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Intelligence Artificielle au Canada

November 1990 No. 25 novembre 1990

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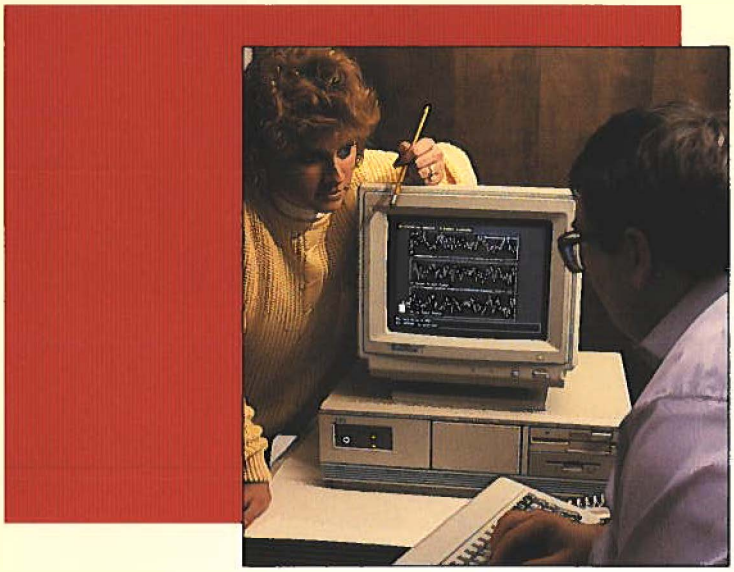
Fraser Mustard – AI, Science-based Innovation and the Canadian Economy
Connie Bryson
L'IA Innovation basée sur science et l'économie du Canada

DataSpan Uses A.I. as a Stepping Stone to Corporate Success
Rosemary Frei
DataSpan utilise l'I.A. pour succès corporate

NeuralWorks Professional II and Designer Pack... the sensible approach to neural network development



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- *robotics (perception, control, action fusion, generation of actior sequence)*
- *artificial skin/muscle, vision and scene analysis*
- *characte and object recognition*
- *process control (process monitoring, qual ity control, generation of flexible manufacturing schedule)*
- *exper systems (diagnosis, control expert system) and automated knowl edge acquisition*
- *voice recognition*
- *signal processing (intelligen noise filtering, signal formatting)*
- *radar clutter elimination*
- *risk analysis for credit authorization*
- *prediction*
- *detection o explosives*
- *autonomous vehicles (sensory and control processes map generation, map interpretation, navigation and maneuvering)*
- *various multiple constraint satisfaction problems (urban traffic optimization, communication network optimization amenity optimization)*
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Tel. (613) 592-3030 • Fax. (613) 592-2333

Canadian Artificial Intelligence

Intelligence Artificielle au Canada

November 1990 No. 25 novembre 1990

Canada's National AI magazine.

Editor · Editeur:
Roy Masrani

Editor Emeritus · Rédacteur emeritus:
Graeme Hirst

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Contents

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Canadian Artificial Intelligence
Alberta Research Council
3rd Floor, 6815, 8th St. N.E.,
Calgary, AB T2E 7H7
or — masrani@noah.arc.ab.ca

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Graeme Hirst
Canadian Artificial Intelligence
Department of Computer Science,
University of Toronto
Toronto, ON M5S 1A4
or — gh@ai.toronto.edu

Roy Masrani

Tooting Horns

Welcome to the 25th issue of *Canadian Artificial Intelligence*. With this issue, we are introducing a new format, a new editorial team, a new cover design, and new sections, but we continue to fulfill our original mission: to keep you informed of AI activities in Canada and around the world. I am proud to introduce you to the members of the team who have committed to helping me achieve this objective.

Jan Mulder is professor of computing at Dalhousie University and currently on sabbatical at the Alberta Research Council. He will be providing regular updates on university activities in the **Academia** section. **Chris Lumb**, in charge of marketing AI and Robotics services at the Alberta Research Council, brings over 10 years of industrial experience (and a healthy skepticism) to report on **Industrial Applications** of AI. **Russ Thomas** of the National Research Council has assumed the **World Watch** portfolio. He will expand on the current World Watch Abstracts by including reports on AI groups around the world. We have already made connections with interesting groups in India, Singapore, and England. We also have our very first European bureau chief – **Grant Thomas**. **Jean-Claude Gavrel**, Director of Research Programs at Precarn Associates in Ottawa, and **Zenon Pylyshyn**, Program Director of the AI and Robotics Program of CIAR, will be providing regular updates on activities in these programs. **Graeme Hirst**, professor of computing at the University of Toronto, will continue as editor of the **Book Reviews** section.

We will continue to take advantage of free-lance writers. In this issue, **Connie Bryson** was commissioned to interview Dr. Fraser Mustard, the Canadian crusader advocating increased spending in R&D, and founder of the Canadian Institute for Advanced Research (CIAR); **Rosemary Frei** reports on one industrial AI success story at **Dataspan Technology Inc.** of Calgary where a constraint-based map conversion system has been developed that is already showing bottom-line benefits.

Finally, **Carol Tubman**, our Production Manager, has, in conjunction with **Ad Ventures Studio Inc.**, assumed all the responsibilities for timely and quality production of the magazine. You will be experiencing the results of her drive for excellence.

The process of revamping and expanding the magazine has been both exciting and rewarding for me. Although as Canadians we are typically understated and modest, there are many AI horns to toot: the Centre for System Science in B.C., the Advanced Computing and Engineering Department of the Alberta Research Council, the AIRS program at CIAR, Precarn, IRIS, ISTC's investment in AI technology, and the Canadian Space Agency's STEAR projects in AI, to name but a few. The marked lack of private sector accomplishments in this list makes it difficult to answer in the affirmative the question "Is AI alive and well in Canada?". It is our intention to seek out these industrial success stories, and toot all these horns to inform, enlighten, and maybe even entertain you.

Letters to the Editor

IJCAI Policy on Multiple Publication of Papers Revisited

In the spring of 1989 the IJCAI Trustees proposed a policy on the multiple submission and multiple publication of research papers. This proposal was made in an article, written by me on behalf of the Trustees, which was published in various AI magazines and newsletters. We invited comments on our proposal – and we certainly provoked some. Having considered these comments we have now revised our proposal to bring them into line with what we perceive as the emerging consensus.

The main criticism of our proposed policy was our decision to regard IJCAI proceedings as archival. This decision was criticized on a number of grounds:

- the IJCAI Trustees could not unilaterally decide that the IJCAI proceedings were archival. Such decisions should be made by the field as a whole.
- the size limits on IJCAI papers mean that they are too short for the archival recording of research results.
- the refereeing process for IJCAI papers is conducted under pressure in a limited time scale. These conditions are not appropriate for assessing whether research is of archival quality.
- conference publication may have been acceptable in the early days of the field when few journals catered for AI papers, but this is no longer the case. If we want AI to be regarded as a mature science then we should encourage researchers to publish their major results in journals.

The IJCAI Trustees have considered these points and

accept them. As a consequence we withdraw our proposal that the IJCAI Proceedings be considered as archival.

Nevertheless, we still see IJCAI conferences as a major forum for the presentation of *original* research results. IJCAIs would lose their attraction if they merely presented results that were already well known. So we are not prepared to accept unsolicited papers that have already been presented at other conferences or have already been published in an archival form, e.g. in a journal. We except from this restriction papers that have only been presented to a limited audience at a workshop or similar functions, and for which there is no published proceedings.

We also except solicited papers, e.g. invited talks. Indeed, it is our intention to re-run as invited talks the best papers from some of the international conferences in sub-fields of AI, e.g. knowledge representation, computational linguistics, vision. We are building bi-lateral relations with some of these conferences in order to make such re-presentations possible. We hope, in this way, to make it easy for researchers in each sub-field of AI to stay in touch with the major developments in the other sub-fields.

Recognizing that IJCAI publication is not archival, we are keen to encourage subsequent journal publication of extended versions of first class IJCAI papers. Most major AI journals are willing to accept the submission of such papers. Note that we (and the journals) expect these papers to be *extended* versions of those that appeared in the IJCAI Proceedings. We accept the argument that IJCAI papers are normally too short to be of archival quality. Greater length is required to develop the arguments in more detail and backed-up by more evidence.

IJCAI also objects to multiple *submission* of unsolicited papers. We will not accept any paper which is already being refereed for another conference or journal, nor permit authors to submit their papers elsewhere while they are being refereed by IJCAI. Our reasons for this are purely pragmatic. This restriction makes it easier to avoid multiple *publication*. It also avoids the waste of refereeing time, so it is a matter of good management, as well as natural courtesy, to try to conserve them.

We think that this revised policy takes into account the criticisms of our original proposal and reflects the consensus that we perceived. We hope that it will be supported by AI researchers, conferences and journals, and will assist the emergence of AI as a mature science.

Alan Bundy
Dept. of Artificial Intelligence, University of Edinburgh
80 South Bridge, Edinburgh EH1 1HN
June, 1990

Dear Editor,

It is with considerable regret and some embarrassment that I become a *former* board member and treasurer of CSCSI after a term of office rivalled only by the likes of Joe Clark and John Turner. I regret that I did not have more time to contribute to the growth and maturation of an organization which has a very important role to play in the country. My belief in AI and its importance to Canada are well known to those who have suffered through my presentations.

However, I have been faced with a unique and timely opportunity to spend a lot of my time in Geneva and I have jumped at the chance. Europe is an extremely exciting place these days, with the economic changes in '92, the unification of the Germanys and the opening of the east. It is very important that Canada, despite its lust to couple with the USA, does not overlook the opportunities in the new Europe. I am hoping to elbow my way in and do some consulting with the international organizations, to represent or assist Canadian companies and to work with the Canadian government as it promotes strategic technology, investment, joint ventures and so on. I will also attempt to contribute to *Canadian Artificial Intelligence* as the Canadian AI Guy in Europe.

Since AI has yet to produce many millionaires, inference engine types (or those just coming out of their shells) who may be looking for a place to throw down their laptops while in greater Geneva should not hesitate to stay with us. Just let me know at:

Grant Thomas
Thomas International Inc.
Grand'Rue, 01630 Péron, France Tel: 50 56 31 69
September 10, 1990

New AI company formed

In the midst of an AI shakeout, a new expert system company has quietly debuted. KnowledgeWorks Research Systems Ltd. and Hierogam Space Systems Ltd. (both of Ottawa, Ontario, Canada) have formed a new company, FirstMark Technologies Ltd. FirstMark will build upon the strengths of its two founding firms – program and project management in computer, aerospace and other high technology industries, and the development and marketing of knowledge-based systems – to continue the development and promotion of KnowledgeSeeker, a PC-based data-base analysis and decision-making tool.

According to Tim Eastland, president and CEO of FirstMark, the company's formation was a result of Hierogam's search for a product complimentary to its management services business. "KnowledgeSeeker and its accompanying AI technology proved to be the perfect choice", he said.

KnowledgeSeeker, developed under contract to Canada's National Research Council, provides decision-making advice to business, research and engineering professionals based on the information buried within their databases. A new version of KnowledgeSeeker is due this month.

Reprinted with permission from AI Week, April 15, 1990.

Treasurer's Report

April 1, 1988 - March 31, 1990

Jan Mulder
CSCSI/SCEIO Treasurer

CSCSI/SCEIO Financial Statement Summary
April 1, 1988 to March 31, 1990

Balance Forward

Savings account	8,200.45
Chequing Account	6,167.14
CIPS account	5,556.00
Total	**19,923.59**

88-89 Revenue

Transfer from Tanlu 85	5.13
Magazine income	25,898.80
Bank interest	169.14
Proceedings sale Morgan Kaufmann	534.15
Transfers from CIPS account	15,000.00
Return Advance CSCSI Conf. 88	4,000.00
Total	**45,607.22**

88-89 Expenses

CSCSI Conf. 88	4,164.92
Magazine expenses	39,403.85
Miscellaneous	141.13
Total	**43,709.90**
Balance	**1,897.32**

89-90 Revenue

Magazine income	22,169.45
Proceedings sale Morgan Kaufman	2,717.02
Transfers from CIPS account	8,000.00
Bank interest	1,286.38
Total	**34,176.85**

89-90 Expenses

Magazine expenses	31,874.03
Miscellaneous	39.20
Total	**31,913.23**
Balance	**2,263.62**

Actual Balance March 31, 1990

Chequing account	2,095.69
Long term deposit	16,491.87
CIPS account (Feb. 28, 1990)	13,082.00
Total	**31,669.56**

The last two years have been a busy time for your treasurer. Your treasurer is, like other executives, a volunteer who must schedule his time in combination with the requirements of a full time job (in my case a faculty position). First a few facts behind the report.

CSCSI funds are held in two different accounts. One (the CIPS account) is held by CIPS which collects membership fees on behalf of the CSCSI. The other account (the chequing account and long term deposit) is the actual CSCSI account which is under direct control of the treasurer and the president. Transfers from the CIPS to the CSCSI account can be made any time upon request of the treasurer. The annual membership fees currently stand at $25 (CIPS members) and $35 respectively with a $10 reduction for students. For each non-CIPS member CSCSI pays a $10 administrative fee to CIPS. This is pretty good value for the quality magazine we are currently producing and for the reduction in CSCSI conference fees members receive.

CIPS collects membership fees on behalf of CSCSI and also subscription fees for *Computational Intelligence* for CSCSI members subscribing to the journal at discounted rates. Recent changes in CIPS' administrative procedures promise to improve the quality of service we are getting from them. Hopefully forgotten renewal notices and improper invoicings are things of the past.

Conference sponsorship has generally been a profitable activity for the society. This includes the sales of proceedings of CSCSI conferences. In Canada our proceedings are sold through the CIPS office. The proceeds are included in the CIPS account. U.S. orders are served by Morgan Kaufmann on behalf of CSCSI. The proceeds from U.S. orders are shown as a separate item in the balance sheet.

The magazine revenues and expenses form the largest items on the budget. The treasurer is currently responsible for the financial health of the magazine. Duties include paying all the bills (expected and unexpected) but it also includes chasing advertisers who do not pay their invoices on time and there have been quite a few of those. As one example, we incurred a $1200 revenue loss as a result of the bankruptcy of Lisp Canada (which is minor compared to the loss incurred by several Canadian universities). The average cost of each magazine issue varies from $7,000 to $9,000. In order to continue producing the magazine in its current form much of this cost must be recovered from advertisers. Thus far, we have been reasonably successful in doing so. As an example, the total production cost of the four 89-90 issues was about $28,000 with an actual cost to the membership of less than $10,000. Praise should therefore be given to Marlene Jones, magazine editor until last October, and to the current editor, Roy Masrani and his team of volunteers at the Alberta Research Council.

As the balance sheet indicates, the CSCSI finances continue to be in good health. Keeping it that way has often been more a juggling activity than solid accounting. Spreadsheets have made the latter a relatively easy job to perform. I wish the new executive the best of luck in leading the society into an interesting and challenging future.

Systems draw on expertise

Knowledge, experience form basis for computer programs

Jeff Rockburn

Imagine being able to take the knowledge and experience of a company's top employee and use it as the basis for a computer program to help run the operations. Instead of having one expert on staff, there could be dozens. That, in essence, is what an expert system allows. And, according to the experts, expert systems will be a key to keeping Canadian manufacturers competitive in the '90s.

"True artificial intelligence is still somewhere in the future, but expert systems are here now", says Sandon Cox, director of the Canadian Manufacturing Advanced Technology Exchange in Toronto. "And, like other forms of advanced manufacturing technology, they are going to help manufacturers stay fast, flexible, and responsive to changing market demands."

Actually, expert systems are a form of artificial intelligence. They are not able to make the intuitive leaps of logic that mark true intelligence, but expert systems are capable of reasoning in a manner not dissimilar to our own. As such, they are also able to make qualitative decisions and solve complex problems faster than you can say nanosecond.

Expert systems differ from conventional information systems in that their knowledge base is expressed in 'constraints' or 'rules' using natural language, as opposed to complex numeric algorithms. These rules are written in a series of if-then statements. Presented with a problem, the expert system searches through its set of rules, sorting, combining, and ordering them to arrive at a correct course of action.

At its most basic, a transaction might run like this: if it's raining outside, then take an umbrella. On a more complex level, if you want to change the way you make widgets, then the expert system could analyze the equipment and skills you already possess, match those with your intentions, and let you know what additional resources you'll require, and how they need to be configured.

What really sets expert systems apart, however, is that the rules come from the experts themselves – maintenance workers, material handlers, and engineers of every description.

"Every phase of manufacturing has its different experts, and each of those people possess vast amounts of knowledge about their particular area of responsibility", said Aldo Dagnino, an associate researcher with the computer integrated manufacturing and artificial intelligence division of the Alberta Research Council. "That knowledge includes every book they've ever read, and every trick, shortcut, and rule of thumb they've ever learned on the job. Expert systems capture that knowledge and represent it in a computer system."

Expert systems can be used to improve every facet of manufacturing operations, from planning production schedules and controlling materials flow, to monitoring product quality and production efficiency. They can also find uses beyond the factory floor, keeping key staff informed of operations changes, for example, or lending a hand on the drawing board.

Bell-Northern Research Ltd. of Ottawa is one of North America's leading developers of expert systems for a number of different fields. One of the systems under development could pay big dividends for manufacturers in the future. The engineering change module (ECM) is designed to make knowledge about a change in product design flow through the system more easily.

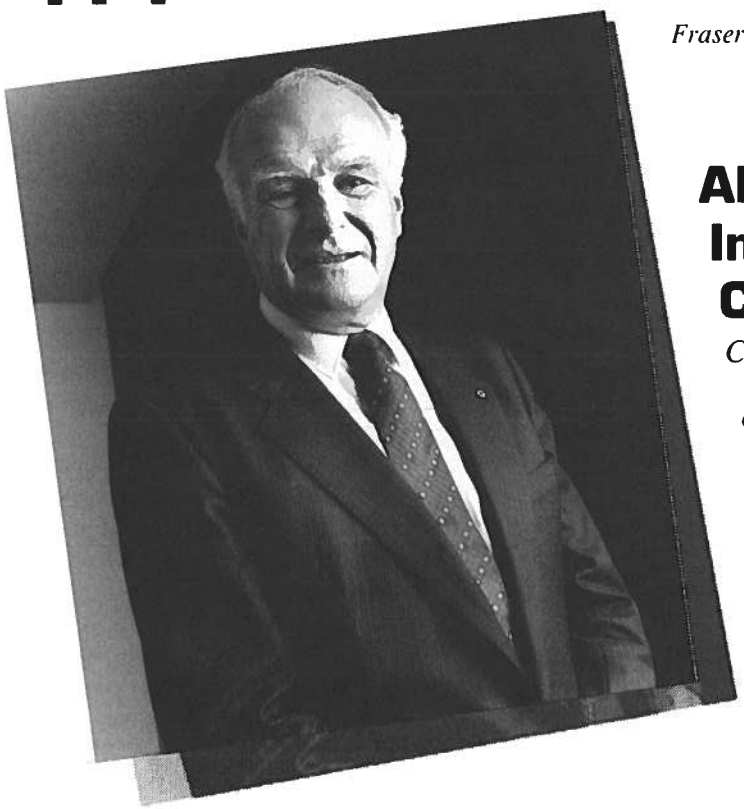
"Whenever there is a change to a product design, it affects a lot of people and operations. Getting the correct information to the people who need to know is a complex and time-consuming operation", said Dick Peacock of Bell-Northern's computer research laboratory in Ottawa. "ECM is an expert system designed to look after that operation for you. When a change comes down the pipe, ECM tells you who will be affected by it, how it will affect them, and exactly what they need to know to adjust to the new set of circumstances."

Expert systems are also being used during the design process itself. William Havens of the expert systems laboratory at Simon Fraser University in Burnaby, B.C., is working on a project that will marry an expert system to a computer aided design (CAD) system called IntelCAD.

CAD systems are basically electronic drafting tables, adept at drawing lines and circles, but little else. IntelCAD will have architectural and engineering knowledge built in, as well as all relevant codes and specifications. "When you make a change to a design, the system will automatically adjust materials and strengths for other parts and pieces that have been affected", Dr. Havens said. "Expert systems are the most commercially viable use for artificial intelligence. There is no limit to their application in the real world."

Aldo Dagnino is a member of the Advanced Computing and Engineering Department of the Alberta Research Council - RM

Reprinted with permission – The Globe and Mail, August 1990



Fraser Mustard

AI, Science-based Innovation, and the Canadian Economy

Connie Bryson

"Failure to capitalize on science-based innovation will result not only in a drop in corporate profits but a decline in our standard of living. This is an issue that affects every Canadian and it is too important and too urgent to wait for a change in political will. We've got to change ourselves."

It's been eight years since the creation of the Canadian Institute for Advanced Research and President Fraser Mustard can look back on a job well done. Seven programs are underway: artificial intelligence and robotics, cosmology, evolutionary biology, superconductivity, population health, economic growth, and law and society. They are based on active networks of highly gifted individuals located in institutions inside and outside Canada.

The artificial intelligence and robotics (AIR) program is CIAR's oldest and best-known program. An international panel reviewed it in 1988 and concluded that CIAR has established three of the top twenty world-class centres in AI and robotics. It said that many of the researchers have made significant contributions to knowledge which have changed the intellectual outlook of their field of work.

CIAR also spawned PRECARN Associates Inc., a national industrial consortium engaged in precompetitive AI and robotics research, and IRIS (Institute for Robotics and Intelligent Systems), one of the networks in the federal government's Networks of Centres of Excellence Program. The relatively small investment ($1.5- million per year) that CIAR has made in the AIR program has made all this possible.

Connie Bryson is a free-lance technical writer based in Vegreville, Alberta.

If CIAR was just another mechanism for funding research and AI was just another technology, such accomplishments would give Fraser Mustard good reason to take it easy. However Mustard is playing for higher stakes – Canada's future prosperity. He sees research as the foundation of science-based innovation, the engine of today's global economy. He calls AI a "transforming technology", one that will fundamentally change all of our activities – from manufacturing to resource development – in the 21st century.

Finally, he believes that Canada must embrace science-based innovation or become an economic backwater.

With a vision like that, Mustard can't afford to take a break. He is criss-crossing the country preaching the gospel of science-based innovation. It's a message not only for Canadian business, it's a message for Canadians. To sustain and enhance our prosperity and system of social justice, Mustard says we must comprehend and make use of the transforming power of science, engineering and technology.

Preaching the gospel

When Fraser Mustard fixes his gaze on you, you better listen up. With the intensity of a TV evangelist and the tutorial style of a university professor, he launches into an economics lesson.

"In the Canadian economy, the sector that produces tradeable goods and services employs about 25 per cent of the work force," says Mustard. "The income from this sector fuels the part of the service sector that includes health care,

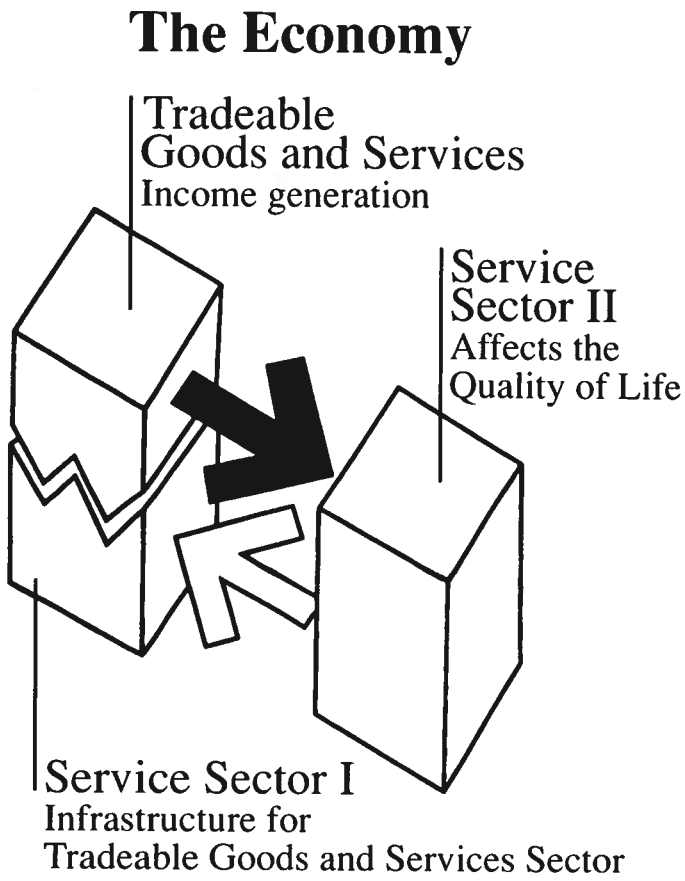


Figure 1: From "Innovation, Competition and Canada's Future and the Canadian Institute for Advanced Research". Speech by J. Fraser Mustard 1990.

education and other public services we've come to regard as essential (Fig. 1).

"The other part of the service sector is the infrastructure that serves to support the trading sector: finance, transportation, communications, etc. It, too, is entirely dependent on the success of our trade in goods and services."

Mustard believes Canada is falling behind in the vital trade sector of our economy. "Among the nations of the world, Canada ranks eighth in terms of per capita wealth. We used to be second. In other words, our relative wealth has declined. That is a sign that our economy is failing.

"To put it bluntly, Canada's economy is proving unable to generate sufficient income through the tradeable goods and services sector to pay for the social benefits we opted for 20 years ago."

The solution? According to Mustard there are two options: cut back on the benefits or increase the productivity of our trade sector. "In short," he says, "it is our ability to maintain the competitiveness of our existing resource-based industries, while enhancing industries that produce high value-added, tradeable goods and services, that really determines whether Canada prospers or becomes an economic backwater."

And just as there can be no growth in living standards without productivity gains, there can no growth in productivity without technological progress. In a world that is now governed by economic rather than military competition, the basis of future growth and rising living standards lies in the application of technologies such as AI and robotics.

It's not only a Canadian problem. A recent study carried out by the Centre for Exploitation of Science and Technology, a British think-tank, interviewed 52 directors and senior managers of U.K. technology-based companies. Those interviewed said technology is of critical importance in maintaining competitiveness; they recognized that they must innovate more frequently or make bigger leaps to keep up with overseas competitors.

Three recently published books, which consider the ability of the U.S. to compete in a global economy, *The Myth of America's Decline, Bound to Lead,* and *America's Economic Resurgence*, highlight technology's key role in determining competitive ability. One of the main points of a recent book *The Competitive Advantage of Nations* by Harvard Business School professor Michael Porter is that a nation's prosperity does not depend principally on natural endowments, its labour pool or interest rates. Much more critical is the capacity of a country's industry to innovate and upgrade.

Economists such as Simon Fraser University's Richard Lipsey and Stanford University's Brian Arthur are questioning the ability of conventional economic theory to describe an economy driven by science-based innovation. Lipsey is leading a CIAR program on this very topic.

But Mustard isn't waiting for a new economic theory. He says there is already enough proof that science-based innovation is the key for economic growth in modern industrial states. (Science-based innovation is defined as innovation in which the realization of an effective and competitive product or service uses, through the focusing processes of research, the full range of scientific and engineering understanding pertinent to the function of the product or service in the marketplace.) Only continuous innovation will increase Canada's supply of goods and services and ensure our future prosperity.

A renewed emphasis on R&D

What does all this have to do with research? According to Mustard, research and development are "key elements in the chain of innovation leading to the development of new marketable products or services and to improvement in the productivity of the economy." He divides research – as related to the overall process of innovation – into three components that must be linked to be effective. Basic, applied and developmental research make up a research pyramid, at the peak of which is a product (Fig. 2).

Basic research forms the base of the pyramid. Its primary objective is the generation of new knowledge and

understanding. It is long-term and there is a high level of uncertainty about what the results will be.

Applied research is medium- to long-term. Although it has a significant level of uncertainty, there is probability of economic benefit because applied research is targeted to the development of a particular product or process. It attempts to

- extend the scope of understanding of materials and processes,
- determine how the accumulated knowledge from basic research, extended where necessary by focused specialized research, can be used to develop a potential new product or service, or
- determine how to modify and improve the performance of existing products or services to sustain their marketability.

Applied research is segmented into two slices – competitive (short-term applied) and pre-competitive (long-term applied). Competitive applied research has direct proprietary value. Pre-competitive applied research is generally useful in sectors of industry.

Developmental research has the least uncertainty and is carried out on a time scale of less than three years. It is research which

In 1989, all sectors of the Canadian economy spent $8.3 billion on research and development, about 1.3 per cent of Canada's gross domestic product. The U.S. spent 2.6 per cent, Sweden 2.8 per cent, and Japan close to 2.9 per cent.

- makes use of the fruits of applied research specifically to create a new marketable product or service,
- improves, through a series of small steps of innovation based on state-of-the-art knowledge, an already existing product or service, or
- enhances the ease of production of a product or the provision of a service.

AI research, because of its fundamental nature and wide applicability, can form the basis of any number of research pyramids.

Just the facts

If science-based innovation holds the key to economic prosperity and R&D is the way to get there, how is Canada doing in R&D performance? Not well. In 1989, all sectors of the Canadian economy spent $8.3 billion on research and development, about 1.3 per cent of Canada's gross domestic product. The U.S. spent 2.6 per cent, Sweden 2.8 per cent, and Japan close to 2.9 per cent.

The federal government places some of the blame on the manufacturing sector. In a speech he made in May of this year, Prime Minister Brian Mulroney said that 97 per cent of

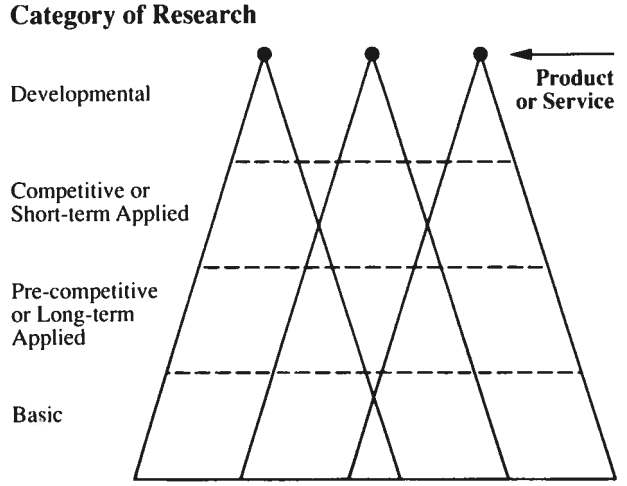


Figure 2: The Science-Based Pyramid of Research.

manufacturing companies perform no research and development in contrast to the 75 per cent of domestic high technology firms that do their own R&D. In 1987, the last year for which statistics are available, Canadian corporations spent 0.7 per cent of gross domestic product on research and development. A recent survey of 635 companies by the Canadian Manufacturers Association showed that about half do not intend to maintain the same level of R&D expenditures.

Canada's industrial research capacity is a particular worry to Mustard. A major conclusion of the 1988 CIAR report *Innovation and Canada's Prosperity* is that "in Canada our capacity to perform in industry and exploit the slice of the research pyramid designated long-term applied research is appallingly weak."

Canada's branch plant economy is part of the problem. With a few notable exceptions, most Canadian subsidiaries of foreign companies do not do their own R&D. But even so, a comparison of R&D expenditures by Canadian-owned firms with that of U.S. firms in equivalent industrial sectors shows a basic weakness in the Canadian research and development effort. Only in telecommunications and aircraft do Canadian-owned companies substantially surpass their U.S. counterparts in R&D spending as a percentage of sales.

Many Canadian corporations point to a tax system that does little to encourage research or product development in Canada. However, a June, 1990, report from the Conference Board of Canada concluded that research and development tax breaks offered by the provincial and federal governments to big companies are more substantial than those provided in Japan, the U.S., or major European countries.

Companies say that high interest rates and the high dollar hurt exports, thus making it difficult to increase spending. Other studies have found that the level of non-tax support for industrial R&D by the federal government – grants, for example – is very low by international standards.

Another worrying statistic is the decline in the number of Canadian students studying science and engineering. According to Statistics Canada, in 1988 doctoral degrees in natural sciences and engineering had slipped to less than 50 per cent of total doctorates granted at Canadian universities. In 1972, the same figure was more than 60 per cent. The situation is unlikely to change in the near future. Full-time undergraduate enrolment in science and engineering is now about 20 per cent of total enrolment, the same as in 1972.

Finally, according to the World Competitiveness Report, Canada is slipping in competitiveness. Canada came in fifth this year – it was fourth in 1989 – behind Japan, Switzerland, the U.S., and West Germany. One of the ten factors used to determine competitiveness is "future orientation" which explores preparations countries are making in anticipation of an increasingly technology-based world economy. Future orientation was Canada's lowest score.

A time for change

Canadian R&D statistics paint a rather gloomy picture of the country's ability to capitalize on science-based innovation. And if economic prosperity is indeed linked to science-based innovation, Canada's weak research base and its limited ability to use the results of research to develop new products and services do not bode well for the future.

For a small country like Canada, science-based innovation comes with a hefty price tag in terms of both financial and human resources. One stumbling block is the cost of capital. In North America the cost of capital for a company is as much as three times the cost in Japan and several European countries.

Mustard calls for the development of strategies to fund long-term, industry-based applied research. "Canada doesn't have an investors' structure that's geared to grow assets for the future," he says. "We're only looking at short term goals."

Mustard notes that in Japan the banks provide part of the capital necessary for long-term applied research. The Japanese system, called "keiretsu", binds most major corporations, their subsidiaries, suppliers and sales corporations with one or two lead banks and affiliated mutual life-insurers. The group reduces aggregate risk costs for relatively risk-averse member firms, with the financial institutions acting as insurers. The capacity to make long-term, high-risk investment is protected and stimulated.

"Science-based innovation requires a strong, long-term applied research capacity, particularly in relation to emerging generic technologies, that is industry-based and industry-controlled," says Mustard. "This capacity has to be linked to a high-quality fundamental research base and a strong market-focused development capability."

Mustard isn't talking theory, it's the research pyramid in action. CIAR's initial efforts were aimed at building a fundamental research base in AI and robotics. The AI and Robotics program created a concentration of high-quality scientists in basic research.

"In Canada we've tended to place on universities and government labs the responsibility for doing applied research," he says. "In other countries this research is industry-directed and driven. Universities and government labs are not the places to do targeted applied research."

"Our first brutal lesson was that having created the capability in Canada, there was no industry to interface with. Canadian industry is woefully deficient in R&D," says Mustard.

"It was like a football game where the quarterback drops back to pass the ball, only to find that all the receivers are on the other team."

Without a capacity for long-term applied research in industry, Mustard reasoned, the fruits of the fundamental research would be lost to Canada. "In Canada we've tended to place on universities and government labs the responsibility for doing applied research," he says. "In other countries this research is industry-directed and driven. Universities and government labs are not the places to do targeted applied research."

Enter PRECARN Associates Inc., a national consortium with a focus on long-term precompetitive applied research. It links the potential users of AI and robotics technology with its creators. PRECARN is industry led and managed, bringing together the needs of a wide range of Canadian industrial interests which recognize their long-term dependence on production technologies driven by expert systems and advanced robotics.

Building on the linkages created by PRECARN, the IRIS program of the Networks of Centres of Excellence adds more university researchers to the network. A national university-industry research network directed by PRECARN, IRIS extends Canada's capability in AI research.

"CIAR's AIR program has created a huge national capacity to do things. That's a unique accomplishment in eight years," says Mustard.

"I've seen a lot of changes. Many more people in business now understand what we're doing and see the applications. They've learned the significance of very high value-added products and services and what they mean to profitability. The fact that we have companies like Shell and Stelco coming together to work on projects demonstrates a level of understanding and cooperation that we haven't seen before. Business and academia are building effective links. My only worry is that governments will destroy them because of their stupidity."

Mustard has particularly harsh words for the provincial governments. Some provinces have refused funding for long-

term AI research because some of the benefits will accrue outside of the province. Mustard identifies Ontario and Quebec as the prime offenders; he likens their intransigence to the antics of selfish children.

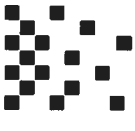
"Canada can't afford this kind of balkanization," he says. "We only have three per cent of the world's population and can't afford to fragment this further. The provinces must learn to think nationally. We must create opportunities across Canada.

"There's no place in the world where long-term, high-risk research that has wide applicability is totally funded by the private sector. There must be ways to socialize the risk and that's where government involvement comes in. By the same token government must not make the decisions about the research, or try to control it."

While Mustard is angered by the attitudes of provincial governments, he's not depressed by them. He is focusing on opportunities, not obstacles.

"For its entire history, Canada has lived off its natural endowment – we've found the resources and extracted them," says Mustard. "Now we must create an endowment. The psychology is entirely different. The creation of wealth requires a sense of collective responsibility which is not yet understood by most governments, businesses and academics.

"Failure to capitalize on science-based innovation will result not only in a drop in corporate profits but a decline in our standard of living. This is an issue that affects every Canadian and it is too important and too urgent to wait for a change in political will. We've got to change ourselves."



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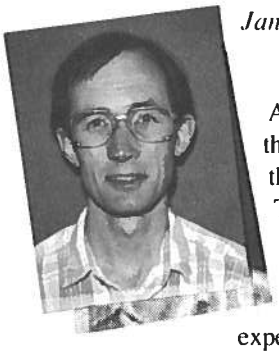


Jan Mulder

As your academic editor I will assume the responsibility of keeping a finger on the academic pulse of Canadian AI. This will ensure regular reports on what's happening where and who is doing what in academic AI. Apart from an occasional visit you can expect me to stay in touch with the different academic groups, large or small. More important, you can expect gentle persuasion on a regular basis to provide contributions to the magazine. Contributions can be of many kinds. They may vary from an "official" description of ongoing AI research projects at a particular institution to more critical reflections on developments in AI, be they local or global.

A new activity I would like to announce at this time is the publication of an annual activity report for each Canadian university with AI representation. The report will be a listing of supervisors, the names of the students they supervise, and their thesis topic (masters or Ph.D.) with, possibly, expected completion date. Not only will such information be an indication of "who is doing what and where", it will also be useful information for institutions and companies looking to hire AI graduates. As well, openings for faculty and research fellows can be advertised in Canadian AI.

Please send your comments and contributions to the magazine's editorial address. As your academic editor I am joining a group of people committed to providing a quality magazine for the Canadian AI community.

Is Canadian AI suffering from Fragmentation and Excellence?

Jan Mulder

Every Canadian AI researcher is nowadays confronted with a large choice of AI conferences to attend. Depending on one's field of specialization there are many specialist conferences and workshops. Even at the general level there is a wide variety of choices such as IJCAI, AAAI, ECAI, and, yes, there is CSCSI, also referred to as the Canadian AI conference.

The first CSCSI conference was organized in 1976 at UBC. Since then it has been organized every second year as an alternative to IJCAI. In 1976 the Canadian AI community was relatively small and all interest groups joined in a single conference. During its first few years the CSCSI conference has largely remained an intimate affair. It served as a central meeting point for Canadian AI researchers and their graduate students, many of whom also presented papers. The intimacy of the conference has also been attractive to a number of foreign researchers who preferred this conference over the mass events associated with AAAI and IJCAI.

By the mid-eighties, however, the situation changed. Interest in AI soared. The number of special interest groups grew. AI researchers now distinguish themselves as to whether they are doing vision, natural language, knowledge representation, programming (logic or otherwise), constraint satisfaction, or reasoning in one of many variants. Special purpose conferences have been on the rise. Research has intensified, partially due to organizations such as CIAR, and Canada's international reputation for excellence in AI research has grown with it.

All these events have had their effect on the CSCSI conference. Canada's international reputation has encouraged well known foreign AI researchers to attend and present their work at the Canadian AI conference. One striking event was the presence of three Computers and Thought lecturers in the conference room during a session at the Ottawa conference in May this year. An equally striking event, however, was the visible absence of some Canadian AI groups during the same conference. Although this is the first time ever that I have noticed such a phenomenon it nevertheless got me worried enough to write about it. The reason for this worry is that I do not see it as an isolated event, but more the result of a development which I have watched with some concern during the last few years.

Do we have a problem? I think so and I have two reasons that strengthen this belief. For one thing, the growing number of specialties in AI has resulted in some degree of narrow-mindedness; researchers limiting their contacts to researchers who are working in the same specialty and who only attend conferences and workshops that solely serve the interests of the specialty. I will refer to this as the fragmentation problem.

The second reason as I see it is that Canada's international reputation for excellence makes it very easy for us to obtain ready access to international conferences and workshops.

As a result, faculty (and their students likewise) are tempted to submit their papers to these conferences directly rather than taking the national route first, or, at least follow a parallel scheme. I will call this the excellence problem.

Although nobody will deny that there are methods and techniques that are unique to each specialty, none of us should have to be reminded either of the fact that there are also methods and techniques shared by the different specialties. As one example, many specialties do research in constraint satisfaction techniques, the results of which may be relevant to other fields as well. I make this point to emphasize the importance of communication between the different fields. General AI conferences are an ideal medium to do so. Presentation of papers in a general conference should therefore remain a high priority on everybody's list.

But even if we agree on presenting papers in a general conference, why should we do so in CSCSI, rather than IJCAI, ECAI, or a conference organized in some tropical paradise. I will not contest the need for presenting good papers with generic importance in IJCAI. However, in such a situation I would prefer the parallel option mentioned before. But still, why CSCSI?

Primarily, CSCSI is a general conference and a good conference. Submissions are always rigorously refereed. A carefully selected list of invited papers virtually ensure that there is always something new to learn. Another attraction is that CSCSI is small. There are no parallel sessions. The conference offers an ideal opportunity to meet faculty and graduate students from other Canadian universities. The last few years have also shown an increasing foreign presence likely the result of our international reputation. In addition, there has been an increasing interest from Canadian business and government who want to find out what Canadian AI research is doing. Graduate students have traditionally presented their papers in CSCSI. Such an action is even more relevant in the currently deteriorating job market both academically and industrially. If you want a job in Canada then you had better make yourself known in Canada. Presenting your papers in international conferences is not likely to achieve that objective.

I have pointed my finger at two problems: the fragmentation and the excellence problem. In the fragmentist move the centrifugal forces appear to be dominant with the result that general conferences such as CSCSI are ignored. In striving for even more excellence there appears to be a tendency to emphasize international over national exposure. I feel both are damaging developments for Canadian AI. Canadian AI researchers must remain a cohesive group, both scientifically and politically. The maintenance of a central and publicly visible point of communication contributes to such a cohesion. The CSCSI conference has and should continue to be a medium for that. Without wanting to sound too dramatic, a loss of cohesion could in the longer term spell the end of Canadian AI. This would leave the country with a few centres of AI research which happen to be located in Canada. Let us stick together and let us keep CSCSI alive.

SOFTWARE REVIEWS

by Dr. Boris Hoovely

Dr. Hoovely studied Motel Management at the Sorbonne before switching to Artificial Intelligence after reading the book *The Lazy Man's Way to Riches*. His current research efforts are directed to applying genetic algorithms to numerology.

Following the collapse of the Nexa Corporation, many research establishments across Canada have been left with costly Symbolics Lisp machines and no money to do research on them. Since vast sums were spent on these machines, it is natural to wonder how they may be put to good use, at least until their monitors burn out.

Fortunately, Specious Software Ltd. has provided the answer. They have announced a complete set of data processing programs for the Symbolics.

Specious's package, DP-O-Rama, contains a complete set of accounting programs, including general ledger, accounts receivable, accounts payable, payroll, invoicing, fixed assets, inventory control, and job-costing. It also includes COBOL and RPG III compilers. The entire package is written in Symbolics Common Lisp.

We ran our standard accounting benchmarks on DP-O-Rama, and the system performed exceptionally well, although it did have an annoying tendency to crash and destroy all its records when the Symbolics did a garbage collect.

Traditional data processing people, with their minds firmly entrenched in the 1960's, will probably quibble over DP-O-Rama's incorporation of Lisp machine concepts, like having the source code and accounting files readable and changeable by any user. Let them complain. Specious Software has given us a splendid package that will serve two important uses: it will let idle Lisp machines be put to productive use, and it will give idle Lisp machine programmers the opportunity to learn COBOL, so they can get a real job.

Dr. Hoovely welcomes comments from his readers. Letters composed of type cut from this publication will receive particular attention.. Due to the volume of correspondence, Dr. Hoovely regrets that he cannot guarantee a personal response, although extremely nasty correspondents may wake up to find their tires slashed and their family pet missing.

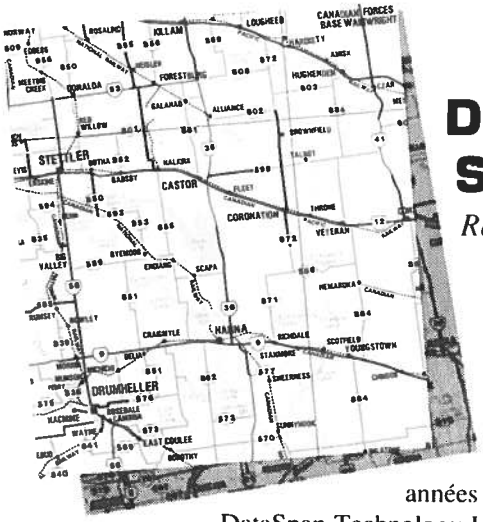
INDUSTRIAL APPLICATIONS
APPLICATIONS INDUSTRIEL

Chris Lumb

I happened into this unusual world of artificial intelligence as many of you probably did. At first I was a skeptic. I thought that AI was interesting, but I had yet to see anything that I couldn't do in good old FORTRAN or PL/I. Sound familiar? I don't know what converted me. Maybe it was that I saw some actual successes. Maybe I was curious about new approaches. Who knows? In any case, I've seen my interest grow as working AI applications have grown, and we now arrive in 1990 with AI being accepted as one more technique in the system development toolbag.

Over the next year I intend to explore the world of AI applications. I'll look at some success stories. I'll also look at some failures. I'll look at engineering applications and business applications. I'll look at techniques that have worked, and also at approaches that haven't worked. Up front I'll declare my bias that whether or not AI represents another world of computing, I believe its ultimate success will lie in its acceptance by the mainstream systems world. I'll thus be on the lookout for examples of AI merging with today's emphasis on CASE and information engineering approaches.

Please join with me in this exploration, and let me know your experiences, opinions, successes, and failures. And at the end of the year, we'll see whether this collection of techniques called "artificial intelligence" has inched its way forwards or backwards in the world of industrial relevance.



DataSpan Uses A.I. as a Stepping Stone to Corporate Success

Rosemary Frei

Depuis les quatre années passée, les principals à DataSpan Technology Inc., un petite compagnie de logiciels en Calgary, ont emploier une variété grande d'expertise et des techniques, avec l'intelligence artificielle, pour developper une suite de logiciels très sophistique pour la conversion des cartes. Le produit est capable de la formation de les images digital pour les cartes dans une manière effectif de temps et de coût plus que quelqu' autre système sur le marché.

Les revenus de DataSpan seront augmenter significatifment dans les mois et les années à venir, parce que le compagnie saut dans le marché de la monde lucratif, avec ce nouveau système qui montrera le chemin.

The principals in DataSpan Technology Inc., a small Calgary software company, recognized a prime opportunity in 1986. At that time, a pressing need for hundreds of thousands of maps to be converted from hard copy to digital form was emerging. Over the next four years, DataSpan employed a wide array of expertise and techniques, including artificial intelligence, to develop a very sophisticated suite of map-conversion software. As a result, the company is now poised to take a significant share of this lucrative new market.

For centuries, governments and industries have created maps using materials ranging from paper, linen and mylar to film. With the advent of the computer, and of Geographic Information Systems, however, the storage of cartographic information on these media became obsolete. The result has been the sudden creation of a very large demand for accurate and efficient conversion of hard-copy geographic data to digital form.

DataSpan, which specializes in the automated conversion of data from hard copy to digital form, was well-positioned to tackle this new application. Some companies have relied on brute, manual conversion of map data into digital form, but this is highly inefficient and uneconomical. DataSpan has successfully developed an automated system to complete this process, and has thereby gained a strong competitive advantage over other firms.

"Through the application of AI technology, we've dropped

the price, and the cost of converting these documents", says Malcolm Macdonald, DataSpan's Technical Director. "Three or four years ago, we charged about $3000 to do one contour map, and that took several weeks. Now, it takes two to three hours of computer time, and about eight person-hours. That's about an order of magnitude increase in speed – and we've decreased our fee to between $500 and $800."

In order to create their automated map-conversion system, DataSpan called on the expertise of members of the Alberta Research Council in a $1.53-million joint research venture. The company has also received financial support from the National Research Council and the Canadian Centre for Mapping. The result has been the meshing of a number of powerful processing techniques from areas such as pattern recognition, AI and human-computer interaction to form a very 'user-friendly' software package which can be easily applied to the conversion of many types of maps.

Upon casual inspection, people may conclude that this is a simple process – but it actually presents a very technically complex problem. The overall conversion process includes many different steps, as illustrated in Figure 1. This figure shows the operation of the system for elevation contour maps.

In the first step of the conversion process, the original map is scanned using a laser scanner. This enters the data into a computer in the form of a raster image. The raster is then converted to a set of vectors, via the logically-named 'Raster to Vector Conversion System' (RVCS). The vectors are then classified, on the basis of size, as either digits or contour lines.

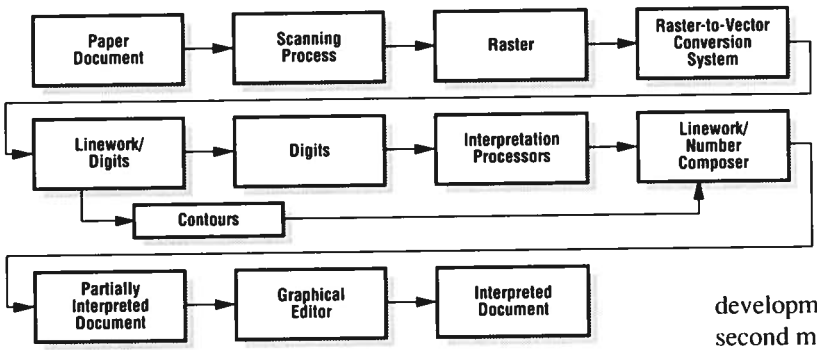


Figure 1: DataSpan's Map Conversion System

Next, the digits are interpreted and composed into numbers using constraint processing (see below). These numbers are then associated with the appropriate contour lines. Finally, an operator uses a graphical editor to manually process any data which the system marked as uninterpretable, producing the fully-interpreted document.

When devising a strategy to tackle this multi-step process, the development team at ARC and DataSpan recognized immediately that their first goal should be the development of a very fast, highly-efficient method of vectorizing the raster data.

At this stage, the expertise of Dr. Paul Kwok of the Department of Computer Science at the University of Calgary was recruited. With his help, the backbone of the RVCS was created. This system employs state-of-the-art skeletonization, or bit-thinning, techniques, and allows maps to be converted to vector format.

The next task was the development of software for interpreting digits, using constraint processing and character-interpretation algorithms. These were designed and implemented by Greg Sidebottom, an AI researcher with the Alberta Research Council in Calgary.

In automated digit interpretation, the vectors that represent a particular digit are first converted to an attributed graph, using image-processing and pattern-recognition techniques. The attributed graph is a symbolic structural representation of the data.

The core of the constraint processing for digits, according to Mr. Sidebottom, works as follows: "Characters are interpreted by matching them with sets of patterns. They are matched by matching the lines of the character to the lines of the pattern. This matches variables in the pattern for length and angles of lines with corresponding values in the character. If variable-value matches are consistent with the constraints, other constraints determine the value, orientation and scale of the character, according to how it matched the pattern."

This is a description of the basic interpretation process for a single digit. Yet it was clearly also necessary to develop a more sophisticated form of the interpretation process for numbers. The 'first crack' at this problem was the initial development of a digit recognizer. This recognizer could determine that a digit is either a '6' or a '9', for example, but wasn't able to discriminate between the two possibilities. The development of this digit recognizer represented the project's second milestone.

The creation of a more capable number interpreter was tackled as the third milestone. This interpreter, which employs AI techniques for constraint processing, was an attempt at higher-level interpretation. The final program's greatest advantage proved to be the determination of the correct meaning of digits or numbers within the context of other map information.

As an illustrative example, suppose the handwritten number 3450 appears on a map, in a right side up orientation (see Figure 2). It is assumed that the orientation and size of the numbers are not known in advance, but that the numbers are in the range from 0 to 3500, in increments of 25. The complete interpretation process would work as follows.

First, without any interpretation, the program produces the full series of 140 numbers which could possibly be on the map: 25, 50, 75, 100, ... 3450, 3475, 3500. Next, the program randomly picks one of the number's four digits for interpretation – in this example, let that be the digit '5'.

The program interprets this digit as either being a '5' right side up, or a '5' upside down. Thus any numbers from the first series which do not contain the digit '5' are eliminated, leaving a series of 109 numbers: 25, 50, 75, 125, ... 3450, 3475, 3500.

The program then moves over one digit from the '5' in a random direction – in this example, let that be to the left. The program interprets this digit as either being a '4' right side up, a '6' upside down, or a '9' right side up. The program rules out the presence of the digit "6", because it could only form the numbers 56__, _56_, or __56, all of which violate the initial assumptions regarding the numbers that may be present on the map.

These interpretations, combined with the fact that the '5' could only either be right side up or upside down, tells the program that the entire number must be right side up.

Thus the digit just to the left of the '5' is interpreted as being either the digit '4' or the digit '9' – and the entire number must contain one of the two-digit combinations '45' or '95'. This leaves only seven possible numbers: 450, 950, 1450, 1950, 2450, 2950, and 3450.

Finally, the program picks the digit one more position to the left. The program interprets this as being the digit '3'.

The result of DataSpan's four years of solid and single-minded commitment to their objective is a product which is an excellent showcase both for the expertise of DataSpan, and for the ability of AI to be used to solve complex practical problems.

Thus any numbers which do not include the sequence '345' or '395' are eliminated. The result is that only the number 3450 remains, and the interpretation is complete (note that it wasn't necessary for the program to process the digit '0').

This example shows that constraint processing allows the number-interpretation procedure to be conducted incrementally on both individual digits and on multi-digit numbers – rather than on each and every digit in isolation. As more information is gathered about the context of each digit and number, the overall pace of the interpretation process increases. Thus while the procedure remains linear and logical in its base-level implementation, the overall procedure is highly efficient.

"The most novel part of this whole map-interpretation package is the use of constraint satisfaction. It cuts down on the search space, while guiding the recognition and interpretation process", affirms Breen Liblong, an ARC employee who served as the technical leader in the joint research venture with DataSpan. "That's where the AI comes in, and where the real 'value-added' to this product is."

Finally, with the successful development of this software for digit interpretation, the fourth milestone could be approached. This involved two main thrusts. First, the constraint processor was redesigned to allow it to be used in the interpretation of features other than digits. The result is more efficient constraint processing that can be used on a number of different applications – for example, the assignment of values to individual lines on contour maps.

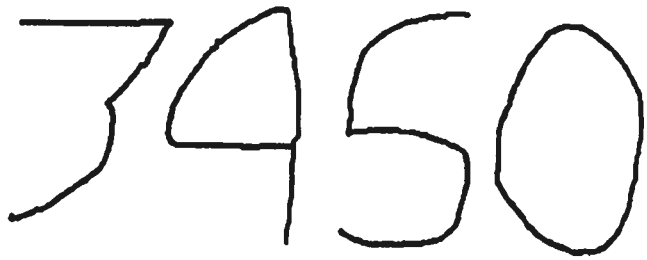


Figure 2: Hand-Drawn Number '3450

This feature, combined with the development of a highly-interactive editing framework, will allow future alterations of the software package for different types of maps to be completed at speeds and costs which the competition will find very difficult to match.

The result of DataSpan's four years of solid and single-minded commitment to their objective is a product which is an excellent showcase both for the expertise of DataSpan, and for the ability of AI to be used to solve complex practical problems.

"DataSpan is pretty much on the forefront in the corporate world with regard to the application of AI technology to map interpretation", affirms Dr. Jan Mulder, a computer scientist at Dalhousie University who is an expert in constraint processing. "They tackled a very complex pattern-recognition problem which had never been solved by anyone in industry, and have come up with an automated system which is unique in the world today. That has given DataSpan the competitive edge."

The great increase in efficiency which this technology offers, coupled with a large drop in the price, will result in a significant jump in DataSpan's revenues within the next year. Sales in 1989 were $2.6 million, and are already projected to hit $3.6 million this year.

The company's customers now include all of the provincial mapping agencies in Canada, and the company is hoping to make large inroads in the private sector market, both at home and in other countries. A sign of the bright times ahead was a sale of a conversion software package to Exxon in Houston, Texas in mid-1990.

"So far, our competitors are applying much more arduous and time-consuming methods to map interpretation", says Kevin O'Connor, the manager of DataSpan's Software Division, and Project Manager for the company's joint venture with the Alberta Research Council. "But we've broken new ground by applying such a sophisticated analytical package to the problem. Others will inevitably take up our approach, but for now, we intend to run as far as we can with our competitive advantage in the world marketplace!"

Jean-Claude Gavrel

PRECARN Associates: An Introduction

Jean-Claude Gavrel

PRECARN's objectives are to enhance the receptor capacity of Canadian industry for these new technologies and to strengthen linkages among universities, government research centres and the Canadian user and supplier industries. Projects are selected based on the interest of the industry, the potential to develop useful precompetitive technologies and the strength of the research teams. PRECARN is an "institute without walls": the projects are carried out by joint industry, university and/or government research teams. This allows PRECARN itself to operate with a small staff and low overhead to maximize the use of its funds for the actual research. The PRECARN research projects are funded by the Members and Canadian governments.

PRECARN has already funded eight feasibility studies, accepted one more and approved four research projects, with two others still under review. Projects will take four to five years and there will be regular briefings and workshop sessions for Members on their progress. Intellectual Property will be vested with PRECARN, with each Member being granted a royalty-free right to use it. The total investment in the research effort could reach $35 million over the next five years. The current active projects, and their participants are:

- Applications of Expert Systems to Advanced Process Control (Approved for research)
  Ontario Hydro/CAE Electronics/Shell Canada/Stelco/University of Toronto

- Telerobotic Development System
  (Approved for research)
  MPB Technologies/Hydro-Québec/CAE Electronics/CRIM/McGill/CIAR

- Active Navigation of a Mobile Robot in a Known Environment (Approved for research)
  Ontario Hydro/AECL/NRC/University of Toronto/York

- An Intelligent Graphic Interface for Real-Time Monitoring and Control (in review)
  MPR/Alberta Research Council/Trans Alta/Shell/Xerox/Simon Fraser University

- Application of AI to Engineering Design (In review)
  SPAR/Bristol/Marconi/U of Toronto/U of Manitoba/Polytechnique/U of Calgary

- Intelligent Robotic Control for Mine Drilling and Ore Handling (Approved for feasibility)
  Inco/Falconbridge/McGill/Polytechnique

Important recent news for PRECARN and the Canadian AI community at large, is the startup of the Institute of Robotics and Intelligent Systems (IRIS) under the management of PRECARN. IRIS is one of 15 Networks of Centres of Excellence announced by the Government of Canada in 1989. Under the agreement, IRIS will receive $23.8 million during the next four years to finance 22 research projects, involving 123 researchers in 19 universities across Canada.

IRIS will provide a link between universities and PRECARN's membership which will ensure the distribution across Canada and the exploitation of the resulting technologies. While the intellectual property developed in an IRIS research project will be controlled by the universities, PRECARN members will have the right of first refusal before that property is licensed elsewhere.

IRIS research covers three general areas. These areas and the research projects being carried out within them are:

A. Computational Perception
   1. Vision Systems for Recognition, Tracking and Navigation
   2. Human and Machine Perception Research for Advanced Telerobotics
   3. Sensory Processing Architectures
   4. Multi-Sensor Perception
   5. 3D Computer Vision: Sensing, Processing and Integrating Architectures
   6. Active Vision in Mobile Robot Navigation

7. Generation and Auditory Perception of Speech Signals

B. Knowledge-Based Systems
1. Design of Large Information Systems
2. Using Connectionist Learning of Adaptive Interfaces
3. Database Techniques for Knowledge-Base Management
4. Design and Human Interfaces
5. Foundations for Reasoning Systems
6. Engineering Applications of Constraint-Logic Programming

C. Intelligent Robotic Systems
1. Telerobotics: Dynamics and Control
2. Simulation, Control and Planning in Robotics
3. High Performance Robots: Design and Architecture
4. Intelligent Robot Planning and Execution Systems
5. Mechanics, Control and Design of Dexterous Robots/ Environment Interfaces
6. Teleoperation: Measurement of Machine Parameters and Human/Machine Performance
7. Dynamics and Control of Complex Space Manipulation Systems
8. Dynamical Design and Control of a Large Class of Space and Ground Flexible Manipulators
9. Dexterity in Teleoperation

When the funding agreement for IRIS was signed last July, G. M. MacNabb, President and CEO of PRECARN, said that Canada, through the related work of PRECARN, the Canadian Institute for Advanced Research and IRIS is now making "a truly concerted effort" in the fields of AI and robotics research.

Future issues of this column will focus on individual projects, as well as reporting newsworthy items in the PRECARN/IRIS AI network. For example the next issue will include a presentation of the APACS project (Application of Expert Systems to Advanced Process Control).

For more information contact:

Mr. Jean-Claude Gavrel, Director of Research Programs
PRECARN Associates
300-30 Colonnade Road, Nepean, Ontario K2E 7P4
TEL: (613) 727-9576 FAX: (613) 727-5672
EMAIL: <GAVREL@A1.ATOTT2.NRCNET>

Zenon Pylyshyn

The Canadian Institute for Advanced Research: Program in Artificial Intelligence and Robotics

Zenon Pylyshyn, Program Director

The editor of the Canadian Artificial Intelligence Magazine has asked me to bring the AI community up to date on what's happening in the AI and Robotics (AIR) program of the Canadian Institute for Advanced Research. Since there has not been a general distribution of information concerning this program for a few years, I welcome this opportunity to provide an update on our activities. The plan is to continue this reporting by providing a summary of the activities at individual "CIAR nodes" and individual research laboratories on a regular basis in the future. For completeness, the current Fellows, Scholars and Associates of the program are listed at the end of this article.

The program is now in its sixth year, having been inaugurated officially in 1984. In 1988 it underwent its scheduled five-year external review from an international panel of experts. The panel consisted of Alan Newell (CMU), Woody Bledsoe (MCC and U of Texas), Michael Arbib (USC), Michael Brady (Oxford), Whitman Richards (MIT), and Boris Stoicheff (Physics Dept, U of T), with John Madden acting as chairman and representative of the CIAR Research Council. After visiting the principal cites of AIR program activity, hearing presentations by all members, and looking over extensive personal and program documentation, the AIR program – the first CIAR program ever to be given a full dress external revue – was given an A+ report. The committee concluded that "...collectively, the three principal nodes were amongst the best twenty artificial intelligence laboratories in the world, and, in several sub-disciplines were among the ten best in the world". It was also the committee's view that "none of these three nodes would have been classifiable as 'world class' without the direct support and encouragement of CIAR." As a result of the committee's detailed recommendations, a few changes were made and most of the Fellows and Scholars (a junior Fellow category) were renewed for another 5 years.

One of the changes that was made was the restructuring of the program's Advisory Committee to include more international experts in artificial intelligence. The committee, which oversees the program's policies and new appointments, now consists of:

Ray Perrault (Director of the Artificial Intelligence Group at SRI International)

Thomas Lozano-Perez (Associate Director of the Artificial Intelligence Laboratory at MIT)

Takeo Kanade (Co-director of the Robotics Institute at Carnegie-Mellon University)

Gordon McNabb (ex officio, representing Precarn)

Jim Ham (representing CIAR, as the special advisor to the president)

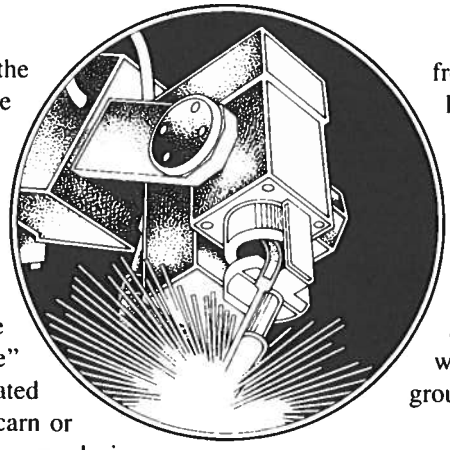
J. Ron McCullough (VP of Corporate Planning, Spar Aerospace), Pierre Belanger (Dean, Faculty of Engineering, MCGill University)

Eric Manning (Dean, Faculty of Engineering, University of Victoria).

The Chairman of the committee is Barry Frost of Queen's University. The program director, Zenon Pylyshyn, is also an ex officio member of this committee. In addition to this committee, the initiative for new program ideas and new appointments comes from an internal committee called the Program Development Committee (currently Alan Mackworth, Hector Levesque, Steve Zucker, and John Hollerbach) whose job is to advise the director on questions of management and direction.

Partly in response to the five year review and partly in response to its increasing size, the program was asked by the CIAR Research Council and its Advisory Committee to provide a document describing the scope and focus of the AIR program, and to outline its strategy for growth and future development. This document was prepared over a one year period by the Program Development Committee and has now been approved by the Council. The report recognizes that the strength of the program at present lies in computational and biological vision, knowledge representation and reasoning, and in motor control and robotics. It proposes that in the future greater emphasis be placed on the experimental side of system design and on the

integration and cross-fertilization among the three areas of current concentration. The report lays out a proposed strategy for the development of the program over the next five years and makes some specific recommendations concerning the use of the various categories of membership (Fellow, Scholar, and Associate). Relating to the latter, the report also proposed the development of new "linking associate" positions involving people who are associated with other related initiatives such as Precarn or IRIS. So far we have only appointed two people in these linking categories (as so-called Precarn-CIAR Associates), but we expect to add more soon. Because the AIR program is closely tied to a number of related Canadian initiatives there has been some discussion towards establishing a committee to help coordinate the entire spectrum of interdependent AI research activity in Canada. This idea is currently being explored among the groups involved.



The program has produced many award winners in its 6-year history. There have been two E.R.W. Steacie Memorial Research Fellows (Cynader & Levesque), two Killam Research Fellows (Zames & Pylyshyn), a Computers and Thought Award Winner (Levesque), an IEEE Field Prize winner (Zames) and a Donald O. Hebb Award winner (Pylyshyn). In addition, John Hollerbach (who became a fellow in 1988) received a NSERC Industrial Chair at McGill, Ian Hunter was awarded the GM Fellowship, Alan Mackworth received the Shell Canada Fellowship, Hector Levesque received the Petro Canada Fellowship, and Geoffrey Hinton was given the Noranda fellowship. Several Fellows are also being considered at present for Province of Ontario Fellowships.

Over the years the program has held regular meetings of all members, as well as special workshops. Two of these workshops have resulted in publications in the "CIAR Series in AI and Robotics" published by Ablex. The first was edited by Zenon Pylyshyn and is entitled "Computational Processes in Human Vision: An Interdisciplinary Perspective" (Ablex, 1988) and the second was edited by Melvin Goodale and is entitled "Vision and Action: The control of Grasping" (Ablex, 1989). In addition, there have been regular annual meetings organized by and for graduate students (primarily, though not exclusively, students of AIR program members), under general guidelines set by the program. These have focused on Vision, Robotics and Motor Control, Knowledge Representation, and the interrelationships among these three. The graduate student meetings have been an important mechanism for creating a community of researchers among graduate students, most of whom now continue to keep in touch through travel and e-mail. There have also been regular meeting-exchanges between McGill and Toronto, with attendance by researchers from Queen's and Western. These have been held annually for four years, with the venue alternating between Montreal and Toronto. The program's "Interaction budget" has also financed exchanges and visits by faculty and graduate students who visited labs at UBC, Western, Queen's, McGill, Toronto, and MIT. It also helped to finance special projects within CSCSI, KR-89, and other relevant groups.

CIAR Fellows of the AIR Program:

- Zenon N. Pylyshyn, Program Director,
  Centre for Cognitive Science
  Social Science Building
  The University of Western Ontario
  London, Ontario N6A 5C2
  Theoretical issues in human cognition; studies in human visual attention.
- Dr. Peter E. Caines
  Department of Electrical Engineering
  McGill University
  Montreal, Quebec H3A 2A7
  Foundations of adaptive control, applications to machine learning.
- Professor Max Cynader
  Eye Care Clinic
  Vancouver General Hospital
  2550 Willow Street
  Vancouver, B.C. V5Z 3WI
  Complexity of the organization of the visual cortex, combining computational, anatomical and physiological approaches
- Professor Geoffrey Hinton (Noranda Fellow)
  Department of Computer Science
  University of Toronto
  10 King's College Rd.
  Toronto, Ontario M5S IA4
  Neural network architectures and applications to learning, vision, and knowledge representation.
- Professor John Hollerbach
  NSERC Industrial Chair of Robotics
  McGill University
  Montreal, Quebec H3A 2A7
  Theoretical studies in human motor control and design of intelligent robitic systems.
- Professor Hector Levesque
  Department of Computer Science
  University of Toronto
  10 King's College Rd. Toronto, Ontario M5S IA4
  Knowledge representation, models of belief, complexity issues in automated reasoning.
- Professor Alan K. Mackworth

Call for Participation

Twelfth International Joint Conference

August 24 - 30, 1991. Sydney. Australia

The biennial IJCAI conferences are the major forums for the international scientific exchange and presentation of AI research. The next IJCAI conference will be held in Sydney. Australia, 24-30 August 1991. IJAI-91 is sponsored by the International Joint Conferences on Artificial Intelligence. Inc. (IJCAII), and co-sponsored by the National Committee on Artificial Intelligence and Expert Systems of the Australian Computer Society.

The conference technical program will include workshops, tutorials, panels and invited talks. as well as tracks for paper and videotape presentations.

Paper Track:

Submission Requirements and Guidelines Topics of Interests.

Submissions are invited on substantial, original, and previously unpublished research in all aspects of AI, including, but not limited to:

- Architectures and languages for AI (e.g. hardware and software for building AU systems, real time and distributed AI)
- Automated reasoning (e.g. therom proving, automatic programming, planning and reasoning about action, search, truth maintenance systems, constraint satisfaction)
- Cognitive modelling (e.g. user models, memory models)
- Connectionist and PDP models
- Knowledge representation (e.g. logics for knowledge, belief and intention, nonmonotonic formalisms, complexity analysis, languages and systems for representing knowledge)
- Learning and knowledge acquisition
- Logic Programming (e.g. semantics, deductive databases, relationships to AI knowledge representation)
- Natural language (e.g. syntax, semantics, discourse, speech recognition and understanding, natural language front ends)
- Philosophical foundations
- Principles of AI applications (e.g. intelligent CAI, design, manufacturing, control)
- Qualitative reasoning and naive physics (e.g. temporal and spatial reasoning, reasoning under uncertainty, model-based reasoning, diagnosis)
- Robotics (e.g. kinematics, manipulators, navigation, sensors, control)
- Social, economic and legal implications
- Vision (e.g. colour, shape, stereo, motion, object recognition, active vision, model-based vision, vision architectures and hardware, biological modelling)

Timetable

Papers must be received by 10 December 1990, and must be 2500 to 5500 words in length. Authors will be notified of the program committee's decision on or before 20 March 1991.

For further information, including specific instructions for submitting a paper, contact one of the Program Committee CoChairs:

Prof. John Mylopoulos
Department of Computer Science
University of Toronto
Toronto, Ont. M5S 1A4, Canada
Tel: 1 (416) 978-5379
Fax: 1 (416) 978-1455
email: ijcai@cs.toronto.edu

Prof. Ray Reiter
Department of Computer Science
University of Toronto
Toronto, Ont. M5S 1A4, Canada
Tel: 1 (416) 978-5379
Fax: 1 (416) 978-1455
email: ijcai@cs.toronto.edu

Videotape Track:

Submission Requirements and Guidelines.

This track is reserved for displaying interesting research on applications to real-world problems arising in industrial, commercial, government, space and educational arenas. It is designed to demonstrate the current levels of usefulness of AI tools, techniques and methods. all video submissions will be peer reviewed.

Timetable

Submissions must be received by 10 December 1990. The notification of the decision will be made on or before 20 march 1991. For further information, including specific instructions of submitting a videotape, contact the Videotape track Chair:

Dr. Alain Rappaport
Neuron Data
444 High Street
Palo Alto, CA 94301, USA
Tel: 1 (415) 321-44488
Fax: 1 (415) 321-3728
email: atr@ml-ri.cmu.edu

IJCAI-91

ın Artificial Intelligence

Panels

Individuals wishing to organize and chair a panel are invited to submit a suitable proposal. A panel allows three to five individuals to present their views or results on a common theme, issue. or question.

Panels should be both relevant and interesting to the AI community, and have a clearly specified topic that is narrow enough to be adequately addressed in a single session of slightly over one hour.

Timetable

Panel proposal should be submitted as soon as possible, but no later than 1 February 1991. Proposals will be reviewed as soon as they are received.

For further information, including specific instructions for submitting a proposal, contact the Panel Program Chair:

Dr. Peter F. Patel-Schneider
AT&T Bell Laboratories
600 Mountain Avenue
Murray Hill, New Jersey 07974 , USA
Tel: 1 (201) 582-3399
Fax: 1 (201) 582-5192
email: pfps@research.att.com

Tutorial Program

Proposals are invited form individuals wishing to offer a tutorial at IJCAI-91. Tutorial topics should be of interest to a substantial segment of the IJCAI audience. Proposals from a pair of presenters will be strongly favored over ones from a single individual.

Timetable

Proposals must be received by 4 Jan. 1991. Decisions about topics and speakers will be made by 22 Feb. 1991. Speakers should be prepared to submit completed course materials by 1 July 1991.

For further information, including specific instructions for submitting a proposal, contact the Tutorial Program Chair:

Dr. Martha Pollack
Artificial Intelligence Center
SRI International
333 Ravenswood Ave.
Menlo Park, CA 94025, USA
Tel: 1 (415) 859-2037
Fax: 1 (415) 326-5512
email: pollack@ai.sri.com

(Note: Indicate clearly on the first page that it is intended for Martha Pollack, Artificial Intelligence Center.)

Workshop Program

Gathering in an informal setting, workshop participants will have the opportunity to meet and discuss selected technical topics in an atmosphere which fosters the active exchange of ideas among researchers and practitioners. Members from all segments of the AI community are invited tn submit proposals for workshops they wish to organize.

To encourage interaction and a broad exchange of ideas, the workshops will be kept small, preferably under 35 participants. Attendance should be limited to active participants only. The format of workshop presentations will be determined by the organizers proposing the workshop, but ample time must be allotted for general discussion. Workshops can very in length. but most will last a half day or a full day.

Timetable

Proposals should be submitted as soon as possible, but no later than 21 December 1990. Proposal will be reviewed as they are receive and resources allocated as workshops are approved. Organizers will be notified of the committee's decision no later than 15 February 1991.

For further information, including specific instructions for submitting a proposal, contact the Workshop Program Chair:

Dr. Josph Katz
MITRE Corporation
MS-K318
Burlington Road, USA
Tel: 1 (617) 271-8899
Fax 1 (617) 271-2423
email: katz@mbunix.mitre.org

(Shell Canada Fellow)
Department of Computer Science
University of British Columbia
Vancouver, B.C. V6T 1W5
Computational vision, representation of visual knowledge.

- Professor Raymond Reiter
  Department of Computer Science
  University of Toronto
  Toronto, Ontario M5S 1A4
  Models of reasoning, non-monotonic logics suitable for automated reasoning, application of logic to diagnosis, vision, and other domains.
- Professor Demetri Terzopoulos
  Department of Computer Science
  University of Toronto
  Toronto, Ontario M4S 1A4
  Computer vision and graphics using modelling methods based on computational physics.
- Professor John K. Tsotsos
  Department of Computer Science
  University of Toronto
  Toronto, Ontario M5S 1A4
  Biological and machine vision, complexity and other theoretical issues in visual processing.
- Professor Robert J. Woodham
  Department of Computer Science
  University of British Columbia
  Vancouver, B. C. V6T 1W5
  Computational vision (low-level), remote sensing.
- Professor George Zames
  Department of Electrical Engineering
  McGill University
  Montreal, Quebec H3A 2A7
  Mathematical theory of systems with feedback.
- Professor Steven Zucker
  Department of Electrical Engineering
  McGill University
  Montreal, Quebec H3A 2A7
  Theoretical analysis of computer and biological vision.

(Several of the Fellows listed above are also pending designation as Province of Ontario Fellows)

Institute Scholars:

- Professor David Lowe
  Department of Computer Science
  University of British Columbia
  Vancouver, B.C. V6T 1W5
  Computational vision, object recognition.
- Professor Ian Hunter (GM Fellow)
  Biomedical Engineering Unit
  Faculty of Medicine
  McGill University
  Montreal, Quebec H3A 2B4
  Theoretical and experimental studies in human motor control.
- Professor Alan Jepson
  Department of Computer Science
  University of Toronto
  Toronto, Ontario M5S 1A4
  Mathematical and computational models of biological vision systems.
- Professor David Poole
  Department of Computer Science
  University of British Columbia
  Vancouver, British Columbia V6T 1W5
  Abductive reasoning, nonmonotonic reasoning.

Associates:

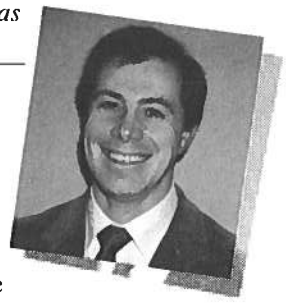
- Professor Wolfgang Bibel
  Informatik Technische Hochschule
  Alexander Str. 10
  D-6100 Darmstadt, West Germany
  Automated reasoning, parallel inference machines, knowledge representation, program synthesis.
- Dr. Stanley J. Rosenschein
  President & Director Research
  Teleos Research
  576 Middlefield Road
  Palo Alto, CA, U.S.A. 94301
  Situational semantics, situated automata and models of intelligent agents.
- Dr. Edward Stabler
  Department of Linguistics
  University of California, Los Angeles
  405 Hilgard Avenue
  Los Angeles, CA, U.S.A. 90024-1543
  Natural language processing and automated deduction.
- Prof. Richard B. Stein
  Department of Physiology
  University of Alberta
  Edmonton, Alberta T6G 2ES
  Studies of human and animal motor control systems; design of motor prosthetic devices.
- Prof. Anne Treisman
  Department of Psychology
  University of California
  Berkeley, California, U.S.A. 94720
  Studies of human attention; visual processing.

CIAR-PRECARN Associates

- Professor Martin D. Levine
  Department of Electrical Engineering
  McGill University
  Montreal, Quebec H3A 2A7
  Design of general purpose vision systems; with applications in biomedicine and robotics.
- Professor John Mylopoulos
  Department of Computer Science
  University of Toronto
  Toronto, Ontario M5S 1A4
  Knowledge representation, Intelligent databases.

WORLD WATCH
VUE SUR LE MONDE

Russ Thomas



I would like to introduce myself as the new editor of the World Watch section of Canadian Artificial Intelligence Magazine. My name is Russ Thomas and I work for the National Research Council of Canada and am based in Calgary (email: russ@noah.arc.ab.ca).

I have recently arrived in Canada from my previous post at the University of Warwick in the U.K. where I have been involved in the UK AI community and the UK AI society (SSAISB).

It is my intention to build upon the existing World Watch by the addition of a number of contributions from AI centres around the world. These would include general descriptions of the research unit along with descriptions of on-going projects and contact personnel for each project. It would provide enough information for those who are interested to follow up by contacting the individuals directly. In general I see this as just an additional means of enlarging awareness of AI work that is going on outside of the bounds of North America.

I would appreciate any contributions, contacts in interesting AI groups or just comments on the role of a World Watch.

1.0 THEORETICAL ASPECTS

502 A knowledge-based fuzzy decision tree classifier for time series modeling.
Kun Chang Lee, Sung Joo Park
(Dept. of Manage. Sci., Korea Adv. Inst. of Sci. & Technol., Seoul, South Korea). *Fuzzy Sets Syst. (Netherlands)*, vol. 33, no. 1, p. 1-18 (25 Oct. 1989).

An approach is suggested to classify a pattern of a particular time series into one of autoregressive moving-average (ARMA) models based on a decision tree classifier. The pattern is obtained by means of an extended sample autocorrelation function. The decision tree classifier is fuzzified to deal with the imprecision inherent in the pattern classification procedure. Two fuzzy decision functions are suggested to compute decision values at each node of the tree. Based on the decision values, a tree search algorithm is presented to find promising paths. A knowledge-based approach is used to provide intelligence for the algorithm. The proposed approach essentially results in a fuzzy logic search through the space of possible terminal nodes. Experimental results show that the proposed approach can efficiently identify the time series patterns with high precision. (39 refs.)

503. A computationally efficient approximation of Dempster-Shafer theory.
F. Voorbraak
(Dept. of Philos. Utrecht Univ., Netherlands).
Int. J. Man-Mach. Stud. (UK), vol.30, no.5, p.525-36 (May 1989). [received: 08 Dec 1989]

An often mentioned obstacle for the use of Dempster-Shafer theory (G. Shafer, 1976), for the handling of uncertainty in expert systems is the computational complexity of the theory. One cause of this complexity is the fact that in Dempster-Shafer theory the evidence is represented by a belief function which is induced by a basic probability assignment, i.e. a probability measure on the powerset of possible answers to a questions, like in a Bayesian approach. The author defines a Bayesian approximation of a belief function and shows that combining the Bayesian approximations of belief functions is computationally less involving than combining the belief functions themselves, while in many practical applications replacing the belief functions by their Bayesian approximations will not essentially affect the result. (9 refs.)

516 Cognition as a holistic process: implications for AI and education.
P. Senrau
(California State Univ., Los Angeles, CA, USA). Combined Proceedings: Third Conference on Applications of Artificial Intelligence and CD-ROM in Education and Training, and Fourth Conference on Applications of Artificial Intelligence and CD-ROM in Education and Training, USA, 28-30 Oct. 1987 and 26-28 Oct. 1988 (Warrenton, VA, USA: Learning Technol. Inst. 1988), p.126-30

Research in AI has much to gain by incorporating theories of cognition related to emotion. Adding the qualitative process of emotions to AI has the potential of more closely replicating factors in human intelligence. Among the basic steps in understanding qualitative processes would be to research the creative problem solving stages of artists involved with expressing emotions. The research in AI needs to examine other qualitative factors in creative problem solving such as cultural attitudes, and beliefs and how these affect learning. Analyzing and converting thinking processes in AI programs would be a major contribution to education research concerned with perception, memory, and individual learning processes. Educational research describing cognitive

processes in creative thinking could provide a more comprehensive model of human intelligence for AI systems. (5 refs.)

754 Formal systems in artificial intelligence: an illustration using semigroup, automata and language theory.
P.T. Hadingham
(Dept. of Comput. Sci., Univ. of Western Australia, Nedlands, WA, USA).
Artif. Intell. Rev. (UK), vol.4, no.1, p.3-19 (1990).

As the field of Artificial Intelligence (AI) matures, methods relying less on ad hoc procedures and more on well defined operations in the context of formal structures are emerging. Evidence for this can be found, for example, in the increasingly sophisticated approaches to inexact reasoning in knowledge-based systems and in the mathematical framework developed for semantic net representation. This tutorial and brief survey presents a facet of formal language theory which provides a formalism for naturally representing and operating on strings of symbols and which also admits obvious means of handling issues such as specialization and generalization, pervasive in AI. The broad subject area covered is part of semigroup theory which has a natural relationship to both finite state automata theory and regular languages. The author aims to introduce some of the underlying theory relevant to representation issues in AI in this context. (21 refs.)

759 Implementation of rule-based expert systems for time-critical applications using neural networks.
P.A. Ramamoorthy, S. Huang
(Dept. of Electr. & Comput. Eng., Cincinnati Univ., OH, USA). IEEE International Conference on Systems Engineering (Cat. No. 89CH2767-2), Fairborn, OH, USA, 24-26 Aug. 1989 (New York, NY, USA: IEEE 1989), p.147-50

The process of constructing a neural-network-based expert system from a given AND/OR inference net is examined. The major purpose of such an approach is to make use of the parallel-processing capabilities of neural networks in implementing expert systems for classifications. In order to provide a clear view of the design process of the proposed expert system and its neural network version are given. It is clear from the result that neural networks can be used as an implementational vehicle for expert systems for time-critical applications. (5 refs.)

1010 Artificial intelligence dialects of the Bayesian belief revision language.
S. Schocken
(Leonard N. Stern Sch. of Bus., New York Univ., NY, USA), P. R. Kleindorfer.
IEEE Trans. Syst. Man Cybern. (USA), vol.19,no.5, p.1106-21 (Sept.-Oct. 1989). [received: 21 Feb 1990]

Several well-known belief languages in artificial intelligence are reviewed, and both previous work and new insights into their Bayesian interpretations are presented. In particular, the authors focus on three alternative belief-update models: the certainty factors calculus, Dempster-Shafer simple support functions, and the descriptive contrast/inertia model. Important 'dialects' of these languages are shown to be isomorphic to each other and to a special case of Bayesian inference. Parts of the analysis were carried out by other authors; their results were extended and consolidated using an analytic technique designed to study the kinship of belief languages in general. (60 refs.)

1020 A neural-net approach to supervised learning of pole balancing.
E. Grant, B. Zhang
(Turing Inst., Glasgow, UK).
Proceedings. IEEE International Symposium on Intelligent Control 1989 (Cat. No.89TH0282-4), Albany, NY, USA, 25-26 Sept. 1989 (Washington, DC, USA: IEEE Comput. Soc. Press 1989), p. 123-9

It is shown how artificial neural nets can be used to solve a difficult learning problem. The task is to balance a pole that is hinged to a movable cart by applying either a left or a right force to the cart. The control process consists of developing pattern formations to give the required motor drive control. The latter is implemented with a connectionist net of the Rumelhart semilinear feedforward type. At each instant in time, the values of a training set of the system's state variable are processed into a single pattern which in turn is applied to the input layer of the connectionist net. The response, at the output layer of the net, is used as the control signal for that instant. During the learning period, the system is controlled by a human operator and the neural net learns to mimic human control by backpropagating the human's decisions through the network and updating the synaptic weights. The authors test the approach and conclude that the neural-net embedded rule is more effective in relation to the other methods used, especially in its ability to respond to changing system parameters. (13 refs.)

1025 The role of time in natural intelligence: implications for neural network and artificial intelligence research.
A.H. Klopf, J.S. Morgan
(US Air Force Wright Aeronaut. Lab., Wright-Patterson AFB, Dayton, OH, USA).
IJCNN: International Joint Conference on Neural Networks (Cat. No. 89CH2765-6), Washington, DC, USA, 18-22 June 1989 (New York, NY, USA: IEEE TAB Neural Network Committee 1989), p.97-100 vol.2

The authors present research on alternative basic elements for neural network modeling. A principle that has emerged

from this research, which may have important implications for understanding natural and perhaps artificial intelligence, is examined. A paradigm that deals with what and when may be essential for modeling natural intelligence. The authors call such a paradigm a spatio-temporal neural network paradigm. Such a paradigm, which emphasizes real-time, closed-loop interactions between a learning system and its environment, is emerging from research on alternative models of single neuron function. In particular, it is found that neuronal models of classical conditioning phenomena and neural network models of instrumental conditioning phenomena suggest that, as a general principle, real-time considerations may be fundamental to natural intelligence. More specifically, the authors are investigating the hypothesis that learning in biological systems consists of acquired positive and negative real-time feedback loops built on a foundation of innate positive and negative real-time feedback loops. (41 refs.)

2.0 SYSTEMS AND TECHNIQUES

522 CLIPS–a powerful development and delivery expert system tool.
R.M. Wygant
(Dept. of Ind. Eng., Western Michigan Univ., Kalamazoo, MI, USA).
Comput. Ind. Eng. (UK), vol.17, p.546-9 (1989). (11th Annual Conference on Computers and Industrial Engineering, Orlando, FL, USA, 15-17 March 1989).

Much of the attention in large expert systems has been on LISP based systems. Several problems that are inherent in LISP based systems include: limited availability of LISP machines and LISP languages on conventional computers, low portability, and restricted capability for integration with other languages, particularly data base systems. To facilitate the delivery of expert systems, the Artificial Intelligence Section of the Mission Planning and Analysis Division at NASA/Johnson Space Center has developed an expert system tool called CLIPS (C Language Protection System) which provides high portability and ease of integration with most external computer languages. (5 refs.)

539 Technological considerations for industrial expert systems applications.
D. Neiman
(ITT Adv. Technol. Center, Shelton, CT, USA).
Int. J. Comput. Appl. Technol. (Switzerland), vol.3, no.1, p.54-6 (1990)

Expert systems promise many new industrial applications for the computer, but practical cost-effective solutions must be able to coexist with present operating systems and hardware. The selection of a language for developing an expert system is discussed. The author briefly describes the options: production systems and the OPS5 language; deductive retrievers and Prolog; hybrid AI languages like OPS83; knowledge representation languages; commercial expert systems toolkits; and microcomputer based expert systems. An alternative to buying a commercial AI language is to write one. The author describes the development experience of the Advanced Technology Centre which has produced several expert systems for the ITT divisions. The DECIDES and SPOT projects are discussed, the former using OPS5 the latter DICK and later OPS83. OPS83 was also used to implement Ingrid control panel configuration program.

543 Building expert systems on neural architecture.
Li-Min Fu
(Wisconsin Univ., Milwaukee, WI, USA).
First IEE International Conference on Artificial Neural Networks (Conf. Publ. No. 313), London, UK, 16-18 Oct. 1989 (London, UK: IEE 1989), p.221-5

A novel approach has been developed for building a rule-based system on the neural architecture. Under this approach, the knowledge base and the inference engine are mapped into an entity called conceptualization where a node represents a concept and a link represents a relation between two concepts. Inference in the conceptualization involves propagation and combination of activations as well as maximizing information transmission through layers. Learning is based upon a mechanism called back-propagation, which allows proper modification of connection strengths in order to be adapted to the environment. Finally, the validity of this approach has been demonstrated by experiments. (17 refs.)

554 Risk weighting in knowledge bases using fuzzy cognitive maps.
W.R. Taber, R. O. Deich
(Gen. Dynamics Electron. Div., San Diego, CA, USA).
Proceedings of the Fourth Annual Artificial Intelligence and Advanced Computer Technology Conference, Long Beach, CA, USA, 4-6 May 1988 (Glen Ellyn, IL, USA: Tower Conference Management 1988), p.499-502

Fuzzy cognitive maps (FCMs) provide a valuable supplement for the knowledge engineer's toolkit. They allow the expert to construct a causal diagram instead of listing rules or building search-trees. The additive nature of FCMs allow expert responses to be combined into a more reliable system, which is useful when multiple experts are available. Although traditional expert systems become less reliable with more contributing experts, the FCM approach to knowledge representation increases reliability with multiple experts. A single differing expert will receive less weight, as his knowledge responses vary more from the other experts. Assuming the addition of more experts, those with highest

variance from the others will be assigned smaller and smaller weights. The weight slides down the weight scale [1,0] away from 1. This behaviour is called roll-off. The paper explains the roll-off behaviour of expert weights estimated with FCMs. (5 refs.)

559 Integration of expert systems into network operations and management.
S.E. Aidarous, D. Helmy
(BNR, Ottawa, Ont., Canada).
IEEE International Conference on Communications. BOSTONICC/89. World Prosperity Through Communications (Cat. No.89CH2655-9), Boston, MA, USA, 11-14 June 1989 (New York, NY, USA: IEEE 1989), p.1438-42 vol.3

The authors report the experiences gained through the planning, design, development, and deployment of a prototype expert system for Bell Canada's special services provisioning. The prototype, circuit design and management system (CDMS), is currently undergoing field trials. The authors show how the telephone company's environment can be examined to select the appropriate functionality of the system and how it can be properly positioned within the existing operational environment. They also show how cost-effectiveness and organizational constraints can influence the design and implementation of a system and its integration into the existing operations environment. Emphasis is on problem selection, knowledge base representation from the users' viewpoint, and the integrations between the system and the Bell Canada operations environment. (2 refs.)

779 The Mac state of mind [expert systems].
D.W. Rasmus
(Western Digital Corp., Irvine, CA, USA).
BYTE (USA), vol.15, no.1, p.305-14 (Jan. 1990).

Evaluates some expert system shells for the Apple Macintosh. They are: Cognate, ExperFacts, flex, Humble, HyperX, Instant-Expert Plus, Intelligent Developer, Level5, MacSmarts, Mahogany, Nexpert Object, and SuperExpert.

785 On interface requirements for expert systems.
R. L. Wexelblat.
AI Mag. (USA), vol.10, no.3, p.66-78 (Fall 1989).

The user interface to an expert system shares many design objectives and methods with the interface to a computer system of any sort. Nevertheless, significant aspects of behavior and user expectation are peculiar to expert systems and their users. These considerations are discussed, with examples from an actual system. Guidelines for the behavior of expert systems and the responsibility of designers to their users are proposed. Simplicity is highly recommended. (18 refs.)

791 The MEDIATOR: analysis of an early case-based problem solver.
J. L. Kolodner
(Sch. of Inf. & Comput. Sci., Georgia Inst. of Technol., Atlanta, GA, USA), R. L. Simpson.
Cogn. Sci. (USA), vol.13, no.4, p.507-49 (Oct.-Dec. 1989).

The MEDIATOR was one of the earliest case-based, problem-solving programs. Its domain is dispute resolution, and it uses case-based reasoning for 10 different tasks involved in its problem solving. While some of the MEDIATOR's processes have been elaborated and improved on in later case-based problem solvers, there remain many lessons that can be learned about case-based reasoning by analyzing the MEDIATOR's behavior. The paper provides a short description of the MEDIATOR and its domain, presents its successes and shortcomings, and analyzes the reasons why it behaves the way it does. As part of the analysis, the differences and similarities between the MEDIATOR and later case-based reasoners are also described, as well as the implications of those differences. (60 refs.)

813 Implementing expert systems: users, uses and a wish-list of shell features.
R. L Citrenbaum, J. R. Geissman
(Abacus Programming Corp., Van Nuys, CA, USA).
Proceedings of the Fourth Annual Artificial Intelligence and Advanced Computer Technology Conference, Long Beach, CA, USA, 4-6 May 1988 (Glen Ellyn, IL, USA: Tower Conference Management 1988), p.87-96

What are the most valuable features in an expert system shell or development and execution environment? What is the relationship between the activities in developing an expert system and the features in a shell? Which shell features are of particular help to someone trying to learn about the expert systems? Which features help the rapid development of prototypes? Which features are required for verification and validation? Which features help the development of classification systems? The authors answer these and other questions from a perspective that considers users, uses and applications. They identify the various uses that users make of shells at the stages in a prototyping development cycle and then the specific demands on shells implied by these uses. They also identify the users of expert system shells and their specific needs, and derive specific shell features that support their needs. The different kinds of applications that are developed are considered and the various demands on shells are made into a wish-list of shell features. (4 refs.)

823 Production expert systems: an analysis of user acceptance.
W.C. Richie
(AI Support Center, Palo Alto, CA, USA).
SEAS. Proceedings Spring Meeting 1989. End User Computing, Vienna, Austria, 3-7 April 1989 (Netherlands: SHARE Eur. Assoc. 1989), p.1631-47 vol.2

Even though there have been literally thousands of expert systems applications developed and placed in production throughout industry, an all too familiar pattern has emerged. Many systems are developed, installed, and used very heavily in the beginning. Then, almost predictably, usage decreases dramatically and the values being realized disappear. Once investigated, valid reasons for this decrease in usage are discovered, and in the vast majority of cases, these reasons can all be tied back to an inadequacy in the initial project or implementation plan. Based upon the actual experiences of members of IBM's Artificial Intelligence Support Center, this presentation centers on the expert systems project planning process, and in particular, on those plan deficiencies that most often result in decreased usage. Specific areas of discussion include how to plan for the new job responsibilities of the expert system application developer; a look at a task analysis methodology presently being used to insure ongoing user enthusiasm: and probably most important, the development of a long range maintenance and enhancement plan for each application.

1028 Rule-based program construction for logical constructs.
Kyung Hwan Park, Yung Taek Kim.
J. Korea Inf. Sci. Soc. (South Korea), vol.16, no.4, p.317-30 (July 1989). In Korean. [received: 13 Feb 1990]

The authors present a method for designing and implementing an automatic programming system which transforms logical constructs in the program specification into the corresponding procedural codes. The transformation process consists of repeated applications of the transformation rules to rewrite a segment of the developing program into a procedural code. This method allows one to intermix logical and procedural constructs for program specification. Such intermixing is very difficult for the deductive method of automatic programming. Based on this method, an automatic programming system has been implemented by employing expert system technology and adopting the object-based representation for programming knowledge. (16 refs.)

1030 High-speed implementations of rule-based systems.
A. Gupta
(Stanford Univ., CA, USA), C. Forgy, A. Newell.
ACM Trans. Comput. Syst. (USA), vol.7, no.2,p.119-46 (May 1989). [received: 14 Mar 1990]

Rule-based systems are widely used in artificial intelligence for modeling intelligent behavior and building expert systems. Most rule-based programs, however, are extremely computation intensive and run quite slowly. The slow speed of execution has prohibited the use of rule-based systems in domains requiring high performance and real-time response. The authors explore various methods for speeding up the execution of rule-based systems. In particular, they examine the role of parallelism in the high-speed execution of rule-based systems and study the architectural issues in the design of computers for rule-based systems. Their results show that contrary to initial expectations, the speedup that can be obtained from parallelism is quite limited, only about tenfold. The reasons for the small speed-up are: (1) the small number of rules relevant to each change to data memory, (2) the large variation in the processing requirements of relevant rules, and (3) the small number of changes made to data memory between synchronization steps. Furthermore, they observe that to obtain this limited factor of tenfold speed-up, it is necessary to exploit parallelism at a very fine granularity. They propose that a suitable architecture to exploit such fine-grain parallelism is a shared-memory multiprocessor with 32-64 processors. Using such a multiprocessor, it is possible to obtain execution speeds of about 3800 rule-firings/sec. This speed is significantly higher than that obtained by other proposed parallel implementations of rule-based systems. (50 refs.)

1056 Impact of expert systems on end-users in organisations: a case study.
E.E. Woherem
(Dept. of Sci. & Technol. Policy, Manchester Univ., UK).
Software Engineering. Papers Presented at the Conferences-Achieving Software Quality, Software Development Environments and Knowledge Based Systems, London, UK, 14-16 June 1988 (London, UK: Blenheim Online 1988), p.247-59

Examines the impact of expert systems on the performance and skills of end-users in organisations. The impact of an expert system used in configuring mainframe computers in a major computer manufacturing company is described. The finding of this and other case studies is that the expert systems enhanced the performance of the end-users (and that of the organisations). Moreover, while expert systems degraded the objective skills of the experts and their domains, (and the more expert were aware of this), a majority of the end-users felt that the system did not affect their skills. Users were generally satisfied with using their expert systems and would not prefer to work without them. The paper concludes by suggesting that there is need for a new design paradigm as the present one treats the human experts as mere transducers of its decisions; it should be one that can satisfy both expert users as colleagues, and inexpert users as consultants. (8 refs.)

3.0 APPLICATIONS

592 Expert systems and ICAI in tax law: killing two birds with one AI stone.
D.M. Sherman
(Law Society of Upper Canada, Toronto, Ont., Canada). Second International Conference on Artificial Intelligence and Law. Proceedings of the Conference, Vancouver, B.C., Canada, 13-16 June 1989 (New York, NY, USA: ACM 1989), p.74-80

The author describes five separate projects he has undertaken in the intersection of computer science and Canadian income tax law. They are: (1) a computer-assisted instruction (CAI) course for teaching income tax, programmed using conventional CAI techniques, (2) a document modeling computer program for generating the documentation for a tax-based transaction and advising the lawyer-user as to what decisions should be made and what the tax effects will be, programmed in a conventional language, (3) a prototype expert system for determining the income tax effects of transactions and tax-defined relationships, based on a PROLOG representation of the rules of the Income Tax Act, (4) an intelligent CAI (ICAI) system for generating infinite numbers of randomized quiz questions for students, computing the answers, and matching wrong answers to particular student errors, based on a PROLOG representation of the rules of the Income Tax Act, and (5) a Hypercard stack for providing information about income tax, enabling both education and practical research to follow the user's needs path. The author shows that nonAI approaches are a way to produce packages quickly and efficiently. Their primary disadvantage is the massive rewriting required when the tax law changes. AI approaches based on PROLOG, on the other hand, are harder to develop to a practical level but will be easier to audit and maintain. The relationship between expert system and CAI is discussed. (18 refs.)

605 A specialized expert system for judicial decision support.
V.P. Pethe, C.P. Rippey, L.V. Kale.
Second International Conference on Artificial Intelligence and Law. Proceedings of the Conference, Vancouver, B.C., Canada, 13-16 June 1989 (New York, NY, USA: ACM 1989), p.190-4

The authors present the design, implementation, and usage of an expert system for assisting judges deciding cases under a specific statue, The Federal Black Lung Benefits Act. This act provides lifetime benefits to former coal miners and their dependents when coal mine dust causes the chronic lung disease of pneumoconiosis and it has been established that the disease disabled the miners from performing their former coal mine duties. The system is called JEDA, an acronym for judicial expert decisional aide. The expert system itself was designed and implemented using Turbo Prolog and Turbo Pascal. It has been in use to assist specific decisions since the spring of 1987. (4 refs.)

626 Testability and its implications.
J. Regev
(Ben Gurion Univ. of the Negev, Beer, Sheva, Israel). Computer and Information Sciences-3. Proceedings of ISCIS III. The Third International Symposium on Computer and Information Sciences, Cesme, Turkey, 29 Oct.-2 Nov. 1988 (Commack, NY, USA: Nova Sci. Publishers 1989), p.349-56

This paper discusses the basic differences in the decision-making operations between the human mind and computer systems, with an emphasis on their ability to cope with the unexpected. Computer systems can never be tested for all the combinations of input that can occur. Computer systems can never have all the commonsense knowledge that every person knows. This is aggravated by the existence of bureaucracy: the combination of bureaucracy, computers and Murphy's rule may lead to unpleasant situations when an exceptional case occurs and a person gets caught in a 'talk to the wall' situation. A possible conclusion can be that every system must have some channel of problem handling and correction. In other words: computer systems are always imperfect and should never be given absolute power. There must always be some human power whose function is to detect problems in the functioning of every system and correct them after some time. The question whether AI and robots are going to improve the situation is also discussed. (2 refs.)

642 HPCS: an expert system configurator for the IBM 9370.
V.D. Arnold, A.M. Dunbar
(IBM Application Bus. Syst. Div., Rochester, MN, USA). ESD/SMI Expert Systems Proceedings, Detroit, MI, USA, 12-14 April 1988 (Detroit, MI, USA: Eng. Soc. Detroit 1988), p.303-15

HPCS (Hardware Placement and Connection Service) is a knowledge based expert system configurator for the IBM 9370 system. It executes when placing an initial order for a system or when upgrading an installed system to add required quantities of the prerequisite components, to assure that the system can be assembled as ordered, and to allow the marketing representative to quote an accurate price to the customer. This is a critical function because it identifies the hardware content of the sales contract which is signed between IBM and the customer. HPCS is also executed in the 9370 manufacturing locations to validate the orders received from the field and to generate the location, connection, and hierarchy data required to assemble the

systems. HPCS has been in production use on the systems supporting IBM sales representatives and 9370 manufacturing locations around the world since March 1987. The successful configuration rate has been extremely high. The paper describes the business problem, the application which was developed to address it, the results that were obtained, and conclusions drawn from the experience. (3 refs.)

644 HONE: a development of the expert configurator paradigm.
J.N. Wilson
(Dept. of Comput. Sci., Strathclyde Univ., Glasgow, UK). ESD/SMI Expert Systems Proceedings, Detroit, MI, USA, 12-14 April 1988 (Detroit, MI, USA: Eng. Soc. Detroit 1988), p.351-63

The manufacture of complex, low volume items such as minicomputer systems is not compatible with organization by job design specification. The movement to just-in-time manufacture also creates difficulties in the organization of assembly operations. The aim of this project is to apply artificial intelligence principles to the generation of step-by-step graphical assembly instructions from lists of system components. The major objective is to enable the engineers who possess the domain knowledge to formulate it in such a way that it can be used directly by the knowledge-based system to provide instructions to shop-floor operators. The system represents a major benefit to shop-floor personnel. It provides an optimum number of graphic-based instructions for each assembly task. The knowledge-based system was developed in association with Honeywell-Bull Ltd. to extend the utility configuring systems in an engineering environment. (9 refs.)

645 Strategic investment justification of advanced manufacturing technology using a knowledge-based system.
D.M. Dilts
(Waterloo Centre for Integrated Manuf., Fac. of Eng., Waterloo Univ., Ont., Canada), D.G. Turowski.
Proceedings of the Third International Conference, Expert Systems and the Leading Edge in Production and Operations Management, Hilton Head Island, SC, USA, 21-24 May 1989 (Columbia, SC, USA: Univ. South Carolina 1989), p.193-206

Investment justification of advanced manufacturing technology is the most significant barrier to advance technology utilization. However, traditional investment justification techniques appear to be inadequate for evaluating projects that are characterized as either using advanced new technology or which may have greater risk and uncertainty than traditional projects. Using the ideas of artificial intelligence and expert systems, the authors have developed a knowledge based system to elicit the strategic focus of a firm from a user, to discern if the proposed new technology will strengthen this focus, and to make recommendation concerning the proposed technology. The theoretical foundation of the knowledge base is the work by M.E. Porter (1980) on competitive strategy and competitive advantage. A significant amount of effort has been expended in transforming these ad hoc recommendations and suggestions into formalized knowledge based rules and attributes. This knowledge based system has been developed and it is currently being tested on actual investment problems in industry. While certain problems have arisen while testing, the general methodology appears to be valid.

647 The role of artificial intelligence in computer-integrated manufacturing.
M. Fehling
(Rockwell Int. Sci. Center, Palo Alto Lab., CA, USA).
Proceedings of the Third International Conference. Expert Systems and the Leading Edge in Production and Operations Management, Hilton Head Island, SC, USA, 21-24 May 1989 (Columbia, SC, USA: Univ. South Carolina 1989), p.241-53

This paper reflects upon the contribution of artificial intelligence (AI) to the development of a viable technology for computer integrated manufacturing (CIM). By now, it is quite evident that AI is helping in the development of CIM as a response to the national crisis of industrial competitiveness and productivity. The author discusses some important technical risks entailed by the use of AI in CIM and considers ways in which those technical risks might be reduced or eliminated. Next, he broadens the discussion and considers AI's potential for clarifying fundamental concepts and scientific or engineering principles upon which the development of CIM technology is based. The paper concludes with a critical discussion of some aspects of the social and institutional infrastructure within which CIM technology in general, and AI technology in particular, is being developed. (19 refs.)

701 An expert system for circuit board repair.
N. Ling, M.E. Malowany, A.S. Malowany
(McGill Res. Centre for Intelligent Machines, McGill Univ., Montreal, Que., Canada).
(IEEE Pacific Rim Conference on Communications, Computers and Signal Processing. Conference Proceeding (Cat. No.89CH2691-4), Victoria, B.C., Canada, 1-2 June 1989 (New York, NY, USA: IEEE 1989), p.253-6

Using a hierarchical approach, an expert system for performing circuit board repair tasks within a robotic workcell has been developed. The new circuit board repair system is rule-based and includes a nonmonotonic inference engine

using forward chaining and nonblocking functions, a database describing a robotic workcell, and rule sets into which repair tasks are implemented. Parallel-processing capability is achieved by using nonblocking functions. Action synthesis is based on matching rules to the given database. The system was programmed in Common LISP on a SUN 3 workstation under UNIX BSD version 4.3 and on a dedicated Symbolics 3600 LISP machine. The development, implementation, and testing of the circuit board repair system are described. (6 refs.)

714 An expert system for wind shear avoidance.
R.F. Stengel, D.A. Stratton
(Dept. of Mech. & Aerosp. Eng., Princeton Univ., NJ, USA). *Eng. Appl. Artif. Intell. (UK)*, vol.2, no.3, p.190-7 (Sept. 1989)

A study of intelligent guidance and control concepts for protecting against the adverse effects of wind shear during aircraft takeoffs and landings is being conducted, with current emphasis on developing an expert system for wind shear avoidance. Principal objectives are to develop methods for assessing the likelihood of wind shear encounter (based on real-time information in the cockpit), for deciding which flight path to pursue (e.g. takeoff abort, landing go-around, or normal climbout or glide slope), and for using the aircraft's full potential for combating wind shear. This study requires the definition of both deterministic and statistical techniques for fusing internal and external information, for making 'go/no-go' decisions, and for generating commands to the aircraft's autopilot and flight directors for both automatic and manually controlled flight. The program has begun with the development of the WindShear Safety Advisor, an expert system for pilot aiding that is based on the FAA Windshear Training Aid, a two-volume manual that presents an overview, pilot guide, training program, and substantiating data, which provides guidelines for this initial development. The WindShear Safety Advisor expert system currently contains over 200 rules and is coded in the LISP programming language. (33 refs.)

727 DUSTPRO: a distributed expert system for coal mine dust control.
J. Durkin
(Akron Univ., OH, USA).
ESD/SMI Expert Systems Proceedings, Detroit, MI, USA, 12-14 April 1988 (Detroit, MI, USA: Eng. Soc. Detroit 1988), p.377-87

The US Bureau of Mines has developed an expert system called DUSTPRO which provides computerized advice to a coal mine operator for the control of respirable dust. This dust is known to cause coal miners black lung disease. The system initially accepts as input from the user a definition of the problem. This initial dialogue is between the user and a supervisor module of the system. The supervisor seeks to determine the source of the dust problem based on user queries about the ventilation system, mining sequence and compliance with federal regulations. The supervisor then calls on appropriate expert system modules to further study the problem and provide recommendations for dust control. The expert system is structured as a committee of individual expert system modules, each with their own expertise in a small area of the dust control problem. As the consultation session with the user continues, modules appropriate to the state of the problem-solving become active and interact either with the user or other modules over a blackboard structure. The blackboard is used by the expert system modules to pass messages, post findings and log recommendations. At the end of the consultation session, the supervisor uses the information posted on the blackboard to provide recommendations to the user and to explain major reasons that led to the recommendations. A prototype version of this system was built on an IBM portable computer to permit ease of transfer to the mining industry and is presently being evaluated by coal operators. (3 refs.)

858 Negoplan: an expert system shell for negotiation support.
S. Matwin, S. Szpakowicz, Z. Koperczak
(Ottawa Univ., Ont., Canada), G.E. Kersten, W. Michalowski.
IEEE Expert (USA), vol.4, no.4, p.50-62 (Winter 1989).

The authors address a complex, two-party negotiation problem containing the following elements: (1) many negotiation issues that are elements of a negotiating party's position, (2) negotiation goals that can be reduced to unequivocal statements about the problem domain and that represent negotiation issues, (3) a fluid negotiating environment characterized by changing issues and relations between them, and (4) parties negotiating to achieve goals that may change. They describe in some detail the way they logically specify different aspects of negotiation. An application of Negoplan to a labor contract negotiation between the Canadian Paperworks Union and CIP, Ltd. of Montreal is described. (14 refs.)

891 Episodic skeletal-plan refinement based on temporal data.
S.W. Tu, M.G. Kahn, M.A. Musen, J.C. Ferguson, E.H. Shortliffe, L.M. Fagan
(Knowledge Based Syst. Competency Centre, Xerox Corp., Webster, NY, USA).
Commun. ACM (USA), vol.32, no.12, p.1439-55 (Dec. 1989).

ONCOCIN is a therapy-advice system designed for use by physicians in the treatment of cancer patients. It has two objectives: the extension of the skeletal-planning technique

to an application area where the history of past events and the duration of actions are important, and the development of an interactive decision-support system acceptable to computer-naive users in a busy environment. Satisfying the requirements of these two objectives has led the system's makers to make several modifications to the traditional expert system technology. These modifications include the integration of a rule-and frame-based expert system with a temporal database, the use of augmented transition networks to represent procedural knowledge, and a control structure that allows a parallel run-time interface that encourages mixed-initiative interaction between the system and the user. (32 refs.)

893 The representation of uncertainty in medical expert systems.
C. Hughes
(Coll. of Eng., Illinois Univ., Clarendon Hills, IL, USA).
Med. Inform. (UK), vol.14, no.4, p.269-79 (Oct.-Dec. 1989).

The development of the rule-based expert system has provided important new techniques for the representation of knowledge. However, continued use of this representational scheme has highlighted some of its deficiencies. In particular, many within scientific and non-scientific fields attempting to use the rule-based design to describe natural phenomena often find it difficult to represent the complexities of the world as 'absolute' rules. For this reason, many investigators acknowledge the need to add an uncertainty mechanism to the rule-base construct. Such a facility would allow the quantification of accuracy or strength of association within individual rules. Although agreement exists on the need for an uncertainty representation facility, the debate concerning the most appropriate methodology is far from resolved. The purpose of this paper is to provide a review and commentary on the current state of debate over the five most popular candidate uncertainty models: symbolic representation, MYCIN certainty factors, Bayesian, Dempster-Shafer and fuzzy set logic. The advantages and disadvantages of each uncertainty calculi are presented and assessed with respect to their applicability to the medical expert systems domain. (36 refs.)

897 Abdominal pain in the emergency department.
E.A. Patrick, P.J. Detterman, J.M. Fattu
(Dept. of Electr. & Comput. Eng., Cincinnati Univ., OH, USA).
Proceedings of the Fourth Annual Artificial Intelligence and Advanced Computer Technology Conference, Long Beach, CA, USA, 4-6 May 1988 (Glen Ellyn, IL, USA: Tower Conference Management 1988), p.44-9

The CONSULT I(R) abdominal pain expert system was evaluated by testing 130 cases of abdominal pain. It is a classification system which ranks findings as a posteriori category probabilities with a posteriori ranked subcategories within these categories. Subcategories are trained with expert knowledge and/or knowledge obtained using hard data examples. Features include signs, symptoms and lab tests. Diagnostic imaging including X-ray and CAT scan are not included. It is hypothesized that abdominal pain diagnosis mostly depends on findings other than diagnostic imaging. The abdominal pain subsystem is in its sixth revision, called ABDOMEN6. Test cases are included which represent common and not so common problems seen in the emergency department. (20 refs.)

898 Measures of performance of the MEDAS (medical emergency decision assistance system) system.
D.C. Georgakis
(Northeastern Illinois Univ., Chicago, IL, USA), R.C. Rosenthal, D.A. Trace, M. Evens.
Proceedings from the Fourth Annual Artificial Intelligence and Advanced Computer Technology Conference, Long Beach, CA, USA, 4-6 May 1988 (Glen Ellyn, IL, USA: Tower Conference Management 1988), p.50-65

A statistical performance evaluation is given of the MEDAS (medical emergency decision assistance system) expert system. The analysis presented is based on a retrospective study of the diagnostic performance of MEDAS applied to 300 patient cases admitted to the Chicago Medical School/Veterans Administration Hospital. The purpose of this evaluation is to determine the accuracy of the MEDAS system using the attending physician's diagnosis as a standard of comparison. Certain measures of performance are developed such as the sensitivity and specificity of the MEDAS system relative to each of 10 major test disorders, the Kappa statistic as a measurement of agreement between two 'judges', Goodman's and Kruskal's Lambda measure of predictive association, and others. The analysis shows the high diagnostic accuracy of MEDAS. (9 refs.)

904 Lexicon management tools for large textual databases: the Lexinet system.
G. Chartron
(Inst. de l'Inf. Scientif. et Tech., Paris, France).
J. Inf. Sci. Princ. Pract. (Netherlands), vol.15, no.6, p.339-44 (1989).

The paper deals with the problem of lexicon creation and update for large textual databases. The problem is a particularly difficult one for research fields where the terminology evolves rapidly. The Lexinet system offers a solution to this problem. It provides a set of statistical and combinatorial algorithms to detect significant items in a corpus of documents from any domain. The results reported concern a corpus of 2380 titles and abstracts from papers on

artificial intelligence, extracted from the French national power company's database. A methodology is described to compare existing terminology with the terminology detected by the Lexinet system. (13 refs.)

954 SPIKE: a generic design standards processing expert system.
W.J. Rasdorf
(Dept. of Civil Eng. & Comput. Sci., North Carolina State Univ., Raleigh, NC, USA), T.E. Wang.
Knowledge Based Expert Systems in Engineering: Planning and Design, Cambridge, MA, USA, 4-7 Aug. 1987 (Southampton, UK: Comput. Mech. Publications 1987), p.241-57

Checking conformance with governing standards is a mandatory step in designing engineering systems. One method of doing so involves the use of application programs into which the standards have been directly coded. This approach is extremely inflexible and often error-prone. The paper investigates the feasibility of alternatively casting standards in a form suitable for flexible processing in a knowledge-based expert system environment. Two prototype standards processing systems utilizing the production system approach have been constructed and are presented. Although the obvious direct translation casting the provisions of a standard as rules has its advantages, a more generic and flexible representation scheme is introduced herein. The approach advocated is to represent standards as databases of facts which can readily and generically be processed by an expert system. The representation is derived from a unified view of standards obtained by using the standards modeling tools proposed by previous researchers in this field during the past decade. A generic knowledge-based standards processing architecture is proposed and described. An implementation of this architecture is also presented. (30 refs.)

955 An expert system architecture for construction planning.
C. Hendrickson, C. Zozaya-Gorostiza, D. Rehak, E. Baracco-Miller, P. Lim
(Dept. of Civil Eng., Carnegie-Mellon Univ., Pittsburgh, PA, USA). Knowledge Based Expert Systems in Engineering: Planning and Design, Cambridge, MA, USA, 4-7 Aug. 1987 (Southampton, UK: Comput. Mech. Publications 1987), p.285-98

Construction planning involves the choice of construction technologies, the definition of work tasks, the estimation of required resources and durations, the estimation of costs, and the preparation of project schedules. A knowledge-based expert system designed to accomplish these tasks, CONSTRUCTION PLANEX, is described in this paper. This system synthesizes activity networks, diagnoses resource needs and predicts durations and costs. The CONSTRUCTION PLANEX system could be useful as an intelligent assistant in routine planning, as a laboratory for the analysis and evaluation of planning strategies, and as a component of more extensive construction assistance systems involving design or project control. The operation of a prototype system to plan building excavation tasks is described and illustrated with an example. (20 refs.)

972 ERASME: a road maintenance multi-expert system.
M. Fajon, O. Corby
(ENPC, CETE-Mediterannee, Les Milles, France).
8th International Workshop. Expert Systems and their Applications. Specialized Conference. Artificial Intelligence and Defense, Expert Systems and Maintenance, Expert Systems and Medicine, Avignon, France, 30 May-3 June 1988 (Nanterre, France: EC2 1989), p.589-601 in French.

ERASME is an expert system project for road surface degradation diagnosis and pavement maintenance. This project is funded by the French Ministry of Transportation and is run in collaboration with INRIA (Sophia-Antipolis). A blackboard-like architecture including specialists and a supervisor has been designed in order to deal with the size and variety of domain knowledge. Furthermore, road surface maintenance is a domain that needs nonmonotonic reasoning within viewpoints to deal with data uncertainty and lack of information. A serious effort has been made to manage knowledge transfer, including the production of domain knowledge reference manual in parallel with the development of the expert system itself. (5 refs.)

996 ECLPS – Enhanced Common Lisp Production System.
B.R. Tibbitts
(IBM Res. Div., Thomas J. Watson Res. Lab., Yorktown Heights, NY, USA). SEAS. Proceedings Spring Meeting 1989. End User Computing, Vienna, Austria, 3-7 April 1989 (Netherlands: SHARE Eur. Assoc. 1989), p. 1649-85 vol.2

ECLPS is IBM's newest entry into the field of 'expert systems' languages. Based on Common Lisp, ECLPS is a forward-chaining production system, where 'rules' are written to express knowledge. It is considered to be a 'language layer' on top of IBM Common Lisp, rather than a self-contained shell. That is, various interfaces are provided for communicating with existing editors, graphics programs, fullscreen panel programs, etc. instead of imbedding them into a 'shell' and limiting the tools used. ECLPS is based on Common Lisp, so you have all the power of Lisp at your disposal, yet you don't need to learn very much Lisp to get started using ECLPS. The knowledge representation vehicle, the working memory element (WME), uses the relational database model, and is simple yet powerful. ECLPS uses a

very efficient pattern matching algorithm, the enhanced RETE algorithm, improved from OPS5. ECLPS is a significant extension of OPS5. OPS5 has been quite successful despite its limitations and problems. ECLPS has added numerous improvements and fixes over the OPS5 language, most especially the total integration into the underlying language, Common Lisp. ECLPS was developed to be suitable for large commercial and scientific expert systems, because of its efficiency and development aids. However, it is also ideal for prototypes and smaller systems, because of the interactive, incremental, and productive development environment that Lisp provides. Lisp, as a compiled language, is very efficient, unlike the Lisp interpreters of the past. (13 refs.)

1091 Using vector and extended boolean matching in an expert system for selecting foster homes.
E.A. Fox
(Dept. of Comput. Sci., Virginia Polytech. Inst. & State Univ., Blacksburg, VA, USA), S.G. Winett. *J. Am. Soc. Inf. Sci. (USA)*, vol.41, no.1, p.10-26 (Jan. 1990).

Since there are many similarities between the fields of information retrieval and artificial intelligence, it may be appropriate to adapt methods developed in one field to applications usually thought of as belonging to the other. The project demonstrates the utility of information retrieval techniques in the expert systems area of artificial intelligence. In particular, it addresses the difficult task of building an expert system for the social sciences. FOCES (foster care expert system) is a prototype assistant to social workers involved in selecting foster homes for children who are in need of placement. The design of FOCES called for the use of GUESS (general-purpose expert system shell) and tailored Prolog routines for extended Boolean matching and vector correlation. Evaluation of the implemented system has shown that FOCES can perform its assigned task as well as trained social workers. (63 refs.)

1092 A farm level expert simulation system to aid farmers in selecting among crop insurance strategies.
G. L. Helms, J. W. Richardson, M. J. Cochran, M. E. Rister (Dept. of Agric. Econ., Texas A&T Univ., College Station, TX, USA).
Comput. Electron. Agric. (Netherlands), vol.4, no.3, p.169-90 (Jan. 1990).

An expert simulation system (ESS) in aiding US farmers select crop insurance strategies is presented. The ESS, entitled CIRMAN, relies on stochastic simulation models to analyze the problem and formulates a series of rules to make recommendations. The following lexiographic hierarchy of rules is used to rank the strategy options: risk efficiency, probability of farm survival, probability of economic success, expected value of after-tax net present value of family withdrawals plus the change in net workth over the planning horizon, average expected annual net-cash farm income, and average expected value of ending net worth. CIRMAN presents a recommendation and explanations on why a strategy was recommended and how it compares to specified alternatives. (44 refs.)

1109 A knowledge-based expert system for managing underground coal mines.
R.L. Grayson, J. Dean, S. Yuan, N.P. Reddy, C.M. Watts, H. Singh, R.S. Nutter, Jr.
(West Virginia Univ., Morgantown, WV, USA).
Conference Record of the IEEE Industry Applications Society Annual Meeting (Cat. No. 89CH2792-0), San Diego, CA, USA, 1-5 Oct. 1989 (New York, NY, USA: IEEE 1989), p.1544-9 vol.2

The authors describe the Mine Management Support System, a knowledge-based expert system being developed for better management of underground coal mines. The program will encompass information and preferred rules on work scheduling, work practices, regulations impinging on the accomplishment of work, responses to operating problems, and the labor-management work agreement. Different components of the mine system, modeled using an object-oriented layering technique, will be displayed graphically to aid in coordinating work plans and to present locations of equipment, supplies, and proposed subsystem components. (17 refs.)

"Based on the information provided in the abstracts, the references provided have been selected by the secretariat of the NRC Associate Committee on Artificial Intelligence as a representative sample of interest and value to Canadian industry. Abstracts provided are reprinted from "Key Abstracts in Artificial Intelligence" with permission from INSPEC. INSPEC is widely recognized as the leading English-language database covering the published information in the field of physics, electronics and computing. Information contained in the INSPEC services is collected on an international basis from over 4,000 Journals and 1,000 Conference Proceedings. INSPEC is a division of the Institution of Electrical Engineers, Station House, Nightingale Road, Hitchin, Herts, United Kingdom. All INSPEC's products and services are available in North America from the INSPEC Dept. IEEE Service Centre, 445 Hoes Lane, P.O. Box 1311, Piscataway, N.J. 08855-1331, U.S.A."

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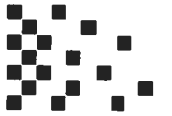

BOOK REVIEWS
CRITIQUES DE LIVRES

BOOK REVIEWS

Automatic refinement of expert system knowledge bases
Allen Ginsberg
[AT&T Bell Labs] San Mateo: Morgan Kaufmann and London: Pitman, 1988, viii+176 pp (Research notes in artificial intelligence) Distributed in Canada by John Wiley & Sons Canada Paperbound, ISBN 0-934613-96-6, cdn$34.95

Reviewed by
Dick Peacocke
Bell-Northern Research

Perhaps my expectations for Ginsberg's *Automatic refinement of expert system knowledge bases* were raised because the problem addressed in it is a key one for expert systems, and I hoped for enlightenment. Expert systems have not been adopted as widely as expected, for a number of reasons. One of them is the difficulty of maintaining a knowledge base, keeping it up to date, and improving its performance as the expert system becomes used more widely. I hoped the book would provide some perspective on this, or perhaps suggest a framework for dealing with it. But the perspective seems rather restricted, although the detailed discussion of control strategies and methods for selecting and verifying knowledge base refinements is strong.

The book gives a detailed account of the concepts and principles embodied in an automatic refinement system, SEEK2. It concentrates heavily on the SEEK2 framework, which generalizes and extends the empirical-heuristic approach to knowledge base refinement developed in SEEK by Politakis and Weiss. SEEK used a tabular format for expressing rules. The approach in SEEK2 has been made applicable to a more powerful rule representation language, and a larger class of heuristics has been added. Ideas for future extensions to SEEK2 are discussed in detail. But no extensions for dealing with frame-based or hybrid representation languages are mentioned. This seems to be a needed extension to the work.

A good summary of SEEK2 appeared in an IJCAI-85 paper (Ginsberg et al, 1985), which is well worth reading. It depends on a two-phase approach:

1. Building the initial knowledge base acquired from the expert. This is not discussed in the book.
2. Refining the knowledge base using "conservative" constraints for modification, or in Ginsberg's terms "correcting a small number of flaws in a complex structure that is assumed to be correct".

The refinement process is described in great detail. Although it is fairly complex, the refinement process is based on simple modifications to components of existing rules — tweaking them a little.

Several key concepts that do not appear in the IJCAI-85 paper are described in the book, such as a viewfinder for examining local views of the knowledge base, testing the plausibility of refinements, and measuring the radicality of changes to see how conservative they are. There are excellent descriptions of work needing to be done, comparisons to be made, experiments to try, etc. A number of issues are raised throughout the book, and they are effective in communicating some of the difficulties inherent in the effort of knowledge base refinement.

A refinement metalanguage, RM, has been designed and implemented. It allows specification of a wide variety of alternative knowledge base refinement concepts, heuristics, and strategies. It can be used interactively, or can read and process a file containing definitions. For example, in interactive mode, typing PDX(1) to RM's command interpreter will return the expert's conclusion (PDX stands for Presumed Diagnosis) in the case whose id is 1. SEEK2's complete control strategy for automatic refinement is presented in the metalanguage towards the end of the book.

My major criticism of the book is the poor description of relationships with other work. There is only a superficial summary of related research, and it seems unnecessarily defensive (connected with the author's own thesis defence perhaps?). The conceptual relation to other AI fields of learning and discovery is described very briefly, and one or two references to existing literature are given without much further discussion. Case-based reasoning is not mentioned at all, although there is a passing reference to explanation-based learning.

The book is written in a very abstract style, and unfortunately lacks much in the way of concrete illustrative examples. The writing is definitely not idiomatic, but it is comprehensible, although it retains something of the thesis style. One phrase sticks in my mind: "This is a possible avenue of future research". It was probably drawn straight from the author's PhD thesis, and really meant "A totally futile area suggested by one of my committee". The book's strength is that it covers the topic of knowledge base refinement thoroughly, albeit in a narrow framework. It is well worth reading by anyone studying the topic of heuristic refinement of knowledge bases, the audience for whom it seems intended.

Reference

Ginsberg, A., Weiss, S., Politakis, P. (1985) "SEEK2: A generalized approach to automatic knowledge base refinement." *Proceedings, International Joint Conference on Artificial Intelligence (IJCAI-85)*, Los Angeles, August 1985, 367-374.

Dick Peacocke is a member of the Computing Research Laboratory at BNR. His current research interests include knowledge-based systems and speech processing. He has just completed a four-year term as president of CSCSI/SCEIO.

KARDIO: A study in deep and qualitative knowledge for expert systems
Ivan Bratko, Igor Mozetic, and Nada Lavrac
Cambridge, MA: The MIT Press, 1989, xiv+260 pp
Hardbound, ISBN 0-262-02273-7, US$37.50

Reviewed by
Taro Shibahara
Bell-Northern Research

This book is about the construction of an expert system for the ECG diagnosis of rhythm disorders of the heart, known as cardiac arrhythmias. Methods of building expert systems based on qualitative modeling are explored by using logic-based representations and applying machine learning techniques. The domain of cardiac arrhythmias needs special attention, because the performance of existing ECG computer programs is at most 80% reliable for abnormal ECGs, and a basic reason for this unreliability is that current systems lack well-organized knowledge of the cardiac conduction system for handling the complexity inherent in cardiac rhythms.

Since the early 1980s, the authors have been working on the arrhythmia problem at the AI laboratory of the Jozef Stefan Institute in Ljubljana, Yugoslavia. This book represents their achievement in the arrhythmia diagnosis project called KARDIO. This AI group is known for their logic-programming related activities; in particular, Professor Bratko is famous for his popular Prolog textbook *Prolog programming for artificial intelligence.*

The first chapter starts by explaining the qualitative modelling in terms of logic programming, using examples of electric switch circuits. Next, after the introduction of the cardiac conduction system, individual algorithms and methods used in the KARDIO system are overviewed. This overview is concise, yet its high-level description of the methodology helps the reader grasp the outlines and intentions of these individual techniques in the KARDIO framework. All these techniques are fully elaborated in later chapters.

The major topics covered in the book are these:

- The qualitative modeling of the cardiac conduction system, which describes the activities of impulse generations, impulse conductions, impulse summations, and eventually ECG generations (in chapter 2).
- The methods of the qualitative simulation in which the model is repeatedly instantiated for all legal combinations of simple arrhythmias (disorders) so that the knowledge-base for ECG diagnosis may collect all possible pairs of combined-arrhythmias and ECG descriptions (in chapter 3).
- The compression method to get a compact arrhythmia-ECG knowledge-base, which uses an inductive learning technique based on Michalski's AQ algorithm (in chapter 4).
- Further experiments, which suggest how the use of abstraction (subsumption) hierarchies could help knowledge acquisition and knowledge-base evolution, and also enhance the performance in deriving arrhythmia diagnoses (in chapter 5).

From the viewpoint of medical applications, KARDIO contributes to the systematic description of multiple arrhythmias. In the medical literature on the cardiac arrhythmias, it is rare to find descriptions of multiple arrhythmias and their effects on ECG features. KARDIO seems to be very successful in this aspect because it can decide whether a particular combination of arrhythmias (disorders) is legal or not, or what the effect is of the presence of multiple arrhythmias according to the qualitative impulse summation rules and legality constraints. In fact, KARDIO admitted 2,419 legal combined arrhythmias and generated 140,966 ECG manifestations, whose relation is represented by 8,314 Prolog clauses in the arrhythmia-ECG knowledge-base.

From the AI viewpoint, the transformation of KARDIO knowledge bases is the main interest. The original model, which consists of components of the cardiac conduction system, their function descriptions, and the relations among conditions of components, reflects naturally the underlying physiological structure. In this representation, however the interrelations between arrhythmias and their resultant ECG descriptions are not apparent, and the diagnostic derivation becomes impracticable due to the high non-determinism (high branching factor) caused by the qualitative modelling process. In KARDIO, therefore, all qualitative simulation results are collected and formulated in arrhythmia-ECG pairs to speed up the search for possible arrhythmias for a given ECG description. In this extensional representation, the size of the knowledge base becomes very large (5 MB for 8,314 Prolog clauses) compared with the original size of the model (27 kB). By means of an inductive learning program, this knowledge-base is compressed for space and time efficiency. The representation thus obtained is compact (25 kB) and diagnostically efficient.

This book will be useful for AI researchers whose main areas of interest concern practical expert systems and, in particular, their implementations by logic programming. The efforts of the researchers shown in this book are highly

commendable, and any reader will be impressed by the clear organization supported by the good overview of the whole methodology, comprehensive descriptions of individual techniques and algorithms, and the thoroughness of examples used throughout the book. However, there is one drawback, in that the discussion of this work is limited to the areas of logic programming and qualitative reasoning. The book could have become more useful to other expert systems researchers and students if their work had been compared and positioned in relation to other research results such as those technologies developed in various medical expert systems, ECG feature-recognition strategies pursued since the 1950s, and reasoning methods based on rules, frames, or taxonomies. Nevertheless, this book is an excellent source of information on the latest effort in logic-based qualitative reasoning and its application to a complex real-world problem.

Taro Shibahara's doctoral dissertation, at the University of Toronto, concerned the use of causal knowledge in an expert system for recognizing cardiac arrythmia. This review contains personal views of the author, and does not necessarily reflect the opinions of Bell-Northern Research Ltd.

Formalismes syntaxiques pour le traitement automatique du langage naturel Présenté par Philip Miller et Thérése Torris Paris: Hermes, 1990, 359 pages ISBN 2-86601-212-7

Compte rendu par
Dominique Estival
Université de Genève

Avec ce volume, Miller et Torris ont produit une contribution qui devrait être appréciée de tous les linguistes informaticiens de langue française. En effet, celui-ci rassemble en une présentation cohérente des travaux récents (toutes les contributions sont postérieures à 1986) représentatifs d'un large éventail des développements effectués ces dernières années en syntaxe formelle et de leurs applications pour la linguistique informatique.

Plus qu'une collection des traductions des références incontournables dans ce domaine, cet ouvrage contient aussi des articles originaux. Les traductions elles-même sont complétées par des notes explicatives extensives, et dans certains cas ont fait l'objet de révisions approuvées par les auteurs.

Introduction: Synopsis court, mais suffisamment détaillé et précis des développements du traitement automatique du language naturel, elle présente de manière claire les problèmes fondamentaux tels que la division entre syntaxe et sémantique, le rôle joué par la contribution de la syntaxe formelle dans un système, et la réalité psychologique des modèles proposés.

Chapitre 1: "Les grammaires basées sur l'unification", (traduction de Shieber 1986). Cette introduction au formalisme est devenu l'ouvrage de référence standard pour tous les travaux sur l'unification. Des révisions et clarifications substantielles ont été ajoutées par les traducteurs.

Chapitre 2: "La grammaire syntagmatique généralisée". (Torris). Cet article inédit présente la théorie de GPSG et ses développements postérieurs à GKPS 1985, particulièrement en ce qui concerne les analyses syntaxiques et le traitement des catégories. Le pouvoir expressif des métarègles et les motivations pour leur élimination sont abordés en conclusin.

Chapitre 3: "La grammaire catégorielle généralisée: le calcul de Lambek-Gentzen". Cette traduction d'une version de Moortgat 1989 déjà adaptée et révisée présente la grammaire catégorielle généralisée et démontre comment les opérations syntaxiques peuvent être dérivées en tant que théorèmes.

Chapitre 4: "La grammaire d'unification catégorielle", (traduction de Uszkoreit 1986). Cet article montre que le mécanisme d'unification est indépendant de toute théorie linguistique particulière puisqu'il peut, comme ici, être combiné avec une grammaire catégorielle, ce qui permet des analyses linguistiques utilisant la notion de sous-spécification des catégories.

Chapitre 5: "Les systèmes de liage", (Miller). Cet article inédit compare les propriétés de liage dans différentes théories syntaxiques pour définir la capacité générative forte des formalismes par rapport à ces propriétés.

Chapitre 6: "Les structures de catégories", (traduction de Gazdar, Pullum, Carpenter, Klein, Hukari and Levine 1988). Cet article fondamental démontre que les notions de catégorie syntaxique peuvent être définies indépendamment des théories linguistiques y faisant appel, ce qui permet de comparer les concepts sous-tendant les différentes théories en faisant abstraction des différences de notation qui obscurcissent généralement de telles comparaisons.

Chapitre 7: "Une sémantique logique pour les structures de traits", (traduction de Kasper and Rounds 1986). De substantives notes ont été ajoutées à cet article dans lequel les auteurs développent un modèle où les structures de traits sont considérées comme des formules logiques, ce qui leur permet d'examiner la complexité de l'unification, en particulier dans le cas de formules disjonctives.

Les deux glossaires "Glossaire des phénomènes empiriques les plus souvent discutés" et "Glossaire des notions techniques les plus souvent utilisées") contiennent des définitions qui sont en fait des explications à la fois simples et précises, et qui constituent une synthèse permettant au lecteur une vue globale des divers problèmes abordés dans le texte et des approches représentées par les différentes contributions. Cette synthèse pourrait se révéler utile même à des lecteurs ayant accès aux textes originaux. Elle s'est avérée suffisante pour que des étudiants néophytes dans le domaine puissent aborder et comprendre les présentations.

Il est évident que le lexique anglais-français comble une cruelle lacune pour les linguistes francophones qui doivent souvent dans ce domaine se battre avec une terminologie fluctuante, et il est à espérer qu'il établisse une liste de référence qui serve de standard à l'avenir.

Les indexes (par noms, termes, et noms de traits et de valeurs) ainsi que la bibliographie très complète constituent un ensemble pratique de sources de références qui n'a d'ailleurs pas son équivalent en anglais.

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Dominique Estival works in machine translation research at the Institute for Semantic and Cognitive Studies at the University of Geneva.

Developing and managing expert systems: Proven techniques for business and industry
David S. Prerau
(GTE Laboratories) Reading, MA: Addison-Wesley, 1990, xv+353 pp Hardbound, ISBN 0-201-13659-7

Reviewed by
Stephen Regoczei
Trent University

The stated objective of this book is to present a practical, step-by-step approach to developing and managing expert systems in business and industry. The book succeeds in delivering; it is based on actual experience with an actual expert system called COMPASS, developed at GTE to diagnose the faults of telephone switching equipment. The description of the knowledge acquisition process given by Prerau is based on actual field work with real, live experts. The book covers the entire lifecycle, and this alone would make the book noteworthy. But how well does it cover the lifecycle, based upon only one system implementation? How good is the suggested lifecycle model? How broadly applicable are the techniques, given that the experience embodied in the actual system is limited to telephone switching equipment? These questions are not easy to answer.

The book recommends a knowledge acquisition-oriented lifecycle which could be summarized as follows:

Elicit -> Document -> Represent -> Implement -> Test -> Reimplement.

This is a good cycle – concise, with the right task divisions – although I would insert a conceptualization, or modelling, phase between documenting and representing.

For implementation, however, Prerau recommends the "trial-and-error" method, at times more politely referred to as "iterative prototyping". This looks very much like code hacking and would not be called "implementation" in most well-run data processing shops. One should note for the record that AI systems are not so special that they can be safely exempted from the basic requirements of sound software engineering practice.

Furthermore, Prerau says nothing about systems requirements specifications. According to him, none seem to be needed. I have difficulty accepting this. I doubt that management would approve the budget for any system without proper requirements specs. I suspect that Prerau himself had such documents for COMPASS, but that he forgot to tell us about them. Otherwise, I doubt that GTE would have allowed the project to proceed.

There are excellent what-to-do checklists of tasks at the end of each chapter. It seems that Prerau expects these lists to be copied without compensation or acknowledgement, because each list is followed by a self-referential bibliographic citation identifying it as coming from Prerau's book.

Interestingly enough, these are the only bibliographic references in the book. It is well known that academic and industry practice diverges when it comes to publishing. It is to be regretted, however, that Prerau's book follows the deplorable industry practice of giving no bibliography, and no references to, or acknowledgement of, other people's work. Prerau is not alone in this. James Martin, the most prolific "author" (collector?) in the computer field, is also guilty of the same practice. In the academic context, using other people's results, insights, or ideas without acknowledgment is not considered acceptable; it is a form of intellectual theft. In industry, on the other hand, anything not nailed down through explicit legal protection is considered to be fair game: free for the taking without compensation or acknowledgement. In the lax environment of industry, people seem to be able to get away with this. Unfortunately, Prerau's book — while an excellent and useful synthesis — conforms to this practice.

Stephen Regoczei is the author of several papers on knowledge acquisition for knowledge-based systems.

BRIEFLY NOTED

Artificial intelligence at MIT: Expanding frontiers
Patrick Henry Winston
with Sarah Alexandra Shellard (editors)
(MIT) Cambridge, MA: The MIT Press 1990, xix+ 656 pp (vol. 1), xvii+634 pp (vol. 2) (Artificial intelligence series) Hardbound, ISBN 0-262-23150-6 (vol. 1), 0-262-23151-4 (vol. 2) 0-262-23154-9 (the set), us$70.00 the set

The AI Lab at the Massachusetts Institute of Technology has been one of the leading centres of AI – perhaps *the* leading centre – since the birth of the field. These volumes collect 43 papers describing research at the lab in the 1980s. The emphasis is on demonstrating the unity of AI, the applicability of the research to real-world problems, and its promise for the 1990s. The collection succeeds well; it clearly shows how firm the foundations of the field are, and that the MIT approach, love it or hate it, cannot be ignored. – *G.H.*

Raisonnements sur des informations incomplètes en intelligence artificielle by Léa Sombé, reviewed by Jean-François Lamy in these pages in April, has now been published in an English translation, *Reasoning under incomplete information in artificial intelligence* (John Wiley, ISBN 0-471-52979-6, 224 pp., us$49.95).

In addition, the text of the book appears as a special issue of the *International journal of intelligent systems*, 5(4), September 1990 (John Wiley, ISSN 0884-8173).

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Books listed below that are marked with a + will be reviewed in a future issue. Reviewers are still sought for those marked with a *.

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+Pattern thinking
L. Andrew Conrad
(Bell-Northern Research) New York: Praeger, 1990, xii+180 pp Hardbound, ISBN 0-275-93427-6, us$42.95

+Artificial intelligence: Its scope and limits
James H. Fetzer
(University of Minnesota, Duluth) Dordrecht: Kluwer Academic Publishers, 1990, xvii+338 pp (Studies in cognitive systems 4) Hardbound, ISBN 0-7923-0505-1, us$63.00, Dfl 160.00, \L53.00

*The foundations of artificial intelligence: A sourcebook
Derek Partridge and Yorick Wilks (editor)
(University of Exeter and New Mexico State University) Cambridge, UK: Cambridge University Press, 1990, xiv+498 pp Hardbound, ISBN 0-521-35103-0, us$22.95; Paperbound, ISBN 0-521-35944-9, us$59.50

+The Programmer's Apprentice
Charles Rich and Richard C. Waters
(MIT) New York: ACM Press in collaboration with Addison-Wesley, 1990, xi+238 pp (ACM Press frontier series) Hardbound, ISBN 0-201-52425-2

+Artificial neural systems: Foundations, paradigms, applications, and implementations
Patrick K. Simpson
(General Dynamics) New York: Pergamon Press, 1990 (Neural networks: Research and applications series) ISBN 0-08-037894-3

Logic programming: Proceedings of the Seventh International Conference
David H.D. Warren and Peter Szeredi (editors)
(University of Bristol)
Cambridge, MA: The MIT Press, 1990, xviii+788 pp Paperbound, ISBN 0-262-73090-1, us$55.00

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