Controversy over NRC report resolved; NRC petitioners issue joint statement

By Joan Bass
CRA Staff
Both sides involved in a controversy over a National Research Council report stating that NSF's mission has outlived its time and issued a joint statement regarding the report and a petition that called for its withdrawal.

The joint statement was signed by two of the petition's sponsors—Robert Boyer of the University of Texas and John McCarthy of Stanford University—and by Wilim Wulf, chair of the National Research Council's Computer Science and Telecommunications Board, and Juris Hartmanis, chair of the committee that wrote the report.

NRC released Computing the Future: A Broad Agenda for Computer Science and Engineering in July at CRA's Snowbird Conference '92 [September CRN, Page 1]. Shortly after that, a petition calling for the withdrawal of the report so it could be rewritten was signed by John Backus, Boyer, Barbara Grosz, Donald Knuth, McCarthy, Jack Minker, Marvin Minsky and NSF's Leon Nimenson and was circulated via e-mail. By early October, more than 900 people in the computer science and engineering community had signed the petition.

A statement from the sponsors of the petition, which was included with the petition when it was sent over e-mail, said that although much of the report was useful, the sponsors "consider it misleading, and even harmful, as an agenda for future research."

All of the documents associated with the report are in the directory "pub/mycal at sail.standford.edu" and are available by anonymous FTP. TTF's moderated bulletin board set up to conduct the debate can be accessed at CTF-DISCUSS@CIS.UPENN.EDU.

Send administrative requests, such as adding names, to CTF-DISCUSS-REQUEST@CIS.UPENN.EDU at a time of your choosing.

The sponsors jointly made their point that the issues raised in the petition, the statement said, and CST-8 officials will talk individually with anyone who has other questions or comments related to the report.

A meeting of the September meeting agreed there were communication problems between NRC and the computer science and engineering community that need to be identified and considered.

NRC has fully responded to the NRC's objections to a "major reorganization of NSF's missions, disciplines and specific opportunities for basic research," the joint statement from McCarthy, Boyer, Hartmanis and Wulf said. "These are different matters than were intended to be included in Computing the Future."
Who will build our new systems?

By Philip M. Lewis

This editorial is adapted from an article titled, “Information Systems is an Engineering Discipline,” which appeared in Communications of the ACM, vol. 32, no. 9, September 1989, pp. 1345–1347.

The industrialized world is significantly enhancing its information system infrastructure. New information systems are being designed and built in such diverse areas as traffic control, hospital patient monitoring, military command and control, stock transactions, manufacturing and engineering. During the next decade and beyond, the lives and safety of our citizens, as well as the economic health of our country, will depend on the correct functioning and efficiency of these new systems.

Who is going to be responsible for building these new systems that are so important to our national economy? To make the answer an air-tight proposition, suppose you were responsible for developing one of these systems. Your boss reminds you that the proposed system will operate in an environment in which human lives and property are at stake. He also reminds you of the many failures of such development projects—systems that are late, grossly over budget, or incorrectly designed. Your career is on the line.

Who would you select to be the project manager of the system development project?

A traditional computer scientist? Not likely. The computer science community, primarily dominated by academic and industrial researchers, has not provided you with the skills that you need to build a new computer-based system. Who then would you select to manage your information systems projects?

Computer scientists are aware of the growing importance of information systems in our society. Many are calling for closer ties between computer science and engineering. But who is going to be responsible for bridging the gap between computer science and engineering? Who is going to be responsible for building new systems?

There has been discussion during this session that Senate appropriations have failed at NSF and its priorities. Earlier this year, in what was interpreted as a political counterattack to the President’s attack on congressional pork barrel, several NSF grants were identified by name as “administration pork,” and $12 million was rescinded from NSF’s fiscal 1992 appropriation. In conference, the specific grants—all for computer science—were dropped without explanation.

The conference committee report was non-committal on the Senate language, although it did remove some of the specific spending earmarks that had been imposed, giving the NSF director greater flexibility in accommodating the budget cuts. Since the conference report was issued, many NSF grants have been notified that their funding is at risk. Where should the Senate’s mandate be interpreted and managed? How is the information systems community going to manage and control the system infrastructure?

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Expanding the Pipeline

Interdisciplinary degree has its advantages

By Thelma Estin

A multidisciplinary master's degree in computer science (CS) would provide CS academics with an opportunity to support interdisciplinary research in the university. Although the National Science Foundation has sponsored interdisciplinary research for the last decade, the strategies of universities are based on single disciplines, and most departments do not encourage young faculty to pursue interdisciplinary work if they are interested in obtaining tenure. Thus many discourage students from pursuing advanced degrees in cross-disciplinary subjects, especially if they wish to pursue academic careers. (Interdisciplinary, cross-disciplinary and multidisciplinary are equivalent in this discussion.) I am advocating such a program in this column because the large number of women obtaining undergraduate degrees in the natural sciences could provide a large base for increasing the number of women in graduate CS programs.

Physicists, chemists, mathematicians, astronauts, biologists, psychologists and computer scientists frequently collaborate with individuals involved in research areas that are closely related to science or technology, plus the large number of women with biology majors, should make computer science an attractive discipline for female graduates.

Challenging research on complex systems is based on the synthesis of methodologies, databases and expertise in several disciplines. Yet the departmental structures of universities hinder the rapid advancement of interdisciplinary fields. Large-scale interdisciplinary research creates problems on the campus, based on " turf issues" ingrained in each department's competitive need for funding and intellectual estate. The temptation of young faculty to tenure and then to more advanced positions, often is controlled by academics who cannot achieve consensus on multidisciplinary work. Academics do not have a clear paradigm for dealing with interdisciplinary-based promotions and often cannot agree on what constitutes a contribution. Time research cannot always be judged by one scientific work: results frequently are a team effort.

Interdisciplinary results often are published with several authors and in non-traditional journals, or in refereed conferences, which typically are viewed as insidiously by tradition faculty. Some professors believe that people involved in interdisciplinary work are trying to succeed without abiding by quality in the existing disciplines.

physical sciences of physics, mathematics and chemistry where " old boy " networks still are strong. In the biological sciences, advances in biomedical research based on computer technology, plus the large number of women with biology majors, should make computer science an attractive discipline for female graduates.

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More rigorous standards of quality in the existing disciplines.

Some critics believe diversity is not the quality of university research. Such research is vital to the economy and should be encouraged. The need for greater global competitiveness and technological integration requires synthesizing and integrating the skills of various disciplines.

C PS professors should create an academic pipeline for interested science and engineering undergraduates and help them pursue an interdisciplinary CS master's program. The master's thesis can contribute to the candidate's training and to the field. The master's program should begin with a rigorous summer course in CS fundamentals, to place students without a CS undergraduate degree on more of an equal footing. Program supervision should include a group of instructors who will be able to develop a friendly and supportive atmosphere. Instructors should encourage students to ask questions.

A formal overview of the field of information technology, including discussion of ethical, societal values and future trends, should accompany this course. Following such an intensive summer course, the program should include typical courses offered to traditional CS master's students, plus an interdisciplinary thesis in the discipline that has contributed to an undergraduate degree. This thesis should be performed in a campus interdisciplinary center or in an industrial setting.

This program would add a strong emphasis in application areas to CS graduate seminars throughout the academic year. Such a program would attract women. Behavioral studies in the past 20 years have shown that women prefer integration rather than separation, prefer collaboration among each team, and prefer dealing with a complete problem rather than focusing on narrow aspects. Cooperativeness is one of women's highest sources of power. It is sometimes called " cooperative individualism," a form of association that does not pit individuals against each other, but merge the individual self-interest with that of the group.

A master's degree in computer science can offer a female student working in a complex technological problem the opportunity to thrive on the " cooperative individualism" of an interdisciplinary research program. With a larger female enrollment in an interdisciplinary master's program, the proportion of women interested in entering a doctoral computer science degree should increase.

Thelma Estin is a Professor Emerita of the University of California, Los Angeles. From 1960-1980 she organized and then directed the Data Processing Laboratory of the UCLA Brain Research Institute. She is a Fellow of the IEEE and A.A.S.
Commission on the Future of NSF is established

A the request of NSF Director Walter M. assey, the National Science Board (NSB) has established a Special Commission on the Future of the National Science Foundation. Assey said that because the political and economic environment for science and engineering research is changing, NSF’s mission and programs must be re-examined. NSF is NSF’s policy-making organization.

The commission is co-chaired by William D. Anderson, chancellor of the Washington University in St. Louis, and Robert Calvin, chair of the Executive Committee of Motorola and former chief executive officer of that company. The commission is planning three meetings to examine the national research climate, models of research excellence, and NSF and its role in a rethinking of research. The commission also may form subcommittees or hold other meetings.

NSB study: Strengthening industrial investment is key

Strengthening US industrial competitiveness may become an important responsibility of the National Science Foundation, a report prepared by that agency. Thereport, The Competitive Strength of US Industrial and Science and Technology: Strategic Issues, was written by NSF's National Science Board Committee on Industrial Support for R&D.

Some observers have said the report may be used in the ongoing debate over NSF's future mission and role. In the report, NSF said industrial R&D and competitiveness is important and that NSF may play a significant role in improving these areas. The report highlighted some alarming trends in overall industrial R&D investments and included four major findings:

• The real rate of growth in US industrial R&D spending has declined since the late 1970s and early 1980s. The report also said that “since 1985, US growth in both total and non-defense R&D expenditures has been less than that of many of its major industrial competitors.”
• The allocation of US R&D expenditures is not optimal. The report said, “the balance between defense and non-defense expenditures is disadvantageous compared to that of foreign competitors.”
• US expenditures are not as effective as they should be in producing needed results. The country’s strong competitive position has been deteriorating during the last 10 years.
• The current information base on industrial science and technology is inadequate. It has gaps, is questionable in particular areas and is not provided in enough detail to meet the needs of policymakers. The report showed significant variations between industrial sectors, which means more research is needed to be done. The computer industry experienced steady growth in R&D expenditures, but new areas like biotechnology have not enjoyed the same growth.
• The report recommended several actions for government, industry and NSF. Several of the recommendations, if adopted, would reverse trends of the past. For example, the government could provide more funds for R&D expenditures, making the program more competitive and making industrial competitiveness a priority. In addition, the government could require that new research be directed toward achieving specific goals. The report also recommended several actions for government, industry and NSF. Several of the recommendations, if adopted, would reverse trends of the past. For example, the government could provide more funds for R&D expenditures, making the program more competitive and making industrial competitiveness a priority. In addition, the government could require that new research be directed toward achieving specific goals.

The report said, “We don’t really know if the structure of the federal research system is really suited to address national objectives.” During the 18 months the Science Committee studied the US research system, senators saw much evidence of stress on the system. The US high-technology market is not as competitive globally as it once was, and mission-oriented research programs at many federal agencies are not producing results relevant to society or meeting statutory goals, the report said.

A number of changes have occurred over the past 15 years and the report recommended that the government take new actions to address these trends. The report recommended that the government:

• Create a new initiative to improve the competitiveness of American industry.
• Promote collaboration between government and industry.
• Enhance the flexibility of federal research programs.
• Increase the role of the National Science Board in the research system.

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Policy News

Press said the basis for public support of science is being challenged. A senior congressional staffer said science funding will not increase in the next fiscal year, and may not increase the year after. "The need to nurture basic research in all disciplines, in spite of these trends, is an issue for the whole community," the statement said.

NRC's mission also is not clear to everyone in the computer science and computer engineering communities. Some of the petitioners seemed to think NRC is a government agency. However, NRC is an independent, non-profit organization that is the operational arm of the National Academies. The council "advises government and often delivers advice that the government would prefer not to hear," the statement said.

At a public session following the meeting between McCarthy, Press and CSTB members, Michael Nelson, a Senate Commerce, Science and Transportation Committee staff member said Congress doesn't know if NRC reports useful because independent senior members of the scientific community generate the reports.

The changing environment for science means the scientific community needs to act collectively, and members of the various disciplines need to exchange information and ideas with each other. "Toward this end, an intellectually substantive, non-polemical debate over the issues raised in Computing the Future and in the petition for its withdrawal will benefit the field," the signers of the joint statement said.

NRC officials said they would not comment on the petition, beyond what was written in the joint statement. McCarthy said the joint statement addressed the issues raised in the petition, but that he had other problems with the report that may not reflect the views of the other petitioners.

Merging the two disciplines of computer science and computer engineering into a single discipline called CS&E is not a good idea, McCarthy said. Scientists make discoveries about phenomena and engineers make useful artifacts. "While science and engineering are closer together in computer science than in other fields, the distinction is important," he said.

Identifying basic research with theory, and program development with applications is a mistake, McCarthy said. "Artificial intelligence, for example, has a large component of experimental research, where experimental programs are written for what they will teach us," rather than for how directly useful they will be, he said.

Linking computer science and engineering with large, short-term projects, such as the High-Performance and Communications (HPCC) initiative, also is a mistake, McCarthy said. "When HPCC ends, the long-term research in science or engineering supported under its umbrella goes into limbo," he said, adding that if the initiative fails, basic research supported by the project "is in additional bureaucratic trouble."

McCarthy said he is not opposed to encouraging computer scientists to learn about computational problems outside of their disciplines. However, some of the methods proposed in the report to broaden computer science "seem rather heavy handed, though not quite as drastic as the Chinese Cultural Revolution practice of sending the scientists to the fields to learn from the peasants," he said.

CRA board of directors to hold December meeting in Chicago

The CRA board of directors will hold its next meeting Dec. 10–11 in Chicago at the O'Hare Hilton, which is located in the airport complex. The board meeting tentatively will be from 2PM–10PM on Dec. 10 and from 9AM–2PM on Dec. 11.

Observers will be charged the cost of a dinner and a lunch if they plan to eat with the board. If you are interested in attending, please contact Kimberly Press at tel. 202-234-2111 or E-mail: kimberly@cs.umd.edu as soon as possible, but no later than Dec. 7.
Western scientists know little about Japanese CS

By David Notkin and Richard D. Schlichting

The following is a summary of an article titled, "Computer Science in Japan: University and Company Structures," which was presented at the IEEE Computer Society's November 1992 Computing Research News.

Japanese universities

The major public universities in Japan are sponsored by the government. A mong these, the top tier are considered to be the University of Tokyo, Kyoto University, Osaka University, and Nagoya University. Other major universities are Hokkaido University, Kyushu University, and Tohoku University. In some engineering disciplines, the Tokyo Institute of Technology often is added to this top tier. Of the many private universities, perhaps the two best known are Keio University and Waseda University. Computer science is well-represented at all of these schools.

In 1990, direct financial support for research was provided by the primary funding source for computer science, Monbusho (the Ministry of Education). Monbusho provides most of the research money to national universities. In 1989, the average grant budget was 55.8 billion yen. Monbusho also provides the primary funding source for computer science in most of the major private universities. Japan has a small cadre of prominent researchers, and the universities are relatively autonomous laboratories. The result is that there are somewhat fewer interlab collaborations than one would find in many US universities.

Japanese culture perhaps is the major factor that contributes to the perception of a "not invented here" syndrome. There are several other limitations as well. Because the primary purpose of a Japanese laboratory is to solve a particular problem and to promote the functioning of each laboratory, there is not as much emphasis on cross-disciplinary research. There is also an emphasis on the personal relationships among scientists that are more ad hoc than in most US departments.

Publications and recognition

A high level of publication activity is not widely recognized outside of Japan, in part because few publications are in English.

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Information technology sector generated more than $4 billion

By Douglas Powell

The Canadian information technology sector generated more than $4 billion in total revenue in Canada during 1990, employed more than 280,000 people and accounted for 35% of all industrial R&D expenditures.

These were the preliminary findings of the Information Technology Statistical Review, released earlier this year by Industry, Science and Technology Canada (ISTC) and based on data from Statistics Canada, private research companies and ISTC estimates.

Communications Canada and the Information Technology Association of Canada (ITAC) were consulted in the preparation of the report. The numbers show that the information technology sector grew at three times the rate of the national economy between 1988 and 1990. Expenditures on computers and peripherals more than doubled to $5.1 billion (Canadian dollars).

Canada’s imports and exports of information technology products also increased. As a proportion of Gross Domestic Product, the value added to products and services, the information technology manufacturing sector now equals that of the pulp and paper industry, one of Canada’s traditional economic engines.

Statistics Canada recently released industrial R&D data for 1990 and 1992, which also point to an continuing increase in R&D within the information technology sector. A major advantage:

- Total R&D expenditures in Canadian industry are expected to exceed $5.2 billion in 1992, an increase of 1.6% over 1991.
- This increase is comparable to a 1.5% increase in 1991, but significantly lower than a 6.9% increase in 1990. (Real terms (after taking into account inflation), growth for 1991 was 1.1%, compared to 3.8% for 1990 and 10.5% for 1989.
- Telecommunication equipment is the leading industry with 15% of all intramural R&D expenditures, followed by aircraft and parts (8%), engineering and scientific services (8%), other electronic equipment (7%) and business services (6%).
- Funding of industrial R&D from foreign sources was equivalent to 18% of the total industrial R&D; while the federal government’s contribution was 8% and other Canadian sources accounted for 10%.
- Most of the industrial R&D in Canada was performed in Ontario and Quebec, with 56% in Ontario in 1990, where electrical and electronic products industries are prominent.

Japan from page 6

Specific projects to professors. Overall, there seems to be much less interaction between Japanese industrial research and Japanese academic laboratories than between the US equivalents. There is little technological transfer from universities to industry, and there are few joint research projects between Japanese academic and industry. Indeed, it is often observed that Japanese industry is stronger ties with top US computer science departments than with the top Japanese laboratories.

Comparing the quality of computer science research done in Japan versus that in the United States is tricky and subjective. Our opinion is that, on the whole, computer science is stronger in the United States. We did, however, see a number of credible research efforts in Japan, including those in such diverse areas as computer vision, software engineering and complexity theory.

Lessons learned

Probably the most important lesson we have drawn from our experience is that it is difficult to oversimplify the influence of culture in distinguishing the structure of American and Japanese approaches to teaching and research in computer science. There are several noticeable differences between US and Japanese universities.

- The tenure system of Japanese faculty to stay in a department, or even a laboratory, from the last year of undergraduate study through retirement differs from the more mobile approach in the American system.
- The narrow focus of most Japanese computer science research programs contracts with generally broader US research programs.
- The structural level of resources, in general, contrasts with the wider range of US institutions.
- The marked absence of women and foreigners among faculty and graduate students contrasts with the more heterogeneous nature of US institutions.
- The small number of faculty and Ph.D. students in top-tier Japanese computer science programs contrasts with the much larger programs found in comparable US universities.

These differences did not adequately capture "the feel of academic computer science in Japan. The influence of Japan on computer science, as in other political, social and scientific realms, is growing. It is essential for us to learn about Japanese computer science in order to benefit from the work that goes on there and to improve our own work. For a copy of the full article, contact David Nokita, D department of Computer Science and Engineering, FR-35, University of Washington, Seattle, WA 98195. E-mail: ndnokita@cs.washington.edu. Contact Richard D. Schlichting D"
Workshop focused on experimental CS research

By Barbara Liskov

It is something of a first for the Office of Naval Research. Sponsored a workshop last fall in Palo Alto, CA, on improving quality of experimental computer science. The overall goal of the workshop was to identify problems and issues in experimental computer science and proposal solutions.

The workshop consisted of two parts and was cosponsored by the National Science Foundation, the Defense Advanced Research Projects Agency (DARPA), and other science agencies that participate in the Federal Coordinating Council on Science, Engineering and Technology (FCCSET).

T was aimed as a group for the first day and a half to identify problems and issues that required more detailed discussion. The remainder of the time was spent in small working groups that proposed solutions to specific problems.

The session summary is documented in this report.

General sessions

A panel opened the workshop with brief presentations by Robert Taylor of Digital Equipment Corp.; David Cheriton, professor of computer science at the University of California at Berkeley; Ivan Sutherland, director of the VAX Project at MIT; and Paul Cohen of the University of Massachusetts at Amherst.

Taylor said that even though the state of computer science research as a whole has improved during his 30-year career, the number of university departments capable of doing first-class experimental research has increased only modestly. He said he believed that good experimental work required that people build what they design and use what they build.

Credit due

A general said we should learn to recognize other’s work and replicate each other’s results. Researchers should get credit for making their work available to others, because the competitive advantage represented by the tools produced by a group may be compromised by their early dissemination. Researchers also should get credit for using someone else’s work, support for distribution of tools and support for the infrastructure needed to make research projects possible.

Selected artifacts must be built and evaluated, but their construction requires a large amount of time-consuming engineering effort. T work can be reduced by reuse, but only well-engineered and well-supported tools are worth the extra effort. Owicki said the goal of performance measurement is not just to get numbers. Instead, performance measurement should identify the effect of particular approaches or techniques on performance to make informed decisions on its value. Because technology is changing rapidly, researchers must either get results quickly or abstract away technology so results will survive changes, she said.

Owicki discussed the results of a survey of papers in A A A I-89, which showed that artificial intelligence needs more sophisticated experimental methodology. Owicki said the conclusion can be made of all fields of computer science.

Experimental work

T was the second session focused on the structure of the project and what was needed to make it work, rather than on the research content of the work.

A Richard Anderson of the University of Washington described his work on using a parallel algorithm to study how they perform in practice. H needed to access state-of-the-art hardware. But because he had not used such processors, he wanted to be able to share his work with others. In addition, he needed good measurement facilities, so good infrastructure support such as programmers and systems experts, and knowledgeable colleagues to help him understand anomalies. Owicki said that Carnegie Mellon University discussed the role of tech machines. H small project began as a student’s idea. T amount of work required was greatly understated, but the project team had support from several staff members in the hardware laboratory at the time. T research focused on getting a particular program to work. After the decision was made to study specific techniques to identify their contribution to the project as a whole.

David Cheriton of Stanford University discussed the way the V -system project has served as vehicle for systems research. H said a substantial research vehicle is needed to enable sophisticated experimental systems research. Such a vehicle is a problem for research groups and allows them to tackle problems more easily than could be done in a conventional setting.

A thought many students worked simultaneously on V systems. T student had to work one-on-one with C Herton, not on an group project with other students. C Herton found that there is a tension between the work needed to maintain the environment and make progress, and the need to free students to pursue their own research objectives.

M. Sarnyayanan of Carnegie Mellon University discussed the idea of running projects using professional and running on using students. T professional staff put the needs of the project ahead of individual needs to do research, and they have fewer quibbles about working together or restructuring the way they do things. T students must do research and accomplish original techniques, and they have problems with taking credit for joint work (deciding what work goes into whose thesis). T do not fully appreciate simplicity, and their time is fractured because they have to take classes and exams. T results will progress slowly, so students need to choose problems that are farther into the future.

Systems research

Hank Levy of the University of Washington discussed systems research at the university. T type of research is unusual among academic institutions because it requires the kind of large-scale collaborative joint work (research collaboration). T joint work is encouraged for the students. T papers have several authors, and the content of individual theses is worked out in a dynamic and flexible fashion. New projects build on the artifacts developed for older ones. T research methodology was to choose a problem, design a solution, choose the most efficient path to demonstrate that the solution works and support this by the results. T algorithm is important. Six months is an acceptable completion period, three years is not.

T Sprout project at the University of California at Berkeley was discussed by R Andy Katz and David Patterson (authors of the original implementers) and Susan Egers, James, and Aras. David Wood [project students who now are on the faculty of Washington and the University of Washington and the University of California at Berkeley]. From the beginning of the goal of this broadly scoped project was high-performance, working system.

T students were broadly educated. T they understood systems, not just isolated components. Developing working prototypes gave students more knowledge in some areas than would have been possible using functional analysis. Students also gained valuable experience and broad exposure outside the university.

If, however, the students felt that they spent more time in school (up to 2.5 years) because of the need to complete the overall project. T use of people was not always used efficiently. T they provided continuity, had skills students lacked, freed students to concentrate on research and suffered less from personal and group tension.

T project might have progressed faster if the ideas were used at an earlier stage of systems research. T students must have been more chance to investigate alternative designs. T student was doing research now on such a large scale.

T commercial RISC machines became available part way through the project, it might have been desirable to redirect the project away from the goal of producing a deliverable system. It, however, doing so would have caused problems because students’ research was contingent on continuing along the original path.

T role of simulation

Douglas Clark of DEC discussed the use of simulation in experimental research. Clark said simulation should be considered the primary tool for evaluation of a design, and hardware should be built only as a last resort.

Simulation has a number of advantages. It is cheap; it provides results quickly. It allows one to evaluate...
Al, expert systems researchers honored in Canada

By Douglas Powell

The two winners of this year's Canadian awards for computer research excellence are researchers in the fields of artificial intelligence and expert systems.

Hinton is the Noranda Fellow of the Canadian Institute for Advanced Research, a position he has held since 1991. He is also a professor of computer science at Concordia University in Montreal, and author of the seminal 1986 paper that introduced backpropagation, a technique for learning in neural networks.

"We're not sure what the number is, but it's a sizable number. I think it's at least a hundred, maybe more," Hinton said. "The backpropagation network can compute very fast once it has learned, so it can afford to look at all of the cells. A result, the error rate in diagnosis has decreased by a factor of 10." Hinton and his co-workers also have created a portable state-of-the-art neural network simulator called Xerion, first released in 1991, that is available to industry at no charge, with no restrictions on its use and products. M ore than 100 universities and industrial research groups have received copies of Xerion. "The best way to transfer results from my research labs Canadian industries would be to give them the software," Hinton said. "Ask for all free. Then they can do what they want with it."

Hinton is the senior fellow of the Canadian Institute for Advanced Research and serves as a consultant to Apple Computer Inc., E.I. du Pont de Nemours Co., and Synaptics Corp. He says, "Our work on neural networks Learn From Experience," was published in the September 1992 Scientific American's single-topic issue devoted to the mind and brain.

Ching Suen, an electrical engineer trained in bioelectronics and human-computer interaction, is a recognized leader in pattern recognition, expert systems and computational linguistics. A founder and current director of Concordia's SC center for Pattern Recognition and Machine Intelligence (CENPARMI), Suen leads a 40-person research team with an annual research budget of more than $500,000.

Based on the concept of multiple expert systems, Suen has developed a sophisticated technology to recognize handwritten (and totally unconstrained) characters by combining human expertise with structural, morphological, neural and statistical methods.

"Because this is an area that mimics the human communication process— in this case, vision— it has something to do with expert systems. It tries to make use of human expertise, which is something very different to specify, in order to recognize patterns," Suen said. "And it's hard to get your results sooner than if you actually build something yourself. If fabrication isn't in time— it's consuming. If the design takes the most of the time, which is the case in many areas of computer science, simulation may become helpful.

Several common themes arose during the workshop. Support is needed for several activities that aid research but are not deemed research by today's standards. We need help in building artifacts that are sufficiently robust and can be used with confidence. We need to find a way to encourage replication of results. We need infrastructure, such as shared equipment and professional staff, and money to buy tools. Support includes both funding and ways to give certain activities, such as replication, academic respectability.

It is clear that we have much to learn about doing performance measurements. Too often the numbers themselves are ig- norable, but numbers alone do not tell enough. We need to be able to evaluate and compare techniques in a way that isolates or neutralizes many of the non-critical aspects possible.

There are two distinct styles of experimental research. One then we experiment to prove or disprove a hypothesis. Some people do exploration instead. It would be a mistake to rule out experimental research on the grounds that it is not scientific enough. Experimental projects suffer in other ways, too, such as in scale or in how real the result must be.

The primary task of students is learning how to do research, as opposed to doing research, or building maintaining and distributing systems. Students need individual projects and unique solutions. There are many demands on their time, so progress is slower than it could be. Projects of any size need professional staff—not just to provide support for infrastructure, but to help build artifacts.

Simulation is a valuable tool, but it has a number of problems. A simulation runs too slowly to provide an artifact that others can use. The lack of such an artifact means that unexpected uses cannot be explored. Simulations are models, which may be incorrect or omit details that will be important if the system really were built. For certain areas it may be as fast to build the system as simulate it.

Finally, it is unclear how far to go when building a system. To provide a tool with good performance requires tremendous effort, more than seems justified in many cases as it achieves research objectives. However, good performance sometimes is required to achieve other goals, such as adoption or technology transfer.

Barbara Lisow is a professor of computer science and engineering at the Massachusetts Institute of Technology and was chair of the workshop's program committee.

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North Carolina State University
Department of Computer Science
A p plications and n nominations are invited for the following department head.
Candidates should have strong leadership skills to organize and focus teaching and research efforts within the department and to work constructively and creatively with the College of Engineering and the greater community.

The department has a reputation for excellence in teaching and research and is involved in collaborative research in several areas.

The department has 25 tenure-track faculty members and 150 students in an expanding graduate program.

North Carolina State University
Computer Science Department
Box 7901, Raleigh, NC 27695-7901
Applications are encouraged from qualified candidates.

The department has received three major grants recently.

In accordance with Canadian human rights legislation, we are committed to equitable employment practices.

Carleton University is committed to a policy of employment equity.

Interested applicants should send a resume and the names of at least three reference to Chair of Faculty Recruiting, Department of Computer Science, 5151 Ouellette Avenue, Ottawa, ON K1S 5B6.

The university guarantees the confidentiality of all applications.

Interested applicants should send

the names of at least three references to Chair of Faculty Recruiting, Department of Computer Science, Box 7901, Raleigh, NC 27695-7901.

The deadline for applications is January 15.

Salary is commensurate with education and experience.

The Computer Science Department has grown substantially over the past five years and has 30 tenure-track faculty and eight research faculty.

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University of California, Santa Barbara
Department of Electrical and Computer Engineering

The Department of Electrical and Computer Engineering at the University of California, Santa Barbara, invites applications for one or more senior tenure-track faculty positions. Senior applicants should possess distinguished research records and the ability to attract substantial research funding; while junior candidates must demonstrate exceptional promise. The College of Engineering and Related Sciences has embarked on a multiyear plan to strengthen the department in experimental computer science and communication. We are seeking applicants primarily in parallel and high-performance computing and communication. We are especially interested in candidates in software systems, scientific computing or software research who maintain a Computer Systems Laboratory and 100 faculty in various disciplines. Excellent instruction and research computing facilities are available.

A position is available to hold a position in computer science or a closely related area. The position is open immediately. Applications are invited from qualified candidates for the position. Mail all applications to the Chair, ECE Search Committee, University of California, Santa Barbara, CA 93106-5110.

The University of Florida is an equal opportunity affirmative action employer.

Pennsylvania State University
Department of Computer Science

The Department of Computer Science at the Pennsylvania State University is seeking qualified candidates for expected tenure-track positions. Applications in all areas of computer science will be considered, with a particular interest in candidates in the areas of networking, operating systems, programming languages, and computer graphics. Excellent opportunity for research and teaching is available. Qualified women and minorities are encouraged to apply.

Applications should be received by November 15, 1992. Please provide the names of three or more references. Mail all applications and supporting documents to the Chair, Computer Science Search Committee, University Park, PA 16802.

The University of Florida is an equal opportunity, affirmative action employer. Women and minorities are encouraged to apply.

Oregon State University
Department of Electrical and Computer Engineering

The Department of Electrical and Computer Engineering at Oregon State University invites applications for faculty positions in computer engineering. A associate and full professor positions require a distinguished teaching and research record appropriate for the title. Candidates should have an earned doctorate, substantial experience in computer engineering, or in a related field and are expected to have a strong commitment to high-quality undergraduate and graduate teaching and to the development of a sponsored research program. A position is available for a distinguished teaching and research record appropriate for the title. Experience will be given to senior-level candidates with a strong research record and the ability to provide leadership in the computer engineering area. A strong interest in leadership, performance computer architecture, parallel architecture, VLSI array processing, performance analysis and data flow computing.

With a faculty of 25, the department enrolls about 400 undergraduate and 120 master’s and doctoral students. The department offers BEE-accredited degrees in electrical and computer engineering. High-technology corporations, including Intel, IBM, and the University of Oregon, offer a strong and growing research environment in experimental computer science and computer engineering. Facilities housed in a new building. Located in the Willamette Valley 80 miles south of Portland, Oregon, the department offers a beautiful and unspoiled environment and many cultural activities.

A position is available for a comprehensive review, a list of five to ten research references, a letter of interest, and a list of three to five references. Mail all applications and supporting documents to the Chair, Computer Science Search Committee, ECE D Department, Oregon State University, Corvallis, OR 97331-3211. Review begins November 15, 1992. Women and minorities are encouraged to apply.

The University of Florida is an equal opportunity, affirmative action employer and complies with all applicable federal and state laws regarding non-discrimination and affirmative equal opportunity policies; all qualified applicants are considered for employment without regard to race, color, national origin, age, sex, marital status, family status, disability, and veteran status.

University of Rochester
Department of Computer Science

The University of Rochester invites applications for tenure-track positions at the rank of assistant professor. Applicants should have a strong research record, preferably in the aforementioned areas, and have demonstrated the ability to attract substantial research funding. Applicants should have a Ph.D. in computer science or a closely related area. Applicants should specify the ranks for which they are applying.

Fully networked departmental Sun Microsystems, IBM and DEC workstations, and other modern computing platforms are available. The department has a strong commitment to high-quality undergraduate and graduate education. The University of Rochester is an equal opportunity, affirmative action employer. Women and minorities are encouraged to apply.

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California Institute of Technology
Department of Computer Science

Caltech invites applications for a tenure-track position at the rank of associate professor, with tenure potential, in computer science. Caltech has a strong commitment to computer science. Applications are invited from qualified candidates with a Ph.D. in computer science or a closely related area. Applicants should have a strong record of research publication, teaching and research funding, while junior candidates should have a strong research record. Salary and rank will be commensurate with experience. Associate professor positions require a strong record in teaching and research, while junior candidates should demonstrate exceptional promise. The department has a strong commitment to high-quality undergraduate and graduate teaching and to the development of a sponsored research program. A position is available for a distinguished teaching and research record appropriate for the title. Experience will be given to senior-level candidates with a strong research record and the ability to provide leadership in the computer engineering area. A strong interest in leadership, performance computer architecture, parallel architecture, VLSI array processing, performance analysis and data flow computing.

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Nagel: Gov’t needs to refocus its R&D spending

T he following is an edited version of testimony given by David C. Nagel, the senior vice president for advanced technology at Apple Computer Inc., before the House Science, Space and Technology Subcommittee on Science.

I am honored to appear before this subcommittee for aopportunity to discuss the relationship of federal R&D activities to the private sector. All through Apple, I have drawn heavily on research and analysis done by members of the Computer Systems Policy Project (CSPP), an affiliation of the chief executives of 13 leading US computer companies.

In 1991, CSPP companies had worldwide revenue in excess of $140 billion, 60% of which was derived from outside North America. Perhaps more than any other industry in the United States, computer systems producers and the high-technology industry of which they are a part—are highly integrated into the global market system. The high and incredibly short product life cycles of the major company can bring a new product to the market in a matter of weeks, while the company must refocus federal R&D spending, both public and private, on research and development that will lead to breakthroughs and new products for the market in the future. The synergy between investment in basic research and international success.

The rapid pace of technological advancements and the computer industry's success depend on the ability of US and international competitors. US companies can bring a new product to the market in a matter of weeks, while the company must refocus federal R&D spending, both public and private, on research and development that will lead to breakthroughs and new products for the market in the future. The synergy between investment in basic research and international success.

The companies of the CSPP, for example, have suggested that the HPCC initiative should be expanded and leveraged in order to provide the foundation for an information and communication infrastructure for the future and to bring the benefits of the HPC technology to individual areas such as healthcare, education, lifelong learning and manufacturing. In addition to science and engineering, CSPP believes that HPC, and future programs like it, can play an important role by providing a framework of challenging national goals, which can catalyze, focus and direct the individual efforts of government and industrial R&D activities.

To examine how government and industry work more effectively to achieve these goals and to maintain and enhance the health of American industry and the economy, it may be best to examine successful cases of commercialization of basic and applied research and technology development. In a 1990 article published in The Wall Street Journal, the technological change in the semiconductor industry, as a result of government research and development efforts.

The companies of the CSPP have demonstrated both a willingness and the ability to work closely with the government to implement the required changes. The result can be more competitive and vital US industry.