Department of
Computer Science
University of Illinois
at Urbana-Champaign

Alumni News

Summer 1997 Vol. 1, No. 8 *Computer Science Alumni Association* • A Constituent group of the University of Illinois Alumni Association

Cyberfest a spectacular hit!

The campus breathed a collective sigh of satisfaction as Cyberfest'97 drew to a close. The media focused their attention on Urbana, Illinois, during the week of March 10-15, as a diverse group of people from all over the world came to join us in celebrating the birthday of HAL and the computing achievements of the University of Illinois. Some 20,000 people flooded over forty events held on campus and off. With Engineering Open House, Ag Open House, and the first round of the NCAA women's basketball tournament, local hotels were full.

"Cyberfest was the biggest event of its kind ever held on this campus," said Carol Menaker, Director of Communications and Chairperson of Cyberfest. "Many would like to see it

continued on next page

Bill Wiegand

Arthur C. Clarke appeared live via the Internet during the CyberGala at Krannert. The video came over the Internet at 3-5 frames per second, quite a feat given the bandwidth available in Sri Lanka, where Clarke lives. Clarke,in a flight suit from 2001, was interviewed by a panel of distinguished guests moderated by Roger Ebert.

High-performance computing:
A time machine to the future

by Dan Reed, department head

Until recently, there were four national supercomputing centers in the NSF Supercomputer Centers program. At Illinois, the National Center for Supercomputing Applications (NCSA) was established in 1985. (The other three were located at Cornell, Pittsburgh, and San Diego.) Reflecting changing research community needs, two years ago the National Science Foundation (NSF) announced a recompetition process for the existing supercomputer centers. Acknowledging the advancements in technology that enable researchers to use desktop

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Ozzie wins COE Alumni Award

Ray Ozzie

Ray Ozzie, BS'79, was awarded the College of Engineering's highest alumni honor at the 33rd Honor Awards Convocation, held at the Illini Union on April 11, 1997. He was presented the award by Dean William Schowalter "for his vision, determination, and programming skill in the development of Lotus Notes, a program that enables groups of people to work collaboratively over computer networks." Ray attended the ceremonies with his wife Dawna Bousquet and his parents, Edward Ozzie, AB'49, and Mary Ann Ozzie.

Ray was on campus not only to accept his award, but to share his wisdom with students and faculty during the Higgerson Forum on Entrepreneurship through Engineering.

Ray has been an important benefactor not only for the Department of Computer Science but for the entire university. In 1996, he helped arrange for IBM to provide the university a site licence to use Lotus Notes on all three campuses.

Most recently, Ray has established the department's first fellowship, the Ray Ozzie Fellowship in Computer Science, which will be awarded next year. ■

University of Illinois
Computer Science
Alumni News

Editor: Judy Tolliver

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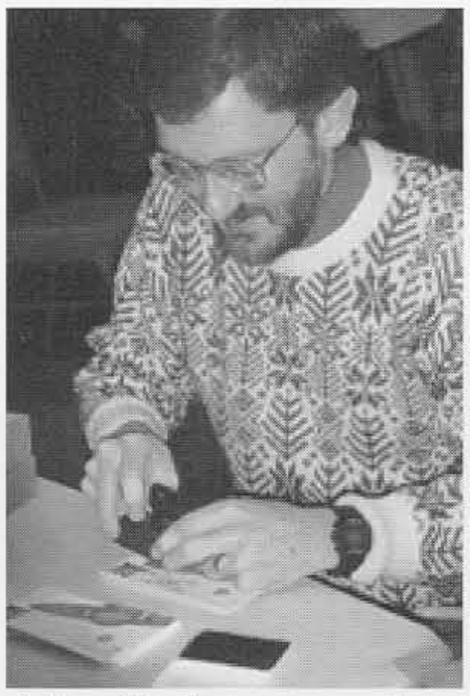
happen again."

An early indication of the level of public interest in Cyberfest came on January 12, HAL's real birthday in the book. Hundreds of people lined up in Lincoln Square mall to purchase commemorative envelopes and have them stamped with a special cancellation by the Urbana Post Office. Allan Tuchman, BS'76, MS'91, president of the Champaign-Urbana Stamp Club, was the originator of the idea. All 5,000 printed quickly sold out.



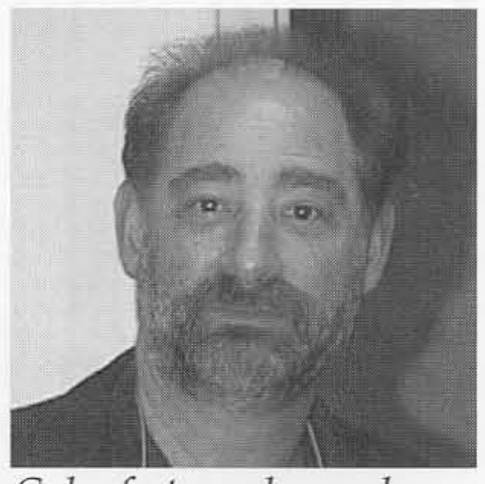
Allan Tuchman cancels commemorative envelopes in Lincoln Square.

The events

Cyberfest week officially kicked off on Monday with a talk by Larry Smarr, director of NCSA, on why HAL was born in Urbana. Smarr cited the literal and metaphorical reasons Clarke chose Urbana as HAL's birthplace, including the fact that at the time the book was written, the university was already a leader in the high performance computing. And because it still leads in this area, he speculated that HAL could yet be born in Urbana: "I think university undergraduates in 2020 would have a very good shot at being a parent of HAL."

The Department of Computer Science's showcase event was packed as over 250 people came to hear some of the world's top computer scientists discuss computational issues raised by HAL at the Cyberfest Forum.

An English symposium, called "Disembodied Creativity," examined the social and aesthetic implications of computers and was directed by faculty member Richard Powers. Powers, author of *The Goldbug Variations* and *Galatea 2.2*, also ran a film festival during Cyberfest, a spin-off of the Cybercinema Web site, a site devoted to the history of computers and AI in movies (http://www.english.uiuc.edu/cybercinema). The College of Communications hosted a symposium called "Opening the Pod Bay Doors: Critique, Control, and Computers," a look at computers from a postmodern and feminist perspective. Piers Bizony and David Stork, both authors of recent books on *2001* gave presentations. Harry Lange shared some of the film's revolutionary effects secrets and stories from the set. He was nominated for an Academy Award for production design on *2001*, and he designed the film's spacecraft. (He later did the same for *Star Wars*.) Don Norman, then VP of Apple Research, discussed his views on HAL and some of the technological predictions in *2001* at a well-attended talk in the Beckman Institute. A concert of works created by School of Music faculty and students gave a brief retrospective look at the early pioneering days of electro-acoustic music coupled with today's diverse activity of computers in music. Over thirty performers presented works by composers Lejaren Hiller, Herbert Brün, and others.



Cyberfest speaker and detective Fred Stahl.

Many alumni returned to campus to enjoy the myriad of Cyber-festivities. Events kept snowballing so that

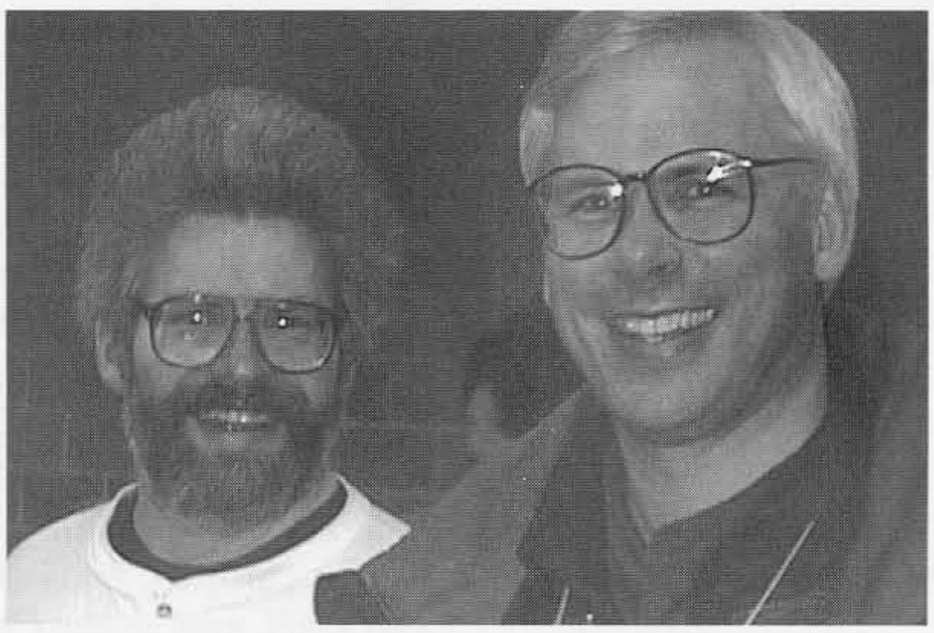
it was difficult to keep up. Thank goodness for the Web and for the Illinois CS alums who make navigation easy! One last-minute addition was a talk given by CS alum Fred Stahl, BS Math'66, MS Math'68, PhD'74, on an ancient Greek computing mechanism, called Antikythera, that was retrieved from the floor of the Mediterranean Sea. He is currently writing a book on the subject. Russ Mitchell, BA Journalism'77, managing editor of *Wired*, returned to campus not only for Cyberfest but to be a guest lecturer in several journalism classes.

The Movie

The landmark Virginia Theater in downtown Champaign was packed to capacity with some 1,600 people on Thursday for a showing *2001*. The Virginia hasn't been showing movies for years, and showing *2001* in 70 mm required an overhaul of the projector and screen and installation of a temporary sound system. This was accomplished thanks to alum Steve Kraus, BA PoliSci'82, who secured the assistance of his company, Movie Theater Supply Co. in Chicago. The last time *2001* was shown in Champaign-Urbana was in 1968 at the Co-Ed II. The Cyberfest showing introduced a new generation to the movie and for most, it was the first time it was seen in 70 mm splendor. Urbana native Roger Ebert, BS Journalism'64, hosted the evening. As the curtains parted to reveal a pristine print of the film lighting up the immense white screen, one could hear the oohs and ahhs of the rapt crowd. The audience burst into cheers when HAL uttered "Urbana, Illinois."

The Gala

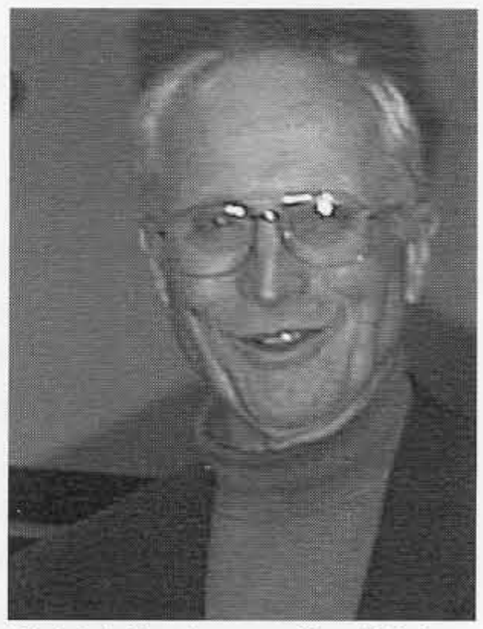
On Friday, the sold-out Academy-Award-style CyberGala at Krannert wrapped up the week. This extravaganza, also hosted by Roger Ebert, paid tribute to HAL, Arthur C. Clarke, and the many others who made *2001* possible. Clarke participated from his home in Sri Lanka on a live Internet uplink, webcast by Hazardous Media. Another highlight of the evening was a surrealistic, virtual reality performance by NCSA's Robin Bargar and Insook Choi, in which 3-D computer-generated images and sounds were controlled by a performer's body movements. Actor Gary Lockwood ("Frank Poole") appeared in person, and Kier Dullea ("Dave Bowman") and others appeared on film. A reception with Cyberfest-inspired munchies and decor followed in the Krannert lobby, where guests could view memorabilia from the film, including the space suit worn by Dullea and HAL's nameplate. It was a wonderful conclusion to a remarkable and important event for the university.



PLATO people: Larry White and Tim Halvorsen.

The CS reunions

But it wasn't over for the Department of Computer Science. Three of its most important events were about to begin, on Saturday: The reunions of Big Iron, PLATO and ACM folks.



ILLIAC pioneer Joe Weir.

About forty alumni, spouses, and friends attended the Big Iron Reunion, to celebrate and reflect on the ILLIAC era. Professor Sylvian Ray, chair of the reunion, led a session in which people shared stories about working in DCL. Attendees included Joe Weir, Toshiro Kunihiro, Ken Smith, Tom Murrell, Masao Kato, Joan Slotnick, Liesel Poppelbaum, and Betsy Gillies. A party was hosted by Professor Mike Faiman at his Urbana home after dinner at the Illini Union.

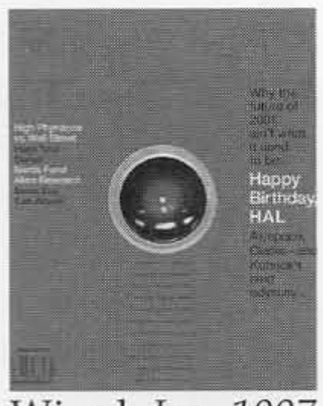
The PLATO Reunion, which kicked off with an Empire tournament, drew some 150 people from all over the country and from Europe. PLATO people could log on to NovaNET, the system's successor, via PCs in the basement of DCL and see if their favorite PLATO lessons were still there. Those longing to clack away at a real PLATO keyboard could do so in the old operator's room of CERL on a PLATO IV, lovingly restored by Lane Blair of CCSO. Papa Del's pizza and beer was enjoyed across the hall in the old "zoo," room 165. The event culminated in DCL when a series of talks were given, followed by an open mike session that not only included talking and sharing memorabilia on the big screen, but poetry and music as well. CCSO programmer and alum Michael Walker, chair of the PLATO Reunion, hosted the evening which featured talks from PLATO founding father Don Bitzer, Brand Fortner, Sherwin Gooch, David Frankel, and other PLATO notables. Also present were pnotes author Kim Mast, gnotes author David Woolley, and Lotus Notes creators Ray Ozzie, BS'79 and Tim Halvorsen, BS'77.

CompE alum Alex Bratton hosted the ACM Reunion, generously providing a classic ACM meal of Papa Del's

to about fifteen alums and thirty current ACM students. After a tour of ACM's facilities and EOH exhibits, alumni and students competed against each other at Tech-Jeopardy, where contestants were required to sing the Windows 95 bootup sound and convert XXVII to hexadecimal.

Goals met

Cyberfest marked the first attempt by the university to hold an event of this size that spanned the entire campus. The three main goals of the event were met, and the university is already thinking about its next Cyberfest-style event. The first goal was to attract national attention to the University of Illinois and its rich history in computing. Over 100 print and broadcast venues nationwide covered Cyberfest between January 12 and March 17, including *Newsweek*, *BusinessWeek*, *Time*, *Wired*, *New York Times*, *LA Times*, *Chicago Tribune*, *Chicago Sun-Times*, CNN, and the BBC. Major events were webcast by WEBX-FM and Hazardous Media, and the official Cyberfest Web site, http://www.cyberfest.uiuc.edu, was visited by more than 200,000 from over sixty countries.



Wired, *Jan. 1997*

The second goal of Cyberfest was to unite the campus by creating a coalition among disciplines. Along with CS, more than a dozen units hosted Cyberfest events, including Math, English, Communications, Commerce, the Library School, and the College of Agricultural, Environmental and Consumer Sciences (ACES, formerly the College of Agriculture). The Cyberfest theme was adopted by both Engineering and Agriculture Open Houses, and students ran and participated in a variety of activities. The Astronomy Club hosted open houses at the observatory, industrial design students competed against one another to design a Cyberfest time capsule (to be buried near the Undergraduate Library and to be unearthed during the university's 200th anniversary in 2046), and journalism students produced the Obelisk, their first on-line magazine (this received coverage in the *Chronicle of Higher Education*), to name a few. More than fifty faculty members, including CS professors Josep Torrellas and David Padua, demonstrated the use of computers in teaching and research in a campuswide technology fair in the Grainger Library. Over 6,000 visited the fair, including the Lieutenant Governor of Illinois.

The third goal was to promote university/community relations. The idea of Cyberfest was brought to the attention of Precision Graphics, a local graphic design firm, by former CS department employee Terry Thiel. The firm, headed by UI alum Jeff Mellander, enthusiastically embraced the idea and contributed the Cyberfest logo and Web Site. Other locally-based firms and organizations followed the lead. Parkland Community College held an Internet Fair, the local convention and visitor's bureau coordinated lodging, and local libraries set up displays. School children in Champaign County were introduced to HAL and science fiction fthrough Web page competitions and *2001* discussions. During the week of Cyberfest, both the *Champaign News-Gazette* and the *Daily Illini* ran daily front-page stories. For a while, signs of Cyberfest were everywhere—posters, t-shirts, storefronts—and people were talking about how cool it was.


The logo

Corporations support Cyberfest

Over $200,000 were raised from corporations who provided cash and gifts-in-kind. Apple Computer, Wired Magazine, Lotus Corporation, Oracle, HAL Computer Systems, and United CD-ROM signed on as national partners. They were joined by the Chicago Sun-Times, Microsoft, Ameritech, and Precision Graphics as corporate co-sponsors. IBM and NovaNET Learning Corp. gave gifts specifically for CS events. Over fifty high-tech vendors displayed their wares at the Cyberfest Showcase, a computer tech fair held in the Illini Union. They also gave presentations on topics like Domino, Microsoft Office, Deep Blue, Java, Internet security, and the year 2000 crisis.

It was hard to be in Champaign-Urbana and not be aware of the excitement surrounding Cyberfest. The original idea was to use HAL's birthday as an excuse to celebrate the accomplishments of the Digital Computer Laboratory and the Department of Computer Science. However, as some of us learned during Cyberfest, these accomplishments were not confined to DCL. Early psychologists used ILLIAC I for statistical analysis, musicians used ILLIAC II to compose music, physicists used ILLIAC III to analyze atomic reactions, and the list goes on. Now it's easy to see the explosion of computer use on campus, by researchers, students, administrators and staff, and in the Champaign-Urbana community as well. The seed of Cyberfest was planted in the Department of Computer Science but it grew to welcome everyone who wanted to be a part of this unique occasion. ■

Computer Science Cyberfest Forum:
Leading computer researchers grapple with *2001's* thorny issues

The Department of Computer Science's showcase event for Cyberfest was the Cyberfest Forum held on March 12, 1997, in which scientists gathered to discuss HAL from a computational point of view and the broader issues that *2001: A Space Odyssey* invokes. The lecture room was packed as over 250 turned out for the event, overflowing to an adjacent room where the event was projected by video camera to a screen. Professor Jerry De Jong, coordinator of the forum, moderated the discussion, and a reception was held in the DCL atrium afterwards. Those who couldn't attend could listen to the forum at http://www.webx.com, WEBX-FM's Web site.

The perfect sponsor: IBM

The CS Cyberfest Forum was made possible by a generous donation from IBM Corporation. IBM played a critical role in the making of the movie *2001*, although Arthur C. Clarke denies that the acronym HAL was a left-shifted play on IBM. NASA scientist Fred Ordway, scientific and technical consultant to Clarke and Kubrick for *2001*, worked closely with IBM researchers from Armonk, Poughkeepsie, and United Kingdom, on the scenes involving HAL. "HAL was all IBM," said Ordway, who unfortunately couldn't make it here for Cyberfest but helped in the preparations. There is also a long tradition of IBM at Illinois. The campus installed an IBM 650 computer in 1958, and a year later, IBM loaned DCL equipment for the ILLIAC II project. In 1967, the CS department acquired its first IBM System/360-50 computer. A few months after that, we added a System/360-70, incorporating it into the ILLININET, one of the earliest computer networks. In the early 1980s the department spearheaded Project Excel for deploying personal computers across the campus, and it set up one of the first networked undergraduate teaching laboratories using IBM AT personal computers. Many other IBM machines have come through the doors of DCL, and many graduates from the department have gone through IBM's doors as scientists and engineers, including forum panelist Joe Hoane, BS'84.

The CS Forum *or* ?

- The Science and Science Fiction of HAL
- HAL: Destination, Steppingstone, or Road-block?
- 2001, HAL, and Computational Correctness
- HAL's Hatchery
- Artificial Intelligence: Threat or Menace?
- So Who Wants to Go to Jupiter Anyway?
- If HAL can't come from the CS department, then let the CS department go to HAL!

Jerry De Jong, who gave us these possible titles, was our host for the evening. He is professor of computer science at the University of Illinois and specializes in machine learning. Machine learning is a central area of artificial intelligence that studies how systems can improve as they interact with the world.

Jerry introduced the themes of the evening which revolved around HAL: Why doesn't a HAL-like machine exist now? Could it exist in the future, and if so, when might we expect it? If not, what parts of it could and what parts couldn't? We chose to focus on HAL not only because it was Cyberfest and HAL's birthday. There were many other computer-related parts of *2001* that we could have examined. But it is HAL that is so elusive and

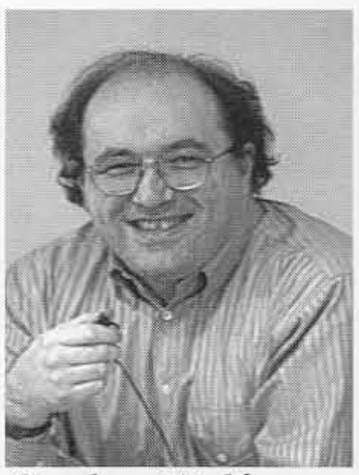
compelling, De Jong pointed out. It is HAL that has captured our imaginations and raised such delectable philosophical problems.

And so De Jong introduced our "panel of Dr. Chandra's," referring to the name of HAL's fictional creator. Each had ten minutes to address these issues from their unique viewpoints as some of the top practitioners of computer science in the world today.

http://www.ai.uiuc.edu/~ebl

It should be noted that this forum took place before Garry Kasparov's historic loss to Deep Blue, which occured two months after Cyberfest.

What our speakers had to say about Hal and about us



Stephen Wolfram

Stephen Wolfram is the creator of Mathematica, one of the world's foremost technological computing programs. He is also founder, president, and CEO of Wolfram Research Inc., in Champaign. Mathematica handles all aspects of technical computing projects by performing calculations, producing graphs, and providing interactive document capabilities for presentation. Wolfram is an adjunct professor of CS at Illinois. In 1981, in recognition of his work in physics and computing, he became the youngest recipient of a MacArthur Prize Fellowship. His new book, *A New Kind Of Science*, is forthcoming.

Wolfram kicked off the forum by talking about why HAL wasn't here for his own birthday. Dismissing the notion that technology has simply not progressed fast enough, Wolfram believes instead that the fact a HAL-like machine doesn't yet exist is "basically just an accident." He went on to explain that history could have gone another way and that perhaps if it did, humans might not necessarily be the most intelligent entity on the planet. To support this view, he gave several historical examples of how paths that should have been taken but were not. For example, lenses existed for hundreds of years before telescopes were invented, and Wolfram pointed out that even the astronomer Keplar himself wore glasses. Wolfram extended the notion to our view of science and how it reflects as much about ourselves as it does about the universe being studied. "Most commonly, when a new kind of technology becomes available, the obvious applications don't get discovered until long after because the right person doesn't come along, or we have the wrong intuition about them. It becomes assumed that discovery is impossible," he said.

Wolfram believes that we are currently living in that "ignorant" state right now—that our current computers are big enough and fast enough to exhibit HAL-like behavior but that we're missing some key, fundamental scientific ideas that make our building a HAL impossible. "When there are machines that think, and I have absolutely not doubt that eventually there will be," he said, "are we going to look back and say 'Why all of this could definitely have been done, have been discovered, in the 90s, perhaps even in the 80s. How on earth did this get missed?'" Furthermore, Wolfram feels that some current efforts in AI are misdirected, saying that he'd be amazed if studying details on how the brain works will help.

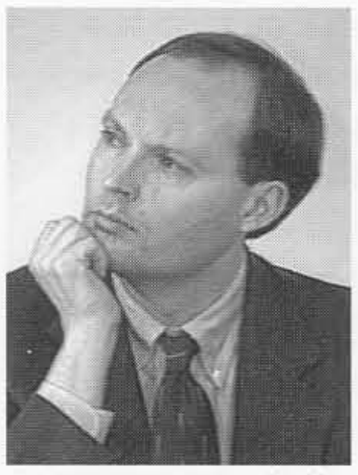
Wolfram believes most important thing that will lead

"When a new kind of technology becomes available, the obvious applications don't get discovered until long after . . ."

to the realization of intelligent machines is simply believing that it's possible. "One big idea, perhaps the most important idea of this century, that is behind computers and is what made computers and software possible, is the idea of universal computing. The idea that you can have a single, universal piece of hardware that you can make do anything you want just by reprogramming it. It's kind of the next step of the idea that's portrayed early in the movie *2001* in the discovery of tools by Moonwatcher the ape. But now instead of having one tool for doing this and another for doing that, we have with the computers a universal tool that can be reprogrammed to do anything we want, and I feel we're only slightly further than Moonwatcher the ape in the development of seeing what can be done with those tools."

"The big accident going on right now is extraterrestrial intelligence," said Wolfram, referring to another misprediction in the movie. "Why haven't we found it? Because we haven't looked at it in a sensible way, and we don't have an understanding of what it is we expect to find." He concluded, somewhat pessimistically, by saying that two of the key mispredictions of *2001*—the lack of a HAL and the lack of any signs of extraterrestrial intelligence—may actually turn out to be not so much embarrassments for the makers of film but instead "embarrassments for all the rest of us. I think there are things that we could easily have had, but we kind of just blew it."

http://www.wri.com



Murray Campbell

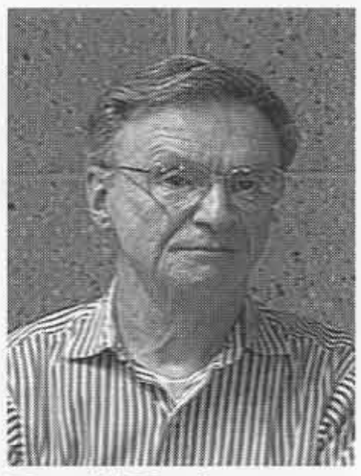
Murray Campbell is a research scientist at the IBM T.J. Watson Research Center in Yorktown Heights, New York. Murray has been working on the Deep Blue computer chess project since joining IBM in 1989. He has been involved in computer chess research for more than fifteen years and was chess champion of Alberta. His principal interest is in the use of large-scale search as a means of solving complex problems, data mining, and parallel-search algorithms.

Murray used the chess match in *2001* as his point of departure. He believes that the chess scene in which HAL beats astronaut Franke Poole says a lot about the relationship between the two players, particularly when examining the body language of Franke when he admits to defeat. Campbell spoke about why the chess scene was in the movie in the first place. "It's pretty clear that the authors, Clarke and Kubrick, intended this to demonstrate that HAL was in fact intelligent. Chess has been

"But is it really essential to have intelligence to play strong chess?"

considered for centuries as sort of the premier intellectual game of the Western world, and the fact that a computer could play this game and play it well would naturally indicate intelligence . . . But is it really essential to have intelligence to play strong chess? Were they making a correct assumption?" To address these questions, Campbell compared the way people play chess to the way Deep Blue plays chess and related these way to our notions of intelligence. He pointed out that computers make good tactical moves, do not commit short term errors, have perfect memory, and are not affected by fatigue or distractions. Humans, on the other hand, exhibit a deep strategic understanding of the game, can predict the long-term consequences of certain actions, have sophisticated methods to evaluate and compare positions, and have a flexible focus of attention. In his analysis of the chess game in the movie, Campbell believes that HAL was playing more in the human style, thereby requiring some form of intelligence. Deep Blue could not have extracted the esthetically pleasing line of play that HAL took to defeat Frank, he said. Campbell concluded that the simple fact that Garry Kasparov could apply further reasoning and leave the domain of chess to apply a novel solution to his predicament by literally pulling the plug on the machine shows, very succinctly, that Deep Blue is not yet intelligent.

http://www.chess.ibm.com



David Kuck

David J. Kuck is chairman of the board of Kuck and Associates Inc. (KAI), a Champaign-based company known for its leading-edge program optimization and parallelization software. This software enables end-users of C++, C, and FORTRAN programs to exploit the high performance of a broad spectrum of advanced computer architectures. Kuck is professor emeritus of CS at Illinois. He has won numerous awards including the Eckert-Mauchly Award from the ACM-IEEE and the Charles Babbage Outstanding Scientist Award. Two of his landmark books are *The Structure of Computers and Computations* and *High-Performance Computing: Challenges for Future Generations.*

Kuck looked at the evolution of computers and humans in the thirty years since *2001* was made and how it might affect building HAL today. First, he traced the progress of computational power in terms of components per chip, clock speed, and parallelism. At the time of the movie, Kuck was involved with building ILLIAC IV, the only computer with floating point arithmetic. ILLIAC IV pioneered the new concept of parallel computation, but it wasn't until the 1980s, when it became obvious that speed wasn't going to increase forever and microprocessors became cheap and easy to work with, that people started building parallel machines of all kinds, first with shared memory and then with distributed memory. Scaling the hardware up was easy, but scaling up the

"HAL would have to be a parallel machine . . ."

performance up was another thing altogether. "There is an unstable nature to parallel computing," he said. "Practical parallel computing is an elusive thing at this moment. HAL would have to be a parallel machine, and until the practical parallelism problem is solved, we won't be able to build HAL." Kuck believes that we could probably deal with the hardware side, but coming up with the appropriate architecture (general purpose or special purpose?) and algorithms would be seriously problematic. But perhaps the biggest problem is that even if we mastered these components individually—the hardware, architecture, and algorithms—we wouldn't know how to connect them together.

He concluded that computers have evolved in a way complementary to human thought. "Even though the AI problem hasn't been solved—maybe it will be in the future—computers have actually evolved in enormously useful ways; in complementary ways to what human

thought has been able to do," he said. "I think the greatest grand challenge from a computational point of view is to solve the practical parallelism problem . . . Parallelism is the only way we're going to keep the thing going."
http://www.kai.com


Ray Kurzweil

Raymond Kurzweil is founder and chief technology officer of Kurzweil Applied Intelligence Inc. and chairman and CEO of Kurzweil Educational Systems. Kurzweil developed the first omni-font optical-character recognition system, the first print-to-speech reading machine for the blind, the first CCD flatbed image scanner, the first text-to-speech synthesizer, the first computer music keyboard capable of accurately reproducing the sounds of the piano and other orchestral instruments, and the first commercially marketed large-vocabulary speech-recognition system. Among his many honors, he received the Grace Murray Hopper Award from the ACM and was voted Engineer of the Year in 1990 by *Design News*. His book *The Age of Intelligent Machines* was chosen Most Outstanding Computer Science Book of 1990 by the Association of American Publishers.

Kurzweil started out by tracing our relationship to early intelligent machines. He believes that the reason we have placed so much confidence in computers in the first place is because they were so good (fast and accurate) at solving hard problems that only adult experts could solve, such as chess and mathematical theorem proving, However, in the areas of pattern recognition (distinguishing a cat from a dog) and skill formation (tying shoes), which form the bulk of human intelligence, computers fall woefully short. Kurzweil noted some of correct scientific predictions made in *2001*, specifically, that humans would routinely talk to computers using continuous speech and natural language and that a computer would play chess at the expert level.

"We already have a potential computer that is about the level of complexity and capacity and speed of the human brain . . ."

How could we build intelligence in computers in the next century? Kurzweil answered this question in terms of the brute force approach. He compared the computational facility of a computer to that of the human brain. Using ballpark estimates, he looked quantitatively at neurons and computational power. Assuming 100 billion neurons, he said, each with 1,000 connections to other neurons, the brain has 100 trillion connections, and each connection is capable of a simultaneous computation. This would give humans about a 100 trillion level of parallelism, which is far beyond what computers are capable of now. But, unlike electronic circuits, human circuits are very slow, about a million times slower. The brain can only do about 200 calculations per second compared to 20 million billion calculations per second for today's fastest computers. So, he concluded, computers are about a million times simpler than our brains, but they're gaining. Following Moore's law and incorporating 3-D chip design, Kurzweil predicts that by 2020, computers will reach the capacity of the human brain. But our stumbling blocks to making these machines intelligent will be the algorithms—the software.

We are already beginning to reverse engineer the human brain, he said, pointing to several efforts underway in areas such as artificial vision, scanning the human genetic code, and brain scanning with MRI. Perhaps we already have a HAL-like computer available to us. "We already have a potential computer that is about the level of complexity and capacity and speed of the human brain, which is the Internet," said Kurzweil. "Most computers sitting on the Internet are sitting there idle. Even when you're doing something on them—you're typing into it—it's using two percent of its capability. Most of the time it's waiting for you to type the next keystroke . . . There's something on the order of 20 million billion calculations per second out there that we can harvest into a human level of intelligence." If only we knew how. . .
http://www.kurz-ai.com

Tom Mitchell

Tom Mitchell is professor of computer science and robotics at Carnegie Mellon University. His research attempts to answer the question: How can we make computers improve automatically from experience? Two spinoffs have resulted from Mitchell's research: Schenley Park Research Inc., a company working on improving decision making by mining historical data, and Empirical Media Corp., a company which develops personal information assistants that learn your interests on the Web. Mitchell is author of the newly published book *Machine Learning*.

What is it going to take, different than what we're doing today, to make a HAL-like machine? Mitchell thinks we're barking up the wrong tree by trying to build such machines "as though we're neurosurgeons, writing

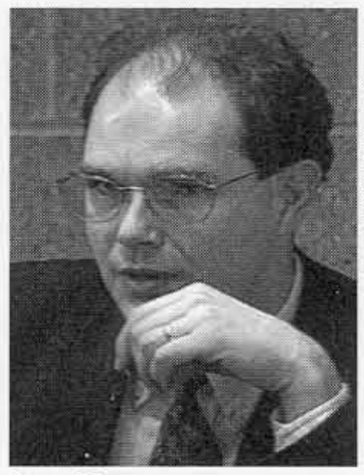
computer programs by hand." To develop the complex hardware and software that would be required, Mitchell believes that we must concentrate our efforts on developing better computer learning algorithms. In the current state of computer science, he said, "We can write programs that learn to do tasks much more competently than we can hand write programs to do that task." To support his argument, Mitchell used the example of a face recognition program. Writing a program to recognize individual faces would not only be too difficult, but the result could not be scaled up to more complex learning tasks. "We need to build systems to do lifelong or cumulative learning, so you don't have to start from ground zero," he said. "If we come up to 2020 and find systems that are significantly more intelligent than the ones we have today, a large part of it is going to be because we've managed to find software architectures that allow systems to accumulate, over time, internal representations that allow it to parse the perceptual input that it's going to get and to organize it efficiently in ways that will allow it to do things that we couldn't possibly think about ahead of time to program line by line."

http://www.cs.cmu.edu/~tom

"We need to build systems to do lifelong or cumulative learning . . ."

A. Joseph Hoane, Jr. has been working on Deep Blue's software for over five years, also at IBM T.J. Watson Research Center. Hoane's work involves compute-intensive searches, big machines, and algorithms that require extremely efficient implementation.

Hoane addressed the notion of intelligent machines by looking back at what he observed during the first chess match between Deep Blue and Garry Kasparov, as a technological feat and as a cultural phenomenon. Hoeane believes that people's reaction to that match says some fundamental things about their relationship to machines and how that relationship is changing. First, he compared the way people (represented by Kasparov) and machines (represented by Deep Blue) play chess. "People play chess through knowing, and what I mean by that is they gather experience, they gather pattern recognition, they develop an intuition about how to do something," Hoane explained. He went on to describe Garry Kasparov as essentially a neural network that has been playing chess for thirty-five years. "He is very good but in a human way," he said. Kasparov obviously has some calculating ability, but the main thing he has over Deep Blue is superior ability to predict the future through past experience and to predict what is going to happen on the chessboard through pattern recognition. Deep Blue, on the other hand, knows a only couple of things about chess but has a huge computing capability. It has no understanding about what it's doing or why a particular move is good.



Joe Hoane

Hoane is fascinated with why so many people were so interested in the match between Kasparov and Deep Blue, framed by the press as the battle of man versus machine. He sees something more, something beyond just our instinctive enjoyment of competition. Possibly, he said, "they use [the competition] to reason symbolically about their relationship with computers, and I think that's why it's so important at this time—in this 50 years into computing. I think that the competition is a symbol of our relationship with machines and the fact that it's going to be a different world for our children, and it's going to be a different world for us in forty years."

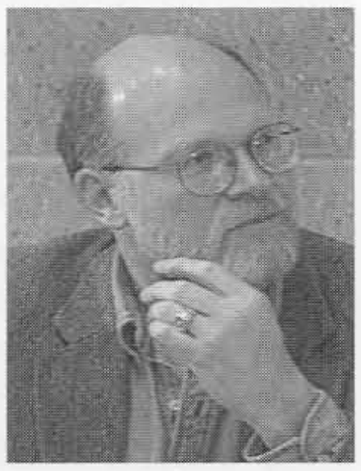
HAL is a great example of how we tend to anthropomorphize our computers, perhaps in order to feel more comfortable with them. Computers have finally reached the point where many of us feel we can't understand them any more, including Hoane. "We are interested in the chess match, now, today" he said, "because we're trying to figure out what it is on the other side of the table. And we don't really know what it is . . . To be honest, I don't know how all the pieces fit together and what it really means . . . I can't see the whole picture of why it plays chess well."

"The [Deep Blue-Kasparov chess] competition is a symbol of our relationship with machines . . ."

So when a computer eventually wins a chess match, what will it mean? "HAL introduced many of us to the idea that a machine could be intelligent, that we could have a relationship with a computer . . . And now with the Kasparov-Deep Blue match, it's demonstrated that it's now becoming important that we define our relationship with our computer. It's an important thing in our lives, and from this point on it'll be more important in our lives. We can solve problems that we couldn't solve otherwise. But what I'd like to see when people think about our relationship with computers now," Hoane concluded, "is that unlike HAL, Deep Blue doesn't think, but Deep Blue is going to help us think better than we ever could before."

http://www.chess.ibm.com

Dave Waltz is vice president of computer science research at NEC Research Institute in Princeton, New Jersey, an organization devoted to long-term, fundamental research in computer and physical sciences. One of their golas is to achieve significant advances in the understanding of intelligence and information processing in biological and machine systems, and in the physical and system aspects of future computer architectures. Waltz is president-elect of the American Association for Artificial Intelligence and is an adjunct professor at Brandeis University. He's also a former professor of CS at Illinois.



Dave Waltz

From his perspective as researcher who was actually doing AI when *2001* came out, Waltz was able to tell us what the research community, and Kubrick and Clarke, knew and what they didn't know then and how this may have affected the portrayal of HAL. In the 1960s, it was assumed that to construct an intelligent machine, psychology and linguistics was important, but neuroscience wasn't. "We thought that the mind operated on something like the knowledge level," Waltz said. "You'd build the perfect logic machine, and then it didn't matter if the computer was made of transistors or neurons. The only thing that was important was that it was a perfect reasoner, and above that everything could be programmed. And moreover, the programs would be pretty simple. There were principles. Logic rules and heuristic search would probably accomplish most of it." Using the general purpose model, intelligent computers would be homogeneous, consistent, and have a common underlying logic, and their particular use would be dependent on how they were programmed. "Now," he said, "I believe that the mind is a bunch of gadgets—a bunch of hacks; that vision and language don't have common principles really."

"The mind is a bunch of gadgets—a bunch of hacks . . ."

Waltz was startled that the movie contained the assumption that error-free hardware equaled perfect decision making. "We don't believe that any more. We know now that there are certain problems that are never going to be solved exactly no matter how much computing power is used . . . This says that we have to find other ways. Humans do, but not by brute force." Also startling was that humans would be completely dependent on giant centralized computers; distributed computing wasn't foreseen at all. Of course, admitted Waltz, this notion would have defused the basic premise of the movie: HAL said he was never wrong in the face of a terrible error, and the astronauts had to dismantle him. "I see the movie as a metaphor for spaceship Earth," Waltz said. "We depend on this giant computer for everything. If it goes haywire, we're in trouble!" He went on to predict that biologists will be the scientists of the next century.

A previously undiscussed but great barrier to our building HAL is funding. Who would, and why, Waltz asked. He did cite the need for robots to do things for which humans are not particularly well suited, such as microsurgery and nuclear and toxic waste disposal. "The real advantage of building smart things would be if they were much bigger or much smaller than us—not replacements but things that could do tasks that we can't do very well."

Waltz also pointed out some sticky ethical problems which would undoubtedly arise if we tried to create a human analog. For instance, "If the system is smart enough and has been around for a while, you may feel weird about turning it off."

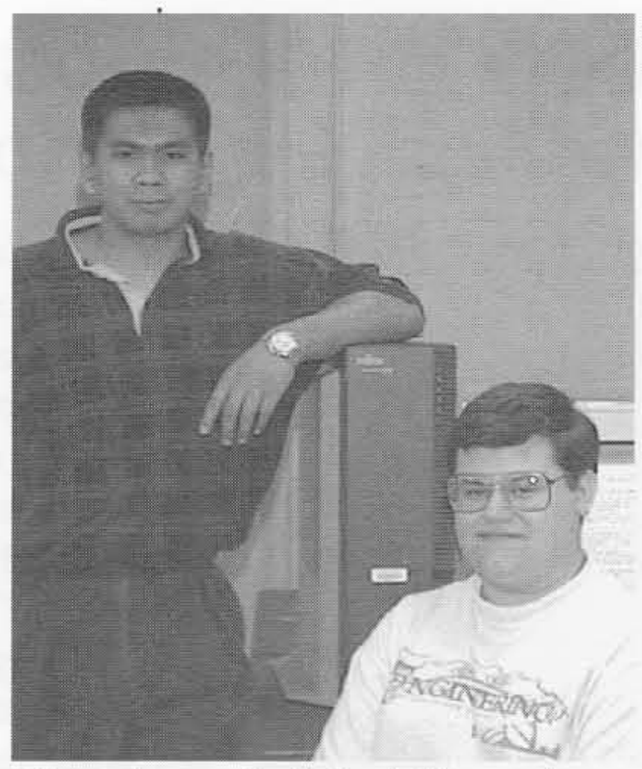
http://www.neci.nj.nec.com/homepages/waltz.html

A lively question and answer period with the audience ensued. Perhaps one of the best comments, which concluded the event, was made by Professor Caroline Hayes. As an AI professor in computer science, she had been frequently asked about HAL before and during Cyberfest. "They would say, 'Well gee, how close are we to making a HAL?' And we say, 'Well gosh, we aren't really trying to make a HAL, but instead we're trying to help people do intelligent thought processes better than what they do now.' And people often seem disappointed in that, and I wanted to say I find this kind of an odd reaction. Because imagine, for example, if we were not computer scientists but surgeons, and somebody had gone out and read a book, not by Arthur C. Clarke on*2001*. But what if they read *Frankenstein*, for example, and they came to these surgeons and said 'Oh gee, why aren't you trying to build a Frankenstein?' And they said, 'Gosh, actually we're instead trying to save the lives and improve the health of people already alive.' And this is very much equivalent to what our goal in AI is. So I feel in many respects that HAL is in some sense similar to Frankenstein, and HAL isn't really what we're trying to build, and our goal of trying to help humans do what they already do better is by no means a modest goal that we ought to be disappointed in." Applause, applause! ■

Hal joins CS department

HAL Computer Systems, a Cyberfest National Partners, recently donated a HAL Station 300 machine to the CS department. This 100 MHz workstation is similar to Sun's Ultra 140 except that it has a fully 64-bit OS, a modified version of Solaris 2.4. The machine is housed in a laboratory reserved for general access by CS students and researchers. Department members are not only expected to work on the machine to run their programs, but because it is the department's first HAL machine, we expect them to be evaluating its performance as well.

Said former CS student Akbar Jaffer, a software engineer at HAL who was on campus for Cyberfest, "What I learned at U of I, I see in action every day. I hope this partnership with HAL Computer Systems will bring technology a few steps closer to Arthur C. Clarke's vision for computers." The machine's name? Why, Hal, of course! ■



CS undergrads Sulasi Shamsul and Brian Sebby flank Hal.

CS 100: Intro to the real world of CS protessionals

CS 100 was a hit with students once again last fall. For the first time, almost every speaker was an alum of the department, and it was a hit with them as well. The course also marked the first time Lotus Notes has been used by the department for instruction.

CS 100 is an orientation class required by freshman in computer science. It is a large class of about 300, taught in two sections. It originated as a complementary course to Engineering 100, the orientation class required of all freshman in engineering. The first several weeks were spent learning some general things, like how to log on to the Engineering workstations and how to use Lotus Notes. That was followed by nine weeks of faculty and alumni guest talks.

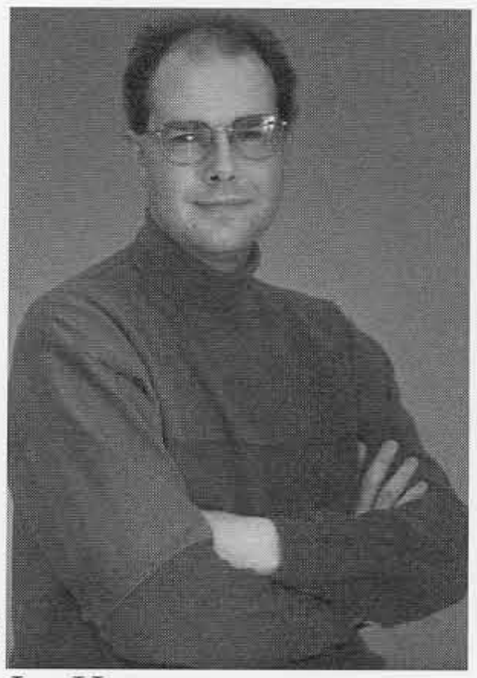
The purpose of CS 100 is to expose students to the variety of careers they can enter with a CS degree, to the different career paths people can follow, and to what daily work is like for practicing computer scientists and engineers. Alumni were invited to talk about their fields and themselves. The course did not originate as an "alumni-taught" course, but we found that not only do our alumni represent an incredibly wide range of areas, they were great speakers and enjoyed coming back and interacting with students as well.

After each talk, students wrote short essays on what they heard. They did this in Lotus Notes. TAs then graded the essays and returned them with their grades and comments, also in Lotus Notes. The only paper required for the course was the attendance sheet that was passed around at the beginning of each lecture. Speakers experienced the capabilities of our first floor lecture rooms by plugging in their laptops and having the images projected by our Hughes/JVC projectors.

Our Fall 1996 alumni guest speakers: **Eric Sink**, BS'90, software engineering manager at Spyglass Inc., talked about what it's like to manage product development team and the Web-based product industry. **Louis Koziarz**, BS'91, game designer and programmer for Williams/Bally-Midway, talked about what it takes to create a new pinball game from scratch and what the future trends in electronic entertainment holds for engineers and programmers. **Mark Tebbe**, BS'83, president of Lante Corporation, a microcomputer consulting firm, focused his talk on ways students can prepare for the dreaded real world and touched on the consulting industry. **Susan Hinrichs**, BS'89, is a programmer at Global Internet Software Group, a firm that produces network security products for Windows NT. She gave an overview of the current technical issues in computer and network security and touched on some of the legal and political issues as well. Graduate students **See-Mong Tan**, MS'91, and **Zhigang Chen** talked about their work with Vosaic Inc., the startup based on their technology for delivering real-time video over the Internet. **Chris Wilson**, BS'92, Microsoft developer, talked about his career writing Internet applications first as a student programmer at NCSA working on Mosaic and now at Microsoft. **Charley Kline**, BS'84, MS'86, senior research programmer for CCSO and architect for the campus's communications infrastructure, talked about networking. ■

*If you think **you** might like to be a CS 100 speaker, please send e-mail to Professor Bill Kubitz, kubitz@cs.uiuc.edu.*

Deep Blue wins:
A triumph for Joe Hoane



IBM

Joe Hoane

History was made on May 11, 1997, when World Champion Garry Kasaprov lost to IBM's supercomputer, Deep Blue, in an intense six-game chess match. The score was 3.5-2.5.

Congratulations go to Joe Hoane, BS'84, member of IBM's Deep Blue development team. Hoane, as the team's software engineer, was in charge of Deep Blue's powerful search algorithms. He also assisted in the design of Deep Blue's architecture and in maximizing the power of the IBM SP machine that is Deep Blue's heart. You may have even seen Hoane on television as the human making the physical moves for Deep Blue during the last game of the match. And now even Deep Blue itself has become a television star, appearing on the basketball court in commercials for IBM.

In a recent interview, published at IBM's chess Web site, Hoane said that what he thought about when he came back to Illinois for the forum was how people anthropomorphize the computer. "It says more about our need to have a relationship than about the fact that there's something there to have a relationship with. And this is what I was thinking about the whole time.

"You have this match, Deep Blue, Kasparov—and people want to envision some sort of personality or some sort of human-like thing there. But there isn't, I mean, it's just a tool, it's just a thing that computes very fast and plays chess well. Deep Blue can compute a certain calculation so fast. It plays chess well, but there's no intelligence there, the way we would define intelligence.

"That's what I was thinking about, going back to Illinois, thinking about HAL. Because HAL as a chess player is a human chess player, okay? He's intelligent, but you can trust that with Deep Blue, [the intelligence] is not there. Would Deep Blue beat HAL? Probably, I mean, yeah. Maybe. But, you know, it's certainly plausible to think that it would—at chess I mean." ■

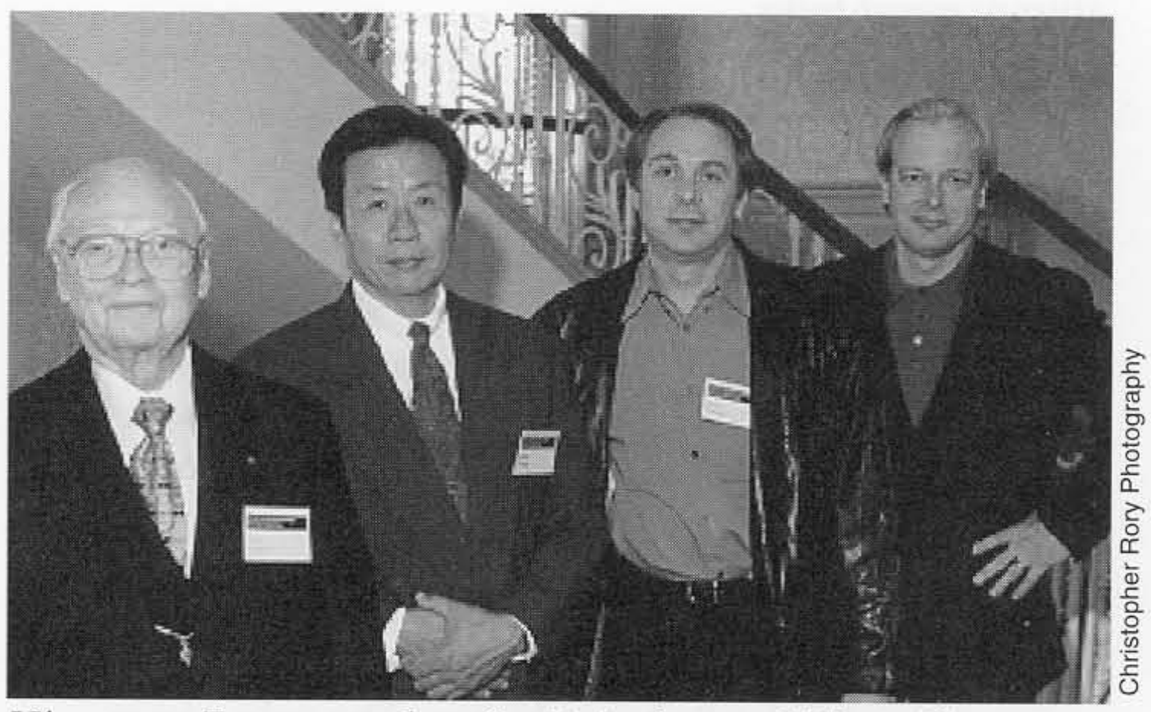
http://www.chess.ibm.com

Get ready for Engineering Expo

The Engineering Empolyment Expo is
September 8, 9, and 10 in the Illini Union
See http://expo.cen.uiuc.edu for details.

Higgerson Forum

The Higgerson Forum is sponsored by the College of Engineering and made possible through the generosity of Cliff and Judy Higgerson. This spring's forum, held April 10 , was the second in a series that explores some of the many paths to entrepreneurship through engineering. It is intended to catalyze thought and ingenuity "north of Green." The last forum explored markets. This one, through the topic "Innovation: Transforming Ideas into Products," explored issues related to invention and product development. After a panel discussion, participants attended break-out sessions with the panelists, and another panel discussion rounded out the day. Joining CS alum Ray Ozzie as panelists were: Scott Anderson, founder of Anderson Physics Laboratories, best known for being the manufacturer of chemicals used in high-pressure sodium and metal halide lamps—the lamps used for street lights, sports arenas, and large parking lots; Milton M. T. Chang, chairman of New Focus Inc., a Santa Clara, California, supplier of photonics tools for laser applications, and co-founder of more than ten successful high-tech companies; and Steven J. Wallach, chief technology officer of Hewlett-Packard Convex Division and co-founder, with Robert J. Paluck, of Convex Computer Corporation. Wallach was featured prominently in Tracy Kidder's Pulitzer Prize-winning book, *The Soul of a New Machine*. As our small world would have it, Ozzie and Wallach both worked at Data General at around the same time. In fact, Wallach speculated that he may have been in the next room, as a Data General recruiter, when Ozzie, as a student, was interviewing with the company in the Illini Union. ■



Christopher Rory Photography

Higgerson Forum speakers Scott Anderson, Milton Chang, Steve Wallach, and Ray Ozzie.

Grad alumni survey

by Tom Burke, MCS'86, and Ira Cohen, BS'81

The Computer Science Alumni Association conducted a survey of all graduate CS alumni last spring to get their advice on how to maintain the strength of our graduate programs and better serve the needs of industry and academia. The survey was designed with the help of recent graduates, Nancy Amato, PhD'95, and Douglas Borgia, PhD'95. Questions covered all stages of graduate work: admissions, coursework, research, thesis, and career choices. We sent 1,602 surveys and received 362 responses. Results were presented to the faculty at their May, 1996, meeting. Some points raised in the survey were:

Strengthen communications skills

An important aspect of graduate education is "learning to express research results in writing and oral presentations." Students may not have developed sufficient communication skills during their undergraduate years, so our graduate programs need to put "more emphasis on writing and presentations skills." Students headed to industry also need to be taught "how to write clear, understandable requirements and good documentation."

Provide project management experience

Graduate students need "more development experience that models real-world software development, i.e. testing requirements, peer reviews, design as a distinct process, team development." One mechanism for providing organizational and management skills would be for "graduate students to help supervise or mentor undergraduate research."

Expose students to large applications

Graduate students often build applications to support their research. However, they also need "meaningful exposure to large, complex software systems which they did not develop. It's both more typical and more difficult to modify large systems on a partial familiarity basis than to write small systems which are entirely configured in one's own style."

Assist students in choosing an adviser

"The method of electing a graduate adviser shouldn't be random." "There needs to be a more formalized method for advisers and graduate students to find out if they have common interests."

Standardize thesis completion criteria

A large number of students found "interaction with adviser" to be the most positive aspect of their graduate education. Advisers have a lot of discretion, however, and several students felt they should be "accountable to someone who has reviewed the progress of each advisee." They also suggested that having advisers "produce status reports on a regular basis would help PhD students graduate faster."

Encourage women to pursue thesis degrees

Judging from responses, we have significantly better female representation in the non-thesis programs (27%) than in the thesis programs (9%). Women may not be receiving enough encouragement to pursue advanced research. Of the MS degree students seeking to publish 76% of the males and 11% of the females received adequate support.

Interesting Statistics

Where respondents work

Computer products	38%
Education	18%
Communications	10%
Research and development	9%
Consulting	7%

What respondents do

Systems software development	18%
Commercial software development	16%
Technical/project management	15%
College/university education	11%
Scientific/research software	8%
Research	7%
Organization/financial management	5%

What respondents earn (median)

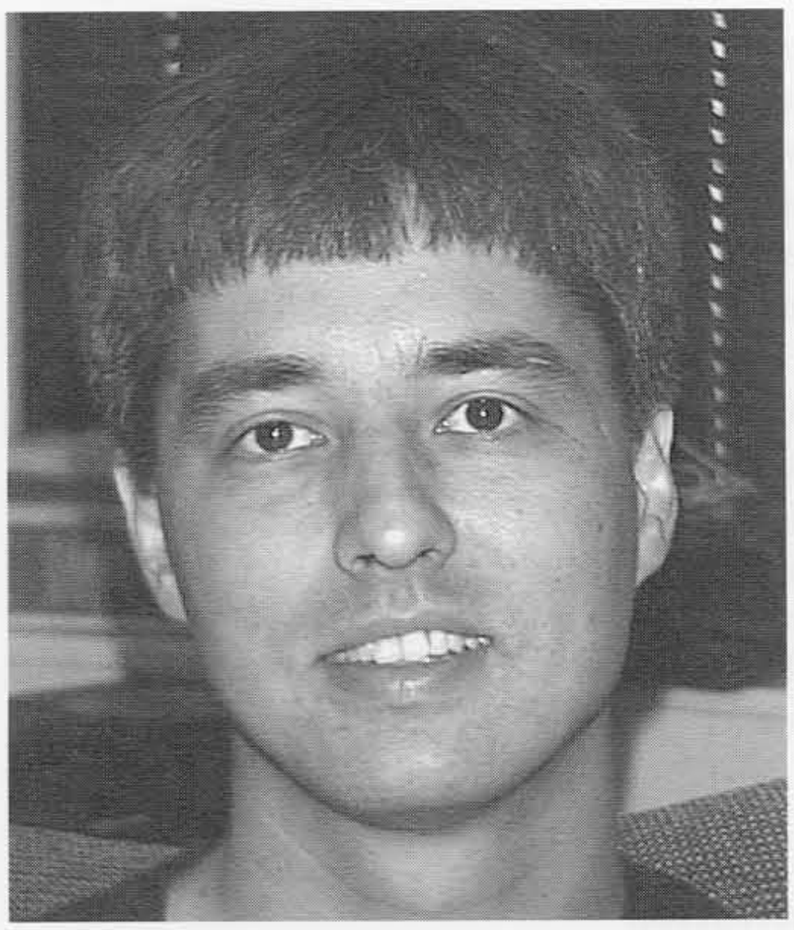
College/university education	60K
Research	64K
Commercial software development	64K
Scientific/research software	68K
System software development	72K
Technical/project management	88K
Organization/financial management	150K+

What respondents studied

Software	56%
Architecture	12%
Artificial intelligence	12%
Hardware	7%
Numerical analysis	5%
Theory	5%

continued on p. 31

Mike Kulas's ascent with DESCENT



Mike Kulas

Mike Kulas, BS'83, is co-founder of Parallax Software, producer of the hit computer game Descent. He is now president of his own company, Volition Inc., and hard at work on a new game due out next March called FreeSpace.

Mike Kulas knew early on that he wanted to write games on the computer. He started his computer career on the Ohio Scientific computers at Maine East High School in Park Ridge, Illinois. These machines, which were 6502 microprocessor-based like the Apple II, were a real challenge to program. Not only were they without manuals, but a cooling fan blew right through the keyboard, freezing the fingers of anyone trying to type something.

Gaming at PLATO sparked his interest at Illinois, and he spent a lot of time playing DND (a dungeon game), Hivolts (a puzzle-type game), and Avatar. It was Avatar that prompted him to start writing his own dungeon game on his Apple II. When Mike graduated, he knew he wanted a job in the game industry, but in 1983 gaming companies did not do on-campus recruiting, and he didn't really know how to approach them. He applied and was accepted to the graduate program in CS, and he also landed a job locally at DuoSoft, a courseware company interested in possible expanding to write games. When this didn't come about, Mike applied for a programming position at WILL. He asked UI alum Stu Moment, co-founder of SubLogic, to write him a letter of reference. Mike ended out working for SubLogic, whose flagship product was alum Bruce Artwick's Flight Simulator, for five years before striking out on his own as a contractor.

In 1993, Mike got together with friend Matt Toschlog and formed Parallax Software. Both of them were working for Lookingglass Technologies; Matt as an employee in Boston and Mike as a contractor working out of his home in Savoy. They had just finished a painful three-year project resulting in Car & Driver, a simulation car game published by Electronic Arts, and they were burned out. "We learned that multi-site development is awful, and getting everyone interested in the project is crucial," Mike said.

Mike and Matt had been kicking around the idea of writing an action game together and came up with some ideas for what was to become Descent. They sought a publisher by sending out copies of a three-page script for the game, and within a week, Apogee handed them a development contract and a check for $10,000. Quickly, they hired two more people, John Slagel, BS'93, and Che-Yuan Wang, BS EE'93, and went to work on the game. The business relationship soured and after only seven months, Apogee backed out. The developers stuck it out, with huge pay cuts, as they struggled to find another publisher. Extremely lucky with regard to market timing, Interplay signed them on, and Descent finished a year later. The game was initially launched as shareware over the Internet two days before Christmas, 1994, and in March, 1995, the full version hit the store shelves. Descent was a smash hit, selling about 450,000 copies on the PC and Macintosh, and another 150,000 for the Sony Playstation. Descent II, its sequel which came out a year later for PCs and Macs, is approaching the 300,000 mark.

Mike and Matt decided to part ways in 1996, and they spun off two companies. Mike runs Volition in Savoy, Illinois, and Matt runs Outrage Entertainment in Ann Arbor, Michigan. Outrage is working on Descent III, and Descent IV will probably be written at Volition. Parallax still exists; Mike and Matt are its sole employees. The Parallax work is being subcontracted to Volition and Outrage. The two companies were formed because, according to Mike, they didn't want to be operating the same company from two offices 350 miles apart.

Volition is now working on a new PC game called FreeSpace, due out in spring 1998, and the original group grew to twelve people,

including programmer Mark Allender, BS'90, MS'92. Mike lives in Champaign with his wife Karen, BS Psych'87, MSW'89, and their two children, Joshua and Katie, ages 3 and 1.

Below are some of Mike's thoughts during an interview on April 23, 1997.

On Illinois

Most of what I learned about how to write games, I learned on my own. In CS 121, I was punching cards, but on my microcomputer at home, I could code to write games. I liked most of my classes, and I especially liked taking those taught by Professor Reingold. I thought he was a great professor. When I took classes from him, it was extremely interesting, and I felt like I was in the presence of someone who really knew what he was talking about and knew how to teach. I looked forward to going to those classes, and that's how I got an appreciation for algorithms and understanding those things just below the level of programming. Another excellent professor I had was Professor DeJong. I loved his AI classes, though one thing I learned from him was that AI, as a practical application, is too far in the future for my tastes. DeJong said as much on the first day of class when he said, "Most people doing research in AI don't believe anything truly exciting will happen in their lifetimes." It took me a couple semesters to believe that.

I never left Champaign because there was always a reason to stay. It's a good place to start a company because the cost of living is low, and it's a good place to raise a kid. We hired half our people from the university, and if there was no university, we probably would not have survived here.

College for game developers

If I spent four years writing games instead of four years going to college, I would have been a better programmer at the end of those four years, but I would not have had the appreciation for algorithms and knowing that there's a much deeper foundation for all this. And all the other ninety percent of what you do in college besides the classes in your major are very useful. You grow up, you have to do your own laundry, you run out of underwear before a test . . . You hang out with people that have your same interests. If you decide not to go to college and you're always in your basement working on a game, well . . . .

People who want to write games for a living, especially high school kids, often ask me whether they should go to college and what classes they should take. I say, take math, physics, computer science, but do as much programming outside as you can. If you're absolutely sure you want to write games for a living—and who at seventeen really knows what he wants to do?—then college is not very efficient. But college is very useful for a lot of other reasons.

Every year a degree matters more in this industry. It's maturing. People are coming in from other industries, from other areas in the computer profession, from other media industries. There are all these acquisitions—media companies buying up game companies. They install their own professional management, and their HR departments often like to see degrees.

Descent

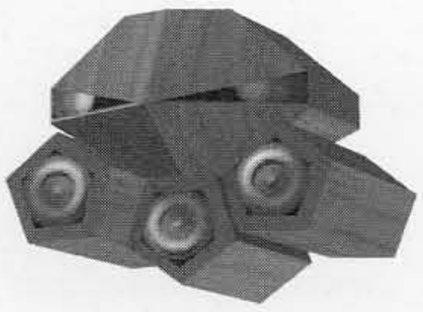
Matt and I had been kicking it around. We wanted to do an action game that was full three dimensions, that was flying, because we thought flying was more interesting than walking. What we thought mattered was that there was something interesting going on on all sides of you, that there was something to

http://
www.volition-inc.com

http://
www.interplay.com/
descent

alt.games.descent

What you see from your ship as you blast a robot while flying through the 3-D mines of Descent.



One of many evil robots, each with its own characteristics, which populate Descent's mines.

see everywhere. It's not like you're in space and in your whole viewcom there's nothing. And so in Descent there's always something around you, and a hostile robot could come at you from any direction. So those were the things that we thought made us different.

Originally we called the game Miner because it was taking place in mines. We knew we wanted to do a high tech game, and we knew we wanted it to be indoors, and we didn't think our computers were powerful enough to model a real-looking building that you could fly through with real 3-D and arbitrary movement, but we thought we could do mines. Someone can't look at that and say that's not what it looks like. And let's put the mines on the moon. We can make it look like whatever we want, with whatever the technology can support. Technology is the reason we chose robots. You can model a robot with fewer polygons than something organic, like a human. If we could have rendered organic forms at a high enough frame rate, I'm sure we would have done it.

Then we came up with the name Inferno, which we liked, but there was already another game with that name. Interplay had a name contest internally and Descent won. I didn't like it at the time, but it's grown on me. The one sentence we had in our heads and that made it onto the box was: "It's an 80s-style arcade game with 90s technology." Matt and I were pretty uninterested in games that were currently on the market. We thought they were too big, too complex, too boring. When we started Descent, Doom did not exist, and I hadn't seen Wolfenstein. Of course, Descent got pretty big and complex, but I hope not too boring.

The significance of Doom

Doom came out and it was a huge success so there was this perception among publishers that we had to do something like Doom. We wrote our script and had done a lot of design work on the game long before we had even heard about Doom, so we didn't think of it as being Doom-like. But everyone else said, "It's high tech, it's first-person, it's 3-D, it's basically a shooter—you just shoot everything—so it's like Doom." So the guy who became our producer at Interplay who reviewed the product said, "Yes, I think this is a Doom-killer," and so by comparing it to Doom, he was able to rally interest in the company and they made an offer on it. The success of Doom enabled our success, so Doom was pretty significant for us.

Challenges

The biggest challenge—the one that matters—is making sure your game is fun. No matter how good it looks or how high-tech it is, it's got to be fun and it's got to be fresh, especially these days when almost every game goes out with a brief demo. If someone plays fifteen minutes of the demo, it's easy to see if the customer is going to like it or not. You can't just wow them with technology and a cool box anymore. You have to have good game play, and that's hard to write. It also has to be fresh. A couple for Doom clones, for example, can be successful, but probably not too many. It's very hard to provide enough originality without being mystifying and to have good balanced game play. It's hard technically: doing cutting-edge graphics on a PC in real time is difficult.

What is Descent?

Descent is a game in which a player enters a true 360-degree, 3-D environment. The scenario is a mine deep within a planetoid in a distant galaxy with tunnels and rooms that you fly through on your ship which you command with complete freedom of movement in all directions. The mine is populated by evil flying robots that plague you as you try to rescue hostages, maintain your ship, blow up things, and escape intact. The game is more complex than just randomly shooting at targets, although that's a good way to get started. It's violent, but it's not bloody—you're shooting robots, after all.

Descent was not only extremely popular among users but it also won critical success as well. In 1995, its accolades included the Academy of Interactive Arts and Sciences Best Computer Game; Internet PC Games Awards Best Action Game of the Year and Best Code of the Year; the Golden Triad Award; Computer Game Review Action Game of the Year; PC Magazine Technical Excellence Award; G+ Magazine Internet Top 100 Games of the Year; and PC Gamer Best Code in the World and Best Action Game in the World. Descent II was intended to be a four-month effort to produce an enhanced version of Descent to support CD-ROM and digital audio, but it turned into a full-blown project lasting about a year. Descent II's features include the ability for users to design their own levels and smart enemies which adjust their actions based upon the player's.

Software

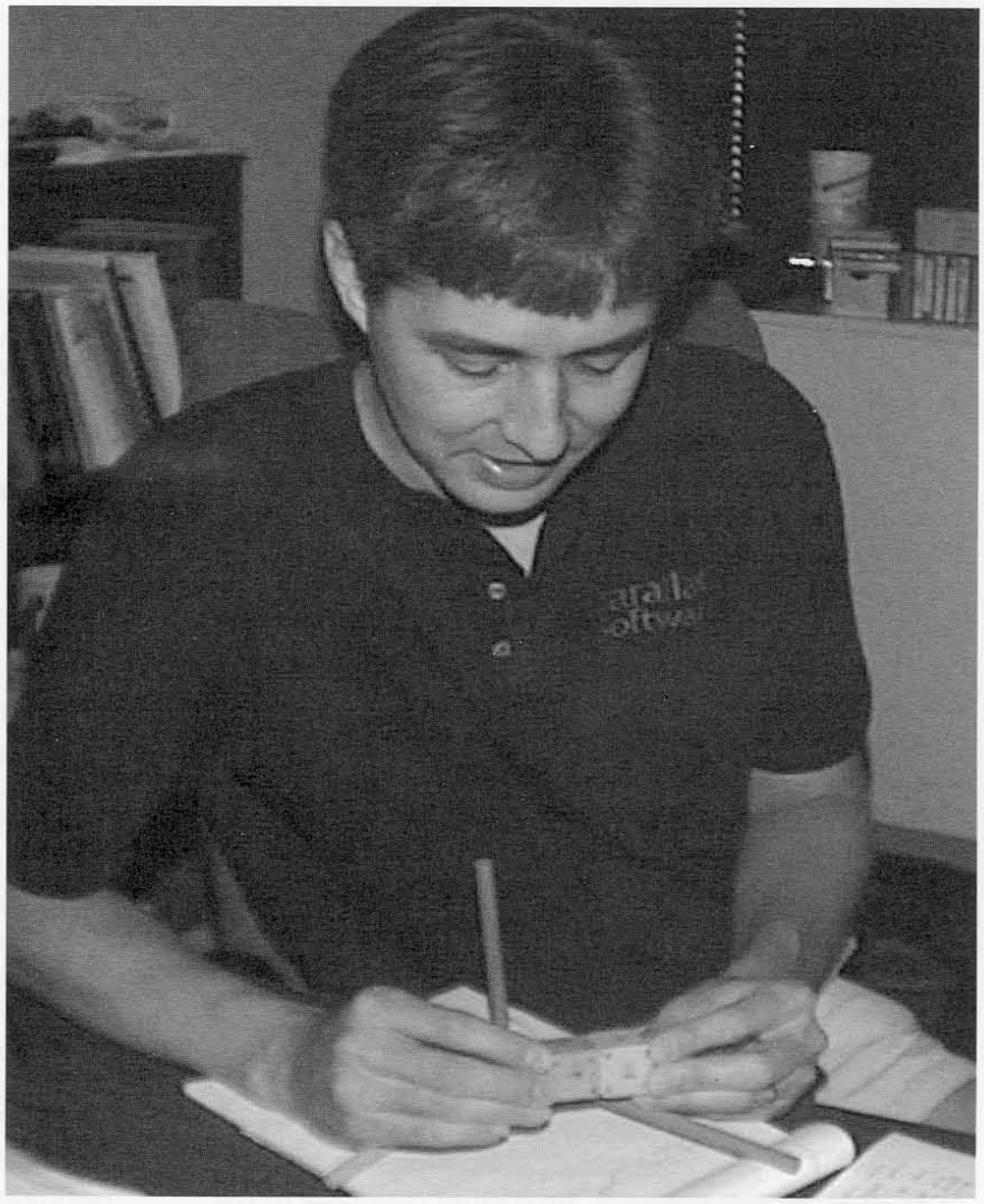
For Descent we used Watcom compilers, the most popular compiler that ran in 32-bit mode on a PC at the time. We didn't want to have to deal with segment registers and memory management. We used 3D Studio for modeling the robots, and we wrote our own editor to create the mines. We used Deluxe Paint and Photoshop. There weren't that many tools. It was pretty much an editor, a compiler, and a debugger for programmers. Now we use Microsoft Visual C largely because we're doing Windows-based development and Windows games, but it's still an editor, compiler, and debugger. Our artists use expensive modeling programs and need more hardware than the programmers, but it didn't used to be that way.

Gaming and the Internet

No one's making money with online games right now. Ultimately, people will make money on it because playing multi-user games is the most fun way to play. I do feel the Internet will have to go to pay-per-packet or something like that, or it will collapse. My feelings on the Internet as related to gaming is that what people have been waiting for is finally here. The Internet has huge problems of latency, packet loss, and unmanageable size, but I think these things can be worked out. I think it will be several more years before there are truly great online games, but it will happen. A lot of people play Descent over the Net using a third-party add-on called Kali that takes the IPX packets that Descent puts out and converts them to TCP packets. This wasn't built into the game, although we did write code so you could play it over a LAN.

FreeSpace

We're about a year into it, and we've got about ten more months to go. It's a space game, and it's much larger than Descent. We've got twelve people one it, including six artists, whereas in Descent we averaged about six people total. We wanted to do something different than Descent and different than other space games. There's more of a plot, it's very high tech. there's thrity minutes of CG prerendered movies. It's not a twitch game—get outta the way, kill that thing—but it's a deeper, thinking game that involves strategy. There's a big galactic war going on, and you start out as a low-level fighter. You advance through that, and ultimately you're leading the charge against the enemies. It's the premise to a hundred movies and games by now. Our goals are to be the highest technology space game there is, and we want to be sophisticated in terms of game play. We're trying to be deeper than most action games. ■



Mike Kulas with the basic building blocks of Descent. Mike could attach the wooden blocks, with its six sides and eight vertices, and keep track of direction and orientation. He spent a lot of time putting these together in different ways while he was debugging the code. The Tinkertoys were used to represent the three orthogonal axes. If the forward vector of one object was pointing at the right vector of another object, and it starts to rotate about one of the axes, what does it look like to the other object? The geometry problems were technically the most difficult thing Mike faced in writing Descent. "Although these tools were definitely useful, I now think a large part of their value was in getting me to look away from the computer and think visually, instead of just writing the code," he said. "You're trying to create something visual, but you spend almost all your time staring at text. I think visual aids help you think more creatively."

High-performance, *continued from p. 1*

workstations with the power of a supercomputer of ten years ago, Larry Smarr, director of NCSA said, "What is needed now is a focused effort to harness these capabilities to develop a computational infrastructure that will enable further scientific research through collaborative technologies and distributed computational science teams."

In late March, NSF announced the competitive results of the replacement program called Partnerships for Advanced Computational Infrastructure (PACI). Two national partnerships were chosen for awards under PACI, one led by the University of Illinois at Urbana-Champaign and a second led by the University of California at San Diego. The Illinois partnership is called the National Computational Science Alliance (NCSA) and is anchored by the National Center for Supercomputing Application (NCSA) at Illinois. What's confusing is that both the partnership and the Illinois site share the same acronym, and both are led by Larry Smarr. To avoid confusion, we call the National Computational Science Alliance simply: the Alliance (like in *Star Wars*).

The Alliance is organized as four major groups: six Application Technologies (AT) Teams that drive the technology and attack large-scale problems in science and engineering in broad disciplinary areas; four Enabling Technologies (ET) Teams that convert the results from computer science research into usable tools and infrastructure for the computational science and engineering community; Regional Partners (RP), including major universities and state organizations, to serve as the main distribution network, providing coverage to the entire U.S.; and Education, Outreach, and Training (EOT) Teams to educate scientific and engineering communities about high-performance computing and to promote advanced computational technologies to sectors of society not normally associated with computational science. In addition, at its Urbana-Champaign site, the Alliance will support a variety of high-end machines and architectures that will enable high-end computation for scientists and engineers across the country.

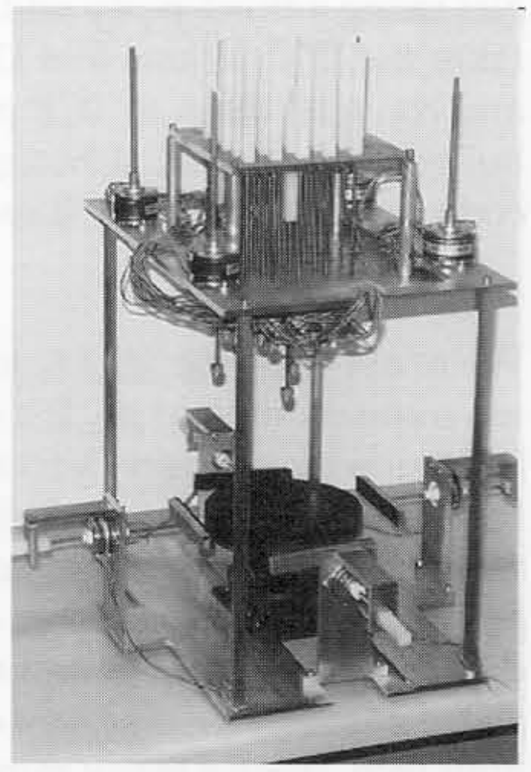
Several faculty in the Department of Computer Science play leading roles in the new Alliance. Professor Dan Reed noted, "The Alliance is an exciting opportunity to couple computer science and computational science research with high-performance computing, high-bandwidth networking, and collaborative virtual environments, creating a computing 'time machine' to explore the future of computing today." As part of the CS collaboration, Professor Andrew Chien's Windows NT clustered computing project is one of three primary computing platforms targeted by the Alliance. Likewise, Professors Klara Nahrstedt and Josep Torrellas are leading efforts to improve network quality of service for multimedia data sharing and to assess the performance of large-scale distributed shared memory (DSM) systems, respectively. Many other CS faculty and students will be participating as well. Finally, Professor Dan Reed leads the ET team on scalable storage management and distributed collaboration, as well as serving as a member of the Alliance executive committee. ■

For details on the new Alliance, see the NCSA Web site at http://www.ncsa.uiuc.edu/Indices/Spotlight/Features/feature_PACI.html.

Jean Ponce's robotic grasping and manipulation project

The construction of a new robotic gripper is being finished by Attawith Sudsang, a PhD student in the computer science department, and Dr. Narayan Srinivasa, a Fellow at the Beckman Institute for Advanced Science and Technology. The work is part of a larger project whose scientific goals are to explore the computational issues involved in holding and manipulating parts with mechanical devices that have a mixture of continuous and discrete degrees of freedom. The target applications are in robotics, rapid prototyping, and small-batch manufacturing.

This project, headed by CS professor Jean Ponce is funded by the National Science Foundation, a University of Illinois Critical Research Initiative grant, and the Beckman Institute. It is housed in the Computer Vision and Robotics Laboratory of the Beckman Institute, and also involves Seth Hutchinson, associate professor of electrical and computer engineering.



Gripper prototype

The gripper prototype has twenty-fivefingers, arranged along a rectangular grid, each capable of independent vertical motion. The gripper achieves a level of dexterity comparable to robotic hands with a much more complex kinematic structure for a small fraction of their price. When it becomes operational later this summer, the gripper will be able to immobilize complex three-dimensional parts and to reposition them within its grasp under the control of efficient geometric algorithms. ■

Congratulations to our 1997 award winners

The Department of Computer Science held its annual awards ceremony on April 10. Instead of our traditional cookies and punch in 2240 DCL, a banquet was enjoyed at Urbana's newest hotel, the Holiday Inn.

Highlights of the evening included the first-time presentations of the Dunn Systems Scholarhip, the Sara and Louis Cohen Scholarship, the Spyglass Scholarship, the W. J. Poppelbaum Memorial Award, and the Duncan H. Lawrie Award. Department head Dan Reed emceed the program, and we were especially happy to have department benefactors Bill Dunn and Liesel Poppelbaum at the banquet.

SARA AND LOUIS COHEN SCHOLARSHIP
established by Ira Cohen, BS'81 and his wife Debra Jo Cohen.
Jose L. Rojas, CS Eng
Taylor E. Jones, CS LAS

DUNN SYSTEMS SCHOLARSHIP
established by Bill Dunn, BS'85, MS'87.
Sherwin C. Tam
Niraj Kumar

SPYGLASS SCHOLARSHIPS
established by Doug and Margaret Colbeth.
An Thi-Nguyen Le
Sandra E. Pineda
Kimberly L. Hushka
Patty Sullivan
Karla L. Miller
Rochelle R. Relova
Srilatha Katragadda

W. J. POPPELBAUM MEMORIAL AWARD
established by alumni, family, friends and colleagues.
Scott D. Paken
Scott's PhD research involves the integration of copmutation and communication and the implications for computer architecture. His adviser is Professor Andrew Chien.

DUNCAN H. LAWRIE AWARD
established by a friend to use at Professor Lawrie's discretion. Lawrie chose to direct the award toward undergraduate students for outstanding leadership.
Arwin K. Levinson
Jennifer Mozen

C. W. GEAR AWARDS
established by Fontaine Richardson, PhD'68, alumni, and friends.

Undergrad award for students planning to attend graduate school:
Pacia J. Harper, CS LAS
Arthur Menaker, CS Eng

Graduate award for research and service:
Christopher L. Elford. His adviser is Professor Dan Reed.

Faculty award for research and teaching:
Professor Josep Torrellas, whose research focuses on the design of scalable shared-memory multiprocessors.

DAVID J. KUCK OUTSTANDING THESIS AWARD
established by alumni and friends.
Kent E. Seamons for PhD thesis: "Panda: fast access to persistent arrays using high level interfaces and server directed input/output." His adviser is Professor Marianne Winslett
Daniel M. Gaines for MS thesis: "Volume-to-methods mapping for flexible CAD-CAPP integration." His adviser is Professor Caroline Hayes.

OUSTANDING TEACHING ASSISTANT
Garry Sittler

JOHN R. PASTA AWARD
established by alumni, friends, and colleagues.
Brett W. Trimble, CS LAS
Danile G. Sachs, CS Eng

DANILE L. SLOTNICK AWARD
established by alumni, friends, and colleagues.
Christina M. Schumacher

JAMES N. SNYDER AWARD
established by alumni, friends and colleagues.
Keith T. McGrath, CS Eng
Gregory C. Harfst, CS LAS

JAMES N. SNYDER/ICCP AWARD
endowed by ICCP.
Andrew A. Bunner

BRONZE TABLET
awarded by the university for a perfect GPA.
Baiju H. Shah

KNIGHTS OF ST. PAT
awarded by the College of Engineering based on scholarship and contribution to the college.
Jennifer A. Mozen
Keith W. Wessel

TAU BETA PI DANIAL C. DRUCKER EMINENT FACULTY AWARD
awarded by the College of Engineering.
Professor C. L. (Dave) Liu
Professor Liu is currently serving a three-year term as associate provost and associate vice chancellor for academic affairs for this campus, in addition to teaching and advising CS students.

INTERSTATE ELECTRONICS CORPORATION SCHOLARSHIP
Ali Dasdan. His adviser is Professor Rajesh Gupta.

XEROX AWARDS FOR FACULTY RESEARCH
college-wide awards established by the Xerox Foundation.
Junior Award: Professor Josep Torrellas
Senior Award: Professor Marianne Winslett

Poster Children's Rose Marshack.

Rose Marshack and the Poster Children

Being in a nationally acclaimed rock band is not a typical profession for a CS grad, but Rose Marshak, BS'88, has managed to marry her computer skills with her musical career.

Most people don't study computer science and then pursue a career as a rock star, but that's just what Rose Marshack, BS'88, is doing as bass player and backup vocalist for the group Poster Children. She and her band have a novel approach to their craft and a positive message for young people. And they have a new enhanced CD, called *RTFM*.

Several things really set Poster Children apart. First, they do everything themselves when possible. That includes writing and playing their own music, doing their own cover art, producing their own CD-ROMs, touring without an entourage, and foremost—making their own decisions. Second, two of the band's four members are computer scientists. Not only is Rose a programmer, but so is her husband Rick Valentin, the band's lead vocalist and guitarist. The programming involved in *RTFM*, as well as their Web page, is Rose's work, and technical aspects involved in the music is Rick's. Two of their goals are to get kids to go and to stay in school and to promote computer science as something really cool to study, and they are using their fameto get this message across. They've been on MTV, have signed with a major label (Reprise Records), and have a strong Web presence. Based in Champaign, the band began another major tour this spring.

Rose started at Illinois as a premed student in biology and lived in Allen Hall. Hanging out with CS majors in the dorm combined with a strong desire to take more math courses led Rose to the CS department, although she had not programmed before. She had been involved in music, however, at an early age, and played piano and violin. During her freshman year, she played violin for the UI orchestra.

Like many beginning CS students, Rose spent a lot of time in the computer room writing programs in Pascal. It wasn't until she took CS 221 (assembly language for the 8086 processor) that she became hooked. She still maintains that every CS student should know assembly language before learning a higher level language because she thinks it is important to understand what is actually going on in the computer. Eventually, she'd use this experience professionally when she got a job after graduation writing assembler for flight simulators at Frasca Air Service Inc. in Urbana. Marshack graduated in 1988 with the rare combination of two CS degrees: one in Engineering and the other in Math/CS.

Poster Children was formed in Allen Hall, where she and Rick met. The second floor of Allen Hall was then known as 42 North, a reference to the Douglas Adams book *Hitchhiker's Guide to the Galaxy*. There is a wealth of information about Poster Children on the Web and even more on *RTFM*, so you can look there for details on the band's history. In a nutshell, they started playing at parties on campus, then local clubs (like House of Chin), and then extending their touring radius to as far as their van and work schedules would allow them on a weekend. Networking with other local bands, such as the Didjits, was also invaluable to making right professional connections.

The band was really a hobby at the beginning, Rose explained. Rick also worked as a programmer at Frasca, and when he and Rose weren't at work, they were doing band stuff, including producing their first CD in 1988 (*Flower Plower*). When they felt the need to tour more extensively, they courageously quit Frasca and devoted all their time to the band. Over the years, the band went through several personnel and name changes. Now, Rose and Rick are the only original members. The other two are guitarist Jim Valentin, Rick's brother, and drummer Howie Kantoff. Rose and Rick are now seasoned veterans of the music scene. Not only is *RTFM* their

seventh recording, but three of their seven videos have been on MTV. A public service announcement the Poster Children wrote to promote a "knowledge is power" theme, is periodically shown on FOX-TV during the *Mighty Morphin Power Rangers*.

The band uses computers in ways not common to other bands. For instance, there are plenty of computer people making music with computers. Poster Children don't do that (yet). What they do is use computers to communicate, via the Internet or CD-ROM, and to enhance their music visually through art, photography, and video. Other bands have Web pages and CD-ROMs too, but what distinguishes Poster Children is that the band members create this stuff themselves, instead of hiring outside techies. Creative control of everything they do is core to the Poster Children's existence as a group, and it's why when forced to label their music, Rose calls it punk rock. "Punk rock is all about taking control of your own music and doing everything yourself," she explained. "Making your own cover art, making your own CD-ROM. That's what it's about. Not adhering to all the rules." This philosophy is extended to their business decisions as well.

Following a suggestion from some computer people at Reprise, the band plunged into multimedia computing, an area that Rose feels has a bad rap. "A lot of computer programmers feel that multimedia is a waste of time simply because there are people doing multimedia who don't know the first thing about computers," she said. She feels, however, that most people just haven't figured out yet what multimedia is really good for, in the same way that most people didn't initially recognize the value of the World Wide Web.

"It's very hard to be in a rock band and go off on tour, and all of a sudden, when you come back, there's Java on the Web," Rose said. "I have to do a lot of reading to keep up." *RTFM* is an enhanced CD. This means that in addition to delivering music, it is also a CD-ROM. As a CD-ROM, *RTFM* delivers an interactive, multimedia environment in which the viewer can learn about the Poster Children and how they do what they do; it's like a do-it-yourself manual for would be bands which includes instructions on things like how to tour and how to build a Web page. It also contains video footage (2 frames/sec) of the band along with some fun stuff, like games. The scenario is a 3-D rendered building, modeled after the Larkin Building (an historic New York building which no longer exists), in which the viewer can walk around and click on items which are links. The 3-D graphics used to create the building were done with Strata Studio Pro. For multimedia, Rose used Macromedia Director, with its high level language called Lingo. She also made extensive use of Apple Quicktime VR and Photoshop.

"I think that writing a program is very much like writing music," said Rose. "I say that to musicians who don't like computers, and they get very upset! Computer programming is composing, and you're making the computer into an instrument, but I don't know what performing a program would be though. I can't extend the metaphor to that." Rick used MIDI and digital editing tools on some of the songs on *RTFM* and wrote the Quicktime For MIDI music in the CD-ROM. One of the songs was actually recorded directly to the hard disk of a computer and pieced together using a digital audio pro-

continued on p. 23

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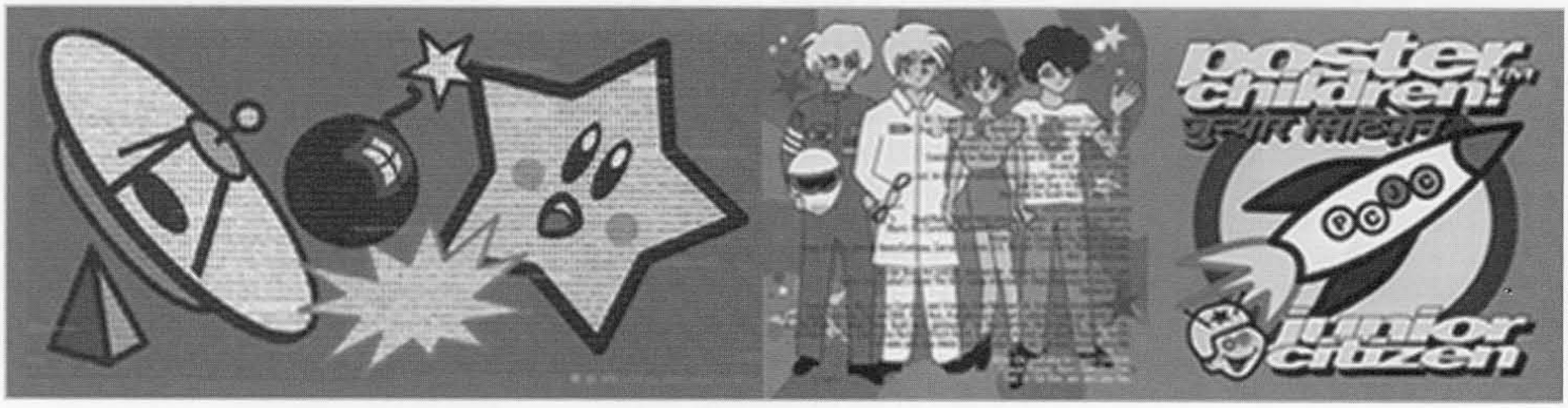
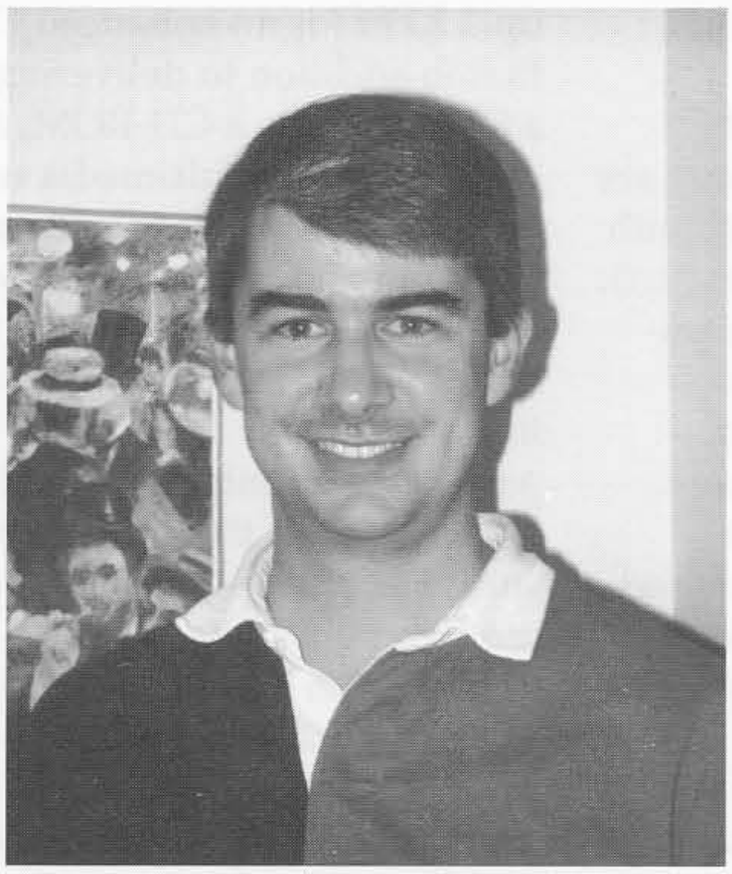


Rose Marshack's original cover art for Junior Citizen *(1994) reflects her interest in Japanese anime.*

Aaron Contorer, technology analyst at Microsoft

One of the minds behind Windows NT, Aaron Contorer, BS'90, is now technology analyst at Microsoft, identifying and understanding the major technological problems that face his company.



Aaron Contorer

In the seven years Aaron Contorer, BS'90, has been at Microsoft, he's risen quickly to his current position as technology analyst to the top executives of the company.

In 1978, in Deerfield, Illinois, when he was eleven-years old, Aaron became "enthralled instantaneously" by computers. He was programming a Commodore PET with 4K memory and a cassette tape drive at an extracurricular program at his junior high school.

When Aaron graduated from high school, he was already selling his first computer program as shareware over electronic bulletin boards. The product was a typesetting program called Bradford, a tribute to ancestor John Bradford, one of the first printers in North America. Bradford would take a dot matrix printer, throw it into graphics mode, and print letters using graphics so that the user could get different typefaces and sizes. "The Internet was very small and obscure," Aaron explained, "but there were modem-based bulletin board services run by companies like Compuserve and The Source and by hobbyists out of their own homes. So I wrote a little README file, saying 'here's my program, if you like it send me some money, and I'll send you a new copy with a printed manual.'" It worked, and Aaron had a steady source of income, and by the time he was a junior in college with version two under his belt, he was making about $1,000 a month from customers in over fifteen countries, all by mail.

When Aaron came to UI, Larry White, BS'75, MS'76, was helping Larry Smarr develop the workstation side of NCSA. White ended up hiring NCSA's first student employees: Aaron, Gaige Paulsen, BS'89, Dave Thompson, BS Psych'90, Tim Krauskopf, MS'87, and Swaminathan Natarajan, PhD'90. "I thought it was really cool to be there," Aaron recalled. "The whole thing was based on Smarr's vision of using small computers to make it easier to use big computers." One of the programs he helped write, along with Gaige and Tim, was NCSA Telnet, a vast improvement over the current Telnet.

Aaron left NCSA to work at the Aviation Research Laboratory on engineering psychology and simulation software. Because of his desire for a broad-based education, and partly because of his mother's influence as a psychologist, Aaron chose to pursue a BS in psychology as well as the BS in computer science. (Aaron's mother, Dr. Betty Contorer, is BS Journalism '62.) After that, he worked in the kinesiology department for a professor who was using computer modeling to study the physiology of performing complex tasks. "I lived my curriculum," Aaron recalled. "I learned even more from work at the university than from the classes. The research labs are just fantastic, and I strongly feel that more undergrads should take advantage of the research lab opportunities available across campus."

In 1990, when Aaron was looking for his first job out of school, he asked Larry White, who had left NCSA for Microsoft, to be a reference and sent him a copy of his resume. Within three weeks of graduation, he was sitting at his desk in Redmond, Washington, where he has been ever since. Aaron started working on LAN Manager, a networking product based on OS/2, trying to abstract a way to comprehensibly explain the complexity of a network to someone who has to run it. When it became clear that Windows NT was going to be much more successful than OS/2, these advanced projects were moved over to Windows NT Server (the high-end version of Windows NT) and Exchange (the high-end messaging and collaboration system), and Aaron became part of the Windows NT team.

Jim Allchin had joined the company and assembled a group of advanced OS projects that weren't part of the NT kernel itself and called it the Cairo group. The Cairo group invented parts of the object system COM (Component Object Model), the forms package (Forms3), and the Win95 user interface. "The original plan," said Aaron, "was to release Cairo in one big bunch, but that's not how it worked out. We decided we weren't going to hold off, but instead we'd ship things as they became ready. The ultimate parts will ship as part of NT Version 5." When Cairo got merged back, organizationally,

with the rest of the NT group, Aaron became lead program manager for Windows NT Server, NT Networking, and NT Storage (object file system and data storage technologies).

Aaron described the program manager's job at Microsoft as keeping everyone working on a large project focused on exactly what they're building and controlling the project so that it doesn't become a monster. "The program manager's job is not to write the code but to do that things that aren't writing the code. They think about what the vision is and take the various inputs, adjust the vision, and communicate it to everybody. They write functional specifications to make extremely clear what we're trying to do and to recommend for or against different ideas people have about changing things. Really, it's a meritocracy of ideas. Program managers also base decisions on customer needs and business reasons (e.g., if we had this feature, we'd sell more copies). The program manager has to figure out what the most important things are, work with the marketing people, and distill that down to something everyone can understand."

At about the time the Internet was on the verge of taking off, Aaron, Anthony Bay, and Diana Murray cofounded a group to work on advanced on-line services within Microsoft. Doug Bayer joined as engineering manager for the team. One goal was to build very large servers to run on the Internet. Now called Normandy, the group is working on the Microsoft Commercial Internet Server. These servers will run gigantic services and include the servers running the world's largest Websites including microsoft.com, and those of Compuserve and other large corporations. For this work, Aaron adopted a strategy of maximizing dependencies. "Our group tries to be as dependent on as many people as possible. Normally this is anathema, but our job is so big that it's impossible to write the software from scratch. It can't be done in a reasonable amount of time with a reasonable number of people. Plus we'd probably end up with two of these in the company. If we use as much software from other groups as we can, we can get away from these problems." Hence the Web server work is based on Internet Information Server and Windows NT Server, and the database work is based on Microsoft SQL Server.

Since last spring, Aaron has held the rotating position of technology analyst, working with company executives on identifying and understanding the major technical problems that span product groups. "Part of why Microsoft moves so fast," he explained, "is that we're organized into separate product groups. Each works on their own products, acting like a small company and moving fast." One massive technical challenge Aaron faces is how to make computers easier to manage. This includes how a computer can automatically do software upgrades and fix its own software problems. "All your computers are on a network now, so the notion that every person has to have their own big box of floppy disks and be a software technician is becoming obsolete. Your computer should find out what applications are available and set them up automatically." Another challenge is how to unify information storage. "Am I going to save it on my local disk? On a server? In an e-mail system with a database underneath? Or a document library or repository? Or in my personal information manager software that has its own file format? We want to bring it all together and have just a couple very simple ways to store information."

Aaron and his wife, Rachael, BS Civil'89, MS EnvEngr'91, whom he met in calculus class in Altgeld Hall, live in Kirkland, Washington. ■

Marshack, *continued from p. 21*

gram called Logic Audio. *RTFM* took two years to make. More bandwidth and better compression algorithms would be nice, Rose said. She also envisions a future where people could have access to their own virtual mixing boards and instruments. "There would be a lot more people making their own music, sitting in their own houses, pressing them up on CDs, making their own movies, sticking them on the Internet somewhere."

Rose predicts that the next big thing will be technomusic—people making music with their computers—and that this will be all the rage in the way that grunge music once was. Salaryman is the Poster Children's foray into the techno-ambient genre, although computers were not used in their recent Salaryman CD. The Salaryman band members are the same, but the music is totally different.

The big thing that keeps Rose and Rick in Champaign-Urbana is their tie to computer science at the university. "I have a lot of pride in my CS degree and the Department of Computer Science at Illinois," said Rose. "I want to apply my computer knowledge to help other people, who may not know the first thing about computers, understand them. I want to tell kids to stay in school, even if they want to be a rock star. The message of our band has always been 'knowledge is power,' and a dream of ours is to be able to get that message across to a lot of people. I'd rather see an article in a kid's magazine about Marc Andreessen than an article about Kurt Cobain. I always try to look at the good side of things." ■

Student spotlight: Our Knights of St. Pat

The Knights of St. Pat is an honorary engineering society for outstanding juniors and seniors based on high academic standing, contributions to campus activities, and character. This prestigious honor went to two computer science students this year: Jen Mozen and Keith Wessel. We'd like to introduce you to these two bright young computer scientists.

Jennifer Mozen

Jen Mozen

Jen Mozen applied to the CS program for the typical reasons. As a sports fan, she wanted to go to Notre Dame, but her father made her apply to Illinois. She chose engineering because it'd be easier to transfer out than in. Even though her computer experience prior to college consisted of programming Basic in her hometown of Willow Springs, Illinois, she picked CS because she knew that job opportunities in the field were good. "I was intimidated here at first," she said, recalling her early days at Illinois. "Everyone seemed so far ahead, and I was clueless."

Now that she's about to graduate, she's appreciative of the broad approach to CS education that Illinois takes. "I really liked the fact that I got to sample a lot of different things like hardware and software and programming and theory and all that stuff. So I learned a lot of different ways to solve problems because everything takes a totally different approach to solving a problem."

Jen has always loved being active in sports, and at UI, sheplayed softball, volleyball, and basketball. During her sophomore year, she joined the Society of Women Engineers (SWE). She started out as workshop director, then became publicity director for Engineering Open House, and wound up as president of SWE her senior year. She was also an engineering learning assistant, which meant helping teach Engineering 100. "It was lots of fun," she recalled. "There were thirty-four or us, and we developed the curriculum for class based on what we would have liked to have known as freshmen." The curriculum included instruction on how to write an effective resume, interviewing skills, how to do e-mail and Web navigation, and how to get involved in campus activities. She also served as a TA for CS 100 and graded MPs for CS 225.

Jen's hard work has been rewarded. In addition to her induction to the Knights of St. Pat, she also received the first Duncan H. Lawrie award for outstanding scholarship and service and was honored by the UI Alumni Association as one of the top 100 seniors at the university based on extracurricular and scholastic achievement.

Jen chose to work for Proctor & Gamble in Cincinnatti, where she did a summer internship her junior year. "There isn't really any one area that I'm specifically interested in, so that's why I decided to go work somewhere where I could apply my whole technical knowledge of programming and what goes on in the background to solve different problems instead of focusing on designing new computer chips or something like that," she said. She feels that because few people currently at P&G have the skills she has, she will be able to bring something new to the organization and make a real difference there. "I'll also get to learn a lot more about business and how technology interacts with business," she said. Her first task will be in the area of Intranet applications.

Before entering the real world grind, Jen is going to take a well-deserved European vacation with two other future P&G employees. They all met as summer interns at P&G. "I'm glad I stuck with computer science," she concluded, with a nod.

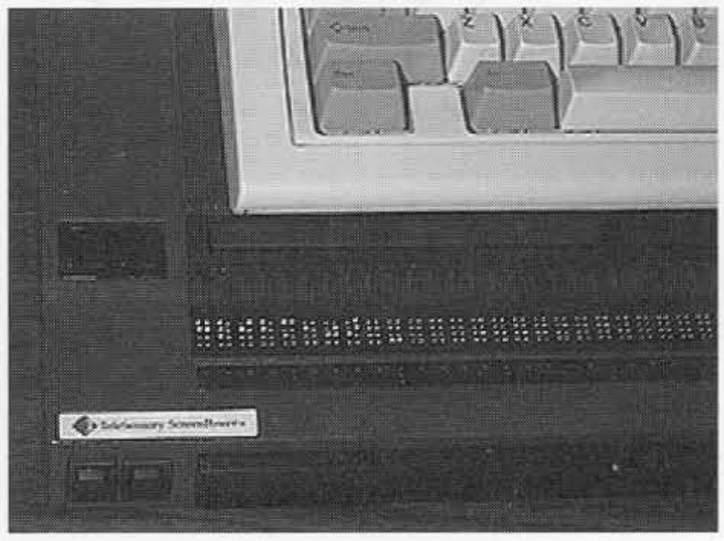
Keith Wessel

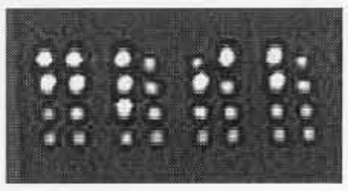
Keith Wessel is from Urbana and has been programming since he was six-years old. He learned by programming Basic on an Apple at Computer Camp, an Urbana summer school program with which he is still involved.

Keith is blind, and is usually accompanied by his guide dog, Apollo. As a child, he was able to read print, but his eyesight decreased and stabilized at about age thirteen. Both his parents are also blind. His father had cancer of the eye, and his mother has the same thing Keith has, which is still unknown. Studying computer science seemed natural for someone who always enjoyed pushing buttons and turning dials. The choice to go to Illinois was a no-brainer; it was in town and had one of the best CS departments in the country.

Keith has worked for NCSA's Education and Outreach program since 1992, when he was a junior in high school. He started out working on an NSF-funded project called Chemistry Visualization for AP high school chemistry classes. The program allowed students to build molecules on the screen and to animate them with a supercomputer,

Keith Wessel uses his Braille display, beneath the keyboard.





Braille display, showing row of Braille characters, left. Closeup of Braille characters, made of plastic dots which raise and lower.

using Schroedinger's equation. As a freshman, he joined the education and outreach division's networking team, and in 1996, he became its system administrator. In addition to his NCSA job, Keith and a friend have been running a DJ business, MW Entertainment, for about seven years.

Keith has been a very active member of Engineering Council, the umbrella organization for the eighty or so engineering student organizations. The council plans Engineering Open House, Employment Expo, Engineering Information Bureau, and Student Introduction to Engineering (a program to encourage students to become engineers). As director of information for Engineering Council Keith maintains its computer systems, Web presence, mailing list, and communication with college administration.

So how exactly does Keith use a computer? "So few people know what's available," he said, referring to computer aids for the disabled. Keith had been using a device for speech output for the computer until recently when he got a Braille display. The display, comprising 8x81 solenoids, is contained in a large base that the keyboard sits upon. When the user types, the Braille pops up. There are several different forms of Braille, consisting of punctuation, numbers and letters, including one called computer Braille. In computer Braille, there is a representation for every single character that appears in ascii. Books, on the other hand, are written in literary Braille. Braille normally has six dots, in a 2x3 array, and has 63 combinations of dots, including contractions to represent common groups of letters and words. Computer Braille has eight dots, in a 2x4 array. The extra dots are used to indicate special characteristics, such as Alt or Control.

Keith's computer Braille display is one row of eighty 8-dot Braille characters. For each Braille character, there are eight holes in which plastic nubs (dots) come up. The Braille display shows one line of text correponding to a line of text on the computer monitor. A bar on the front of the display moves the system cursor from line to line, and another bar moves a second reading cursor from line to line without moving the system cursor. On the Web, he can use a bar to go from link to link.

Web navigation has introduced new problems for blind people. Image maps on Web pages are dead ends for blind people—the words "Image Map" appear and you're stuck. "As the range of people on the Internet increases, the number of disabled people on the Web will increase," said Keith. "Not just blind people, but motor impaired, learning disabled, and others. It's inevitable that these kinds of things will get in people's way." Whether the Americans with Disabilities Act (ADA) applies to information accessibility is a huge issue right now. For instance, if classes at U of I require that students have access to the Web, under ADA, the university is required to provide some type of accomodation to disabled people. "This means that they need to find a workaround," said Keith, "and if we find a workaround, it's going to make it easier for business to hire disabled people. If the workarounds are already in place and they don't have to spend a lot of money finding alternative ways to do things, then the groundwork will already be there to hire disabled people." In addition to Web readability, another big issue for blind people is the use of graphing calculators. "There's not an easy way to produce a refreshable, tactile graph. With current technology, a graphing calculator for the blind would cost too much, take up too much space, and wouldn't be portable. Traditional output would require too much paper."

Keith will graduate in 1998 and is considering three options: going to graduate school to become a professor, system administration, and rehabilitation engineering. "Rehab engineering," Keith explained, "involves designing the workplace to make it accessible to the disabled. There are very few disabled people in the field and very few technical people in the field." Keith has done rehab engineering consulting on an individual basis. "It's a lot of fun—problem solving, working with hardware, and people." Keith has also been playing piano as long as he's been programming computers, and he just picked up guitar. ■

Some Things I Wish I Learned in School

by Rick Cattell BS'74

Rick Cattell shared the following twenty tips with students during Java Day, an informational day-long seminar on Java held at the Beckman Institute on February 18, 1997.

1. Research is not fun if people don't use your ideas or technology.

2. Research may not be fun if someone else gets all the fame or fortune for your ideas.

3. Nearly all startup companies fail: you should go there to have fun, not to get rich.

4. Remember that most research and startup companies are supposed to fail: they are an experiment.

5. Almost every research or development group tries to take on too much themselves.

Corollary: Build on what's already successful (or will be successful).

6. "Technology transfer" is very hard: having good technology is only 20 percent of the solution.

Corollary: Don't worry too much about people stealing your good ideas - most of the best ideas you have to stuff down their throats till you show them they were wrong.

7. The most popular technology is usually not the best, and vice versa.

8. Learn basic principles of markets, management, and finance, not just technology; you must know and use these to avoid wasting years of your life (but learn from someone who has it right!).

9. There is little useful creative work in standards groups and they go on forever (also true of most conferences). If you need a standard, use a faster ad hoc process.

10. One percent of the people in R&D are the key to most of the successes; these people have a rare combination of intelligence, drive, leadership, insight into technology futures, insight into the market, and other skills.

Corollary: Think hard when hiring and funding projects.

11. Don't base a risky project on another risky one.

12. Successful people frequently move in groups from one company to another.

13. Venture capitalists pour a lot of money into experimental ideas even when they have a negative return on investment on average. They are a major asset to our industry and our country.

14. Think hard about technology and market trends and base your work decisions on these . . . it's worth the time.

15. Be aware of software patents: you must play this game.

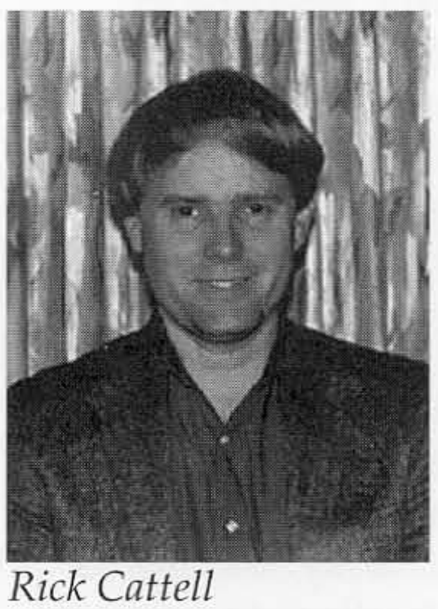
16. Most managers are at heart opposed to telecommuting; it's still hard to do.

17. It is worth taking time to increase your productivity, especially on tools you use every day.

18. Prioritize tasks every day, every week, every year . . . don't get stuck in an unproductive rut.

19. Work as a team: build on other work, use existing infrastructure, delegate to others, leverage partners.

20. Take a year off to have fun sometimes. ■



Rick Cattell

Rick Cattell, BS'74, is a Distinguished Engineer at JavaSoft, where he is lead architect on database connectivity. He has worked for 12 years at Sun Microsystems in both management and senior technical roles, and for ten years in research at Xerox PARC and at Carnegie-Mellon University, where he got his PhD.

Rick is widely known for his contributions to database systems, particularly in object-oriented databases and database user interfaces. He was responsible for the Cypress DBMS at Xerox PARC, the Sun Simplify database GUI, SunSoft's NEO CORBA database integration, and JavaSoft's JDBC Java-database API. He was founder of SQL Access, founder and chair of the Object Database Management Group (ODMG), the author of the world's first monograph on object database systems, and the recipient of the ACM Outstanding Dissertation Award. Rick grew up in Champaign where his father, a UI professor of psychology, used ILLIAC II to analyze data from psychological tests.

Department notes

Professor **Jean Ponce** was program co-chair of this year's big American computer vision conference (CVPR) which took place in Puerto Rico on June 17-19, 1997.

Professor **C. L. Liu** was awarded the prestigious Tau Beta Pi Daniel C. Drucker Eminent Faculty Award from the College of Engineering. The award is given to those who have received national or international acclaim for dedication to academic excellence through teaching and research and have made exemplary contributions to the understanding of their fields. It is named in honor of Daniel C. Drucker, Dean of the College of Engineering from 1968-84 whose striving for scholarly excellence had great influence on the faculty and students of the College.

Liu has won numerous awards for his teaching and research. He is a Fellow of the IEEE, the ACM, and the S. Guggenheim Foundation and honorary member of the Golden Key National honor Society. His award include the Karl V. Karlstrom Outstanding Educator Award from ACM, and the Taylor L. Booth Education Award and the Education Medal, both from IEEE. Liu's research includes the CAD of digital systems, real-time systems, and theoretical computing. In 1973, he developed rate-monotonic schedulable utilization, the theoretical basis of modern methods and tools for predicting the timing behavior of multi-programmed real-time systems. Liu is currently serving a three-year term as associate provost and associate vice chancellor for academic affairs for the UIUC campus.

Professor **Andrew Chien** received a $1.6M grant to research Windows NT clustering technologies for high performance and scalability. His group will have a 64-node cluster together by June and is planning a 256-node cluster. These systems will not only support "supercomputing," but be a playpen for next generation distributed applications.

Professors **Josep Torrellas** and **David Padua** received a research grant from the Experimental Systems Division of NSF to research the design and implementation of next generation distributed shared memory multiprocessor architectures.

Professor **Duncan H. Lawrie** received the Outstanding Electrical Engineer Award from Purdue University's School of Electrical and Computer Engineering in November,1996. The awards recognizes industrial and academic leaders for contributions to the progress of the profession of electrical engineering and related industry.

Graduate student **Ying Chen**, advised by Professor Marianne Winslett, was awarded an Intel Foundation Graduate Fellowship for 1997-98. Christopher Elfrod, advised by Professor Dan Reed, who was awarded the fellowship last year will continue.

Graduate student **Thomas Kwan** received a National Semiconductor Graduate Fellowship for 1996-97. He is advised by Professor Dan Reed.

Graduate student **Jaejin Lee**, advised by Professor David Padua, was awarded an IBM fellowhip.

Professor **H. George Friedman, Jr.** was featured in a *Champaign News-Gazette* article on October 14, 1996, about his passion for trolleys. A certified streetcar motorman, Friedman works with the Illinois Railway Museum and hopes to write a book on local streetcar history. Friedman continues as director of the CS department's undergraduate programs.

Professors **Josep Torrellas** and **Marianne Winslett** both received Xerox Awards from the Xerox Foundation for outstanding research. Torrellas received the junior award for assistant professors based on one year of research. He is currently doing experimental work designing new concepts in parallel comptuer architecture, as well as parallel operating systems and compilers. Winslett recieved the senior award for associate professors based on five years for research. Her current research centers on data management techniques and their application to real-world problems, specifically data input and output for high-performance scientific computing applications running on parallel platforms and clusters of workstations.

The following teaching assistants were ranked excellent by their students for Fall 1996: **Ian Chai**, **Cinda Heeren**, **Mario Medina**, **Christopher Seguine**, and **Linda Weizhe Sun**; **Ali Dasdan**, **Joel Jones**, and **Esmeralda Wyngaarde** were given an additional rating of outstanding. Professor **Andrew Chien** was ranked excellent for his taking of CS 491. For Spring 1997, the following TAs were ranked excellent: **Monali Athanikar**, And**rew Brown**, **Michael Cibulskis**, **Terrance Fleury**, **Christopher Hess**, **Afra Zomorodian**, and **Jason Zych**; **Garry Sittler** was given an additional rating of outstanding. Professor **Herbert Edelsburnner** was ranked excellent for his teaching of CS 497. ■

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January CS Bay Area Bash at SGI

This year's Bay Area CS alumni bash was hosted by Silicon Graphics in Mountain View on January 24, 1997. SGI employees Mahdi Seddighnezhad, MS'92, and Pavlos Konas, MS'91, PhD'94, championed the idea, and another SGI employee, trumpet player Ed Burns, BS'95, coordinated our musical enterprise. The music was an idea to get some of our alumni musicians together. Torrential rain kept away many who signed up, but saxiphonist Robert Mueller-Thuns, MS'88, PhD'90, turned out to join our core musicians guitarist Jerry Fiddler, AB IPS'97, MS'77, drummer Greg Chesson, MS'75, PhD'77, bassist Joe Pinzaronne, BMusic'70, MMusic'72, and pianist, Rich Nosek, BS Math'71, MS Math'73. We hope to do something like this again; our alums have a lot of musical talent! Over sixty dedicated Illini braved the weather and had a great time. We'll let you know when and where the next one is. ■

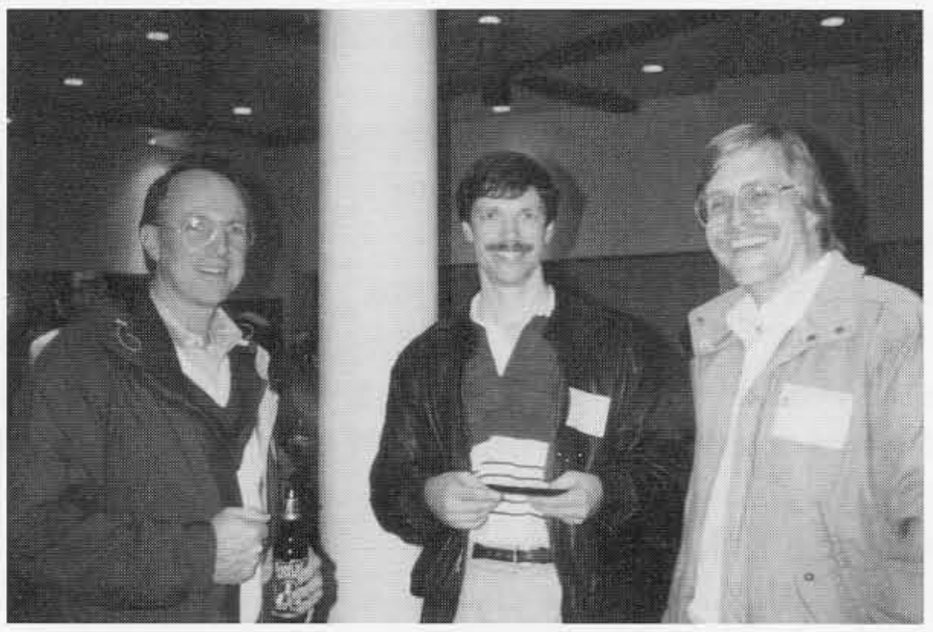
Robert Mueller-Thuns, Ed Burns, Jerry Fiddler, and Rich Nosek.

Kin-Man Chung, PhD'79, Jackson Hu, MS'76, PhD'78, and Martin Liu, MS'69, PhD'72.

Greg Chesson, Dale Jurich, BS'71, MS'72, and Rich Balocca, MS'80.

Rich Nosek, Jerry Fiddler, and Joe Pinzaronne.

Alan Braverman, BS'96, David Kruckemeyer BS'93, and Mike McCool, BS'95.



Rob Catlin, MS'76, Barry Pangrle, BS'82, PhD'87, and Bill Stenzel, BS'73, MS'75.

Classnotes

Steve Chen, PhD'75, became Chief Technology Officer at Sequent in June 1996. Chen, principal architect of the Cray X-MP, was previously working with Chen Systems Corporation.

Michael J. Borman, BS'77, was elected last fall to the Illinois Chamber of Commerce. He is general manager of the midwestern area for IBM in Chicago.

Kasuaki Masamoto, MS'77, is senior vice president and general manager of Open Systems Software Development for Hitachi Computer (America) in Waltham, MA.

Steve Dorner, BS'83, was featured on the front page of the National Report section of the *New York Times* on January 21, 1997, in an article called "Satisfaction In Job Well Done Is Only Reward for E-Mail Software Inventor." Dorner is the creator of Eudora, the popular e-mail software, and PH, the telephone directory program. **Charley Kline**, BS'84, MS'86, one of the creators of the CU-SeeMe audio-visual conferencing program, is quoted in the article. Charley, senior research programmer for CCSO, is a very popular speaker among CS students and is the UIUC Campus Area Communications Architect. He also wrote wxmap, an X-based graphical weather display system, and with former CS graduate student **Eric Scouten** wrote Maven, which allowed you to use a Macintosh on the Internet as a voice conferencing tool. Eric now works for Adobe in Minneapolis.

Ruth Ann Knoernschild, BS'85, was married in August, 1996, to Bill Rupp. She is a senior information systems analyst at S.C. Johnson Wax in Racine, WI.

Bill Schaeffer, MCS'85, is a digital artist at Digital Domain in Venice, CA. He is currently working on the movie *Titanic* as well as a CD of original piano music.

Terry Joe Graves, BS'87, was married in June 1996 to Shawna Lane Burgett. He is a computer engineer with Rolling Thunder Inc., and lives in Broomfield, CO.

William "Chip" Mayse, PhD'92, is systems analyst/engineer for Cambridge Research Associates, in McLean, VA. He was involved with PowerScene, a program which generates 3-D scenes from satellite data at 20-30 scenes/sec, one of the fastest VR systems that runs on SGI machines. The program is used for military mission-critical and commercial applications. chip@illini.cambridge.com

Alex Bratton, BS ECE'93, has left BALR to start WebRPG, a company specializing in providing an on-line community for role playing gamers. Says Alex, "We're striving to be the site where role playing game enthusiasts can discuss their passion with other kindred spirits outside of their own circle of friends and maybe pick up some new ideas." http://www.webrpg.com

Daniel J. Orum, BS'93, was married to Jennifer Ann Kusmierz in August, 1996. He is a computer marketing support representative for IBM.

Jason Weber, BS'93, was married in August, 1996, to Kristine Kelly. He is a software manager for Event Technologies in Hales Corners, WI.

Illini become Aggies! Three alums, **Riccardo Bettati**, PhD'94, **Lawrence Rauchwerger**, PhD'95, **Thomas R. Ioerger**, MS'92, PhD'96, joined the faculty of Texas A&M last year.

Brian J. Basarich, BS'95, was married in October, 1996, to Kerry B. Nekola. He is programmer with Alliance Systems and Programming in Fenton, MO.

Chad T. Langley, BS'96, was married in June, 1996, to Suzette Parrott, BS Psych'96. They are both attending U. Pittsburgh.

David Zaiz, BS Math/CS'96, was married in September, 1996, to Michelle Stroh. He is an engineer for McDonnell Douglas in St. Louis.

Ning Liu, MCS'97, was married in May, 1996, to ECE alum Scott M. Basinger, BS'91, MS'93, and PhD'96. ■

Album debut for the eclectic Xaz

Illinois alums Jerry Fiddler, Joe Pinzarrone, and Rich Nosek, pictured on facing page, are Xaz, a jazz group with a new CD. Jerry, a CS alum, is chairman of the board of WindRiver Systems. Joe, a manager at Logitech, and Rich, who works at Lawrence Berkeley Lab, are alums of Music. The three were friends at Illinois and have been playing together in California for several years.

The CD is called *Prized Ale of Non-Drinkers*, and all pieces were written by the band members. The album name is an anagram of "FiddlerNosekPinzaronne." "The computer came up with thousands of anagrams," wrote Jerry, "including such bizarre creations as 'Personalized Dinner Fork,' 'Frozen in Red Leopardskin,' and 'Frenzied Spinnaker Drool.' It must mean something, but I don't know what." The music can be described as "jazz with influences from everywhere." Instruments include piano, bass, percussion, viola and lots of guitars—classical, acoustic, electric, and a guitar synthesizer.

"We did this just for fun," said Jerry, "but it's also fun to have others hear it." The group is now looking for a distributor, but if you'd like to hear it now, you can by contacting De Anna Mekwuyne at 800-545-9463, ext. 2172.

Thank you to our donors

We wish to recognize and thank each of you who have generously supported the department. Your support enables us to strengthen existing programs and to add new programs and initiatives to enhance the quality of education we provide.

This list includes alumni and friends who have directed their gifts specifically to the Department of Computer Science during the period from July 1, 1995 to April 30, 1997. If your name has been overlooked, please let us know.

* indicates that the donor is a member of the Presidents Council, the university's highest donor recognition organization. We hope you will consider becoming a PC member with your gift of $15,000. Company matching funds can be applied toward PC membership, and payments can be made over a ten-year period. Please call Judy Tolliver, 217-333-1621, if you would like more information on the Presidents Council.

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A SPECIAL THANK YOU *to these friends for believing in the Cyberfest vision*
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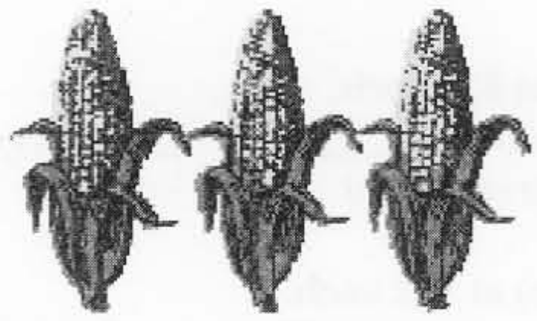
Not decked in corn yet?



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Survey, *continued from p. 13*

Most valuable experience
- Coursework
- Research experience
- Interaction with faculty
- Interaction with other grads
- Project experience

Skills needing improvement
- Written communications
- Verbal communications
- People/team interaction
- software development process
- Project management

Additional advice
- Pleased with program
- Maintain high standards
- Build closer ties to industry
- Improve thesis advising
- Assist in adviser selection ■

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