University of Massachusetts Amherst

Spring 2004

Significant BITS

Newsletter of the
Department of Computer Science

Multi-agent vehicle tracking system chosen for demonstration

A major research focus of the Multi-Agent Systems Laboratory (MAS) over the last four years has been the development of an adaptive distributed sensor network of low-cost radar sensors for vehicle tracking as part of the DARPA Autonomous Negotiating Teams (ANTs) program. The UMass team was one of two teams chosen out of the original five teams to demonstrate their system at the end of the program. "This sensor network application was extremely interesting and challenging because of its requirement to make effective coordination and resource allocation decisions in soft real-time and in low-communication-bandwidth environments, while dealing with issues of scale," said Professor Victor Lesser, Director of MAS. "It also provided an opportunity to verify the practical applicability of some of the technology that the MAS lab has been developing over the last 10 years to real-world problems."

The sensor platform in the ANTs program provides 360-degree range from three, 120-degree scanning radars – only one of these radars can be active at a time (see Figure 1, top left). The sensor communicates using a low-speed, unreliable, simplex, radio-frequency (RF) system over eight separate channels. Each sensor platform is capable of locally hosting one or more processes. According to Lesser, the goal of this application is to track one or more targets that are moving through the environment: in this case, model railroad trains traveling on railroad tracks along an unknown course (see Figure 1: top right).

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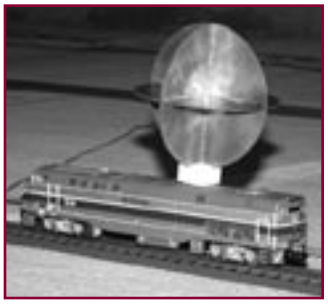

Figure 1: Sensor Network. Top left: radar unit with three sensing heads. Top right: vehicle being tracked. Bottom: an example configuration with 35 sensors and 3 vehicles.

Berger receives NSF CAREER award

Assistant Professor Emery Berger of the Department of Computer Science has received a National Science Foundation (NSF) CAREER award for 2004. The Faculty Early Career Development (CAREER) Program offers the NSF's most prestigious awards for new faculty members.

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RESEARCH

Multi-agent *(from page 1)*

No one sensor has the ability to determine the precise location of a target by itself, so the sensors must cooperate in a manner that permits their measurements to be used for triangulation (see Figure 2). "The need to triangulate a target's position requires frequent, closely coordinated actions amongst the agents, ideally three or more sensors performing their measurements at the same time," said Lesser. With resource limitations on computing and communication, the sensor network must employ a strategy to optimize tracking accuracy, minimize the time between triangulation measurements, and maximize the number of triangulated positions. Exhaustive planning and scheduling is not possible in such an environment, yet sensors must coordinate tracking responsibilities and balance the trade-off between discovering new targets and tracking existing ones.

The Lab's solution is built upon a soft, real-time agent architecture, developed as part of the project, called SRTA. SRTA provides a robust planning, scheduling, and execution subsystem capable of quantitatively reasoning over deadlines and resource constraints. Such a system allows the agent's higher-level reasoning components to operate on course-grain goals, without sacrificing fine-grained control and reactivity.

Built upon this agent architecture is a virtual agent organization based on geographically partitioned *sectors*, each with its own local *sector manager* (see Figure 3). Among the sector manager's responsibilities is the dissemination of a *scan schedule* to each of the sensors in its sector. When a new target is detected, the sector manager delegates responsibility to a *track manager.* This delegation process uses an abstract view of sector activity to make a choice that load balances processor and communication requirements.

The track manager must estimate the target trajectory by merging the measurements from multiple sensors and negotiating commitments for *data collection*. The SRTA will attempt to satisfy the possibly conflicting responsibilities of scan schedule and data collection tasks. Conflicts can be detected and potentially resolved through negotiation with agents to find an equitable long-term solution. "As data is gathered, it is fused and interpreted to estimate the target's location, which allows the process to continue," said Lesser. "We call this a virtual agent organization since a particular sensor/processor node may be multiplexing among different roles, e.g. sector manager and data collection. The SRTA architecture provides an abstraction for all of these scheduling activities based on role, priority and deadline." The movement of one or more targets through the environment further complicates scheduling. Different radar and different agents will contribute to tracking at different times. Resource contention is introduced when more than one target enters the viewable range of the same sensor platform. These fine-grain resource allocation processes are intimately tied with the course-grain task of merging of information to estimate target trajectories. Thus, a successful system will dynamically coordinate resources to achieve both low-level and high-level goals.

"This type of resource allocation can be too complex and time-consuming to perform in a centralized manner when the environmental characteristics are both distributed and dynamic, because the costs associated with continuously centralizing the necessary information are impractical," said Lesser. The

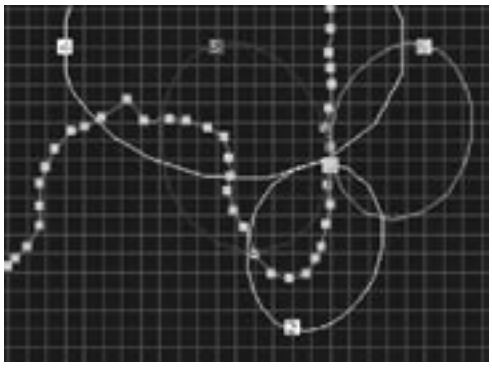

Figure 2: Shows a vehicle track in square dots and the radar lobes produced by the four different radars sensing the vehicle independently. The intersection of the lobes provides an estimation of the location of the vehicle.

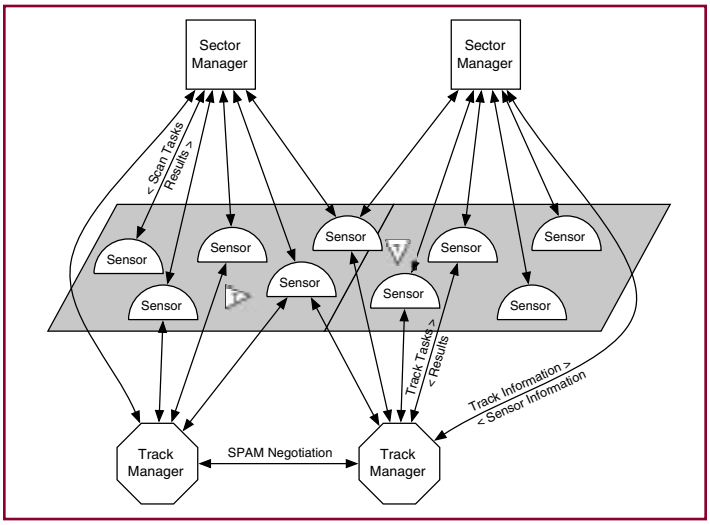

Figure 3: Organization structure of sensor network control

MAS Lab's approach, called SPAM (The Scalable Protocol for Anytime Multi-level negotiation), is a real-time, distributed, mediation-based negotiation protocol. *Mediation-based* means that each agent may act as a mediator to resolve resource conflicts. As a mediator, an agent gains a localized, partial view of the global allocation of resources. This allows the mediator to identify over-constrained sub-problems and suggest resolution strategies. Typically, the agents rapidly converge on solutions that are in most cases good enough and fast enough. Overall, SPAM has many characteristics in common with *distributed breakout*, particularly its distributed hill-climbing nature and the ability to exploit parallelism by having multiple negotiations occur simultaneously.

"The use of a sophisticated agent architecture (that includes capabilities for planning and scheduling) and distributed resource allocation mechanisms for short-term agent control and resource allocation, together with an organization structure for long-term agent control, create a powerful paradigm for building large-scale and intelligent sensor networks with heterogeneous and adaptable sensing capabilities," said Lesser.

Along with Lesser, the main contributors to this research were MAS graduate students Bryan Horling, Roger Mailler, Jiaying Shen, and Dr. Regis Vincent, former MAS Lab Research Scientist.

FACULTY

Kulp joins Department faculty

David Kulp

David Kulp, whose primary research interest is bioinformatics, joined the Department as an Assistant Professor this semester. "I'm very pleased to have the opportunity to work in the UMass Computer Science department. The potential for creative cross-disciplinary research is a big advantage for me," said Kulp.

Kulp is the Director of the newly formed Bioinformatics Research Laboratory, which is engaged in the development of novel methods to address challenges in genomics. The lab is specifically concerned with assays and analysis methods for studying DNA sequences, including gene-finding and variation detection. Said Kulp, "my research mixes conventional computer science topics such as algorithms and learning methods with the engineering challenges needed to answer open biological questions in the life sciences."

Over the past eight years, Kulp has been active in bioinformatics research, specifically in the development of algorithms for the identification of protein-coding gene structure in genomic DNA. His contributions to this research area have resulted in the co-authorship of three seminal papers in *Science* and *Nature* regarding the analysis of the complete genome sequences of Drosophila melanogaster (fruit fly), human, and mouse. Recently, Kulp's primary concern has been the design of high-density oligonucleotide microarrays for the detection and discovery of transcripts and splice variants in eukaryotes. Currently active research topics are genomic gene-finding, microarray designs for sequencing by hybridization and associated basecalling algorithms, fast sequence searching algorithms using physical models of hybridization, and the integration of quantitative expression and genetic markers.

"I am interested in methods to better annotate the human genome and the genomes of other organisms to identify and understand all the component parts," said Kulp. "With the sequencing of complete genomes we have a better handle on these questions, but much is still unknown and basic questions such as the number and nature of genes in an organism are still important open problems."

Kulp played a role in three of the major genomics achievements: the sequencing and analysis of the fly, mouse, and human genomes. While a student at UC Santa Cruz' Center for Biomolecular Science and Engineering, studying with David Haussler, Kulp co-authored the "Genie" gene finder. "Genie is a generalized hidden Markov model in which the states represent a multi-symbol grammatical structure along a DNA sequence," said Kulp. Genie was used in both the human genome analysis and the mouse genome analysis as one of the two most successful annotation techniques. It was also the primary gene prediction program used in the first annotation of the Drosophila genome. This work was done while Kulp was a bioinformatics researcher at a start-up called Neomorphic that later merged with Affymetrix, the major manufacturer of "Gene Chip" microarrays. "A microarray is a tiny slide containing a grid of unique, addressable, synthesized, small fragments of single-stranded DNA," explained Kulp. "Exploiting the complementarity of the two strands of the DNA double helix, researchers wash single-stranded DNA across the slide surface to see what 'sticks' to the synthesized fragments on the surface. A laser scanning image of the grid reveals the DNA content of the sample." Kulp took his basic research in sequence analysis and applied the results to the design of commercial microarrays containing snippets of DNA from all known genes. These products are now widely used by molecular biology researchers in industry and academia to assess the gene content of samples of interest.

Besides studying DNA sequences, Kulp led a research group at Affymetrix that has recently published on functional prediction of genes, signal analysis of microarray images for expression and genotyping, predicting and estimating concentrations of gene variants, and thermodynamic models of hybridization. Said Kulp, "I continue to work on many of these topics at UMass, and I am particularly interested in the use of microarray technology for studying variation in DNA. The vast majority of microarray users today study gene activity, but with the right designs and analysis methods I believe that microarrays will become an important tool to study genetic variation as well. That has become a major focus of my research."

Before joining UMass Amherst in 2004, Kulp was the Vice President of Bioinformatics at Affymetrix, Inc. where he managed a group of 45 people. Prior to joining Affymetrix, he was the Chief Technology Officer and Vice President of Research at Neomorphic, Inc. He received his Ph.D. in Computer Science from the University of California, Santa Cruz. Kulp was appointed to the University of California, Santa Cruz School of Engineering Advisory Board in 2002.

Croft appointed for second term

Distinguished Professor Bruce Croft has been appointed for an additional three years as Chair of the Department. "I look forward to leading the department during a phase of exciting growth and opportunity," said Croft, who has served as Department Chair since 2001. His new term will commence in January after a one semester sabbatical at the University of Melbourne in Australia. Professor Andy Barto will serve as interim Chair during that period.

NEWS

Who's in the news?

The Department once again attracted media attention for its research. The UMass Robotics team's autonomous Segway Human Transporter project was highlighted in the *Boston Business Journal* and the *New Hampshire Sunday News/Union Leader*. Assistant Professor **Oliver Brock** was quoted in both articles about the uses of the new autonomous Segway. In another Segway article, Professor **Rod Grupen** was quoted in *Mass High Tech* magazine about the project. The *Segway Chat News and Discussion Group* also took note of the project with the posting "man …too cool…."

Associate Professor **Andrew McCallum's** research on using Bayesian classifiers to filter out email spam was cited in Jon Udell's O'Reilly Network column on **xml.com.**

The Center for Computer-Based Instructional Technology (CCBIT) was noted in a *Daily Hampshire Gazette* article about the Goody Parsons Project. CCBIT, under the direction of Research Associate Professor **Beverly Woolf** and Executive Director **Dave Hart,** worked with Historic Northampton on an interactive Web site that will be used by teachers and students in Northampton to study 17th century history about the city. CCIBT Online Web-based Learning System (OWL) was also featured on Apple Computer's "Profiles in Success" stories on their web site.

Associate Professor **Hava Siegelmann** was recognized in a recent American Institute of Physics Bulletin of Physics News for her work on developing a model which shows that the functioning of a model gene network is comparable in expressive power to the workings of a Turing machine, the generic idealized computer.

Emery Berger

Berger *(from page 1)*

Berger received the award for his proposal "Cooperative System Support for Robust High Performance." His project will include a combination of programming language and systems research, which is the main thrust of his current research. The work will develop a synergistic new research area in cooperative memory management between the operating system and run-time systems, including coarse-grained and fine-grained garbage collectors, to reduce or eliminate paging. "Our work represents a promising new direction in the areas of memory allocation, garbage collection, and virtual memory research, and should act as a bridge leading to further collaboration between the programming language and operating system communities," said Berger.

The algorithms developed within this project will enable systems to make better use of available resources, improve throughput, reduce response time, and adapt robustly to sudden increases in load, improving resilience to denial-of-service attacks. "Our research will improve the performance and behavior of nearly every server," said Berger. "By eliminating the need for additional memory, we will potentially save millions of dollars in component and energy costs." Berger's work will also improve the performance, and thus speed the acceptance, of safe garbage-collected languages.

Berger directs the Programming Languages and Systems at Massachusetts (PLASMA) research group. His current research interests include runtime and operating system support for modern programming languages, with a particular focus on cooperation between virtual and user-level memory managers. Berger is part of a multi-university research effort led by UMass Amherst and University of Texas-Austin that was recently singled out by NSF site visitors as "the best garbage collection group in the country." He invented Hoard, a widely-used scalable memory manager that dramatically improves the performance of multithreaded applications. He also developed the Heap Layers infrastructure for building high performance memory managers, including both Hoard and reap, a hybrid region-heap allocator.

Berger joined UMass Amherst as an Assistant Professor after receiving his Ph.D. in 2002 at the University of Texas at Austin (his Ph.D. advisor was Kathryn McKinley, former UMass Computer Science Associate Professor). Prior to moving to Amherst, he has lived in New York, Orlando, Miami, Canterbury, Grenoble, Austin, Seattle, and Barcelona.

The CAREER program recognizes and supports the early career-development activities of those teacher-scholars who are most likely to become the academic leaders of the 21st century. Berger was selected on the basis of his creative career development plans that effectively integrate research and education within the context of the mission of the University.

Travelers Scholarships

This spring, the Travelers Foundation awarded $2500 scholarships to Computer Science undergraduates Amos Wetherbee (left) and John Altidor (right). The Travelers Insurance Company recently merged with St. Paul's Companies to form St. Paul Travelers.

IN MEMORIAM

Professor Emeritus Robin Popplestone, 1938 - 2004

Professor Emeritus Robin John Popplestone, one of the early pioneers in Robotics and Computer Programming Languages, died on April 14 in Glasgow, Scotland after a 10 year battle with cancer. He was 65.

"We will all miss Robin very much," said Professor Rod Grupen, co-director of the Laboratory for Perceptual Robotics with Popplestone. "Robin is a lengendary figure in our community; technically, as a personality, and as a sage mentor. He inspired new research topics for budding dissertations literally until the day he retired from UMass."

Popplestone was born in Bristol on December 9, 1938. After World War II, his family moved to Belfast, where he grew up. He was educated at Belfast University, and received an honors degree in mathematics in 1960. He then spent the next four years at Manchester University doing graduate work in mathematics. One of the widely believed stories surrounding Popplestone (...although Robin refused to corroborate it...) has it that he never completed his Ph.D. in mathematics because he lost his thesis manuscript in a sailing accident shortly before it would have been delivered to the faculty at Manchester University. Sailing remained a passionate pursuit nonetheless, and, though computer science became his profession, mathematics remained at the heart of his research.

Popplestone arrived at Edinburgh University as a lecturer in 1965 and spent the next 20 years establishing one of the first world-class research groups in robotics in Europe. He did visionary work in robotics involving the integration of multi-modal sensing (including vision) into robotic control, and developed techniques for modeling and spatial reasoning about geometric objects. In addition to this work in robotics, he co-developed the programming language PoP-2. This work, which started soon after he arrived in Edinburgh, anticipated functional and higher order programming by over a decade. PoP-2 was the main language used by researchers in artificial intelligence in Britain during the 1970's. While on the faculty at Edinburgh University, he played a major role in keeping the fledging field of robotics alive in Britain after the Lighthill report on artificial intelligence precipitated a major decrease of funding in this area. He had a long history of fostering university and industrial interaction in Edinburgh and served as departmental chairperson in 1981.

In 1985, Popplestone joined the faculty of the University of Massachusetts Amherst as a Professor of Computer Science and Director of the Laboratory for Perceptual Robotics. Together with his students, he advanced group theoretic frameworks for describing relationships between bodies and describing symmetries in tasks that could be exploited by control and planning.

In 1990, Popplestone was selected as a Founding Fellow of the American Association for Artificial Intelligence (AAAI) in recognition of his seminal contributions to AI. Due to illness, he retired in 2001 from the University of Massachusetts as an Emeritus Professor, and returned to Glasgow, Scotland to be near his family and the sea.

"Some would describe Robin as the classic absent-minded professor in appearance, and few who knew him could help but notice that he was truly unique, sometimes a touch eccentric, with flashes of genius," said Professor Victor Lesser. "He was a beloved advisor to many students, a warm and caring friend, a deep intellectual thinker on a wide range of subjects, a witty conversationalist, and an expert sailor." After retiring, he pursued his interest in the Irish language by beginning work on a translation program. He spent considerable time in his later years living with his wife on their boat, sailing extensively around Scotland, Ireland, Sweden, and Denmark.

"Robin was a profoundly unique person who touched the lives of all who knew him," said Lesser.

Popplestone leaves his wife, Professor Kristin Morrison, and three children by earlier marriages: Michael Popplestone, Jennifer Dukovich, and Sally Brackenridge, as well as three grandchildren. He is also survived by his mother and three brothers.

Ronnie Boss

Ronya "Ronnie" Boss died in Amherst at the age of 71 on April 4, 2004 after a battle with cancer. From 1990 until her retirement in 2000, Boss was grant administrator and bookkeeper for the Laboratory for Advanced Software Engineering Research (LASER), co-directed by Professors Lori Clarke and Lee Osterweil. "Ronnie 'watched over' LASER for ten years, making sure that the budgets and paperwork were in tip-top shape and keeping all of us in line," said Clarke. "I am glad she had some time to enjoy her well-deserved retirement. We'll all miss her."

In addition to her work at UMass, Boss and her husband Hillard "Hill" Boss operated the Grist Mill Antique Shop in South Amherst for 18 years, retiring in 2002. Memorial gifts may be made to Jewish Community of Amherst, 747 Main Street, Amherst, MA 01002, VNA/Hospice Alliance, 168 Industrial Drive, Northampton, MA 01060, or the Center for Extended Care at Amherst, 150 University Drive, Amherst, MA 01002.

University of Massachusetts Amherst

Alum Matters

Vol. 4, No. 5 • Spring 2004

A newsletter for alumni of the Department of Computer Science

Making markets and democracy work

From within the confines of the Agent-Mediated Electronic Marketplaces Lab at Carnegie Mellon University's Computer Science Department, Associate Professor Tuomas Sandholm (Ph.D. '96) is leading research efforts that could affect the outcomes of such varied events as divorce settlements, product bidding, or presidential elections. Sandholm's research deals with computational approaches that make markets and democracy work.

"Game theory provides a basis for engineering the incentives into the interaction mechanism (e.g., rules of an election or auction) so that a desirable system-wide outcome (e.g. President, resource allocation, or task allocation) is chosen even though every agent acts based on self-interest," said Sandholm.

Sandholm addresses the practical computing, communication, privacy, and economic concerns of game theoretic mechanisms. "This is a particularly exciting research area because those issues are intimately intertwined," said Sandholm. "Whether you like it or not, preference aggregation settings are all around us." Preference aggregation is a problem of multiple agents jointly choosing an outcome, such as a President, task allocation, or a resource allocation. What makes it so difficult is that, generally, the agents have different preferences over outcomes, said Sandholm. This is a central problem in multiagent systems, be the agents human or software. *Mechanism design* is the art and science of designing the rules of the game so that the agents are motivated to report their preferences truthfully and a desirable outcome is chosen.

Voting is a general method for preference aggregation in multiagent settings, but a key problem with voting mechanisms is voter manipulation. "An agent is said to vote strategically when it ranks alternatives not according to true preference, but in order to manipulate the results so the outcome is ultimately more favorable to the agent," said Sandholm. "For example, if an agent prefers Nader to Gore to Bush, but knows that Nader has too few other supporters to win the 2000 Presidential election, while Gore and Bush are close to each other, the agent would be better off by declaring Gore as its top candidate. Manipulation is an undesirable phenomenon. If the agents reveal their preferences insincerely, a socially undesirable candidate may be chosen." Seminal economic impossibility results show that all voting protocols are manipulable. Sandholm's work takes the next step to designing protocols that are especially hard to manipulate. He designed voting mechanisms where finding a beneficial manipulation is so hard computationally, that although a manipulation exists, it is intractable. "Computational complexity can be used as a barrier to strategic behavior in settings where economic mechanism design falls short," said Sandholm.

According to Sandholm, the design of interaction mechanisms can be automated, and these yield better mechanisms than the best known to date. Applications for automated mechanism design include divorce settlement negotiations, public works project decisions, and dealmaking in auctions. Sandholm's design software created optimal mechanisms for divorce settlements (which spouse gets what as a function of their reported valuations of the items), for (combinatorial) public goods problems (e.g., for deciding whether to build a road, bridge, neither, or both), and for revenue-maximizing multi-object auctions (a tough open research problem).

Since 1997, Sandholm has also been working on algorithms for clearing complex auctions. In a combinatorial auction, bidders can bid on self-selected packages of items. Sandholm's research generalizes that idea to what he calls *expressive competition*. In that framework, bidders can express their offers in rich formats: package bids, item attributes, discount schedules, capacity constraints, etc. The bid taker can also be highly expressive about how her preferences should factor into the determination of

the winners of the auction. Her expressiveness includes side constraints (e.g., "I don't want more than 200 winners; more is too much hassle," "I don't want anyone to win more than 15%," "I want minorities to win at least 5%," ...), trade-off expressions, and statements about how item attributes and bidder attributes are to be taken into account. To enable expressive competition, algorithms are needed for winner determination, a hard combinatorial optimization problem. Sandholm has developed the fastest optimal algorithm for this problem. The hardest real-world expressive competition that Sandholm has encountered was a transportation services procurement auction with 22,665 trucking lanes to be bought, multiple units of each, 323,015 bids, and several side constraints. Sandholm's technology achieved (and proved) optimality in 5.5 minutes while the nearest competitor took 6 hours for a 97% optimal solution and didn't improve even after 68 hours. In other expressive competition events that Sandholm's technology has solved there have been over a million bids, over 110,000 side constraints, or over $750 million on the line. Expressive competition creates economic value, makes bidding easier, and is today technologically feasible, said Sandholm.

Are there yet unforeseen ways that computing and complexity can improve preference aggregation? Sandholm believes that there are, and his future research will focus on the achieving those improvements.

At the age of 35, Sandholm not only teaches and directs a research lab, but is also Founder, Chairman of the Board, and Chief Technology Officer of a successful company, CombineNet, with 70 full-time employees and 45 Fortune 500 clients. In the last two years, CombineNet has used Sandholm's expressive competition technology to clear $7 billion of procurement auctions, generating $1.2 billion in savings. (This savings is achieved through increasing economic efficiency, not through squeezing the suppliers' margins).

While a Ph.D. student at UMass Amherst, Sandholm was advised by Professor Victor Lesser. He is the 2003 recipient of the prestigious Computers and Thought Award, presented by the International Joint Conference on Artificial Intelligence (IJCAI), and the Sloan Research Fellowship, presented by the Alfred P. Sloan Foundation. He has also received several other prestigious academic awards, including the National Science Foundation CAREER Award in 1997 and the inaugural ACM Autonomous Agents Research Award in 2001. Sandholm has published more than 160 technical papers on electronic commerce, game theory, artificial intelligence, multiagent systems, auctions, automated negotiation and contracting, coalition formation, voting, safe exchange, bounded rationality, machine learning, and combinatorial optimization. Sandholm is not only a risk-taker in cutting edge research, but in personal life as well. He was once ranked 12th in the Worlds (1987) and #1 in Finland (1986) in windsurf racing, and continues to windsurf today, even after an encounter with a shark on the Cape Cod coast.

Erratum

In the *Alum Matters* section of the fall 2003 issue, we listed Jamie Callan's (Ph.D. '93) advisor as Bruce Croft. Callan's Ph.D. advisor was Paul Utgoff. We regret the error.

Alumni Connections

Rich Sutton (Ph.D. '84) has been appointed as the iCORE Chair in Reinforcement Learning in the Department of Computing Science at the University of Alberta. His research program will be a cornerstone of the new Alberta Ingenuity Centre for Machine Learning (AICML), which has recently been established in Edmonton. To develop the research program, Dr. Sutton has received a five year iCORE Chair and Professor Establishment (CPE) grant. Sutton joined the University of Alberta in August 2003 as Professor of Computing Science. Sutton's UMass advisor was Andrew Barto.

Henning Schulzrinne (ECE Ph.D. '93), Columbia University Associate Professor, was named one of the 50 most powerful people in networking by *Network World*. Schulzrinne, the only academic on the top 50 list, was advised by Professor Jim Kurose while a student at UMass.

The surveillance research of Computer Science alumnus **Rakesh Kumar** (Ph.D. '92), director of David Sarnoff Research Center's media lab, was highlighted in the "10 Emerging Technologies that will Change Your World" issue of MIT's *Technology Review* magazine. Kumar was advised by Professor Allen Hanson while a graduate student at UMass Amherst.

Another CS alumnus, University of Colorado at Boulder Professor **Alexander Wolf** (Ph.D. '85), was featured in the CU Engineering *Corporate Partner* newsletter for his direction of the Computer and Communications Security Center. Professors Lori Clarke and Jack Wileden were Wolf's advisors at UMass Amherst.

Alumni updates needed!

What have you been up to lately? Keep in touch with other alumni. Tell us where you are living and working and we'll include your information in **Alumni Connections**.

Email us at: alumni@cs.umass.edu. Thanks!

Debra Richardson named dean at UC Irvine

Debra J. Richardson (Ph.D. '81), professor of informatics at the University of California Irvine (UCI) and interim dean of the School of Information and Computer Science (ICS) since December 2002, has been named dean of the school. She also will hold the Ted and Janice Smith Endowed Dean's Chair.

"Dean Richardson has a clear vision for the future of computer science and information technologies at UC Irvine," said UCI Chancellor Ralph Cicerone. "Her dedication to increasing the diverse participation in the field combined with her strong leadership, her drive to continue to elevate the University of California's first computer science school, and her experience will serve UCI well in this position."

Richardson joined UCI in July 1987 as assistant professor in the then-department of information and computer science; she became department chair in July 2000 and interim dean in December 2002. She was instrumental in securing a recent $20 million anonymous gift to ICS. Under her leadership, information and computer science enrollment at UCI has grown to more than 2,400 undergraduate and graduate students, a 125 percent increase since 1998. Richardson serves as director of UCI's Ada Byron Research Center for Diversity in Computing and Information Technology (a hub of the National Center for Women and Information Technology), whose mission is to ensure that women and other underrepresented populations are fully represented in the influential world of information technology.

"I am honored to be named dean of ICS and pleased to have the support and endorsement of UCI's administration and ICS faculty for the direction in which the school is moving – a nationally acclaimed research institute with a broad, interdisciplinary emphasis," Richardson said. "This appointment allows me to continue recruiting the very best faculty and building the school's reputation as an excellent choice for Southern California students."

Active in the community, Richardson sits on many different boards, including the board of trustees for Girls, Inc. Orange County, a non-profit organization committed to preparing at-risk girls for successful, independent, and fulfilling lives; the executive advisory board of the Association for Women in Technology, a local non-profit organization devoted to the advancement of women and girls in all fields of technology; the board of trustees of the Orange County Chapter of ARCS (Achievement Rewards for College Scientists) Foundation, which is dedicated to helping the best and brightest students by providing scholarships to scientists and engineers; and the board of directors of Cotelligent, Inc., a leading provider of mobile business solutions, services and wireless hosting.

Richardson received her B.A. from UC San Diego, and earned both her M.S. and Ph.D. from the University of Massachusetts Amherst. While a student at UMass, Richardson was advised by Professor Lori Clarke. "Debra provided outstanding leadership and worked extremely hard to establish a school of computer and information sciences at UC Irvine. I am sure she will continue to provide strong leadership as Dean," said Clarke.

Help fund the CS Department's educational and research efforts

Gifts like yours help the Department in many ways: they fund Departmental seminars by outstanding scientists, assist undergraduate research, and help new faculty establish their research programs. In addition to contributions ear-marked for a specific purpose, general support helps us continue activities that enrich our educational and research programs.

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Visit **www.cs.umass.edu/csinfo/donate.html** for online donations. If you would like to mail a donation directly to the Department of Computer Science, please make checks payable to "UMass Department of Computer Science" and mail to: External Relations Director, University of Massachusetts, Department of Computer Science, 140 Governors Drive, Amherst, MA 01003-9264. To have a postage paid donation envelope sent to you, send email to alumni@cs.umass.edu.

Thank you for your support of the Department.

Lights, camera, action

This past fall, Computer Science Professors David Mix Barrington and Robert Graham, along with graduate students Armen Babikyan, Jamieson Cobleigh, and Rachel Smith, participated in the Valley Light Opera's production of Gilbert and Sullivan's *H.M.S. Pinafore*. Graham was responsible for set construction. Barrington, Cobleigh, and Babikyan played sailors on board the H.M.S. Pinafore, and Smith played a cousin of the ruler of the British navy, Sir Joseph Porter. Cobleigh was also one of the three producers of the show, held at Amherst Regional High School. For additional photos and details on the Valley Light Opera, visit **www.vlo.org.**

H.M.S. Pinafore ***participants (left to right): Armen Babikyan, Dave Barrington, Rachel Smith, Jamie Cobleigh, and Bob Graham***

CENTERS

CCBIT supports successful campus course redesign project

The Center for Computer-Based Instructional Technology (CCBIT) is providing critical support for a new, technology-rich model for teaching large courses on campus. Ten UMass Amherst departments are participating, under the direction of the Provost's Office, in a two-phase project. Funded by the Davis Educational Foundation, it is designed to improve the way large lecture classes are taught through the introduction of innovative instructional technologies.

"This Davis Educational Grant continues to recognize UMass Amherst as a leader in rethinking how large public Universities can deliver quality education to undergraduates, even in times of shrinking budgets and growing enrollments," said Provost Charlena Seymour.

In the first phase of the project, six departments redesigned large introductory lecture courses (minimum 200 students) to introduce a classroom communication system, the Personal Response System (PRS), during lecture and CCBIT's Online Web-Based Learning (OWL) online mastery-learning environment for out-of-class assignments. CCBIT staff supported the development of OWL materials through feature enhancements to the OWL software as well as implementation of new multimedia instructional materials embedded as OWL exercises. During this first phase, student and instructor satisfaction with the courses has increased along with student performance.

This project is a direct response to the financial pressures facing UMass Amherst and most other colleges and universities, as faculty sizes shrink and smaller classes are replaced by large lecture sections. At UMass, these range in size from over 100 students in a class to almost 500, and are most common in the first and second year curriculum. Thus, incoming students have fewer opportunities for direct contact with their instructors. "New instructional technologies are being used to 're-personalize' their learning experience by encouraging them to interact more during lecture and giving them online homework assignments. These provide instructor-authored feedback and encourage practice until they have mastered the material," said CCBIT Executive Director Dave Hart.

Under the first phase of the project each course was redesigned to employ PRS during the lecture and OWL homework outside of class. Faculty were trained to use PRS during lecture as a feedback tool, stopping the lecture periodically to poll students with provocative conceptual questions, short quizzes or surveys. Each student responds using a handheld infrared transmitter, or "clicker," which sends his or her response to a wall receiver and from there to the instructor's laptop. The student's response, while hidden from the class, is stored under the student's record, making him or her more accountable for class participation.The aggregate results for the class are projected for the class to see and used to stimulate discussion, assess whether the class is grasping new material, and lead into new topic areas.

Often students are encouraged to discuss a PRS question with their neighbors in the lecture hall before submitting their answers, enlisting peers to help peers. By interleaving PRS questions with the lecture, instructors found they could break up the format and keep the students better engaged during class. PRS also acts as an attendance tool; class attendance and participation have risen dramatically.

Daily Hampshire Gazette photo

Students in a UMass Amherst Statistics class answer questions with their handheld PRS devices.

Each of the instructor teams from the first phase worked with CCBIT to develop a semester's worth of OWL homework assignments for their redesigned class. OWL is an online assessment system that provides regular homework and quizzes that are individualized for the student and provide constructive feedback authored by the instructor. Instructor teams structured OWL assignments so that they supported each lecture in several ways. First, students were assigned to do a pre-lecture exercise comprising simple questions designed to ensure adequate preparation. Second, students completed a more challenging OWL exercise after the class to engage the students with the material. OWL's ability to generate new, randomized problem variants allows the student to repeatedly try difficult problems in order to become proficient at the material. Finally, a number of the instructors capped this process with a weekly timed quiz in OWL.

In addition to facilitating the creation of OWL content databases for each course, CCBIT staff provided two other critical support roles for instructor teams by providing software enhancements appropriate for particular disciplines and developing multimedia functionality. OWL was enhanced to support statistical operations on datasets for the statistics course taught by the Resource Economics Department. This allowed students to submit new datasets (e.g. U.S. census data, surveys of their friends, baseball statistics, etc.) and perform standard statistical analyses on data that was meaningful to them. OWL was also enhanced to incorporate multimedia assignments.

"The results of the first project phase are very positive," said Hart. "Students in the redesigned courses rated the PRS and OWL systems very highly, and appreciated that it made classes more interactive and easier to keep up. Instructors also found that students came better prepared." To assess whether student performance improved in the redesigned courses, these courses were directly compared to a control group of courses taught by the same instructors in a previous semester. The redesigned courses had a total of 2450 students and the control, or "traditional" courses had 2294. The mean final course grade for the redesigned courses was 2.81, while the mean for the traditional courses was 2.65 – a statistically significant result.

The participating departments in Phase I, chosen to reflect a

continued on page 10

Not all fun and games for Hi-Score

Computer Science undergraduates Ryan Sobol and Dan Roy recently established a game development club on campus called Hi-Score. The club, launched in February 2004, attracted 90 people to its first meeting.

"One day last spring while playing basketball in Orchard Hill, Ryan and I had the idea to start Hi-Score," said club President Dan Roy. "We then met weekly through the fall to plan the details of the club, such as how often we should meet, and what officer positions we would need." Fellow Computer Science undergraduate Nick Rycar joined the pair halfway through the semester to help them define their vision and create the club's website.

At the first monthly meeting in February, Jesse King, Design Department Director from Cyberlore Studios in Northampton, spoke about being a designer in the game industry. Assistant Professor Brian Levine provided pizza and drinks, and Senior Research Scientist Andrew Fagg brought a projector for the group to use. Roy and Sobol only expected 20 to 30 people at the meeting, and were surprised at the showing. "By 7:00 p.m., when the meeting started, there was standing room only and people kept coming," said Roy.

Since that initial meeting, the group has been working hard to build on their success. They hosted two LAN parties. They elected six new officers at a March meeting, bringing the total to nine. They hosted a presentation by Mike Gesner, CEO of Dragonfly Game Design, who explained to Hi-Score members what it is like to start a game company. "Now Ryan, Nick, and I are working hard to transfer many of our responsibilities to the new officers," says Roy. The current officers are Dan Roy, President; J. Ryan Sobol, Vice President; William H. Holland, Secretary; Matt Edwards, Financial Officer; Lauren Chalas, Webmaster; Chris Davy, Event Coordinator; Mike Beauchemin, Workshop Coordinator; Mike Mintz, Librarian; and Nick Rycar, Advisor.

Hi-Score's mission is to accumulate experience in computer game design and implementation to help students break into the games industry job market. They are working towards that goal in three ways. First, they bring students, faculty, and industry professionals to monthly meetings where they can network and share ideas. Students and faculty have already started sharing tips on which classes to take related to games, such as Research Associate Professor Beverly Woolf's 3D Modeling (CMPSCI 551) and Fundamentals of Graphic Communication (CMPSCI 391F) courses. Second, they have organized a series of four student-run workshops. These workshops teach students specific game development skills, including level design and programming for games. Third, they are encouraging members to start group projects with teams of students working together to create games that they can then add to their portfolios.

"Hi-Score isn't just for students," said Roy. "Faculty can benefit as well. They get to see students who are inspired about learning and who do it for fun. They can work with students to show off their research. In Computer Science, for instance, a game could make the perfect showcase for advanced artificial intelligence or networking techniques. Faculty can also see which classes students would like created. Finally, they get to meet industry professionals, possibly stimulating collaboration."

For more information about Hi-Score, or to sign up for the monthly newsletter, visit **www.HSGameDev.org.**

CCBIT course redesign *(from page 9)*

broad cross section of colleges, were Art History, Astronomy, Economics, Finance, Psychology, and Resource Economics. Phase II will include greater representation from the humanities including Classics, English, Music and Dance, and Chemistry.

One of the chief goals of Phase II will be the integration of the PRS system with OWL so that the results of in-class activity in PRS can be incorporated into OWL homework assignments and likewise OWL results can be passed back to PRS. By integrating in-class activities with out-of-class assignments in this way students can be further engaged in the activities of the course, especially when the subject of the assignments is data about the class itself.

On the job hunt

It is job-hunting time, and though the market is tough, events such as EMC²'s recruiting event "Smart Choices, Bright Futures" are a great boon to graduating students.

Several of the Computer Science Department's top undergraduates and students from the Electrical and Computer Engineering Department were recruited by EMC² at the event held on March 30 at EMC². The students joined over one hundred students from Tufts, Northeastern, UMass Lowell, MIT, and WPI, where they listened to talks from, among others, Executive Vice President Dave Donatelli and Senior Vice President Tom Heiser, a UMass Amherst alumnus.

Graduating Computer Science senior Meeta Oberoi found the event to be well organized and informative. Speaking of the highlights of working for EMC², she listed "the encouragement to learn new things" and "the ease with which one can try different projects internally." At each table where the students sat, an EMC² representative further endorsed the benefits of the EMC² corporate culture. Each student had a half-hour interview with a project manager (57 managers participated in the event) and a half-hour tour of a lab. These preliminary interviews would then lead to an invitation for a more detailed interview.

Another indispensable tool for job seekers is the Department's newly created job postings website **(www.cs.umass.edu/csinfo/jobinfo/).** The postings, varying from departmental jobs and campus-wide jobs to internships and full-time jobs, are collected by professors and staff and by request from companies that contact the Department. It is an invaluable resource to both current students and alumni looking for work. To request that a position be posted on the site, send e-mail to jobinfo@cs.umass.edu.

Faculty News

Professor **Lori Clarke,** co-director of the Laboratory for Advanced Software Engineering Research (LASER), was presented with the University of Colorado at Boulder Distinguished Engineering Alumni Award in the category of Research and Invention. The award ceremony was held on April 16. ■ Professor **Jim Kurose** and Distinguished Professor **Arny Rosenberg** both gave Information Science and Technology Center (ISTeC) Distinguished Lectures at Colorado State University. Kurose's talk "Networking…Successes, New Challenges, and an Expanding Waist as the Field Approaches 40" was presented in December. Rosenberg's lecture "N+1 heads are better than N --- or are they?" was presented in January. In another notable event for Rosenberg, this year is the 40th anniversary of his first conference paper: "On n-tape finite state acceptors," presented in the 5th IEEE Symposium on Switching Circuit Theory and Logical Design, Princeton, New Jersey in 1964. This conference evolved into the present-day IEEE Symposium on Foundations of Computer Science (FOCS Symposium). ■ **Bruce Croft,** Distinguished Professor and Department Chair, gave a distinguished lecture, "Question Answering and Semi-Structured Text," at the University of Illinois at Urbana-Champaign in February. ■ Associate Professor **Sridhar Mahadevan** was appointed an associate editor for the *Journal of Artificial Intelligence Research* (JAIR). ■ **Micah Adler,** Assistant Professor, is the chair of the Sixteenth ACM Symposium on Parallelism in Algorithms and Architectures (SPAA 2004) to be held in Barcelona, Spain in June. ■ The paper "Interactive Information Extraction with Constrained Conditional Random Fields" has been selected for Honorable Mention at the American Association for Artificial Intelligence Nineteenth National Conference (AAAI-04) to be held in July in San Jose, California. The paper's co-authors are Associate Professor **Andrew McCallum,** CS graduate student **Aron Culotta,** and Trausti Kristjansson and Paul Viola, both from Microsoft Research. ■ Professor **Jim Kurose** is the technical program chair for the 2004 ACM Internet Measurement Conference (IMC) to be held in Sicily, Italy in October. ■ Since September, Professor **Edwina Rissland** has been serving as the Program Director for the Artificial Intelligence and Cognitive Science (AICS) Program at the National Science Foundation. The AICS Program is part of the Data, Inference and Understanding Cluster in the Division of Information and Intelligent Systems, a division in the Directorate for Computer and Information Science and Engineering (CISE). On a side note, Rissland's daughter Olivia has been named a Rhodes Scholar. Each year 32 U.S. students are selected to study at Oxford for 2-3 years. Currently, a senior at Brown University, Olivia is a triple concentrator with majors in mathematics, biology, and classics. At Oxford, she will pursue a D.Phil in biology. Upon her return, she will attend medical school.

Visitor News

James Sterbenz is a Visiting Research Scientist with the Computer Networks Research Group. Sterbenz is a Senior Network Scientist at BBN Technologies. ■ Working with the Center for Intelligent Information Retrieval (CIIR) as Visiting Researchers, **Ji Seoung Kim** and **Tae Il Kim** are from NHN Corporation in Korea. ■ In a collaborative arrangement between UMass Extension Services and the Center for Computer-Based Instructional Technology (CCBIT), **Kim Anderson Pond** is a Visiting Research Scholar. ■ **Yao Chen** is a Visiting Research Scholar with the Laboratory for Advanced Software Engineering Research (LASER). She is an Instructor at the School of Software Engineering at Beijing University.

CIIR sees double (and more)

Two members of the Department's Center for Intelligent Information Retrieval (CIIR) became fathers of twins and two others became grandparents within a three-week span recently. Associate Professor James Allan and wife Cathy Luna (and big brother Will) welcomed their twins Elizabeth and Daniel into the world on March 16. On April 1, Senior Research Fellow Sergio Guzman-Lara and wife Jeanne Stacciarini (and big brother Bernardo) became the parents of twin daughters Daniela and Paola.

CIIR Software Engineer Margie Connell and her husband John announced the birth of their granddaughter, Luna, on April 5. Luna's parents are Sam Connell and Ana Gonzalez. Kate Moruzzi, CIIR Secretary, and her husband John are the proud grandparents of their first grandchild, Sienna, born on April 7 to Trina Moruzzi and Dan Moore.

Research News

David Westbrook, formerly with the Experimental Knowledge Systems Laboratory, has joined the Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) as a Senior Research Fellow. **Michael Zink** joined CASA as a Research Scientist. Professor **Jim Kurose** is an Associate Director of CASA. ■ **Michael Rosenstein** (Ph.D. '03), Laboratory for Perceptual Robotics Senior Postdoctoral Research Associate, and Autonomous Learning Laboratory (ALL) graduate student **Mohammad Ghavamzadeh** are co-chairs of the AAAI-04 Workshop on Supervisory Control of Learning and Adaptive Systems, to be held at the Nineteenth National Conference on Artificial Intelligence in San Jose in July. For details see **http://www.cs.umass.edu/~mgh/AAAI-2004/.**

Student News

Current graduate student **Brent Heeringa** was appointed a visiting faculty position at Williams College for academic year 2003-04. Heeringa is teaching theory of computation and algorithm design courses while at Williams. ■ Computer Science undergraduate **Kevin Grimaldi** won second place in the 19th Annual Mathematics Competition run by the UMass Department of Mathematics and Statistics. CS undergraduates **Vitaliy Lvin** and **Michael Sindelar** earned honorable mention in the competition. ■ Graduate students **Toby Dragon** and **Ed Walters** received nominations for the 2003-2004 UMass Distinguished Teaching Award. ■ Current graduate student **Güray Alsaç** was accorded an Honorable Mention by the National Science Foundation in the competition to receive a 2004–2005 Graduate Research Fellowship.

Staff News

Laurie Connors has accepted a Grant Administrator position with the Computer Networks Research Group. Connors previously was the Department's Graduate Programs Assistant. ■ **Cindy Loiselle** joined the Knowledge Discovery Laboratory (KDL) as its Technical Writer.

Significant Bits

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

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GIFTS

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