattern recognition, adaptation and learning, man-machine interface.
John Kendall: Development of deep-knowledge expert systems, in particular in VLSI design systems.
Ian Witten: Natural language, man-machine interface, adaptation and learning.
(Three new faculty members will be announced in January 1986. All are expected to be involved in AI to some extent.)

Research equipment

Vax 11/780 (14MB, Dual Processor); two Xerox 1100s; 28 Corvus Concepts in network; access to three Vax 11/780s (one with dual processor), Honeywell Multics, CDC 205; six Sun 375 workstations and 2 file servers on order.

Graduate AI courses

CPSC 670 Artificial Intelligence (Cleary, Vollmerhaus, Gaines).
CPSC 681 Human-Computer Interaction (Hill).
CPSC 433 Inference and the Automation of Reasoning (Cleary).
(The curriculum is presently being revised to improve the AI stream.)

Enquiries

Dr. Jon Rokne, Director of Graduate Affairs (403-220-6016) or Lorraine Storey, Graduate Secretary (403-220-3528 or 220-6015).

Other notes

Brian Gaines, the Killam Professor of Computer Science is setting up a Knowledge Sciences Institute, which will be involved with all aspects of Knowledge Engineering.

Strong ties are being developed with cognitive psychologists

and philosophers in the University.

University of Alberta

• Department of Computing Science
Edmonton, Alberta T6G 2H1

Programmes

MSc programme (current enrolment: 14 students in AI). PhD programme (current enrolment: 4 students in AI).

AI faculty and staff

W. W. Armstrong: Adaptive pattern recognition.
W. A. Davis: Image processing.
R. Elio: Expert systems.
T. A. Marsland: Tree searching.
F. J. Pelletier: Natural language understanding, theorem proving.
J. Schaeffer: Tree searching.
L. K. Schubert: Natural language understanding, question answering, knowledge representation, robotics.
K. V. Wilson: Natural language processing.

Research equipment

Four Xerox 1186 Lisp machines; Amdahl 5860; time-sharing network of four Vax 11/780s and 11 Sun workstations running Common Lisp picture processing and graphics lab using the network, together with a PDP 11/45, two Norpak VDP color frame buffers, two Jupiter 7 frame buffers and an IIS image processor; attached to these are a TV camera, tablet, trackball and joystick inputs, several high resolution color monitors, and color camera outputs). A Vax 11/730 and a variety of mini- and microcomputer systems are also available, as is a multiprocessor tree machine with six CPU nodes. A robotics lab has recently been established, featuring a modified Heathkit Hero-1 (ET-18) robot linked to the Vax/Sun network.

Graduate AI courses

CMPUT 551 Artificial intelligence I (Schubert, Elio): Reasoning and planning.
CMPUT 552 Artificial intelligence II (Schubert, Pelletier): Computational linguistics and other topics in semantic information processing.
CMPUT 509 Knowledge-based systems (Elio).
CMPUT 665 Seminar in AI (Schubert).
CMPUT 5XX, 6XX Various AI-related courses have been offered under various course numbers; e.g., image processing, computer animation, and biological information processing.

Enquiries

Graduate Committee Chairman (Graduate Secretary: 403-432-4194).

Simon Fraser University

• School of Computing Science
Burnaby, B.C. V5A 1S6

Programmes

MSc programme (current enrolment: 15 students in AI). PhD programme (current enrolment: 7 students in AI).

AI faculty and staff

Nick Cercone: Natural language understanding, knowledge representation, computational linguistics.
Veronica Dahl: Logic programming, natural language understanding, computational linguistics.
Jim Delgrande: Knowledge representation, incomplete knowledge bases.
Brian Funt: Computer perception, vision.
Bob Hadley: Computational linguistics, learning.
Paul McFetridge: Computational linguistics.
Tom Calvert: Biomedical applications, animation.
Tom Poiker: Picture processing, computer mapping.

Research equipment

Two Vax 11/750s; 20 Sun workstations; two Iris workstations; IIS imaging system; Lambda 2×2 Plus Lisp machine; distributed systems accessed via Ethernet; IBM 3081.

Graduate AI courses

820: Artificial Intelligence (Cercone, Hadley, Funt, Delgrande, Dahl).
821: Pattern Recognition and Image Processing (Bhattacharya, Funt).
822: Computational Vision (Bhattacharya, Funt).
882: Special Topics in AI (Cercone, Hadley, Funt, Delgrande, Dahl).
861: Biomedical Computing (Calvert).
862: Computer Mapping (Poiker).

Enquiries

Dr. A. Liestman, Director of Graduate Programs.

Other notes

Weekly AI discussion group meetings are held (informally) under the direction of Jim Delgrande.

University of British Columbia

• Department of Computer Science
6356 Agricultural Road
Vancouver, B.C. V6T 1W5

Programmes

MSc programme (current enrolment: 12 students in AI). PhD programme (current enrolment: 5 students in AI).

AI faculty and staff

Paul Gilmore: Theory and design of databases, mathematical logic, applied optimization.
William Havens: Computer vision, image processing and graphics, interactive programming languages, microcomputers and systems.
Alan Mackworth: Computational vision, image processing applications, languages for problem solving and perception
Richard Rosenberg: Natural language processing, AI and society. (On leave 1985–86.)
Robert Woodham: Image analysis, remote sensing, productivity technology.

Research equipment

The department maintains Vaxes, Sun workstations (4.2BSD Unix), PDP/11's (V7 Unix) and TI 990/10's (Verex). The Laboratory for Computational Vision has a Vax 11/780 with a tape drive and 300 megabytes of disk, a Comtal Vision One and a Rastertech image analysis and display system, and an Optronics C-4500 color film scanner-writer. Local area networks using both a Cambridge Ring and an Ethernet interconnect the Department computers.

The UBC Computing Centre has an Amdahl V/8 and an Amdahl V/7 attached to a local area network with 1000 remote high-speed terminals, operating under the Michigan Terminal System (MTS). Most general-purpose programming languages are available, as well as many special-purpose ones.

Graduate AI courses

502 Artificial Intelligence I: An introduction to AI emphasizing various approaches to the representation of domain-specific knowledge.
503 Computational Linguistics I: Formal models for natural language, syntactic analysis by computer.

(Continued on page 42)

Book Reviews and Publishing News

Performance and evaluation of Lisp systems
Gabriel, Richard P
[Stanford University and Lucid, Inc]
(MIT Press series in Computer Systems)
The MIT Press, 1985, 285 pp.
ISBN 0-262-07093-6, pbk., $^{US}22.50

Reviewed by
Rayan Zachariassen
University of Toronto

This book is a collection of information and data about the implementation and performance of Lisp systems. The material was gathered as part of the 3½-year Stanford Lisp Performance Study, from people familiar with the Lisp systems they were providing information about. In many cases the sources of the information are the implementors themselves, and the quality of the people who furnished the information shows in the quality of material in the book.

The book contains three chapters corresponding to sections of the book. Chapter One is a general introduction to the components that make up a Lisp system and the facilities provided in such systems. It includes a discussion of the effect of the underlying hardware, choice of variable binding model, function calling, data structures, type checking, and arithmetic. This is all with a view to how the performance of an implementation might be affected by for example the hardware architecture, or by different methods of achieving the same functionality. The chapter ends aptly by discussing benchmarking, how it is done and what can influence the results. I say 'aptly', because the rest of the book is dedicated to presenting Lisp systems and benchmarks (including results) that have been run on those Lisp systems.

Chapter Two devotes a subsection each to the Lisp dialects: MacLisp, MIT CADR, Symbolics, LMI Lambda, S-1 Lisp, Franz Lisp, NIL, Spice, Vax Common Lisp, Portable Standard Lisp, Xerox (Interlisp) D-machine, and Data General Common Lisp. The sections describing Lisp machines devote comparatively much space to presenting the hardware support for Lisp built into the machine. For example, because the MIT CADR, the Symbolics 3600, and the LMI Lambda all run very similar versions of ZetaLisp, the interesting comparison is in the different approaches to implementing the same user-level functionality.

The final chapter, taking up two-thirds of the book, presents a series of benchmarks that seem to cover most aspects of Lisp system performance. Each benchmark includes its Common Lisp code — major changes to the code for other dialects are noted — a discussion of what the benchmark tests and how, the raw data of both instruction counts and timing results for many different implementations of Lisp (including results for the same dialect run on different hardware). As examples of the benchmarks included, there is one that behaves much as a theorem prover would, another that does pattern matching, a polynomial evaluation benchmark, input-output benchmarks, and, of course, recursion and pure arithmetic.

If you have implemented, or are thinking of implementing, an extensible language using ideas from Lisp (including, possibly, a dialect of Lisp) this book is a very valuable resource. The book is well written, the style is lucid and informative. One would need a non-trivial background in Lisp to be able to absorb the information in the benchmark discussions, but the first two sections of the book are well suited as an introduction to the considerations that go into all levels of a Lisp system, and to the designs adopted by actual implementations. That material would be good for a course in high-level language architectures.

So, you ask, which was the fastest Lisp system? No one implementation really is *the* fastest. They are too different in their emphasis for one to be able to make a fair across-the-board comparison. A rough ranking would be: single-user mainframes, descendants of the MIT CADR Lisp machine, trailed by the rest of the pack. □

Rayan Zachariassen looks after the Lisp machines at the University of Toronto, Department of Computer Science.

(Continued next page)

A Guide to Expert Systems

Waterman, Donald A
[The Rand Corporation]

(The Teknowledge series in knowledge engineering)
Reading, MA: Addison-Wesley, 1986
xviii+419 pp., ISBN 0-201-08313-2, $^{CDN}37.75

Reviewed by
John Tsotsos,
University of Toronto

The expert systems 'hoopla' can get pretty annoying at times. It almost seems as if funding agencies, government, and industry immediately connect AI research with expert systems, and this can be frustrating for the serious AI researcher, say, in vision (just to pick a 'random' area). This book certainly does nothing to add some sanity back into the field. In fact, one could easily believe that it was written for the sole purpose of capitalizing on the hype.

To the AI researcher, in my opinion, it is not a terribly useful book. One can only endure through so many MYCIN and PROSPECTOR and XCON examples before one is thoroughly convinced that there is really nothing mystical about these systems. In fact, one immediate conclusion — which is correct — is that there simply aren't many expert systems out there in real production environments, if, in each overview of the area, the same examples are being used. Applications are never as simple as they seem, and the experts systems that have been successful are as dependent on the fortuitous choice of application domain as they are on the talents of the developers and the environments in which they were developed.

However, it is really not fair for me to use this space as a platform for criticizing the hype surrounding expert systems. After all, I am supposed to be reviewing Waterman's book. On the other hand, the book is intended as a guide to expert systems and their development, and the thoughts in the previous paragraph are my immediate reactions to the book.

The material in the book is presented in six major sections: an introduction; a discussion of tools; a 'recipe' for building expert systems; a presentation of possible pitfalls; expert systems and the market place; and, an overview of existing systems, research labs, and software.

The first half of the book presents a very simple-minded view of the research, design, implementation, and validation of expert systems, far too simple to be a true reflection of reality for those of us who have actually built an expert system, and struggled through each phase over a period of years. The last section is approximately half the book, and is the most useful from my point of view. A good reference list is provided, a discussion of application domains, and much other useful information for labs that are starting to think in these terms.

However, the book suffers from myopia in the same way that Feigenbaum's *Fifth Generation* book does; that is, the world consists of the United States, and the important work that is being done in Europe, Japan, and Canada, for example, is ignored. I could speculate on why this is so, but I'll keep my thoughts on this to myself for now.

This book is a good introduction to the field for the corporate or government person interested in expert systems. I can recommend it for such an audience as perhaps the best collection of introductory information on the topic. The researcher, however, would find it more useful to spend his time on continuing his research, rather than on reading this book, but may find it a useful addition to his library for the reference value of the last half of the book. □

John Tsotsos is Principal Investigator of the second generation expert systems project at the University of Toronto, Department of Computer Science, and is co-director of the Research in Biological and Computational Vision Group in that department.

Short review

Artificial Intelligence:
Concepts, Techniques and Applications

Shirai, Yoshiaki and Tsujii, Jun-ichi
[University of Tokyo and University of Kyoto]
(F. R. D. Apps, translator)

(Wiley series in Computing)
A Wiley-Interscience publication,
distributed by John Wiley and Sons Canada Ltd
Japanese edition, 1982; English edition, 1984
viii+177 pp., ISBN 0-471-90581-X, pbk., $^{CDN}25.95

This book presents a view of AI that was current in the 1970s: AI as the study of representing problems as state-space graphs, and searching the graphs for solutions. Although there is a chapter on knowledge representation, it is not given the prominence appropriate in 1985. Despite the last word of the title, there is very little on applications. There is also little or nothing on such essential subfields of AI as machine vision and language understanding.

G. H.

(Continued next page)

Books received

Research and development in expert systems: Proceedings of the Fourth Technical Conference of the British Computer Society Specialist Group on Expert Systems, University of Warwick, 18–20 December 1984

Bramer, Max A (editor)
[Computing Science, Thames Polytechnic]

(The British Computer Society Workshop Series)
Cambridge University Press,
on behalf of the British Computer Society
1985, vii+228 pp., ISBN 0-521-30652-3, $^{US}34.50

Programming in Common Lisp

Brooks, Rodney A
[Massachusetts Institute of Technology]

John Wiley & Sons Canada Ltd, 1985, xv+303 pp.
ISBN 0-471-81888-7, pbk., $^{CDN}29.95

Getting computers to talk like you and me: Discourse context, focus, and semantics (An ATN model)

Reichman, Rachel
[Department of Computer Science,
University of California, San Diego]

Cambridge, MA: The MIT Press, 1985, xiii+221 pp.
ISBN 0-262-18118-9, $^{US}20.00

Computer speech processing: Contributions by speakers at an advanced course on computer speech processing held at the University of Cambridge, 1983

Fallside, Frank and Woods, William A (editors)
[Cambridge University and Applied
Expert Systems]

London: Prentice-Hall International, 1985
xxi+506 pp., ISBN 0-13-163841-6, $^{CDN}55.95

Teleoperation and robotics: Evolution and development

Vertut, Jean and Coiffet, Philippe

(Robot technology, volume 3A)
Englewood Cliffs, NJ: Prentice-Hall Inc
and Toronto: Prentice-Hall Canada Inc
1986, 332 pp., ISBN 0-13-782194-8, $^{CDN}40.95
[Translated from French. Original edition published 1984 by Hermes Publishing.]

Abstracts of papers in *Computational Intelligence*, 1(3), August 1985

[*Note:* Production of *Computational Intelligence* is behind schedule. Issue 1(2) was mailed in November, and issue 1(3) is in production. The editors are working to bring the journal back on schedule.]

Generating paraphrases from meaning-text semantic networks

Michel Boyer and Guy Lapalme

This paper describes a first attempt to base a paraphrase generation system upon Mel'cuk and Zolkovskij's linguistic Meaning-Text (MT) model whose purpose is to establish correspondences between meanings, represented by networks, and (ideally) all synonymous texts having this meaning. The system described in the paper contains a Prolog implementation of a small explanatory and combinatorial dictionary (the MT lexicon) and, using unification and backtracking, generates from a given network the sentences allowed by the dictionary and the lexical transformations of the model. The passage from the net to the final texts is done through a series of transformations of intermediary structures that closely correspond to MT utterance representations (semantic, deep-syntax, surface-syntax and morphological representations). These are graphs and trees with labeled arcs. The Prolog unification (equality predicate) was extended to extract information from these representations and build new ones. The notion of utterance path, used by many authors, is replaced by that of "covering by defining subnetworks".

Spatiotemporal inseparability in early vision: Centre-surround models and velocity selectivity

David J. Fleet and Allan D. Jepson

Several computational theories of early visual processing, such as Marr's zero-crossing theory, are biologically motivated and based largely on the well-known difference of Gaussians (DOG) receptive field model of early retinal processing. We examine the physiological relevance of the DOG, particularly in the light of evidence indicating significant spatiotemporal inseparability in the behaviour of retinal cell type.

From the form of the inseparability we find that commonly accepted functional interpretations of retinal processing based on the DOG, such as the Laplacian of a Gaussian and zero-crossings, are not valid for time-varying images. In contrast to current machine-vision approaches, which attempt to separate form and motion information at an early stage, it appears that this is not the case in biological systems. It is further shown that the qualitative form of this inseparability provides a convenient precursor to the extraction of both form and motion information. We show the construction of efficient mechanisms for the extraction of orientation and 2-D normal velocity through the use of a hierarchical computational framework. The resultant mechanisms are well localized in space-time, and can be easily tuned to various degrees of orientation and speed specificity.

(Continued next page)

Hierarchical arc consistency: Exploring structured domains in constraint satisfaction problems

Alan K. Mackworth, Jan A. Mulder, and William S. Havens

Constraint satisfaction problems can be solved by network consistency algorithms that eliminate local inconsistencies before constructing global solutions. We describe a new algorithm that is useful when the variable domains can be structured hierarchically into recursive subsets with common properties and common relationships to subsets of the domain values for related variables. The algorithm, HAC, uses a technique known as hierarchical arc consistency. Its performance is analyzed theoretically and the conditions under which it is an improvement are outlined. The use of HAC in a program for understanding sketch maps, Mapsee3, is briefly discussed and experimental results consistent with the theory are reported.

A theory of schema labelling

William Havens

Schema labelling is a representation theory that focuses on composition and specialization as two major aspects of machine perception. Previous research in computer vision and knowledge representation have identified computational mechanisms for these tasks. We show that the representational adequacy of schema knowledge structures can be combined advantageously with the constraint propagation capabilities of network consistency techniques. In particular, composition and specialization can be realized as mutually interdependent cooperative processes which operate on the same underlying knowledge representation. In this theory, a schema is a generative representation for a class of semantically related objects. Composition builds a structural description of the scene from rules defined in each schema. The scene description is represented as a network consistency graph which makes explicit the objects found in the scene and their semantic relationships. The graph is hierarchical and describes the input scene at varying levels of detail. Specialization applies network consistency techniques to refine the graph towards a global scene description. Schema labelling is being used for interpretating hand-printed Chinese characters, and for recognizing VLSI circuit designs from their mask layouts.

Subscription information

Computational Intelligence is published by the National Research Council of Canada and sponsored by CSCSI/SCEIO. Non-institutional CSCSI/SCEIO members may subscribe for $^{CDN}16, a considerable discount on the regular price. To subscribe, use a copy of the form on the inside back cover of this issue of *Canadian A. I.* The form must be sent to CIPS, who will certify your membership and forward your request to the NRCC. If you wish to subscribe without joining CSCSI/SCEIO, write to: Distribution R-88 (*Computational Intelligence*), National Research Council of Canada, Ottawa, Ontario, CANADA K1A 0R6. Regular rates are $^{CDN}37.50 for individuals, $^{CDN}75 for libraries; add $10 extra for postage outside Canada. Make cheques payable to "Receiver General of Canada, credit NRCC".

Recent AI Technical Reports

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

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University of Toronto

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

Joanne Mager
Department of Computer Science
University of Toronto
Toronto, Ont., CANADA M5S 1A4

Theory and parsing of the coordinate conjunction "and"

Victoria L. Snarr

MSc thesis, TR CSRI-171
September 1985.

Although the conjunction *and* appears to have a simple function in the English language, it has proved to be a stumbling block for both theoretical and computational linguists.

One of the theoretical problems of conjunction is to determine what governs the acceptability of a structure in which two elements are connected by *and*. The corresponding computational problem is, given this knowledge, to incorporate it into an efficient parser for English.

This thesis proposes a solution to the theoretical problem which is in the form of two general constraints — a syntactic constraint and a semantic one; and then incorporates these constraints into a "strictly deterministic" parser for English.

A foundational approach to conjecture and knowledge

James Patrick Delgrande

PhD Thesis, Technical Report CSRI-173
September 1985

A foundational investigation of the notion of hypothesis in knowledge representation schemes is presented. Three major areas are addressed. The first concerns formal issues in forming and maintaining a set of hypotheses, based on a stream of facts or ground atomic formulae. The second concerns deductively reasoning with a set of known and hypothesized sentences, and the relation of such a reasoning system with a hypothesis formation system. The last area, which represents preliminary work, deals with an informal theory of meaning for statements that are in some sense general, and yet admit exceptions.

For the first part, a language *HL*, and from it an algebra and logic, is derived for forming hypotheses and maintaining the consistency of a set of hypotheses. The hypotheses are expressed in set-theoretic terms. Two soundness and completeness results for the logic are presented. Through these formal systems, the set of potential hypotheses is precisely specified and a procedure is derived for restoring the consistency of a set of hypotheses after conflicting evidence is encountered. For the second part, reasoning with knowledge and hypothesis, an existing first-order language, *KL*, that can represent and reason about what it knows is extended to one that can reason with knowledge and hypothesis. The third part, which addresses the issues of exceptions to general statements, is treated by outlining a theory of meaning for naturally occurring classes.

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University of Waterloo

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

Donna McCracken
Department of Computer Science
University of Waterloo
Waterloo, Ontario, CANADA N2L 3G1.

The logical definition of deduction systems

David L. Poole

Research Report CS-84-12

The separation of an algorithm into logic plus control has special benefits in the definition of problem-solving systems. Such a separation allows proving the correctness and completeness of the logic base, independent of the control imposed. The control component can then be developed to enhance the efficiency and explanation whilst preserving the logical power and correctness of the system.

This paper presents the definition of one such logical base for the non-clausal first-order predicate calculus. This logical base specifies how to transform a predicate calculus deduction problem into a problem of searching an AND/OR tree. Different control strategies are developed, with resulting systems combining the efficiency of connection graph proof procedures with the efficiency of non-chronological backtracking. Each implementation uses the input form of the unconstrained first-order predicate calculus, with each step being locally explainable in terms of input given by the user. This allows the debugging and explanation facilities of expert systems to be incorporated into the implementations.

A logical system for default reasoning

David L. Poole

in *Proceedings of the AAAI Non-monotonic Reasoning Workshop*, October 1984, New Paltz, NY, 373–384.

This paper proposes an alternate motivation, justification, syntax and a model-theoretic semantics for default logic. This is a conservative extension of the first-order predicate calculus, to incorporate defaults as well as facts. Provability becomes "explainable by a theory". This theory is like a scientific theory, and must be consistent with the facts. The defaults are the possible hypotheses in a theory.

We outline how a computational mechanism for such a default reasoning system can be obtained from an existing deduction system with negation. The analogy with science is discussed, along with a proposal as to how such reasoning can be used to implement expert diagnosis systems. By allowing the theories to be explicit we overcome many of the problems which motivated the development of non-normal defaults. The problems associated with quantified defaults are also discussed.

On the comparison of theories: Preferring the most specific explanation

David L. Poole

in the *Proceedings of the Ninth International Joint Conference on Artificial Intelligence*, Los Angeles, August 1985

One of the problems with systems that reason with defaults occurs when two contradictory answers can be produced when one is preferable. In this paper, defaults are treated as possible hypotheses in a "scientific" theory to explain the results. Within such a system we propose a theory comparator to resolve conflicts by choosing the result supported by the most specific knowledge. This overcomes many of the problems which motivated non-normal defaults, and produces the correct results in inheritance systems. A model-theoretic semantics for the default logic is defined, as well as a computational mechanism in terms of normal first-order predicate calculus deduction systems. A comparison with other proposals shows that this has advantages in its semantics, and in modularity of knowledge.

The need for pragmatics in natural language understanding

Robin Cohen

in the *Proceedings of the CSCSI Workshop on Theoretical Advances in Natural Language Understanding*, May 1985, Dalhousie University, Halifax, N.S.

This position paper maintains that considering the beliefs, goals, and intentions of the conversants is absolutely critical to the construction of some natural language understanding systems. Two particular examples are studied in detail: *(i)* designing interfaces to interactive systems and *(ii)* constructing a model to understand arguments. The consequence is that the knowledge representation scheme must be more than a blueprint for representing "shared facts". In essence, pragmatic analysis is an important constituent of natural language understanding and user models are thus a critical component of the underlying knowledge representation.

Automated discovery

Paul Van Arragon

Research Report CS-85-14 [M. Math essay]

Discovery learning is the area of AI that attempts to automate the process of scientific discovery. We discuss the definition of discovery learning, and review the previous work in the area, including Lenat's AM (that researches mathematics), EURISKO (a revision of AM that studies several domains), Langley's BACON (that discovers empirical laws), and Aref's system (that discovers data structure concepts). We critique each program and suggest directions for future research.

An expert system for educational diagnosis based on default logic

Marlene Jones and David Poole

Proceedings of the Fifth International Workshop on Expert Systems & their Applications, May 13–15, Avignon, France, 673–683

This paper shows how a formal logic can be used to build an expert system with an explicit semantics so that the knowledge can be understood without appealing to the working of the system. This is based on a default logic, which was explicitly designed to handle incomplete knowledge of the form found in diagnosis problems. The defaults correspond to possible hypotheses we are prepared to accept in a diagnosis. The diagnosis consists of finding the best theory that explains the symptoms. The semantics of the system and a definition of "best" are provided, which allows us to reason in an efficient, hierarchic manner to do a diagnosis. It is shown how this approach can be employed in an expert system for diagnosing or assessing children with learning disabilities.

Expert systems: Their potential roles within special education

Marlene Jones

Peabody Journal of Education, **62**(1), 52–66

We investigate the potential of expert systems within the field of education, particularly special education.

Student models: The genetic graph approach

B. J. Wasson

Research Report CS-85-10 [M. Math thesis]

A major component of an intelligent computer-aided instruction system is the student model. We identify certain criteria which an ideal student model must satisfy and we use these criteria to evaluate existing

modelling techniques. One particularly promising approach, due to Goldstein, is to use a genetic graph as a framework from which the student model is obtained. Goldstein's method is described and its potential as a base for the student model is examined in detail. We propose extensions to the genetic graph which are necessary to fulfill the requirements of the ideal student model.

To show the flexibility and usefulness of the approach and its extensions, two radically different domains, subtraction and elementary ballet, are illustrated as genetic graphs. We discuss the necessity and feasibility of dynamic expansion of the student model, and argue that this is an attainable goal.

Inductive concept learning using the artificial intelligence approach

Bruce Cockburn

Research Report CS-85-12 [M. Math essay]

This essay is a critical survey of past attempts to build programs that learn symbolic concepts by induction from examples. Specifically, emphasis is placed on programs that use AI techniques, as opposed to the alternative methods of numerical and statistical analysis. First, the distinguishing characteristics of previous programs are described to provide criteria for the evaluation of actual systems. Then, learning programs are presented and their properties discussed. A critical discussion outlines areas of weakness in past research. Finally, appropriate directions for future research are identified.

A comparative study of pattern recognition and artificial intelligence techniques for the development of intelligent systems

Sheila A. McIlrath

Research Report CS-85-11 [M. Math essay]

The purpose of this paper is to evaluate and compare pattern recognition and AI techniques for developing intelligent systems, and to indicate areas where pattern recognition techniques could be incorporated into an AI framework.

An intuitive introduction to pattern recognition principles is provided. It contains a summary of pertinent techniques in both decision-theoretic and syntactic pattern recognition. Pattern recognition and AI techniques are compared with respect to methodology, formalization, ease of implementation, ease of understanding and modification, domain applicability, and potential for future expansion. Three specific areas of AI are isolated for more in-depth study: knowledge representation, problem-solving techniques, and learning. Within each area, a comparison of pattern recognition and AI is provided, and suggestions are made for the application of pattern recognition techniques to the AI environment.

The potential role of Canada in the European Communities' ESPRIT project

Randy Goebel

A recent meeting of Canada and the Commission of the European Communities included a presentation on ESPRIT, the recently initiated European Communities programme designed to accelerate research and development in information technology. This brief paper reports some observations on the ESPRIT programme and the potential for Canada to take a cooperative role.

Concurrent Prolog in a multi-process environment

Rosanna K. S. Lee and Randy Goebel

Research Report CS-84-46 [M. Math thesis]
Research Report CS-85-09
Also in the *Proceedings of the IEEE 1985 International Symposium on Logic Programming*, Boston, July 1985

Concurrent Prolog is Shapiro's definition of a simple yet powerful transformation of Prolog that incorporates concurrency, communication, synchronization and indeterminacy. Here we report on the development of a computation model for Concurrent Prolog which uses processes communicating via message-passing. A prototype implementation, *Port Prolog*, has been programmed.

Interpreting descriptions in a Prolog-based knowledge representation system

Randy Goebel

Research Report CS-85-08
Also in the *Proceedings of the Ninth International Joint Conference on Artificial Intelligence*, Los Angeles, August 1985

Descriptions provide a syntactic device for abbreviating expressions of a formal language. We discuss the motivation for descriptions in a system called DLOG. We describe two approaches to specifying their semantics, and a method for implementing their use. We explain why some descriptions should be given a higher-order interpretation, and explain how such descriptions can be dealt with in the simpler logic of Prolog. The essential idea is to constrain the domain of descriptions so that an extended unification procedure can determine description equivalence within the Prolog framework.

On eliminating loops in Prolog

David Poole and Randy Goebel

SIGPLAN Notices, 20(8), August 1985, 38—40.

Recent papers have explained how infinite loops in a Prolog search tree can be avoided by use of subgoal deletion. We show here that this works only in limited cases, and argue that these cases can be better avoided by slight modifications of the program, rather than by increasing the complexity of all programs with a rule that has very limited applicability.

Design and Implementation of the Waterloo UNIX™ Prolog Environment

Mantis H. M. Cheng

Research Report CS-84-47 [M. Math thesis]

This document describes the development of a new Prolog system on a VAX 11/780 running under UNIX.

Madame: A Planner for ISH

J. A. N. A. Trudel

Research Report CS-84-48 [M. Math thesis]

An ongoing project at the University of Waterloo is the design and construction of an interactive UNIX consultant, ISH (Intelligent Shell). The consultant has been designed to answer the type of questions normally posed to its human counterpart.

A planner called "Madame" was developed to be used as ISH's planning component. Madame is based on D.H.D. Warren's Warplan which is a goal directed planner that uses goal regression. An important feature of Madame is a data structure called a "spider." The spider is used to store previously generated goal states. These states then serve as alternate start states for Madame, so Madame has many start states at its disposal instead of only one. Experiments show that the spider does increase the efficiency of Madame. Madame also required an axiomatization of the UNIX domain.

This dissertation describes Madame, the spider, and the UNIX axiomatization.

Quantitative deduction and its fixpoint theory

Maarten H. van Emden

Research Report CS-85-15

A disadvantage of logic programming is that in expert systems one often wants to use, instead of the usual two truth values, an entire continuum of "uncertainties" in between. That is, instead of the usual "qualitative" deduction, a form of "quantitative" deduction is required. In this paper I present an approach to generalizing the Tarskian semantics of Horn clause rules to justify a form of quantitative deduction. Each clause receives a numerical attenuation factor. Herbrand interpretations, which are subsets of the Herbrand base, are generalized to subsets which are fuzzy in the sense of Zadeh. I show that as result the fixpoint method in the semantics of Horn clause rules can be developed in much the same way for the quantitative case.

As for proof theory, the interesting phenomenon is that a proof should be viewed as a two-person game. The value of the game turns out to be the truth value of the atomic formula to be proved, evaluated in the minimal fixpoint of the rule set. The analog of the Prolog interpreter for quantitative deduction becomes a search of the game tree (*i.e.*, proof tree) using the alpha-beta heuristic well-known in game theory. □

Forthcoming Conferences, and Calls for Papers

CSCSI-86:
Canadian Artificial Intelligence Conference

21– 23 May 1986

Montréal

For details, see the announcements on pages 15 and 18.

ACM SIGDOC '86
Fifth International Conference on System Documentation

9– 11 June 1986

Toronto

We face a computerized world that revolves upon itself. It is time to open out the focus to all related fields of knowledge, especially of human communication and learning. We can begin to explore the ways to make computers fit human needs, not to force human values to conform to algorithms. The conference aims to explore such topics as:

- Computers and the study of human languages.
- How computers affect or reflect human thought.
- Effective storage, organization, and retrieval of on-line texts.
- Documenting user-adaptive and expert systems.
- The art of visual presentation for human recognition.

For more information:

Chris Hallgren
7 George Street South
Toronto, CANADA M5A 4B1

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Second Conference on Expert Systems in Government

October 1986

Washington, D.C.

Volunteers at all levels are solicited to participate in the 1986 ESIG program. ESIG 1986 is anticipated to be much larger and broader in scope than the 1985 conference. It will include one day of tutorials followed by the sessions on unclassified and classified topics. People interested in participating in ESIG 1986 should contact:

Kamal N. Karna
The MITRE Corporation
1820 Dolley Madison Blvd.
McLean, VA 22102, U.S.A.
Phone: 703-883-5866 (O), 301-921-0392 (H)
CSNET: karna@mitra.arpa

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24th Annual Meeting of the Association for Computational Linguistics

10– 13 June 1986

Columbia University, New York

Papers are invited on all aspects of computational linguistics, including, but not limited to, pragmatics, discourse, semantics, and syntax; understanding and generating spoken and written language; linguistic, mathematical, and psychological models of language; phonetics and phonology; speech analysis, synthesis, and recognition; translation and translation aids; natural language interfaces; and theoretical and applications papers of every kind.

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 send eight copies of an extended abstract up to eight pages long (single-spaced if desired) to:

Alan W. Biermann
Department of Computer Science
Duke University
Durham, NC 27706, U.S.A.
Phone: 919-684-3048
CSNET: awb@duke.csnet

Papers are due by 6 January 1986. Authors will be notified of acceptance by 25 February. Camera-ready copies of final papers prepared on model paper must be received by 18 April along with a signed copyright release statement.

The meeting will include a program of tutorials and a variety of exhibits and demonstrations. Anyone wishing to arrange an exhibit or present a demonstration should send a brief description to Alan Biermann along with a specification of physical requirements: space, power, telephone connections, tables, etc.

For other information on the conference and on the ACL more generally, contact:

Don Walker (ACL)
Bell Communications Research
445 South Street, MRE 2A379
Morristown, NJ 07960, U.S.A.
Phone: 201-829-4312
CSNET: walker@mouton.arpa
UUCP: bellcore!walker@berkeley

Linguistic Society of America Summer Linguistic Institute: ACL-86 is scheduled just before the 53rd LSA Institute, which will be held at the Graduate School and University Center of the City University of New York from 23 June to 31 July. The 1986 Institute is the first to focus on computational linguistics. During the intervening week, a number of special courses will be held that should be of particular interest to

computational linguists. For further information contact:

D. Terence Langendoen
CUNY Graduate Center,
33 W. 42nd Street,
New York, NY 10036, U.S.A.
Phone: 212-921-9061
CSNET: tergc%cunyvm@wiscvm.arpa

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Artificial Intelligence and Advanced Computer Technology Conference and Exhibition

29 April— 1 May 1986

Long Beach Convention Center
Long Beach, California

23— 25 September 1986

Rhein-Main Halle
Wiesbaden, West Germany

Commercially-organized conferences, with an emphasis on presenting AI and its potential in commercial applications to the general business computing community. Includes tutorials and commercial sessions. To present a paper at the U.S. conference contact:

Murray Teitell
Dept Computer and Information Science
Northrop University
Inglewood, CA 90306, U.S.A.
Phone: 213-641-3470 or 213-776-3410

For other information about either the U.S. or European conference:

Tower Conference Management Co
331 West Wesley Street
Wheaton, IL 60187, U.S.A.
Phone: 312-668-8100

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IEEE Transactions on Systems, Man and Cybernetics Special issue on Causal and Strategic Aspects of Diagnostic Reasoning

Papers are solicited for a special issue of *IEEE Transactions on Systems, Man and Cybernetics* on the topic "Causal and Strategic Aspects of Diagnostic Reasoning". Robert Milne, Army Artificial Intelligence Center, will be the guest editor.

While it is expected that the research to be reported will be typically backed up by concrete analyses or system building for real-world diagnostic problems, the intent is to collect the most sophisticated ideas for diagnostic reasoning viewed as a generic collection of strategies. Articles should attempt to describe the strategies in a manner as independent of domain as possible. Articles that merely describe a successful diagnostic expert system in a domain by using well-known languages or strategies will typically not be appropriate. Papers reporting on psychological studies, epistemic analyses of the diagnostic process, elucidating the strategies of first-generation expert systems, descriptions of specific diagnostic systems that incorporate new ideas for diagnostic reasoning, learning systems for diagnosis are some examples that will be appropriate. It is expected that most articles will typically concentrate on some version or part of the diagnostic problem, so it is important that the paper state clearly the problem that is being solved independent of the implementation approaches adopted.

Five copies of the manuscript should be submitted to the following address by 15 January 1986:

Dr. Robert Milne
U.S. Army AI Center
HQDA DAIM-DO
Washington, DC 20310-0700, U.S.A.
Phone: 202-694-6913
ARPANET: milne@wpafb-afita

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OIS-86 Third ACM Conference on Office Information Systems

6— 8 October 1986

Biltmore Plaza Hotel
Providence, Rhode Island, U.S.A

OIS-86 is an interdisciplinary conference on issues relating to office information systems (OIS), sponsored by ACM SIGOA in cooperation with Brown University and the MIT Artificial Intelligence Laboratory.

Submissions are solicited from the following fields: Anthropology, Artificial Intelligence, Cognitive Science, Computer Science, Economics, Management Science, Psychology, and Sociology.

Topics appropriate for this conference include (but are not restricted to) the following as they relate to OIS: Technologies including display, voice, telecommunications, print, etc.; knowledge bases and reasoning; human interfaces; deployment and evaluation; system design and construction; goals and values; distributed services and applications; indicators and models; needs and organizational factors; impact of computer-integrated manufacturing.

Unpublished papers of up to 5000 words (20 double-spaced pages) are sought. The first page of each paper must include the following information: title, the author's name, affiliations, complete mailing address, telephone number and electronic mail address where applicable, a maximum 150-word abstract of the paper, and up to five keywords (important for the correct classification of the paper). If there are multiple authors, please indicate who will present the paper at OIS-86 if the paper is accepted. Proceedings will be distributed at the conference and will later be available from ACM. Selected papers will be published in *ACM Transactions on Office Information Systems.* Please send eight (8) copies of the paper by 1 February 1986 to:

Stan Zdonick
Department of Computer Science
Brown University
P.O. Box 1910
Providence, RI 02912, U.S.A.

Direct inquiries to Margaret H. Franchi, phone 401-863-1839.

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Avignon '86
Sixth International Workshop on Expert Systems and Their Applications

28–30 April 1986

Palace of the Popes
Avignon, France

The purpose of Avignon '86 is to provide a forum for presentation of new implementations of expert systems and basic tools and techniques for building expert systems. Aimed at developers and users of expert systems, the conference and exhibition will offer an assessment of available tools and techniques; will provide practical guidelines for making decisions concerning the application of expert system technology; and will help define, clarify, and make sense of the claims, promises, and realities of practical expert system applications.

Original papers are solicited in all areas relating to expert systems technology: applications, tools, and techniques. Papers of up to 20 pages in 8×11-inch camera-ready format are due 15 January 1986. Send five copies to the chairman:

Jean-Claude Rault
Agence de l'informatique
Tour Fiat — Cédex 16
92084 Paris — La Défense
FRANCE

This address may also be used to obtain more information on the conference, tutorials, and exhibits.

Directory of AI Graduate Programs

(continued from page 30)

University of British Columbia

(Continued)

505 Image Understanding I — Image Analysis (Woodham).
512 AI Knowledge Representation (Havens).
519 Logic Programming and Functional Programming (Abramson).
522 Artificial Intelligence II: Heuristic search and game playing, problem solving and planning.
523 Computational Linguistics II.
525 Image Understanding II — Scene Analysis (Mackworth).
532 Topics in Artificial Intelligence.

Enquiries

Alan Mackworth (604-228-4893) or Theresa Fong (604-228-3061).

Other notes

The UBC Graduate Program in Remote Sensing and the Laboratory for Computational Vision provide facilities for interdisciplinary research in applications of AI. UBC is also a node in the Canadian Institute for Advanced Research programme in AI and Robotics.

Letter to the Editor

Botanical Interface Forthcoming

Just a brief note of clarification regarding the product announcement in *Canadian Artificial Intelligence*, September 1985.

The palm tree visible in the background of the photograph of the Xerox 1185/86 is a *standard feature* with the 1108 Busmaster option. It is not supported with the initial release of the 1185/86 series of processors, although we plan to port the required microcode in late 1986.

We apologize for any confusion, and hope that this will set the record straight.

R. L. Appleton
Xerox Canada Inc.

Directory of Canadian AI Businesses

Following are updates to the *Canadian A.I.* Directory of Canadian AI Businesses, published in the September 1985 issue.

New entry (Software and R&D):

ART-EXPERT INC.
1225 boul Alexis Nihon, Suite 402
St.-Laurent, Qué H4R 2A6
514-337-0736
Contact: Fadel Fodda

Software, consulting, and R&D in expert systems, intelligent databases, natural language. Current projects include: An intelligent tool for project management; expert systems in law; intelligent DBMS; metastructures for knowledge representation; and intelligent assistance for building expert systems.

Change of address and contact:

SYMBOLICS (CANADA) LTD.
5915 Airport Road, Suite 200
Mississauga, Ont L4V 1T1
416-671-0510
Contact: Russell Senyk

Canadian representative (sales and service) for Symbolics Inc., manufacturers of the 3600 series of Lisp machines.

Use this form to join CSCSI/SCEIO, and to order
Computational Intelligence and CSCSI/SCEIO conference proceedings

Canadian Society for Computational Studies of Intelligence

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

Application for Membership and / or Journal and Conference Proceedings Order

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

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

Membership: $20 regular, $10 students (Canadian funds); there is a discount of $5 for CIPS members. *Computational Intelligence*: $16 / year (CSCSI/SCEIO members only). Conference proceedings: $25 each, plus $5 for postage within Canada, $7 for postage outside Canada. Payment may be made in U.S. dollars at the current rate of exchange.

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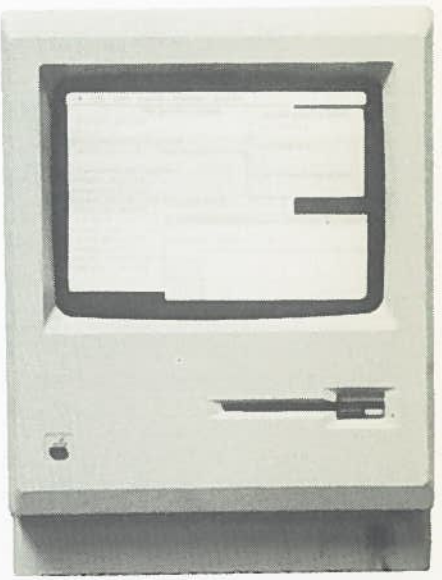

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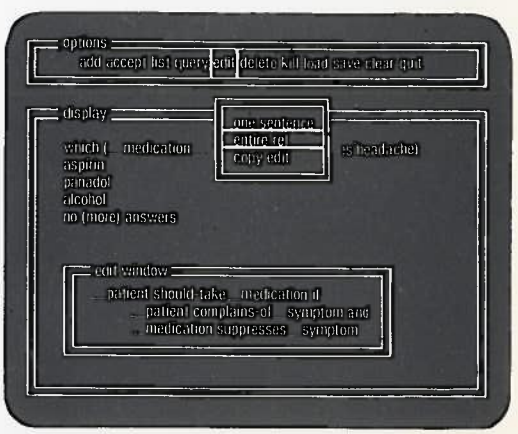

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Applied AI Systems, Inc.
P.O. Box 13550
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Telephone: (613) 592-0084