University of Massachusetts Amherst

Spring 2005

Significant BITS

Newsletter of the
Department of Computer Science

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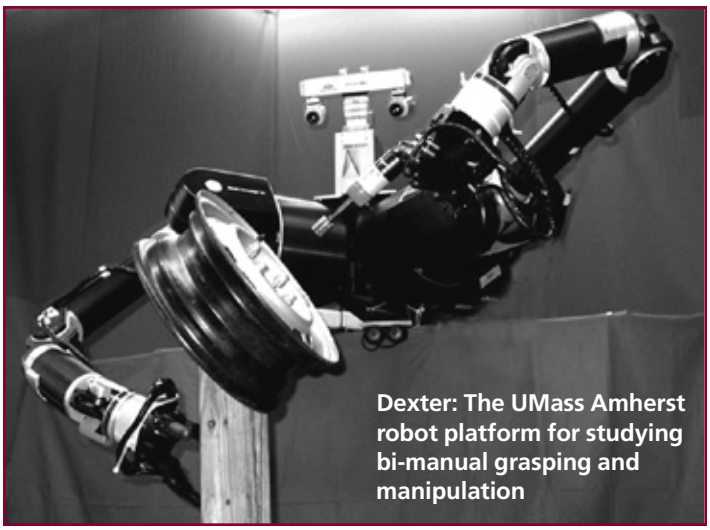
SAVE THE DATE

Computer Science Homecoming

Friday, October 14, 2005

www.cs.umass.edu/homecoming



Dexter: The UMass Amherst robot platform for studying bi-manual grasping and manipulation

Grasping the World:
Grupen creates the basis for robots with manual dexterity

The last twenty years have witnessed a dramatic increase in worker productivity derived from the large scale dissemination of electronic information. Information sources are now distributed globally and are becoming more and more personalized from the perspective of the user. The future, however, presents additional challenges that information alone can't address – they involve a similar distributed projection of mechanical work to remote locations – for disaster relief, agriculture, logistics and material transport, health care, and exploration. On the other hand, robotics researchers world-wide are pushing robot technology in remarkable ways; to nanotechnology and minimally invasive microsurgery, to autonomous planetary exploration, and humanoids. Together, technologies for archiving and disseminating information and accomplishing mechanical work promise to improve productivity even more. Professor Rod Grupen and researchers in his Laboratory for Perceptual Robotics are studying the nature and role of knowledge acquisition in human behavior to create the basis for robots with manual dexterity.

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Corner receives NSF CAREER award

Assistant Professor Mark Corner has received a five-year National Science Foundation (NSF) CAREER award for 2005 for his proposal "Systems Support for Data Management in Mobile Devices." The Faculty Early Career Development (CAREER) Program offers the NSF's most prestigious awards for new faculty members.

"The number of mobile devices is on a rapidly increasing trajectory, including millions of Bluetooth and WiFi enabled devices such as cameras, personal digital assistants (PDAs), cell-phones, and music players," says Corner. "Along with this growth comes a data management nightmare: systems frustrate users with the lack of availability of data, complications in transferring data from one device to another, and limited battery lifetime."

With his CAREER award, Corner is working on designing and building mobile sys-

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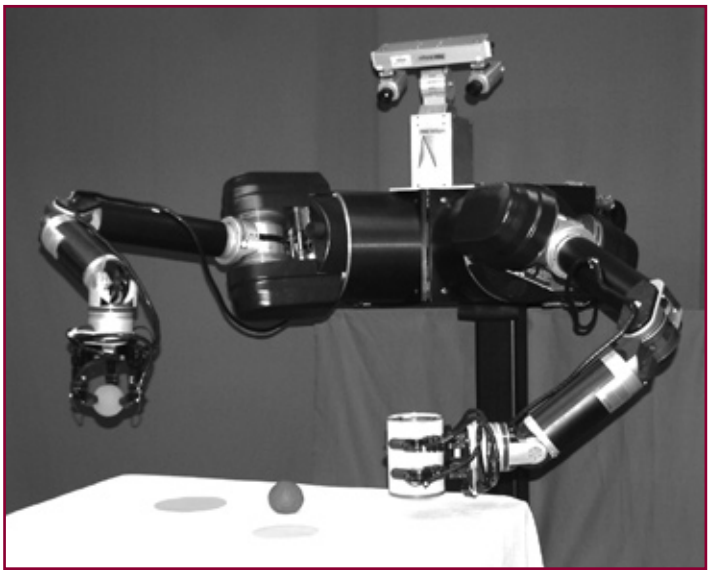
RESEARCH



Grasping the World *(from page 1)*

Service robots aim to integrate information and work. General purpose service robots could, for example, act as physical and cognitive assistants for health care clients in assisted living contexts. This technology would ease the burden on the health care community and might allow elderly clients to remain independent and live in their own homes for longer periods. "To get there, we need to develop new robot technologies that interact manually with objects, adapt to tasks and operating conditions, that *imprint* on their respective clients, and that exploit the information network," said Grupen. This effort is producing technology that incorporates new insights from biological systems while simultaneously helping to advance theories in psychology, neurology, neuroscience, social, and behavioral sciences.

Manual skills and dexterity appear to be a technological linchpin for many of the proposed applications. Part of the answer requires innovation concerning computational models of biological knowledge systems. "Robots need rich world models that, once learned, support a whole lifetime of future problem solving," noted Grupen. This is sometimes known as common sense – a domain general understanding that can be brought to bear in many related situations. This is likely the answer we need to get robots out of highly structured (factory) environments and into natural, messy domains. Such a framework would come in handy for a robotic mission to save the Hubble space telescope, for example. When the bolts and hinges, pins and doors do not function as designed, the robot must be able to rely on what it already knows to compensate – cleaning, jerking, or jiggling as appropriate.

Grupen and his students are asking some challenging questions: how manipulation "gaits" move objects through constraints related to the morphology of the robot; how can a robot learn to manipulate using *all* the surfaces of its body; how do the constraints imposed by tasks influence a grasping and manipulation strategy; and how does one "program" a comprehensive manual skill in robot systems.

Their approach uses results from control theory to propose a useful set of analogs to biological reflexes to help manipulate objects. They have used motor primitives like these to reach and grasp, to walk with legs, to assemble simple objects, and to coordinate the activity of several robots. For details, publications, and videos illustrating the kind of behavior one can achieve using these ideas, see **www-robotics.cs.umass.edu**.

Grupen has undergraduate degrees in physics and mechanical engineering. After receiving his undergraduate degrees, he worked as a design engineer with General Electric for 3 years and then returned to graduate school for a Master's degree in Mechanical Engineering. Grupen received his Ph.D. in Computer Science from the University of Utah in 1988 working on issues surrounding the control of dexterous hands. He joined the UMass Amherst Department of Computer Science, where he is now a Professor and Director of the Laboratory for Perceptual Robotics. Grupen is an associate editor of *Artificial Intelligence in Engineering Design and Manufacture* and the *Journal of Robotics and Autonomous Systems* and is currently teamed up with colleagues at MIT and NASA's Johnson Space Center to create robots capable of autonomous manipulation.

Digital Government study calibrates conflict resolution

"Conflict resolution" sounds inherently dramatic, the stuff of wars and messy divorces, a process full of grand-standing tactics by showboating participants who hope for victory, not compromise. In reality, says Digital Government researcher Leon Osterweil, most disputes are resolved through disciplined negotiation or mediation processes. It's all about details, not drama.

The settling of disputes is, after all, a legal process. As such, there are deadlines, documents, and other administrative necessities that must be adhered to. The "what if" that Osterweil, Professor of Computer Science and Dean of the College of Natural Sciences and Mathematics, and his co-PIs, Ethan Katsh, UMass Amherst Professor of Legal Studies and co-Director of the Center for Information Technology and Dispute Resolution, and Norman K. Sondheimer, UMass Amherst Isenberg School of Management Dean's Executive Professor and co-Director of the UMass Amherst Electronic Enterprise Institute, have set out to answer is whether or not some of the routine requirements of the process can be automated.

"Human creativity, such as that which is required in effective dispute resolution, has to be supported by more pedestrian things, such as precise record-keeping, filing, and communication. As these are relatively more tedious, people tend to shortcut them," says Osterweil. "The disciplined and careful use of technology could handle such tedious, but critical, chores, freeing humans to concentrate on the more

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NEWS

Kurose elevated to rank of Distinguished Professor

The UMass Board of Trustees recently approved the appointment of Jim Kurose to Distinguished Professor of Computer Science.

Kurose has made pioneering and sustained contributions to the design and analysis of network protocols and architectures, particularly for supporting multimedia communication, quality-of-service, and multicast communication. He was elected a Fellow of the IEEE (Institute for Electrical and Electronic Engineers) in 1997 and a Fellow of the ACM (Association for Computing Machinery) in 2002.

Kurose's effective and popular classroom teaching has been recognized with the National Technological University's Outstanding Teaching Award each year from 1988 through 1998. He received the UMass Amherst College of Natural Science and Mathematics Outstanding Teaching Award in 1995, the prestigious Outstanding Teaching Award of the Northeast Association of Graduate Schools in 1996, and a Lilly Teaching Fellowship in AY 93-94. For his educational endeavors, Kurose has been awarded the 2002 Taylor Booth Award, the highest award in education given by the by the IEEE Computer Society.

Corner ..... *(from page 1)*

tems that address power management, variable connectivity, and usability concerns. He will address the power management issue in always-on devices by using connected low-power embedded subsystems. This will enable the mobile devices to efficiently enter low-power modes to provide data transfer opportunities. Second, because many devices frequently disconnect from their peers, it is necessary to use third party devices to transfer data updates. Using techniques from distributed file systems, as well as disruption tolerant networking, Corner's research involves building systems that take advantage of mobility to transfer data between normally disconnected devices. Third, efficiently transferring data using mobile devices requires efficient operating support for storing carried data. Corner is building a non-persistent, non-interfering file system that can store large amounts of data in the free-space of storage systems. This removes one of the disincentives for providing resources to network peers.

Corner is conducting many of these initiatives in collaboration with other faculty members, not just within the Department, but also through an external collaboration with Mount Holyoke College. It is through that collaboration that Corner hopes to encourage more female undergraduates from the Five College system to attend graduate school, either at UMass Amherst or at other institutions.

Corner joined UMass Amherst in 2003 after receiving his Ph.D. in Electrical Engineering Systems from the University of Michigan. He co-directs the Privacy, Internetworking, Security, and Mobile Systems Lab (PRISMS) with Assistant Professor Brian Levine. His current research focuses on the performance, security, and usability of mobile computing systems. He has also made contributions in the areas of adaptive multimedia systems and broadband networking.

McCallum new Lilly Fellow

Associate Professor Andrew McCallum has been selected as a UMass Amherst Lilly Teaching Fellow for the 2005-2006 academic year. For his Lilly project, McCallum will create a new course on natural language processing (NLP) that will attract both computer science and linguistics students. "By integrating both types of students, the course will enable new synergistic learning opportunities that would not be possible otherwise," said McCallum.

He explains that the marriage of these two skill-sets is becoming increasingly interesting. The study of natural language processing has been experiencing a sea change over the past five to ten years, wherein the integration of linguistics with highly sophisticated computer models is yielding new capabilities and discoveries. "For example, in computer science, automated machine translation from one language to another has become viably accurate just in the past few years, thanks to new advances in both statistical parameter estimation, and linguistic parsing techniques," added McCallum. "In linguistics, new discoveries about how ancient Mayan languages were pronounced are being made thanks to the use of sophisticated computer models of ancient and modern writing systems."

As a result of the Lilly project, McCallum looks forward to creating new ties between two world-class departments that have unfortunately been largely disconnected in the past.

McCallum joined UMass Amherst in 2002 and is currently an Associate Professor and Director of the Information Extraction and Synthesis Laboratory (IESL). The main goal of his research is to dramatically increase our ability to mine actionable knowledge from unstructured text. He is especially interested in information extraction from the Web, understanding the connections among people and between organizations, expert finding, social network analysis, and mining the scientific literature.

Previous Lilly Teaching Fellows in the Department include Brian Levine (2003-2004), Prashant Shenoy (2001-2002), James Allan (1999-2000), Ramesh Sitaraman (1996-1997), David Mix Barrington (1994-1995), Jim Kurose (1993-1994), and Eliot Moss (1991-1992). The Program is run by the UMass Amherst Center for Teaching (CFT).

RESEARCH

Founding of Bioinformatics Research Lab marks new academic initiative

The sequencing of the human genome undoubtedly represents an important scientific milestone in the history of mankind. This accomplishment was made possible by the synergistic use of methods from computer science and biology, illustrating the importance and potential impact of research in the area of bioinformatics. The Department of Computer Science is recognizing this importance by founding the Bioinformatics Research Laboratory, currently consisting of three faculty members, UMass Amherst Assistant Professors Oliver Brock and David Kulp and Smith College Professor Ileana Streinu. In addition, seven faculty affiliates from four departments, one postdoctoral researcher, and five graduate students contribute to research activities spanning a number of subfields of bioinformatics, such as gene finding, resequencing, regulatory networks, remote homology, protein structure prediction, and protein docking.

In an attempt to initiate and facilitate inter-disciplinary research initiatives and training at the interaction of computational sciences and life sciences, Kulp initiated the Systems Biology group (**sysbio.cs.umass.edu**), a five college-wide organization concerned with research and training in the computational aspects of biological systems. Systems biology addresses the study of complex biological phenomena by means of interdisciplinary activities in computer science, mathematics, statistics, and engineering. The group promotes research and training in diverse sub-disciplines such as bioinformatics, computational neurobiology, and metabolic engineering. This initiative has met with significant interest from academia and industry. "The systems biology email list informs about 250 researchers and practitioners about lectures, events, research initiatives, and funding opportunities," said Kulp.

To foster interactions between academic bioinformatics initiatives and industry, the Western Massachusetts special interest group (SIG) in bioinformatics, computational biology, and systems biology was formed in early 2005. This group is intended to facilitate academic-industry partnerships and outreach to the larger community in and near the Pioneer Valley. The organization of this SIG is supported by the Bioeconomic Technology Alliance, which is part of a Western Massachusetts technology alliance, and by the UMass Amherst Office of Industry Liaison and Economic Development (ILED). "The expectation for this nascent group is to serve as a networking organization to facilitate inter-disciplinary and cross-culture (academic/industry) relationships," said Brock. "We plan to regularly present bioinformatics-related topics of mutual interest to academic and industry participants and to support activities such as internships, research collaborations, small business grants, and business start-ups." About 50 people from academia and industry attended an organizational meeting held in March 2005.

"These initiatives only mark the beginning of a focused effort in our department to develop scientific leadership in the area of bioinformatics," added Kulp. For more information about the ongoing research in the Bioinformatics Research Laboratory, please see **brl.cs.umass.edu.**

Folding origami, robot arms, and proteins

Smith College Computer Science Professor Ileana Streinu and UMass Amherst Computer Science graduate student Audrey Lee are investigating questions in computational geometry falling under the general heading of "folding and unfolding" problems. Streinu and Lee's work, a joint project with Stanford University, is sponsored by the National Science Foundation and DARPA under the CARGO program (Computational and Algorithmic Representation for Geometric Objects) on a three-year grant titled "Folding and Unfolding Processes for Polygonal Linkages, with Applications in Biology."

This collaboration includes a project on "Single Vertex Origami" founded on a result by Streinu and Walter Whiteley in which the following problem is considered. Given a three-dimensional object obtained by a sequence of simple folds, all meeting at a single point or vertex, what is the folding process that produced the final object? "The problem of general origami folding patterns is very complex and currently not very well understood," said Streinu. "The single vertex case is one of the few with a precise mathematical and algorithmic basis."

Currently, Streinu and Lee's research is motivated by problems facing the biology community. Protein docking is one such problem, where the goal is to "dock" one protein to another protein or ligand. The main application of protein docking is in the domain of drug design. For instance, if a target drug could be found to dock to the HIV-protease protein, its function could be inhibited. However, proteins can be comprised of thousands of atoms, making it a very difficult computational problem to accurately predict their behavior. "We are developing algorithms using rigidity theory to effectively model the flexibility inherent in protein structures," said Lee. "Such models reduce the amount of computation required to investigate protein behavior." Streinu and Lee are also collaborating with Assistant Professor Oliver Brock on developing a framework that relies on techniques from robotics to approach the protein docking problem.

"These collaborations promise exciting new research in theoretical as well as applied directions," said Streinu.

Undergraduates save Incan treasure in robotic competition

To the North of Cuzco, the capital of the ancient Incan empire, lies an elaborate maze, called Sacsayhuaman. This maze is the setting for a robotic competition, which was held as part of this year's undergraduate introductory robotics class taught by Assistant Professor Oliver Brock. Five teams spent an entire semester programming small mobile robots, incrementally improving the robots' skills in navigating known and unknown environments. During the competition, which also served as the final project for the class, robots competed in the maze to pick up Incan gold treasures. Instead of flying our undergraduates to Peru, the maze was recreated in the Department's Laboratory for Perceptual Robotics in the Lederle Graduate Research Center and golden bows replaced the Incan treasures. About 75 spectators from all over campus were present as team Scorpion, consisting of Scott Myers, Matt Edwards, Krida Karnchanachari, and Phuoc "Trong" Chu, collected Incan treasures from the maze faster than anybody else, winning the competition and saving the Incan Treasure.

This class, which in its current form was taught for the first time in fall of 2003, gives students an appreciation for the importance of theoretical concepts when solving real-world problems. "In the classroom, students learn about kinematics, dynamics, control, motion planning, computational geometry, and probability theory," said Brock. "Then, they immediately apply these concepts in practical exercises using the robots. In the context of robotics, theoretical concepts translate into motion, illustrating the underlying principles and keeping students interested." During the semester, the students wrote software that enabled the robots to perform rather sophisticated tasks in a maze-like environment. Without a solid understanding of the underlying theoretical concepts, these tasks would have been unachievable. According to Brock, another critical ingredient for success in this class is team work. The kind of creativity and coordination required to succeed in this class forces students to think and work as a team, building on each other's strengths and helping each other to overcome the challenges of real-world applications.

(I to r) Phuoc "Trong" Chu, Krida Karnchanachari, Matt Edwards, Scott Myers, and Assistant Professor Oliver Brock.

As part of the Department's investment in undergraduate education, Department Chair Bruce Croft provided the funds to purchase the mobile robots, without which this class would not have been possible, added Brock.

Conflict resolution *(from page 2)*

interesting and creative tasks." Further, Katsh asks, could online dispute resolution yield benefits that are unobtainable in face to face meetings?

To answer those questions, Osterweil, Katsh, Sondheimer, and their collaborators have partnered with Dan Rainey of the National Mediation Board to design a prototype online dispute resolution system. The project will both be a test of technology applied to dispute resolution and a way to closely analyze the process of dispute resolution itself.

The team's approach on this project is based on the use of Little-JIL, a graphical process programming language, created by Osterweil, who can be considered the father of process programming. His paper describing the concept was presented at the ACM's 9th International Conference on Software Engineering in 1987. Ten years later in a conference retrospective, it would be awarded the title "Most Influential Paper."

Osterweil contrasts true process programming from the familiar flow charts used in management. Process programming focuses on such issues as exception management, resource utilization, and coordination of parallel activities, most of which are awkward or impossible for flow charts. Flow charts can't truly model processes because, among other things, "They tend to depict the world as if things don't go wrong," says Osterweil. Production flow charts, for example, optimistically list things like, "Text to Graphics on March 1. Graphics to Production on March 21." They never say, "Graphics to Production on March 21, unless our designer breaks her wrist, in which case ..."

A process programmer must know how to reason about processes and focus on just these sorts of exceptions to define precisely how to prepare for unanticipated problems, says Osterweil. "The choreography of that is complicated and not something you can depict with a flow chart."

By contrast, Little-JIL was conceived with exception management as part of its structure. "This NMB project will entail programming processes that are expected to have a really dazzling variety of exceptions, thus providing an important experimental evaluation of the Little-JIL language semantics," says Osterweil.

From a computer scientist's point of view, Osterweil looks forward to validating whether the Little-JIL language is effective in various domains. There have been many experiments with process technology, explains Katsh, but it's never before been studied systematically. He finds this project particularly exciting because, "It brings together computer scientists, social scientists, a lawyer, and someone from our school of management to apply all of our expertise to one area of government."

This is an edited version of the article written by Karen Heyman for the Digital Government Research Center and provided by *dgOnline*, the Monthly Newsletter of Digital Government Research. The complete article can be found at **http://digitalgovernment.org/dgonline**

University of Massachusetts Amherst

Spring 2005

Alum Matters

A newsletter for alumni of the Department of Computer Science

Anandan leads Microsoft Research India

Dr. Padmanabhan Anandan (Ph. D. '87) has recently been named managing director of Microsoft Research India. Inaugurated on January 12, this newest Microsoft Research facility will carry out basic research in computer science, with its initial focus on technology for emerging markets and underserved communities in the fields of multi-language computing systems, sensor networks, and geographical information systems. A central issue being explored in the lab, and one in which it is well positioned to answer, is the basic question of how information technology can be made "accessible, affordable, and relevant" to the rural populations of emerging markets such as India.

One project that Microsoft Research India is already participating in is rural information technology (IT) kiosks. The emerging markets group, expected to be the largest group of the lab, has partnered with a number of organizations in India and in several African countries in an effort to assess the real computing needs of rural villagers and to determine the efficacy of rural computing kiosks. Given the prohibitive cost to the villagers for purchasing a computer, these kiosks often serve as the only way rural villages can benefit from information technology. Recognizing this, the project also aims to uncover the socio-economic concepts underneath information technology as we know it today, and is working with ethnography experts as well.

There are literally hundreds of rural IT kiosk projects in India representing the joint ventures of dozens of companies and research organizations. Anandan estimates that there are probably 6000 to 8000 individual kiosk stations in India alone, and there are projects going on in various African countries as well. Typically, the kiosks are comprised of one or more computers housed in a community building, with a designated operator assisting people with the computers' use. Some type of connectivity is usually provided, and with it comes access to potentially valuable information such as grain markets and farming equipment company websites. Often, the kiosks also serve as a place for children to receive informal computer training.

Twelve year old boy learning to type in a kiosk.

There are various models for the kiosks, from those completely funded by private corporations or government agencies to those that are entirely commercial, and subsist by charging for hourly usage, or by charging the kiosk operator to perform certain tasks. The emerging markets group, which is led by the Assistant Managing Director Kentaro Toyama is in part trying to assess which model would work best for the computing needs. One thing that has become immediately clear from this research, said Anandan, is that the success of a kiosk depends a great deal on the training the kiosk operator has received.

Kiosk near Chennai, India.

Anandan has a very simple view of how to make an excellent research facility. "The best way to build a lab is to find good people for research and let them do problems they want to work on." He quips, "it's better to hire someone good and listen to them than to hire someone who's not good and tell them what to do." The Microsoft labs in general tend to be very much like academic departments, he said, and are very casual without much hierarchical management structure. With little pressure from the higher-ups to direct research, unlike most corporate labs, there is a great deal of personal freedom here.

After graduating from UMass Amherst, Anandan worked as an assistant

professor of computer science at Yale University, and built the computer vision group from the ground up. Then he had the opportunity to join forces with another UMass Amherst alumnus, Peter Burt (Ph.D. '76), at Sarnoff Corporation. Anandan worked as a research manager there, directing projects in airborne video surveillance and video stabilization technology.

Anandan left Sarnoff to join Microsoft where he served for seven years as a senior researcher in the Microsoft Research headquarters in Redmond, Washington. There he worked primarily in the areas of computer vision and video processing, the former being the subject of his Ph.D. research at UMass Amherst in the computer vision laboratory. Although these days he is not working in the area of his thesis directly, Anandan said that his time at UMass Amherst was an excellent preparation for him because of the responsibilities given to him by his advisors, Professors Ed Riseman and Allen Hanson. "Ed and Al gave me opportunities for leadership at a very young stage of my career," said Anandan. "They were very generous advisors." Even during his thesis work, Anandan began advising some of the more junior members of the lab. "By the time I finished my Ph.D., I felt like I had done much more."

Anandan recalls his UMass Amherst days fondly, remembering daily walks that he and his wife would take around the campus pond. Even in the winter, they would walk along the pond to the COINS department building, and his wife would say that the ducks weren't quacking but actually laughing at them. Asked about the reason for his success, Anandan replied that his wife would say he is just good at bringing out the best in the people around him.

Having been in both industry and academia, Anandan is in a unique position to comment on the differences between the two. He first qualified his industry experience as perhaps different from most because he was able to set his own agenda, and so it was a lot like academia. However, he noted that in a campus setting one constantly interacts with students, or as he put it, "fresh minds," which can invigorate or inspire research. The benefit of industrial research is that you can impact many people's lives through the product(s) the company makes. This benefit, however, can also limit one's efforts, as the research you conduct must be relevant to the business.

(l. to r.) P. Anandan, managing director of Microsoft Research India; Kapil Sibal, Minister of State for Science and Technology, and Ocean Development for the Government of India; and Rick Rashid, senior vice president, Microsoft Research, at the Microsoft Research India inauguration. Minister of State Sibal inaugurated the operations by unveiling a plaque at the opening ceremonies for the facility.

More information about Anandan's recent post as managing director can be found at **research.microsoft.com/aboutmsr/presskit/anandan/** and more information about Microsoft Research India can be found at **research.microsoft.com/aboutmsr/labs/india/.**

Save this Date

Computer Science Homecoming
Friday, October 14, 2005
www.cs.umass.edu/homecoming

Alumni Connections

Dr. Tom Wagner (Ph.D. '00) is serving an appointment as a Defense Advanced Research Projects Agency (DARPA) Program Manager in the Information Processing Technology Office (IPTO). While Wagner was Principal Research Scientist in the Advanced Applications Laboratory at Honeywell Laboratories, he collaborated with Professor Victor Lesser, his Ph.D. advisor during his years at UMass Amherst.

Michael Zyda (M.S. '78), a noted interactive game creator and theorist, joined the University of Southern California's Viterbi School of Engineering. He shares appointments at the Viterbi School's Information Sciences Institute (ISI) as Director of the GamePipe Laboratory and also at the Integrated Media Systems Center (IMSC), where he serves as an Associate Director and major thrust leader. The GamePipe Laboratory undertakes research and development in all aspects of interactive games. Zyda has created several highly successful games for the American military, including "America's Army" in his role as originator and director of the MOVES Institute at the Naval Postgraduate School in Monterey, California, as well as researching many basic aspects of interactive media. He has a D.Sc. in computer science from Washington University in St. Louis, and in 2003 was named a National Associate of the National Academies, in recognition of "extraordinary service."

Dan Suthers (Ph.D. '93), Associate Professor of Information and Computer Sciences at the University of Hawaii at Manoa, spent over a month on the National Oceanic and Atmospheric Administration (NOAA) research vessel conducting a scientific expedition to the Northwestern Hawaiian Islands. As part of the Education and Outreach team, Suthers documented the research and monitoring efforts as science writer for the expedition. More on the expedition and Suthers' journals can be viewed at **hawaiianatolls.org/research/NWHIRAMP2004/.**

Alden DoRosario (M.S.'04) left a senior research engineer position at Terra Lycos to co-found Chitika, Inc., a contextual advertising provider. Chitika offers unique one-stop-shop contextual advertising services that combine the strengths of multiple pay-per-click advertising networks into one, simplifying ad placement and revenue generation for clients.

CENTERS

OWL: a commercial success in chemistry

OWL is advertised as a powerful learning supplement on Thomson's instructor website.

Chemistry students across the country are now facing what UMass Amherst students have faced for eight years: online homework assignments administered and graded by the Online Web-based Learning system (OWL). Developed by UMass Amherst chemists in collaboration with computer scientists in the Center for Computer-Based Instructional Technology (CCBIT), OWL has been licensed to Thomson Learning for use in chemistry departments nationwide with their popular line of chemistry textbooks. Last year over 35,000 students at more than 100 schools bought OWL access cards shrink-wrapped with their Thomson textbooks. "This successful commercial venture has been over five years in its development, but is now paying dividends as OWL is recognized as the leading product of its type for chemistry homework and the number of users continues to grow," said CCBIT Executive Director David Hart.

Over the last nine years, use of OWL has spread to over 20 departments at UMass Amherst and is used by 20,000 seats each year (a "seat" is the use of OWL by one student for one class), or roughly 20% of the homework in first and second year classes.

Thomson Learning, one of the major college textbook publishers, licensed OWL for use with its general chemistry texts in 2000. After a successful pilot year in 2001, use of the system has tripled each year to the more than 35,000 users in 2004. The number of institutions who continue to use OWL after its initial adoption is 99%. The success of the general chemistry version has led Thomson to license additional OWL applications for preparatory and organic chemistry. Expansion to support high school and refresher courses is also planned.

CCBIT staff have worked closely with Thomson and with the chemistry authors at UMass Amherst to make this licensing arrangement a success. CCBIT provides technical support for the Thomson OWL system, which runs on Thomson servers, and develops new features required by Thomson's users. CCBIT also continues to be a catalyst for new feature development as it integrates innovative OWL advances growing out of campus collaborations into the Thomson system.

The chemistry version of OWL emphasizes mastery learning, where students work on problem sets in which they must correctly answer a certain percentage of the questions in order to pass. If they don't pass, they are allowed to retry the assignment repeatedly on different problem sets until they do. Each time a student tries a problem, the system shows the correct answer and a constructive, highly detailed body of feedback written by the chemistry authors about how the problem should be solved. Through repeated trials and high-quality feedback, students master new concepts and new problem solving skills as they use OWL.

Chemistry OWL also features extensive use of multimedia simulation and tutorial activities developed by the chemists themselves. These interactive learning tools enhance students' understanding of the materials and provide critical scaffolding for students who grew up in the Internet age and find this a comfortable learning modality.

The Computer Science Department has used OWL for the last four years in the Introduction to Java Programming and Data Structures courses. Professor Robert Moll is principal investigator on a large NSF curriculum development grant to the Department supporting the development of OWL homework assignments. Under the grant, OWL has been adapted to compile and evaluate Java code, allowing instructors to write questions that require the submission of code for the answer. This powerful feature has attracted the attention of the computer science division of Thomson Learning, which is currently negotiating with Computer Science and CCBIT to license CS OWL for its textbook line in Java, C++ and other books. This partnership would push the paradigm of OWL to make it a completely online, assessment driven textbook.

CKC wins Verizon award for *Wayang* customization

The Verizon Foundation awarded Beverly Woolf, Research Associate Professor and Director of the Center for Knowledge Communication (CKC), a grant to support the customization of the *Wayang Outpost* tutor to better align with the Massachusetts K-12 mathematics curriculum framework as well as to expand the content coverage over the whole framework. *Wayang* is an intelligent, multimedia tutoring system that prepares students for the high school geometry portion of the Scholastic Aptitude Test (SAT).

Developed under the National Science Foundation's Gender Equity Program, *Wayang* uses animation and multimedia to teach girls effective problem solving strategies for the geometry portion of the SAT test. *Wayang* teaches mathematical reasoning within the context of endangered species preservation, an enticing motivator. Boys also find *Wayang* helpful. Recent studies in two area high schools found 20% and 8% increases in all students' performance after only three or four hours use of the tutor. Psychology Professor Carole Beal and CKC's Dr. Ivon Arroyo are co-investigators in this project.

While Wayang is focused on the national SAT test, teachers in Massachusetts are increasingly focused on the statewide standardized Massachusetts Comprehensive Assessment System (MCAS) mathematics test that 10th grade high school students must pass to graduate. With the Verizon award, expansion of the *Wayang* tutor to align it with the Massachusetts framework will increase *Wayang*'s appeal for local math teachers, said Woolf.

CITI: Towards a seamless K-20 program of information technology education

The Commonwealth Information Technology Initiative (CITI) is bringing together K-20 (elementary, secondary, post-secondary, and post-graduate) institutions, industry, and government in a partnership to insure that all Massachusetts students are IT fluent and prepared to thrive in a knowledge-based economy. Several facets of CITI make the project unique: the strong partnerships it has created, the large number of supporters who give their time to CITI and its goals, and its emphasis on Information Technology Across the Curriculum (ITAC).

CITI represents a coalition of 28 public higher education institutions, the six preK-16 regional networks established by the Board of Higher Education Pipeline Fund, a number of Massachusetts-based corporations and industry associations, and government agencies. CITI is addressing both the traditional technical programs in computer science, computer engineering, and information systems and ensuring *fluency* in the concepts, tools and capabilities of IT for graduates in all disciplines. Beginning this year CITI expands its scope to include K-12 education.

Founded in 2000, CITI was initially led by Computer Science Professor Jim Kurose and UMass Amherst Engineering Dean Joe Goldstein. After a two year funding hiatus, the project was revived in late spring 2004 with support from the Board of Higher Education and an anonymous private donor. Now led by the Department of Computer Science and School of Education at UMass Amherst, CITI is working toward a unified model of K-20 information technology education that meets the workforce needs of Massachusetts. Computer Science Professor Rick Adrion and Education Dean Andy Effrat are co-directing the renewed and expanded CITI. Jim Kurose and Joe Goldstein remain active advisors.

CITI began with a mandate to improve computing and information systems (CIS) programs across the 28 public community colleges, state colleges, and University campuses. CITI sought input from a broad set of stakeholders, developed a statewide partnership led by UMass Amherst, and focused on new curricula and programs, teacher development, and regional cooperation. It also supported the creation of 170 new or enhanced CIS and ITAC courses, the development of 26 online courses, the founding of five ITAC programs (minors and certificates), and the expansion, revision, and/or accreditation of many CIS programs across the 28 campuses. CITI sponsored sixteen professional development workshops and tutorials for higher education faculty and several statewide conferences and symposia. With new funding, CITI seeks to expand and institutionalize these programs and curricula, expand its partnerships to the full K-20 spectrum, reach out to underrepresented groups and women, and continue to enhance the quality of information technology training.

Extending the CITI programs to K-12 education is perhaps the biggest challenge. K-12 teachers, students, parents, and administrators are faced with a number of barriers: the pressures brought by accountability to standards and curriculum frameworks (and the accompanying high-stakes testing), the difficulty of maintaining IT infrastructure and technical support, and the many financial and social problems that beset public K-12 education. Also there is confusion about the role of IT: IT as infrastructure; IT as a medium for delivering curricula and content; or IT as a new "fundamental" with which graduates must be fluent if they are to succeed in higher education or in the workplace The CITI "seamless" K-20 strategy begins with forming a consensus among K-20 stakeholders (offering conferences and workshops), influencing public policy (promoting IT as the "T" in Science, Engineering, Technology, and Mathematics frameworks and testing, supporting the International Society for Technology in Education standards, advising on teacher licensure), pre-service teacher preparation (incorporating IT fluency in teacher education), professional development (sponsoring content institutes and in-service teacher training), and K-20 partnerships (enabling school-community college-4-year college-private sector pathways for students and teachers). CITI has a primary focus at the K-12 level on Information Technology Across the Curriculum and not on technology curricula (programming, web design, system or network certification) per se.

"As a new generation of IT-fluent high school students graduate, we expect greater numbers of students to be attracted to traditional computer and information systems programs, as well as to higher education ITAC programs," said Adrion. "Our higher education ITAC programs have recruited and retained women and minorities in numbers which reflect campus populations, far greater numbers than are attracted to traditional technical disciplines." CITI aims to increase the overall STEM and IT pipelines and to prepare graduates at all levels of K-20 education for the challenges of the new information economy. According to the Progressive Policy Institute, Massachusetts ranks first in the "new economy" and in the number of "knowledge jobs," but maintaining a workforce that can meet this demand is a major challenge.

CITI is fortunate to have the support of many people from many sectors of the economy. If you are interested in joining the CITI partnership or wish more information on CITI, go to its website **www.citi.mass.edu**.

Jonsson reaches Google finals

Graduate student Anders Jonsson competed against more than 7,500 participants from more than 100 countries to reach the championship finals in Google's Code Jam 2004 computer programming competition. As one of the 50 finalists, Jonsson was flown to Google headquarters in Mountain View, California to compete in the Championship Round this fall.

Advised by Professor Andrew Barto, Jonsson is a graduate student in the Autonomous Learning Laboratory who is expected to graduate with a Ph.D. in September 2005. His dissertation is titled "A Novel Approach to Abstraction Discovery in Reinforcement Learning."

A Department SWIRL

The Student Workshop for Information Retrieval and Language (SWIRL) is a new forum within the Department that provides graduate researchers, in the broad areas of Information Retrieval (IR) and Natural Language Processing (NLP), an opportunity for an intercollegiate exchange of information. **(ciir.cs.umass.edu/swirl)**

Founded by Center for Intelligent Information Retrieval (CIIR) graduate student Hema Raghavan and MIT graduate student Jaime Teevan, the group's aim is to give an informal platform for students in information retrieval and related fields to talk and exchange ideas.

The UMass Amherst group hosted students from the CS and AI Lab at MIT. Later, MIT hosted CIIR students Vanessa Murdock, Fernando Diaz, Ramesh Nallapati, and Raghavan. Students from the New Jersey Institute of Technology and Cornell University also came here to discuss their research.

"The benefits of such kind of communication are not restricted just to information retrieval graduate students," said Raghavan. "At some level I really care for science education and research and I would like to see such collaboration and exchange of ideas between students from various universities happen in all labs in the Department."

Corporate support benefits faculty research

Attracted by the Department's research and the quality of its faculty and students, companies continue to provide generous gifts to the Department and to collaborate on research initiatives with faculty.

Nortel Networks provided Distinguished Professor Jim Kurose with a gift in recognition of his research in computer networking, Sprint Advanced Technology Lab provided a gift to Distinguished Professor Don Towsley in support of his research in the development of an information-theoretic framework for network monitoring, and Honeywell Labs provided a gift in recognition of Professor Victor Lesser's multi-agent systems research.

Distinguished Professor Bruce Croft and Associate Professor James Allan received a gift from UptoDate in support of their research efforts in the Center for Intelligent Information Retrieval (CIIR). The CIIR also received a gift from Yahoo!, and Lexalytics joined the CIIR to collaborate with Croft and Allan. BBN Technologies joined the CIIR to collaborate with Associate Professor Andrew McCallum on information extraction and coreference research.

Research Associate Professor Beverly Woolf received a grant from the Verizon Foundation for her instructional technology work. Verizon is also sponsoring two graduate student fellowships.

Google and FAST Search & Transfer joined the Department's Industrial Affiliate Program (IAP) and both held recruiting events on campus.

The Department is committed to working with industry to further our research and teaching goals, and to provide opportunities for our students. Contact Jean Joyce (jean@cs.umass.edu) to learn more about the Department.

Making the world a safer place

Associate Professor David Jensen is profiled in the new book *Safe: The Race to Protect Ourselves in a Newly Dangerous World* (HarperCollins 2005; http://www.safethebook.com). The book describes recent research & development advances on security technologies. *Safe*'s chapter 12, "The Dangers of Data", highlights Jensen's cutting-edge research on technologies for knowledge discovery and data mining to help make the world a safer place.

"Through dramatic, enlightening, and often entertaining narratives, *Safe* makes visible -- and understandable -- the high-stakes work being done by some of the most ingenious problem-solvers across the country and around the world, people committed to creating real and dependable security in the twenty-first century," writes the publisher, HarperCollins.

Data mining algorithms discover useful, previously unknown knowledge by analyzing large databases. "The domain of counter-terrorism presents fundamentally new challenges that require new algorithms and new theoretical foundations for the field," said Jensen, director of the Knowledge Discovery Laboratory. Jensen estimates that it will take three to five years before commercial software uses these new technologies, but great strides are already being made.

A frequent theme in assessments of the technical capabilities of the U.S. intelligence community is how the volume of available data is increasing much faster than the analytical resources to analyze the data. "High quality analysis is a key opportunity because the raw data have to be synthesized to be useful, because analysts do not have enough hours in the day to comprehend the raw data streams themselves, and because the knowledge that is used to synthesize and prioritize analysts' attention needs to be adaptive," said Jensen. Data mining for counter-terrorism requires a set of new capabilities that are not found in current commercial tools.

Jensen adds that it makes sense to direct data mining techniques toward predicting low-level activities that are both consistent and common. Such activities include illegal immigration, money transfers, operating front businesses, and engaging in recruiting activities. "Predictive models of these activities could be used to direct analysts' attention to situations that warrant greater attention," said Jensen.

More information about data mining and KDL's open source software can be found at: **kdl.cs.umass.edu/.**

Verizon Fellows

The Verizon Foundation awarded Fellowships to graduate students Shangzhu Wang (left) and Sarah Osentoski for the 2005-2006 academic year.

Faculty News

At the annual IEEE Infocom Conference (the major networking conference of the IEEE), Distinguished Professor **Jim Kurose** accepted the 2005 award for "Exemplary Service to the Community." The other recipient of the award was **Henning Schulzrinne** (ECE Ph.D. '93), professor and chair of Computer Science at Columbia University. At UMass Amherst, Schulzrinne was a Ph.D. student of Kurose and **Don Towsley**. ■ Associate Professor **James Allan** and **Anton Leuski** (Ph.D. '01) won the 2004 James Chen Annual Award for Best Journal Article in *User Modeling and User-Adapted Interaction: The Journal of Personalization Research (UMUAI)*. Their paper, "Interactive Information Retrieval Using Clustering and Spatial Proximity," appeared in June 2004. ■ Less than a year after being ordained a deacon in the Episcopal Church, Associate Professor **Eliot Moss** was ordained a priest in April. He will remain full-time with the Department and will continue with his current church assignment at the Church of the Atonement in Westfield, MA. ■ Distinguished Professor **Don Towsley** was named the next Editor-in-Chief of the *IEEE/ACM Transactions on Networking*. The journal, co-sponsored by the IEEE Communications Society, the IEEE Computer Society, and the ACM and its Special Interest Group on Data Communications (SIGCOMM), is considered the leading archival journal in the field of computer networks. ■ From *Slashdot* to the *New York Times*, the handwriting retrieval research led by Research Assistant Professor **R. Manmatha** has been getting both local and national media coverage lately. ■ This summer, Associate Professor **Andrew McCallum** will give a keynote address at the Association for Computational Linguistics workshop on "Feature Induction for Machine Learning in NLP" and another at the International Conference on Machine Learning workshop on "Learning in Web Search." ■ Professor **Jack Wileden** and Associate Professor **Eliot Moss** each received Professional Development in Teaching Program grants. The UMass Amherst Center for Teaching created the program to support improvements and innovations in teaching. ■ Adjunct Professor **George Avrunin** was appointed to the Editorial board of the ACM *Transactions on Software Engineering and Methodology*. ■ **Scott Kaplan**, Assistant Professor of Computer Science at Amherst College in the Department of Mathematics and Computer Science, joined the Department as an Adjunct Assistant Professor.

Clarke elected as CRA Vice Chair

The Computing Research Association (CRA) election committee announced the election of Professor Lori Clarke as Vice Chair of CRA's Board of Directors for a two year term beginning in July. Clarke joined the CRA board in 1999. She currently serves on the Executive Committee and was a member of the program committee for the CRA Conference at Snowbird 2004. Clarke is co-Director of the Laboratory for Advanced Software Engineering Research (LASER).

Visitor News

Dr. **Soon-Cheol Kim**, an Assistant Professor at Daegu University in Korea, is a Visiting Professor with the Laboratory for Advanced System Software. ■ Distinguished University Professor Arnold Rosenberg is hosting Research Scholar **Gennaro Cordasco** during his visit from the University of Salerno, Italy. ■ Dr. **Giovanni Neglia**, from the University of Palermo, Italy, is a Research Scholar with the Computer Networks Research Group. ■ Working with the Center for Intelligent Information Retrieval (CIIR) as a Visiting Scholar, Dr. **Koji Eguchi** is an Assistant Professor at the National Institute of Informatics in Tokyo, Japan.

Research News

Research Scientist **Dan Corkill** (Ph.D. '83) received a new Air Force Research Laboratory award, "A Cognitive Framework for Resource-Aware Sensor Net Organizations." ■ **Chris Pal** joined the Information and Extraction Synthesis Laboratory (IESL) as a Research Scientist. ■ On leave from his Research Scientist position in the Department, **Michael Rosenstein** (Ph.D. '03) is a Postdoctoral Associate at Massachusetts Institute of Technology.

Student News

Computer Science undergraduates placed first through fourth at the Henry Jacob Annual Mathematics Competition organized by the UMass Amherst Department of Mathematics and Statistics. First prize went to **Kevin Grimaldi**, second prize to **Shaohan Hu**, third prize to **Daniel Arpino**, and fourth prize to **Jesse Winn**. ■ CIIR graduate student **Jiwoon Jeon** and his wife Young Hwa Kim are the proud parents of their daughter Jina Jeon, born on December 13.

Staff News

Roberta Tatro joined the Laboratory for Advanced Software Engineering Research (LASER) as its Grant Administrator. ■ The Computer Science Computing Facility (CSCF) welcomed **Andrew Berkvist** and **Jonathan Leachman** (B.S. '05) to their group as Associate Software Specialists. ■ **Rachel Lavery** of the Center for Computer-Based Instructional Technology was promoted to a Grant Administrator Clerk IV position.

Alumni Association awards

This spring, three Computer Science undergraduates received honors from the UMass Amherst Alumni Association for their achievements.

Irina Ros and Russell Silva received 2005 William F. Field Scholarships. The award recognizes and honors the academic achievements of sixty third-year students across campus.

Amos Wetherbee received the Alumni Association's Senior Leadership Award. He also received honorable mention in the National Science Foundation's Graduate Research Fellowship program and was recently inducted into Phi Beta Kappa. This summer, he'll be working for the National Security Agency. In the fall, he will pursue an M.S. in Security Informatics and a Ph.D. in Computer Science at Johns Hopkins University.

Significant Bits

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

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GIFTS

The following alumni and friends have actively supported the Department of Computer Science from **October 2004 through March 2005.** 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.

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