



Significant BITS

Newsletter of the
Department of Computer Science

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Due to the building gala there was no fall '00 issue of Significant Bits.

A Celebration of Excellence



Photographic Services

How many Department chairs does it take to cut a ribbon? Former chairs Dave Stemple (left) and Rick Adrion (right) demonstrate and current chair Jim Kurose (center) looks on.

The Reinforcement Learning Renaissance

THERE IS A RESURGENCE IN REINFORCEMENT LEARNING (RL). The increased number of RL sessions offered at Machine Learning conferences, their high attendance levels, and the growing number of related publications provide evidence of the many researchers pursuing this field.

At the heart of this renaissance is the work done in the 1980's by Professor Andrew Barto, Director of the Adaptive Networks (ANW) Laboratory in the Department, and his former student, Rich Sutton '84G, now a principal technical staff member at AT&T Shannon Laboratory in Florham Park, NJ. Borrowing ideas from psychological principles of reward and punishment for animal learning, Barto and Sutton have built a mathematical framework that connects trial-and-error learning with the theory of optimal control and its solution using value functions and dynamic programming. This has led

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THE NEW COMPUTER Science Research Center had been finished and occupied for months, but with *A Celebration of Excellence* it finally became official home to the Department. This gala event, September 14-15, 2000, brought industry executives, alumni, legislators, and computer science luminaries to the campus.

Participants in the two-day grand opening toured the building, visited 22 lab demonstrations, and learned about the Department's research by viewing some of the 43 student posters or attending several of the many technical talks given. (An index of the event is still online at www.cs.umass.edu/excellence.)

"It was great to be able to open the Department up to so many people," recalls Department chair, Jim Kurose. "We were honored to have several distinguished visitors," including honorary degree recipients Barry Boehm, of the University of Southern California, Leonard Kleinrock, of the University of California - Los Angeles, and Raj Reddy, of Carnegie Mellon University, each of whom delivered a keynote addresses during the celebration.

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FROM THE CHAIR

The Cycle Continues

By Jim Kurose

Four years ago, our Department decided to move to a “rotating” Department chair position. While that may conjure up images of a chairman spinning around (it seems like I do that a lot!), the idea was to have a senior faculty member step into the Department leadership role and then, after three years, return to the relative peace of full-time research and teaching. It’s hard to believe that my three-year term is coming to an end!

Much has happened over the past three years:

- **We’ve grown in many ways.** We’ve moved into our beautiful new building, added four talented and dynamic new faculty members to our ranks (with more to come on board this year), and more than doubled the number of undergraduate majors.

- **We’ve forged many new collaborations.** We’re launching new research and educational efforts within UMass

(Biochemistry, Chemistry, Education, Electrical and Computer Engineering, Forestry, Math and Statistics, and Psychology to name a few), working across our campus to develop a new IT minor program, and leading a state-wide effort, funded by the Board-of-Higher-Education, to develop and modernize the IT

curriculum at UMass, state, and community colleges. We’ve also worked more closely with our alumni, who have generously supported our efforts, and expanded our research and educational collaborations with industry.

- **Maintaining what we treasure.** When things are going really well, the best thing to do is work hard to maintain that which is good. The intellectual excitement that powers our Department remains

as strong as ever. Our collegiality, collaborative culture, and esprit de corps make the Department not only a great place to work, but also a wonderful place to serve as chair.



Looking ahead, there’s no shortage of challenges. Our teaching capacity is straining under the load of a doubling of majors and an equally large increase in the number of non-majors taking our sophomore- and junior-level courses. We must continue to compete for the best and brightest faculty and graduate students in the world. And we need to be constantly “on our toes” in a field that changes as rapidly as ours.

The Department is well positioned to meet these challenges. It has just been announced that Bruce Croft, who joined our faculty in 1979 and has risen through our ranks to

become a Distinguished University Professor of Computer Science, will begin his three-year term as chair this summer. The exceptional qualities Bruce brings to the job include his deep roots in the Department, his experience running the large and well-funded Center for Intelligent Information Retrieval, and his leadership in national-level Computer Science groups (e.g., ACM and the Computer Science and Telecommunications Board). We’re fortunate to have him as our next Chair. You’ll be hearing more about this in our fall issue.

I’m stepping down as chair a happy man! I’m looking forward to returning to the joys of research and teaching full time. But I’m also happy because it’s been a great experience – a true pleasure to work with such dedicated, hard-working, and wonderful people (faculty, students, and staff alike), and a privilege to represent them.

Collaboration connects infrastructure and teaching

THE DEPARTMENTS OF COMPUTER SCIENCE (CS) AND ELECTRICAL AND COMPUTER ENGINEERING (ECE) have a long history of collaboration. Although they are in different colleges – CS in the College of Natural Sciences and Mathematics and ECE in the College of Engineering – students from both departments in the networking area will benefit from two recent awards from the National Science Foundation (NSF).

“Curriculum Development and Infrastructure for an Advanced Systems Laboratory” (Principal Investigator: Jim Kurose, CS) brings together faculty members researching networking (multimedia, quality of service), distributed operating systems, database systems, convergent computing systems, real-time systems, and fault tolerant systems. This 3-year grant will be used to create and teach new laboratory-based instructional materials and courses that integrate recent research results into the curriculum via hands-on, experimentally-oriented, lab experience. It is tar-

geted to both advanced undergraduate and graduate students. Other PIs include from CS: Brian Levine, Krithi Ramamritham, Prashant Shenoy, Don Towsley, and Jack Wileden; from ECE: Aura Ganz, Lixin Gao, and C. Mani Krishna.

The second award is a Computer, Information Science, and Engineering (CISE) Research Infrastructure grant for equipment and support, “Mixed Wireless and Wired Networked Systems” (PI: Don Towsley, CS). It enables the research and development of control strategies and services required by application suites executing over mixed wired/wireless networks. The vision of this 5-year effort reflects a fundamental shift in the way users will compute and communicate in the future, moving from being immobile and wire-based to mobile and wireless. Other PIs include from CS: Jim Kurose, Brian Levine, Krithi Ramamritham, and Prashant Shenoy; from ECE: Aura Ganz, Dennis Goeckel, and C. Mani Krishna.

The total funding of the two grants is just under \$1.5 million.

ALUMNI

Debra J. Richardson '81 now UC Irvine chair

DEBRA J. RICHARDSON '81, known for her pioneering work in formalizing software testing and developing leading-edge software testing and analysis technology, was named chair of the University of California Irvine's (UCI) Department of Information and Computer Sciences (ICS), effective July 1, 2000. Dr. Richardson, a former student of Professor Lori Clarke, stayed on as a visiting professor at UMass for six years after receiving her Ph.D.

"It is wonderful to see Debra moving into the department chair position at UCI," says Professor Clarke. "Debra was my second Ph.D. student and we have remained close over the years. Recently, Lee Osterweil, Debra, and I worked together on the MCC Quest project. And, Debra and I usually go skiing together over spring break."

Richardson will oversee the largest information and computer science department in the UC system and the third largest west of the Rockies. Thirty-six professors, four lecturers and seven researchers guide the work of more than 1,000 undergraduate majors, 300 minors, and some 200 graduate students.

Richardson joined UCI in 1987. Her research has inspired much of the work in specification-based testing, whereby formal specification methods and analysis are employed to guide and evaluate software testing. She began to explore this work while at UMass. Her current research looks at enabling specification-based testing technology to be applicable throughout the life span of a software system. She has developed leading-edge testing and analysis technology and has worked with several companies and consortia in adopting technology to improve the quality of software systems and software processes.

Prior to her appointment, Richardson directed the Microelectronics Innovation and Computer Research Opportunities program under the UC President's Initiative on Industry-University Cooperative Research. She also is a founding member



Photo courtesy of Lori Clarke

UCI ICS Chair Debra J. Richardson '81G (second from left) enjoys skiing with University of Colorado Boulder Associate Professor Alex Wolf '85G (second from right), Professor Lori Clarke (right), and members of Clarke's family.

of the University of California Software Institute, an Organized Research Unit at UCI, and was a founding member and acting director of its predecessor, the Irvine Research Unit in Software.

Known for its research in Internet infrastructure software development, data mining, embedded systems, and networking, UCI's Department of Information and Computer Science is recognized as one of the leading computer science departments in the United States. The high-tech magazine *eWeek* (formerly *PC Week*) recently named UCI one of the top 10 universities for information technology education, and the Computer Research Association ranked ICS in the top 30 doctorate-granting computer science and computer engineering programs in North America.

Debra's non-academic passions include rock climbing, SCUBA diving, in-line skating, skiing (both downhill and cross country) and snow boarding, biking and hiking, weight training, and country-western dancing. "I certainly hope that her department chair duties will not interfere with our skiing!" comments a smiling Clarke.

NEWS

Ramamritham named ACM fellow

PROFESSOR KRITHI Ramamritham has been named a fellow of the Association for Computing Machinery (ACM). The ACM is the oldest and largest society for computing and technology professionals worldwide. Twenty-seven new fellows were named this year, bringing the total number of ACM Fellows to 411.

Department chair Jim Kurose said, "It's a wonderful and well-deserved honor

for Krithi, recognizing the pioneering work he has done in real-time and distributed computer systems. We're fortunate indeed to call him one of our own."

"I am delighted to be named an ACM fellow, and to join the Department's roster of ACM fellows," said Ramamritham. "I am thankful for having had excellent students as well as collaborators – both at UMass and around the world, over the

years – without whom this would not have been possible." Donald Towsley, Arnold Rosenberg, Leon Osterweil, Lori Clarke, W. Bruce Croft, and W. Richards Adrion have previously received the honor.

Ramamritham's research interests span the areas of real-time systems, transaction processing in database systems, and real-time database systems. He is applying concepts from these areas to solve problems in mobile computing,

e-commerce, intelligent Internet, and the Web. He is also a fellow of the IEEE.

Ramamritham received a Ph.D. from the University of Utah before coming to UMass. He also currently holds a visiting position at the Indian Institute of Technology Bombay.

Ramamritham will be inducted at an awards banquet on March 11, 2001, in San Jose, California.

– Elizabeth Luciano

RL Resurgence (from page 1)

to several noteworthy experiments that demonstrated the viability of this approach to machine learning. Their book, "Reinforcement Learning: An Introduction" (MIT Press, Cambridge, MA, 1998), has become the essential introductory book on RL.

RL can most simply be described as learning by trial and error in pursuit of optimal behavior. "It's a very common sense notion of learning," says Barto. "If you do something and it feels good, do it again; if it feels bad, do something else." But what distinguishes RL from the related field of supervised learning is that it does not depend on examples from experts to train the system. "Supervised learning systems rely on having an expert, mimicking the expert, and then generating rules based on the examples that have been tried," Barto explains. "We got interested in situations that have no expert. We wanted the system to discover from its own experiences how to do something when there's no expert around that it can copy." An RL system, then, evaluates the results of its own actions rather than follows the instructions of others. That capacity is critical when there is no way to give full instructions.

In one highly successful RL experiment in the early nineties, IBM researcher Gerry Tesauro, using an algorithm developed at UMass by Sutton, built a system that learned how to play backgammon. A supervised system would learn from a collection of expert moves; Tesauro's RL system, named

TD-Gammon after Sutton's Temporal Difference algorithm, taught itself to play, adjusting the rules as it went along based on whether it won or lost. After simulating more than a million

games – more than any single human could play in a lifetime – TD-Gammon was beating some of the best players in the world. Among its more successful maneuvers was to play certain opening positions

in unconventional ways.

The machine's human rivals promptly began stealing its moves.

Inspired by the backgammon machine, UMass computer science student Bob Crites '96G set about creating a system that would improve elevator scheduling. The system simulated a ten-story building with four elevators, and was penalized for making people wait. The system spent four days simulating seven

years of elevator time. "It learned a strategy for scheduling the elevators so as to try to get this penalty as low as it could," Barto says. If passengers on three floors requested pickups, which floor should the elevator stop at first? If no one

was waiting, how should the elevators distribute themselves to best respond to the next request? The result was a dispatching strategy whose simulations appeared to perform better than a collection of other dispatching strategies. "We can only look at simulations, though; the policy has yet to be put on a real elevator," Barto points out.

A major challenge of RL is the credit assignment problem. For example, in backgammon, how do you identify which move or moves were responsible for a win? "You just don't know

which specific move clinched the win," says Barto. Research Scientist Andrew Fagg describes it as follows, "It's like teaching a dog what's good and bad to do. You come home and the dog has done something you don't want it to do. So you punish the dog, and this dog then has the problem of figuring out which one of the things that it has done was wrong."

The exploit/explore dilemma is another challenge. An RL system must progressively favor strategies that were effective in the past at producing rewards, yet to discover such strategies it must experiment with new ones. In other words, it must exploit what it already knows,

but at the same time explore new, potentially more effective, means of achieving its goal. The dilemma is that neither exploration nor exploitation can be

pursued exclusively without stalling the learning process.

But the problem subject to the most scrutiny is that RL requires a great deal of time – that is, a lot of experience – to devise a strategy, as the million backgammon games and seven years of elevator time illustrate. Though modern methods have helped, more remains to be done.

Consequently, according to Fagg, much of the current

work in the ANW lab and at labs around the world is aimed at making RL more efficient. Researchers are trying to limit the choices a system considers by programming it to choose between entire strategies instead of individual actions.

"If I'm trying to walk from here to the car in the parking lot," says Fagg, "I don't want to have to plan in terms of individual twitches of muscles in order to get my leg going to walk out the door and down the hall. What I'd rather do is plan in terms of getting to the door and down to the end of the hall, and going out the other door to the parking lot."

Some of the current work being done in the community, and collaboratively in the Department involving the ANW lab and the Laboratory for Perceptual Robotics (Robotics), shows several strong cases where RL is able to find better solutions to hard problems than were previously known. Several graduate students and recent graduates from the Robotics Lab are involved

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AWARDS

Department faculty and alumni awarded more than \$13.8M in NSF ITR grants

THE DEPARTMENT AND OUR ALUMNI realized great success in the first offering last year of the highly competitive \$90M National Science Foundation (NSF) Information Technology Research (ITR) initiative. Department researchers were awarded more than \$5M while several alumni received awards totaling more than \$8.8M. The awards ranged from 3-5 years.

“It is a testament to the quality of the work of our faculty and our former students,” beams Department chair Jim Kurose. “We are delighted that our Department is so well represented in the awards granted as part of this new and forward-thinking NSF program.”

The announcement came just before the official opening celebration of the new Computer Science Research Center. “It gave real meaning to the event’s theme – A Celebration of Excellence,” said Kurose.

Selected from over 1,400 proposals, the funded activities will promote IT-driven science and engineering. Included are 62 large projects that will average \$1M per year for three to five years, involving 41 institutions in 22 states. Another 148 smaller projects will each total \$500K or less for up to three years, involving 81 institutions in 32 states.

ITR emphasizes the subject areas of software; scalable information infrastructure; information management; revolutionary computing; human-computer interfaces; advanced computational science; education and workforce; and social or economic implications of IT. The program’s main goals are to augment the nation’s IT knowledge base and strengthen the IT workforce.

Department projects receiving awards are:

J. Eliot B. Moss; Kathryn McKinley; Chip Weems
Dynamic Cooperative Performance Optimization
celestial.cs.umass.edu/DaCapo

Don Towsley; Jim Kurose; Lixin Gao ('99G)
Collaborative Research: Scalable Quality-of-Service Control for the Next Generation Internet: Fundamental Challenges and Effective Solutions

The awards received by our Department’s alumni are:

Claire Cardie ('94G) (Collaborators’ names omitted for simplicity. See nsf.gov for more information.)
The Construction, Analysis, and Evolution of Information Networks
Cornell University

Raju Pandey ('86G)
Supporting Dynamic and Scalable Distributed System Infrastructures
University of California Davis

Debra Richardson ('81G)
Quality Software by Design
University of California Irvine

Tuomas Sandholm ('96G)
Secure Automated Negotiation under Limited Computation: Deliberation in Equilibrium
Carnegie Mellon University

Elliot Soloway ('78G)
Learning-Centered Design Methodology: Meeting the Nation’s Need for Computational Tools for K-12 Science Education (Engineering Scaffolded Work Environments)
University of Michigan Ann Arbor

Bryant York ('81G)
New Approaches to Human Capital Development through Information Technology Research
Northeastern University

Zhi-Li Zhang ('97G)
Collaborative Research: Scalable Quality-of-Service Control for the Next Generation Internet (see Towsley grant)
University of Minnesota-Twin Cities

Wei Zhao ('86G)
On a Virtual Laboratory for Network Engineering Educational Programs
Texas A&M University

RL Resurgence continued.....

in this work. For example, David Wheeler, under the direction of Fagg and (Associate) Professor Rod Grupen, is preparing an experiment based on infant development that will utilize RL to drive the development of reaching/grasping strategies. Manfred Huber '00G has shown that RL can be used to very quickly “teach”

a four-legged walker to turn in place and walk toward a goal. The turn-in-place program has also been used to control a four-fingered hand turning a soda can in place. Jefferson Coelho has shown that RL can be used to direct the movements of fingers around an object in order to establish a stable grasp. Justus Piater '00G has used RL in getting a robotic head to

learn time-optimal vergence control – moving the two eyes as quickly as possible so that they are pointed directly at the same object.

It appears that RL has come of age. The infusion of energy into this area of machine learning has been invigorating for the researchers. Born from a solid mathematical background and a curiosity about how sys-

tems learn, RL has had a profound impact on the field of machine learning and is continuing to cross disciplines. Who knows where its influence will be felt next?

For more information, see www-anw.cs.umass.edu and www-robotics.cs.umass.edu

Trends for Women ... in Computer Science and more

A NEW INITIATIVE AT UMASS AMHERST aims to raise awareness of the issues women face in computer science and other technical disciplines.

TWIST – Trends for Women in Science and Technology – brings together faculty, staff, and students from across the campus. Its mission is “to encourage women to pursue and support women who are pursuing majors in the science, mathematics, engineering, and technical (SMET) disciplines.” It does this by hosting highly visible role models on campus, providing financial support to student groups, maintaining a web site (www.umass.edu/twist) and mailing list, and being the voice of SMET women’s issues to the administration and faculty. TWIST has already:

- Hosted Kathy Olsen, NASA’s chief scientist, who spoke to a crowd of 125 people from the Five College community.

- Provided the site for a CRA-W/Lucent Technology Distinguished Lecture Series featuring Margaret Martonosi of Princeton University, followed by a panel discussion with other female technical Ph.D.s (CRA-W is the Committee on the Status of Women within the Computing Research Association).

- Presented a panel of accomplished industry and academic technical women titled, “Been There, Done That: Technical Women Tell Their Stories,” designed to provide some insiders’ perspectives about SMET careers for women.

“TWIST has received the full support of the campus and the

Department,” says Marla Michel, external relations director for the Department and chair of the TWIST Steering Committee. “More and more people are noticing this organization. It’s especially good for female undergraduate and graduate students who often feel isolated in classes dominated by men. By making the [technical women’s] community more accessible on campus and showing students successful role models, women are more likely to stay the course of their studies and have successful careers.”

The Department’s program is bucking the national trend of decreased female enrollment. The fall 2000 incoming class of graduate students was 22% female (compared to the national average of 16% {source: 1999-2000 Taulbee Survey, CRA}). “We work hard to attract women to our program,” says Department chair, Jim Kurose. “We are pleased they are selecting us.”

Making the Department a good place for women researchers to develop is also a priority. Last September, for example, the Department sent nine women to the Grace Murray Hopper conference organized by the CRA & ACM (Association for Computing Machinery). Some students received travel scholarships

from the conference’s sponsors but the Department provided funding for students not covered by the scholarships.

“We wanted to make sure that anyone who wanted to go could go,” noted Kurose. “As a result, our Department had a large visible contingent at the conference,” commented Kat Hanna graduate student and member of the TWIST Steering Committee. “It’s good to be in a Department that is so supportive of women.”



Computer Science Program Trends: Applications Soar, Undergraduate Majors Double

For the past two years, the Department’s Graduate Admissions Committee has hit new milestones: For the 2000-2001 AY it received more than 1,000 applications for the 40 available graduate program slots. This number, more than 12 percent of all graduate applications sent to UMass Amherst, indicates the popularity of the computer science program to students around the globe. And this is no exception. For the 2001-2002 AY the program is expecting upwards of 1200

applications for the same number of slots.

“The quality of the students has always been excellent,” comments Professor Allen Hanson, chair of the committee. “But it certainly tests the limits of our admissions processes and our ten committee members.”

“We’re getting very efficient in how we handle applications,” says graduate program manager, Sharon Mallory. “The number of applications has increased steadily over the past few years, a 35% increase

from ’99 to ’00 and a 20 percent increase this year, so we’ve had to adjust our processes accordingly.”

The Department’s undergraduate program has also seen explosive growth. Over the past four years, the program has nearly doubled, and now boasts more than 430 majors. Students can either declare their majors as first year incoming students, if they meet certain entrance criteria, or they can transfer in after several prerequisite courses have been completed satisfactorily.

“With the competition for a well prepared workforce so fierce, the rise in undergraduate majors is good news for corporate recruiters,” notes external relations director, Marla Michel. “But it puts an incredible strain on our faculty who are already extremely busy with their existing course-loads and research programs.”

“It’s always a good sign to have a growing program,” comments Department chair, Jim Kurose. “This is a problem I am happy to have us deal with.”

CENTERS

Large textbook publisher licenses OWL system

Saunders College Publishing, a division of Harcourt, Inc., has licensed the Online Web-based Learning system (OWL) for use in general chemistry. The OWL system is a web-based homework system developed at UMass by the Center for Computer-Based Instructional Technology (CCBIT) and the Departments of Chemistry and Physics, and now used in twelve departments by over 10,000 students annually.

CCBIT is led by Research Associate Professor Beverly Woolf and executive director David Hart. Saunders has licensed the Chemistry OWL database, which has over 2,000 homework questions and 40 interactive discovery modules, for use with a new textbook starting in September 2001. Instructors who use the text will have the option of requiring students to do their homework using OWL. The University will receive a royalty for each student user. Saunders has one of the most popular lines of general chemistry texts.

CCBIT is a partner in two recent awards from the National Science Foundation for Course and Curriculum Development. Both grants are for extensions to OWL. The first would enhance OWL to support its use in Mathematics and Statistics courses, including the development of adaptive, interactive homework activities. The other is to expand OWL's use in the Chemistry Department to support Organic Chemistry. This will include support allowing students to draw organic chemical structures and submit those drawings to be graded automatically by OWL. See ccbit.cs.umass.edu.

CIIR provides undergraduate students research experience

The Research Experience for Undergraduates (REU) program at the Center for Intelligent Information Retrieval (CIIR) provides opportunities for undergraduates to help with research into Information Retrieval and Organization technologies. Participating students will work collaboratively with faculty, researchers, graduate students, and other REU undergraduates from all over the country. The program, funded by the National Science Foundation, lets undergraduates experience and partake in the research process within an important and growing field of Computer Science and gives the students an opportunity to explore options for graduate study.

The REU program runs during the summer and, in 2000, ten students came to campus to test the waters of information retrieval research. At the summer's conclusion, the students presented their work, which focused on the following five projects:

- Cross-document Summarization
- Face Recognition
- Question Answering
- Video Retrieval and Browsing
- Acronym Identification

The program, overseen by Professors James Allan, Bruce Croft, and R. Manmatha, is in its third year. For more information, go to ciir.cs.umass.edu/REU/.

IT UPDATE

CITI partnership to strengthen IT programs

THE UNIVERSITY OF MASSACHUSETTS AMHERST has been selected to lead a statewide initiative to strengthen information technology (IT) programs at the University and at public colleges throughout the state. Called CITI (Commonwealth Information Technology Initiative), the initiative was officially launched in October 2000 when the state Board of Higher Education (BHE) accepted and funded a proposal developed by faculty from the UMass campuses, community colleges, and state colleges. The proposal was developed under the leadership of UMass Amherst Provost Cora Marrett, Dean Joseph Goldstein of the College of Engineering, and chair of the Department of Computer Science, Jim Kurose. The BHE has provided \$1.7 million in funding for year one of a three-year program and is committed to future funding.

CITI is a partnership involving the University, the state, and private industry which seeks to strengthen, modernize, and expand computer science and information technology programs at Massachusetts public higher education institutions. It provides a framework and financial resources for faculty at state colleges, community colleges, and the University to work collaboratively to create system-wide change. CITI focuses on four key areas:

- **IT Across the Curriculum**
integrates Information Technology education into non-technical disciplines such as journalism, nursing, and business.
- **Regional Cooperation**
creates geographically based alliances among schools and industry to leverage faculty, courses, and other resources for Information Technology.
- **Curriculum Enhancement**
revises and modernizes existing courses and programs in computer science, management information systems, and computer engineering.
- **Faculty Development**
ensures that faculty in technical disciplines have the skills to teach relevant and modern courses within their disciplines.

"One of the most exciting aspects of this effort is that we'll be relying on the input and involvement of experts not just from UMass, but from colleges throughout the state, as well as from our partners in industry," says Kurose. "An important goal of CITI is to address the state IT workforce shortage. Over time, the lack of well-educated IT workers could put the state at a serious disadvantage economically."

Not all of the benefits of CITI will be measured by the quality and quantity of trained IT workers. CITI has brought together 28 different public institutions working towards a common goal.

For more information, contact administrative director Brenda Philips, bphilips@ecs.umass.edu, (413) 577-2213.

Industry Support for Department Expands

PARTNERSHIPS BETWEEN ACADEMIC AND INDUSTRIAL researchers are not new in the Department of Computer Science. But over the past year or so, the Department has enjoyed expanded support from a variety of companies. Equipment, software, and unrestricted gifts enable the Department to continue its tradition of research and teaching excellence.

Below is a sampling of this support.

- The generosity of the Sprint Advanced Technology Laboratory (www.sprint.com) has enabled Professors Jim Kurose, Brian Levine, Prashant Shenoy, and Don Towsley to advance their research in the area of networking and distributed systems. Sprint also helped underwrite the Department's *Celebration of Excellence* building opening gala last fall.

- The Small Equipment Grants program at Intel Corporation (www.intel.com)

has supported the upgrade of the primary education laboratory where undergraduate students have the opportunity to experiment with and apply the skills they acquire in their classes. Intel also graciously helped underwrite the Department's *Celebration of Excellence* building opening gala last fall.

- GTE Labs (www.gte.com) (now part of Verizon) sponsored our Spring 2000 Alumni Reunion in Lexington, MA. See accompanying article in the Spring '01 issue of Alum Matters.

- CAIDA (www.caida.org), a non-profit organization at University of California – San Diego comprised of several networking companies, has made a donation of network routers to the Laboratory for Advanced System Software and Secure-Internet and Group Network Laboratory as part of their Internet Teaching Laboratory (ITL) initiative. It will support

a multimedia and networking teaching laboratory, led by Professors Prashant Shenoy and Brian Levine, respectively.

- Fidelity Investments (www.fidelity.com) has become the newest member of the Department's Industrial Affiliates' Program. This program, designed to provide members with access to research and students, is administered by the Department's external relations director. Fidelity was also an underwriter for the Department's *Celebration of Excellence* building opening gala last fall.

- Informix Corporation (www.informix.com) has donated copies of its flagship database products to support the research of the Vision Laboratory and Knowledge Discovery Laboratory.

- In addition to helping underwrite the Department's *Celebration of Excellence* building opening gala last September, Microsoft Research (www.microsoft.research.com) has selected the UMass Amherst campus as one of its trial sites for its Microsoft Developers Network Program

and has awarded the Laboratory for Advanced System Software a special equipment grant for research in proxy-based mobile information access.

- IBM Corporation (www.ibm.com) has become a member of the Department's Electronic Enterprise Institute and has awarded several Faculty Fellowship Awards to Department faculty.

- Raytheon Corporation (www.raytheon.com) has awarded Professor Krithi Ramamritham a grant to continue his work with large database systems.

- EMC Corporation (www.emc.com) has given the Department a research gift for investigating Multimedia delivery architectures.

- Monster.com (www.monster.com) has joined the Department's Electronic Enterprise Institute.

- The Knowledge Discovery Laboratory has received an anonymous gift from a large telecommunications company to support its work in data mining.

A Celebration

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Many alumni returned to campus for the extravaganza, taking advantage of the opportunity to see what the Department has been doing and to rekindle former relationships. Several alumni participated in the technical presentations, specifically in the software engineering and networking/distributed systems sessions. Alumni were also present at the dedication of the Computer Science Path of Pride – an elegant brick pathway made possible through the generosity of alumni and friends.

The gala was the result of months of planning by external relations director Marla Michel. It was supported by the gen-



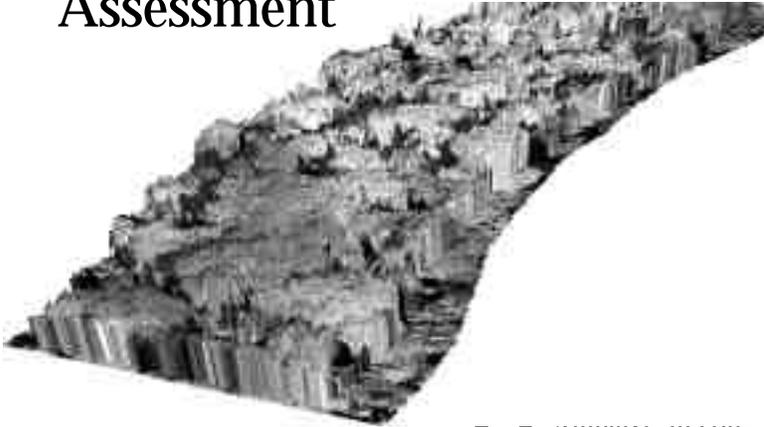
Barry Boehm, Leonard Kleinrock, and Raj Reddy received honorary degrees at gala

erosity of several corporate sponsors and campus organizations and attended by more than 400 visitors. "The event exceeded our expectations," remarked Michel. "I couldn't have asked for nicer weather for the Open House and Ribbon Cutting Ceremony. Visitors came away knowing more about the Department and feeling good about the quality of work that occurs within the building's walls." Visitors demonstrated their satisfaction with their many inquiries as to the date of the next open house.

In response, the Department is considering new ways to highlight its exciting ongoing work.

MEETINGS

18th Biennial Workshop on Color Photography & Videography in Resource Assessment



AMHERST, IN CON-
junction with the American Society for Photogrammetry & Remote Sensing (ASPRS), will host a workshop on airborne film, video, and digital camera systems and applications for natural resource assessment. Approximately 40 papers will be presented in non-concurrent sessions, covering a wide range of topics from biomass measurements and habitat classification to urban water use. In addition, there will be special presentations and discussion panels on four pivotal areas changing the nature of this work:

- **3D viewing and reconstruction as an analytical tool.** Desktop 3D GIS will become the principal way images are interpreted and integrated into databases. Demonstrations of commercial GIS and UMass software for constructing stereo mosaic strips from digital aerial video.

- **Automatic georeferencing and 'mosaicking.'** Papers and discussions will focus on new methods for using GPS and INS data to automatically register digital video mosaics to an Earth coordinate system.

- **Digital multispectral camera systems.** Representatives from the best of these will present their systems and host a round table discussion to provide a full range of the capacity and purchase options available.

- **The integration of airborne and satellite data.** The place of digital aerial camera systems in a world of one-meter space imagery, and the use of large scale frame sampling to both drive the classification and verify the results of satellite data.

This meeting will be of benefit to any researcher or natural resource manager who uses, or is considering the use of, these tools to monitor the landscape for forestry, conservation, municipal, or ecological purposes. The proceedings will be published on a CD-ROM, allowing a wide use of color illustration, animation, and examples.

The workshop co-chairs are Dana Slaymaker of the Department of Natural Resources Conservation and Howard Schultz of the Department of Computer Science.

See vis-www.cs.umass.edu/18Aerovideography

The Bay State Fellowship Program

Taking Advantage of the Opportunity

COMPUTER SCIENCE STUDENTS at UMass have a great opportunity to continue their studies. Since 1998, the Department's Bay State Fellowship (BSF) Program has enabled undergraduates who complete the program with a 3.50 overall GPA to pursue a masters degree tuition-free. These 'Bay State Fellows' may participate in the program for up to three semesters, although they may complete their degree in less time.

The fellowship includes at least a partial assistantship, with a small stipend and a waiver of most fees; many Fellows will be offered full teaching or research assistantships which pay \$5,000 or more per semester. Participating students are required to make a corresponding commitment to the educational or research mission of the Department.

Professor Robbie Moll, who directs the program, notes that it's difficult to become a well-rounded computer scientist in four years because the discipline is growing so rapidly. "Bay State Fellows have the opportunity to extend their education for several semesters, and they get paid to study."

He finds that the Department benefits in several ways. "It's been very helpful for recruiting strong high school students, who see BSF as a challenge to work for if they attend UMass. The Department also gets a proven collection of strong graduate students who are often invaluable as teaching assistants, since they know

our courses so well."

Current fellow Rachel Smith concurs. "The BSF was the biggest factor in motivating me to continue into graduate school and, in particular, UMass. I have self-financed my education, so the financial support freed me from having to work in industry before I could continue with school. Plus, the BSF guaranteed my acceptance into the master's program if my undergraduate GPA was high enough. That cinched it for me – the decision was easy." Her advice to other majors: "Take advantage of the opportunity!"

"As an Honors student, I had done a Departmental Honors project in software engineering, but I wasn't satisfied when I had to turn in the final report on it. My research assistantship has allowed me to continue with that project, and I have more confidence coming into graduate school with a project where I had already invested some time and energy."

Twelve students have participated in the program so far. Seven are currently enrolled, and four are expected to enroll in September 2001.

To be eligible for the program, an undergraduate must have actually completed the computer science degree, and must have taken at least 15 of the department's required 21 technical courses at the Amherst campus. Transfer students are also eligible to participate in the program.

For more information, visit www.cs.umass.edu/csinfo/uginfo/BSS.html

Faculty News

■ The Department welcomed **Weibo Gong**, Professor of Electrical and Computer Engineering, as an Adjunct Professor. ■ Professor **Neil Immerman** gave an invited talk in a special one-day NSF/CISE Workshop on the Unusual Effectiveness of Logic in Computer Science. See www.cs.rice.edu/~vardi/logic. ■ Professor **Jim Kurose** presented several Distinguished Lectures this year. He spoke at the University of Kentucky, Purdue University, Columbia University, RPI, and UC Irvine. ■ Professor **Brian Levine** is co-editing a special issue of the *IEEE Journal on Selected Areas in Communication* on multicast networking, together with Professor **Don Towsley**, Christophe Diot of Sprint, and Luigi Rizzo of the University of Pisa. He is also co-editing a special issue of *Computer Communications* on network security with Clay Shields of Purdue University. ■ Professor **Kathryn McKinley** has given the lecture "Improving Memory Performance for Java" at Carnegie Mellon University in December 2000 and as a CRA-W Distinguished Lecturer at the University of California, Irvine in February 2001. She also participated in a panel discussion, "Why go to graduate school?" with several women graduate students and a female Lucent researcher. ■ Professor **Krithi Ramamritham** gave the keynote talk at the Third International Conference on Information Technology in Bhuvaneshwar, India, December 2000. He also gave an invited talk at the DNIS 2000: International Workshop on Databases in Networked Information Systems, University of Aizu, Japan in December 2000. ■ During her sabbatical semester, mezzo-soprano and Professor **Edwina Rissland** completed a Performance Diploma

in Voice from the Longy School of Music in Cambridge, MA. She also served as a member of an outside evaluation team for the International Panel for review for the Institute on Autonomous Intelligent Systems, GMD- German National Research Center for Information Technology, Bonn, Germany, in February 2000 and gave a talk at the Sixth International Conference on Substantive Technology in Legal Education (SubTech 2000) held at the Harvard Law School and Kennedy School of Government in July 2000. Professor Rissland has also been appointed editor of a special issue of the *Artificial Intelligence Journal* on AI and Law. ■ Professor **Arnold Rosenberg** has become conference chair for the ACM Symposium on Parallel Algorithms and Architecture. The position will be either 2 or 3 years. Professor Rosenberg has also recently retired after twelve years as the editor-in-chief of the journal, *Theory of Computing Systems*. ■ Professor **Don Towsley** gave the keynote addresses this year at the Multimedia Information Systems Conference in Chicago, and the Quality of Service 2001 Conference in Rome. ■ Professor **Bill Verts** has published and republished several books including "Representing, Storing, and Retrieving Information" Harcourt Custom Publishers, (first edition), August 2000; (second 'slipstream' edition), January 2001; and "Computer Literacy Workbook" (seventh edition), Kendall/Hunt Publishing, August 2000. ■ Professor **Chip Weems** has written "Introduction to Java and Software Design," with Nell Dale and Mark Headington. Jones and Bartlett Publishers, 2001. ■ Professor **Shlomo Zilberstein** gave an invited talk, "Resource-Bounded Reasoning: New Directions and Opportunities,"

Professor Croft Receives ASIST 2000 Research Award

DISTINGUISHED UNIVERSITY PROFESSOR BRUCE CROFT has received the 2000 Research Award of the American Society for Information Science and Technology (ASIST). His nomination describes him as a scholar of the highest caliber; one of the most prolific contributors to the state of the art of information retrieval; a significant contributor to the general direction of the field; and a preeminent leader in the information retrieval community.



Croft

ASIST has been the leader for over 60 years in keeping information professionals on the cutting-edge. It provides high-quality and unique education and conference programs, highly-regarded publications and journals, and other professional services for information systems developers, on-line professionals, information resource managers, librarians, record managers, and others who bridge the gap between the present and the future, between research and application, and between developer and user. See www.asis.org.

at the National Institute of Standards and Technology (NIST) in June 2000. It was transmitted live via the Internet to another NIST center in Colorado and is available on their web site www.nist.gov.

Visitor News

Neil Berthier, a long-time collaborator with the Adaptive Networks Laboratory, is serving as a Visiting Professor within the Department. ■ **Miguel Garcia** has joined the Laboratory for Perceptual Robotics as Visiting Researcher. ■ The ALI group is fortunate to have as a visitor Professor **Richard Jones**, from the University of Kent at Canterbury, UK, for the months of February and June 2001. He is the co-author of the definitive book on garbage collection, entitled "Garbage Collection: Algorithms for Automatic Dynamic Memory Management." He is collaborating with

Eliot Moss, **Steve Blackburn**, **Kathryn McKinley**, and graduate students in the group. ■ **Michitaka Sekine** has joined the Center for Intelligent Information Retrieval as a Visiting Research Scholar. ■ The Architecture and Language Implementation Laboratory welcomed **Kim Shin-Dug** as a Visiting Professor.

Research News

Emery Berger has joined the Architecture and Language Implementation Laboratory as a Research Fellow. ■ The Center for Intelligent Information Retrieval welcomed **Stephen Cronen-Townsend** as a Senior Postdoctoral Research Associate. ■ **Yang Guo** joined the Computer Networks Research Group (CNRG) as a Senior Postdoctoral Research Associate. ■ The CNRG also welcomed **Vishal Misra** as a Senior Postdoctoral Research Associate.

Professor Shlomo Zilberstein received Lady Davis Fellowship

PROFESSOR SHLOMO ZILBERSTEIN has received a prestigious Lady Davis Fellowship to support his sabbatical at the Technion (Israel Institute of Technology) in Haifa. He is spending the 2000-2001 academic year in their Department of Computer Science conducting research with host Professor Shaul Markovitch, and teaching a graduate seminar in Artificial Intelligence. Professor Zilberstein's research interests are autonomous agents, decision theory, intelligent information gathering, real-time planning, and resource-bounded reasoning. "I am particularly pleased to return to my alma mater as a visiting professor," said Professor Zilberstein, who received his B.A. there in 1981.

The fellowship is endowed by the Lady Davis Fellowship Trust of Canada. It seeks to make the cultural heritage of Israel and its achievements in development, state-building, scholarship, science, and education widely available and known to people from all over the world.

Lady Davis fellowships are awarded for study at Israel's two leading academic institutions, the Hebrew University and the Technion, on the basis of excellence in achievement and promise of further distinction. They are open to candidates of every race, creed, nationality, and sex. Additional information about the program is available at sites.huji.ac.il/LDFT.

Professor Shenoy Receives Prestigious IBM Faculty Fellowship Award

IBM CORPORATION HAS AWARDED PRASHANT SHENOY its prestigious Faculty Fellowship Award, part of their University Partnership Program, for further research in Web Proxy Caching. This \$30,000 award will be used for the 2000-2001 academic year. Professor Shenoy's research interests include multimedia systems, operating systems, computer networks, and distributed systems.



Zilberstein



Shenoy

Graduate Student News

■ **Dan Bernstein**, of the Resource-Bounded Reasoning Research Laboratory, was selected to participate in the NASA Ames Research Center and the Research Institute for Advanced Computer Science Summer Student Research Program. ■ **Bill Hesse**, of the Theoretical Computer Science Group, presented a paper, "The Dynamic Complexity of Transitive Closure is in TC₀," in Proceedings of International Conference on Database Theory (ICDT). ■ The Best Student Paper Award was given to **Mia Stern** (and co-author Professor Bev Woolf) at the International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems. The paper is entitled "Adaptive Content in an Online Lecture System." ■ **Dan Rubenstein** received the Best Student Paper award at the

2000 ACM Sigmetrics Conference. The paper was co-authored with his advisors, Jim Kurose and Don Towsley.

Staff News

Alvaro Bolivar has joined the Center for Intelligent Information Retrieval (CIIR) as an Associate Software Engineer. ■ **Ronnie Boss**, grant administrative assistant, retired from the Laboratory for Advanced Software Engineering Research (LASER) after 10 years. ■ The Computer Science Computing Facility welcomed **Deborah Cahillane** as an Associate Software Specialist. ■ The Department welcomed **Laurie Connors** and **Matthew Farrell** as Main Office Administrative Assistants. ■ **Andre Gauthier** has joined the CIIR as an Associate Software Engineer. ■ The Experimental Knowledge Systems Laboratory welcomed **Andrew Hannon** as an Associate

Staff Programmer. ■ **David Hart** (CCBIT) and **Alan Peterfreund** (Peterfreund Associates) gave an invited talk entitled "Re-evaluating the Evaluator" at the annual FIPSE Project Directors Meeting, San Diego, CA, November 16-19. ■ **Leslie Marsland** joined LASER as Grant Manager. ■ The Center for Computer-Based Instructional Technology welcomed **Matthew Mattingly** as its Multimedia Supervisor. ■ **David Pinto** joined the CIIR as a Software Engineer. ■ **Karren Sacco** was welcomed as the Grant Manager for the Theoretical Aspects of Parallel and Distributed Systems Laboratory. ■ The Multimedia Asynchronous Networked Individualized Courseware Group welcomed **Kenneth Watts** as Senior Software Engineer.

Alumni News

Kevin Ashley (Ph.D. '87), a Professor at the University of Pittsburgh, is co-editor with Professor Rissland of a special issue of the *Artificial Intelligence Journal* on AI and Law. ■ **Edmund Durfee** (Ph.D., '87) was recently promoted to full professor at the University of Michigan and was general chairman of the International Conference of Multi-Agents. ■ **Tuomas Sandholm** (Ph.D., '96), recently was appointed an associate professor at Carnegie-Mellon University. Sandholm was the 2001 winner of the SIGART Autonomous Agents Research Award, intended to recognize researchers whose current work is an important influence on the field. He will give a lecture, "Agents in Combinatorial Markets," at the 2001 International Conference on Autonomous Agents.



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Significant Bits

NEWSLETTER of the
DEPARTMENT OF COMPUTER SCIENCE
at the UNIVERSITY OF MASSACHUSETTS, AMHERST

140 Governors Drive
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External Relations Director/Writer Marla S. Michel
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Contributors Elizabeth Luciano, Laura MacKay,
J. A. Roberts, Howard Schultz, Photographic Services

GIFTS

Thanks for your support

THE FOLLOWING ALUMNI AND FRIENDS have actively supported the Department of Computer Science from February 2000 through January 2001. Such financial support is greatly appreciated and helps maintain a world-class instructional and research program. Contributions of alumni and friends help to fund important special activities that are not supported through the state budget.

Those interested in helping the Department should send a check made out to the University of Massachusetts to:
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