University of Massachusetts Amherst

Fall 2004

Significant BITS

Newsletter of the
Department of Computer Science

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Mapping the Internet:

Towsley reveals the hidden characteristics of a vast and complex global network

As the Internet grows in size and diversity, its performance becomes ever more difficult to model and measure. At present, the Internet consists of thousands of autonomous networks, hundreds of thousands of routers, and hundreds of millions of end hosts. Router and link capacities are increasing exponentially. New types of network applications continue to appear, ranging from Internet telephony to peer-to-peer file sharing applications such as Kazaa and BitTorrent. In addition, new security threats in the form of worms and viruses, and techniques for denial of service are introduced at an increasing rate. This raises significant challenges to developing an understanding of the behavior and dynamics of the Internet.

Don Towsley

Some of the challenging questions include:

1. What is the internal behavior of the Internet and how does one infer it?
2. How does one model its behavior? And what are designs for controlling the Internet in an orderly manner?
3. How does one deal with the challenges posed by Internet worms such as Code Red?

These questions have been at the core of Distinguished Professor Don Towsley's research over the last five years. His research has focused on two fundamental problems: developing a framework within which to design and understand network measurements, and predicting the behavior of the Internet based on the use of fluid models of data flow. This research has led to exciting developments.

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Department welcomes four new faculty

The Department of Computer Science is fortunate to have attracted four strong new hires resulting from its faculty recruiting efforts. Joining the Department as tenure-track faculty are Deepak Ganesan, David Jensen, Erik Learned-Miller, and Arun Venkataramani. The new faculty members have research strengths in sensor networks, knowledge discovery and data mining, computer vision and machine learning, and distributed systems and networking. "All of them have exceptional skills that will enrich our research and teaching programs," said Associate Professor Shlomo Zilberstein, faculty recruiting chair. Active recruiting of additional faculty will continue in the 2005 recruiting season as the Department continues to meet the challenge of maintaining its position of leadership in computer science.

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NEW FACULTY

Deepak Ganesan

DEEPAK GANESAN joined the Department as an Assistant Professor this fall. "UMass Amherst has a great computer science department with a history of outstanding research and culture of friendly and active collaboration. I am very excited to be a part of this Department," he said.

Ganesan's thesis, "Scalable Multi-Resolution Storage for Sensor Networks," proposes a long-term data storage framework over resource-constrained sensor nodes for handling the data requirements of scientific applications. His research, at the forefront of data-centric storage in sensor networks, has included analytical studies of optimal placement of sensor nodes for data collection, empirical measurement of time, and communication dynamics in large-scale sensor networks of many hundreds of sensor nodes.

Ganesan's research interests lie in addressing core systems and data management challenges in emerging applications of large-scale, networked, un-tethered sensors and actuators. He envisions a hierarchical structure comprising small low-power devices that perform specific sensing tasks, higher-powered larger devices that manage the data from the sensor cloud in application-specific ways, and larger servers that perform complex data and query processing. "Such hierarchical sensor networks will be ubiquitous in coming years," said Ganesan. "Large networks of radio frequency tags (RFID) are already beginning to be deployed in supermarkets such as Walmart, and sensor networks for weather monitoring, security and surveillance, building monitoring for earthquakes, medical care, and others will emerge in the coming years. My research will focus on trying to understand the energy and data management challenges posed by these systems."

Prior to joining UMass Amherst, Ganesan was a member of the Center for Embedded Networked Sensing and the Laboratory for Embedded Networked Sensing at UCLA. In the summer of 2001, he worked at Intel Research, Berkeley on some large-scale demonstrations and measurement work with many hundreds of motes. In the summer of 2003, he was at the Laboratory for Audio-Visual Communications, Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland, where he worked on some information-theoretic research on sensor networks.

Ganesan received his Ph.D. in Computer Science from the University of California, Los Angeles in 2004, his M.S. in Computer Science from the University of Southern California, Los Angeles, in 2000, and a B.Tech. in Computer Science from the Indian Institute of Technology, Madras in 1998. He is on the program committee for the Fourth International Conference on Information Processing in Sensor Networks (IPSN '05) and the IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS '05). He is a member of the Institute of Electrical and Electronics Engineers (IEEE) and the Association for Computing Machinery (ACM).

David Jensen

DAVID JENSEN, who joined the Department in 1995 as a Research Scientist and became a Research Assistant Professor in 2000, begins this fall as a tenure-track Associate Professor. Jensen directs the Knowledge Discovery Laboratory (KDL), which he created in 2001. His research focuses on the statistical aspects and architecture of systems for knowledge discovery in databases, as well as on the assessment of those systems for government and business applications.

"The Department is a very special place, with first-rate faculty and students, and a strong tradition of collaborative research," said Jensen. "This makes it an ideal environment for pursuing the deep questions that motivate my work – how humans and computers can find patterns in data, how to use that understanding to produce practical technologies, and how to anticipate and manage the impact of those technologies. I was honored to discover that so many people in the Department value my work."

Jensen's research focuses on *relational knowledge discovery* – constructing useful statistical models from data about complex relationships among people, places, things, and events. "New developments in this area are vital because of the growing interest in analyzing data drawn from the Web, telecommunications and computer networks, social networks, and other sources of structured and semi-structured data," said Jensen.

Jensen leads an active research group of 14 students and technical staff. In 2003, KDL's students and staff won the prestigious KDD Cup, the most widely recognized competitive evaluation of technologies and practices of knowledge discovery and data mining. Recent concerns about national security and the broader impacts of data mining technologies have created an even stronger demand for his research and expertise.

Prior to joining UMass Amherst in 1995, Jensen was an analyst with the Office of Technology Assessment, an analytical agency of the U.S. Congress. He received his D.Sc. in 1992 from Washington University in St. Louis in Engineering & Policy and his B.S. in 1986 from University of Nebraska Lincoln in Mechanical Engineering. He has served on numerous program committees, including the International Conference on Knowledge Discovery and Data Mining, the International Conference on Machine Learning, and the National Conference on Artificial Intelligence. He co-chaired the 1998 AAAI Fall Symposium on Artificial Intelligence and Link Analysis, and the 2000 and 2003 Workshops on Learning Statistical Models from Relational Data. He serves on the editorial boards of *Machine Learning* and the *Journal of Artificial Intelligence Research*. He is a member of the American Association for Artificial Intelligence, the ACM Special Interest Group on Knowledge Discovery in Databases, and Computer Professionals for Social Responsibility.

NEW FACULTY

Erik Learned-Miller

Erik Learned-Miller joined the Department in September as an Assistant Professor. He is an accomplished researcher in both computer vision and machine learning. Erik's diverse research includes work on learning from a small number of examples, independent component analysis, learned color constancy, developing probability models of shape deformation, and mathematical expression recognition. His Ph.D. thesis is concerned with using learned statistical knowledge from one visual task to speed learning of a new, related task. The two major types of statistical knowledge used are distributions over shape variability and distributions over joint color variability. He describes a handwritten digit classifier that achieves 90% accuracy using only a single example of each handwritten digit.

"UMass Amherst is a great place for my combination of interests. In addition to its long history of significant contributions in computer vision, the presence of very strong groups in both machine learning and robotics and a highly collaborative atmosphere make this a very exciting place to be," he said.

Learned-Miller has published in machine learning, machine vision, medical imaging, and neurosurgery. He has worked in natural language, speech recognition, and neuropsychology laboratories, and has a bachelor's degree in psychology (Yale University, B.A.,1988) in addition to his Ph.D. in Electrical Engineering and Computer Science. His research goals are to understand what makes human vision possible, and to replicate these capabilities in a machine. "I want to understand how we learn to see, and how we can build machines that learn to see," he said.

In addition to his academic background, Learned-Miller was co-founder and CEO of CORITechs, Inc., a successful company in the neurosurgery industry. The company designed virtual reality software used by neurosurgeons in the operating room to "navigate" through a patient's brain using medical images.

Before joining the Department, Learned-Miller was a Postdoctoral Research Engineer in the Electronics Research Laboratory, Department of Computer Science and Electrical Engineering at the University of California, Berkeley. He received his M.S. in 1997 and his Ph.D. in 2002 from the Massachusetts Institute of Technology, Electrical Engineering and Computer Science Department. While a student at MIT, Learned-Miller received the Microsoft-MIT graduate student fellowship and the Morris Joseph Levin Award (best Master Works oral thesis). He holds a patent on an apparatus for neurosurgical stereotactic procedures. Learned-Miller is currently the Production Editor for the *Journal of Machine Learning Research (JMLR)*.

"So far UMass Amherst has been terrific. The students have a lot of energy and enthusiasm, and the other faculty have been extremely supportive. It's really a lot of fun," said Learned-Miller.

Arun Venkataramani

Arun Venkataramani will join the Department in January 2005 as an Assistant Professor. He is in the process of completing his Ph.D. in the Department Computer Sciences at the University of Texas at Austin where he received his M.S. in 2000. "I look forward to beginning my career at UMass Amherst's Department of Computer Science, a place that I have greatly respected for its quality of research even as a graduate student," said Venkataramani.

Venkataramani has broad research interests in distributed systems and networking. His work is on problems that use ideas from operating systems, congestion control, fault-tolerance, security, and algorithmics, and it has a strong focus on system building. He also has a particular interest in using or developing a theoretical framework to gather a deeper understanding of the systems that he builds.

His thesis, "Mechanisms and Algorithms for Massive Replication Systems," develops an innovative approach to large-scale replicated systems over wide-area networks. Designing large-scale replicated systems involves balancing several metrics and constraints such as availability, response time, consistency, network connectivity, available bandwidth, and storage space at replicas. Venkataramani's work enables construction of simpler, robust, and more efficient replicated systems by making aggressive speculative replication – moving content to a location before it is accessed there – possibly in a non-interfering manner. While at UMass Amherst, he plans to continue working towards building highly reliable and available services over wide-area networks. "I believe that advances in network processors as well as research in network architectures and measurement techniques places us in a position to re-evaluate requirements and design of next generation networks that would expose richer and more flexible primitives to applications and yet be robust and simple," said Venkataramani.

Venkataramani received his B.Tech. in Computer Science and Engineering in 1999 from the Indian Institute of Technology Bombay. In the course of his Ph.D., he was a co-recipient of the J.C. Browne Fellowship that is annually awarded to an outstanding graduate student in Computer Sciences at UT Austin. His research has resulted in publications in reputed conferences such as the Symposium on Operating Systems and Principles (SOSP), Symposium on Operating System Design and Implementation (OSDI), USENIX Symposium on Internet Technologies and Systems (USITS), and Symposium on Principles of Distributed Computing (PODC).

"I'm excited about being a part of this Department, having its excellent faculty as colleagues and potential collaborators, working with the undergraduate and graduate students, and living in the academically and otherwise diverse community in the Amherst-Northampton area," said Venkataramani.

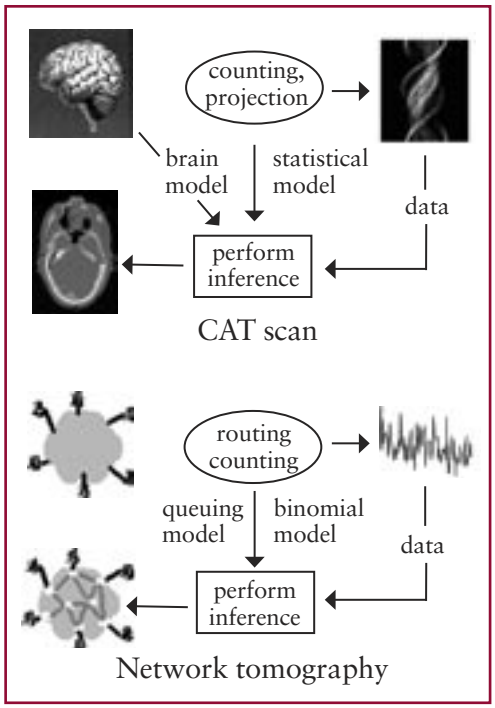
RESEARCH

Internet Mapping *(from page 1)*

Network Tomography: Inferring Internal Network Behavior from End-to-End Measurements

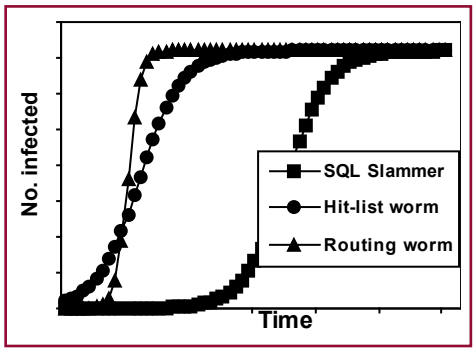
In principle it is possible to determine the performance of routers and communication links through simple queries. However, this requires administrative access to these devices. Unfortunately any one organization has access to only a small fraction of the network's internal nodes, whereas commercial factors often prevent organizations from sharing internal performance data. End-to-end measurements, on the other hand, are easily executed. Towsley, with his colleagues at AT&T Labs-Research and in the Department of Mathematics and Statistics at UMass Amherst, has pioneered the area of *network tomography*. "It is very similar to CAT scans in medical diagnostics," said Towsley. "A CAT scan consists of a sequence of x-rays of the body taken from many different angles. These x-rays, called slices, are then correlated using sophisticated statistical techniques to form a three dimensional view of the body. We have developed a similar approach based on transmitting a sequence of small packets, called probes, from a sender to a set of receivers over what is called a multicast distribution tree. The results of the probes (losses, or delays) are correlated to produce estimates of link-level performance, i.e., packet loss rates and delay statistics of the links that comprise the tree. The view of the network taken from the perspective of one sender and its collection of receivers can be thought of as analogous to a slice. We then perform the same step for many different senders and collections of receivers and, ultimately, correlate the results of all of these slices to form a detailed view of the interior of the network. This approach is incredibly useful for pinpointing problem spots in the Internet."

The initial approach, *Multicast Inference of Network Characteristics* (MINC), was developed under the DARPA Next Generation Internet program. One limitation of the approach is that it relies on multicast, a service that is not always available. More recently, Towsley and his colleagues have extended the approach to work in the absence of multicast. The basic idea of this extension is to send tightly bunched groups of packets from a sender to two or more receivers. Because the packets are tightly grouped together, each group behaves very much like a single multicast probe sent to the same set of receivers. This approach does not have the resolution of the MINC approach, but it is able to identify link-level loss rates as low as 1/2%.



Even more recently, Towsley has shifted his attention to the development of a theoretical foundation for internal network measurements. The goal is to develop an information theoretic framework suitable for designing low cost, low overhead network measurement infrastructures.

Fluid Models: Scalable Methods for Understanding the Internet



Network tomography is useful for diagnosing problems and understanding behavior of current networks. Different performance and modeling tools, however, are needed in order to be able to design and build better networks. The second major focus of Towsley's research has been the development of fluid models to describe the behavior of data flows within networks. Towsley and his colleagues in the Department of Electrical & Computer Engineering at UMass Amherst have developed simple models that capture the intricate dynamics of TCP, the dominant Internet transport protocol. These models abstract away the behavior of individual packets, replacing them by fluids, whose rates are determined by the dynamics of TCP and the applications generating them. The behavior of large networks is described through simple sets of differential equations that are easily solved on current computers. The results obtained from these models are surprisingly accurate, especially given that the models abstract away packet behavior. At the same time, large networks (thousands of routers, millions of flows) can be solved within minutes. These models and their solution methods have the potential of revolutionizing the solution of large network models encountered during the network design phase or the network configuration phase.

Network fluid models serve another goal, namely to aid the development of network control strategies, such as congestion controllers. Towsley and his colleagues pioneered the use of such models for answering the question: when can TCP lead to network instabilities? Briefly, TCP implements a congestion control algorithm that operates by increasing sending rate incrementally while conditions are good (no congestion) and by halving its sending rate at the onset of congestion. Towsley and his colleagues identified conditions under which a set of interacting TCP flows can lead to unstable network behavior (here unstable refers to the presence of oscillations, leading to packet loss and poor performance). Using the same framework, they have also

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AWARDS

Barto receives IEEE Pioneer Award

Computer Science Professor Andrew Barto is the recipient of the 2004 IEEE Neural Networks Society Neural Networks Pioneer Award. He was selected to receive this award for fundamental work on reinforcement learning. The award was presented in July during the Opening Reception of the 2004 International Joint Conference on Neural Networks in Budapest, Hungary.

Barto's research interests center on learning in both machines and animals. He has been developing learning algorithms that are useful for engineering applications while overlapping with learning as studied by experimental psychologists and neuroscientists. He has had a long interest in artificial and real neural networks. Most recently he has been working on three projects: the first focuses on extending reinforcement learning methods so that agents can autonomously construct hierarchies of reusable skills; the second, being conducted in collaboration with neuroscientists and developmental psychologists, involves modeling how animals learn motor skills; and the third applies machine learning methods to intelligent tutoring systems.

Jacek Zurada (left), president of IEEE Computational Intelligence Society (formerly known as Neural Networks Society), presents Professor Andrew Barto with the Pioneer Award.

Rosenberg accepts research award

For his many excellent, seminal, and influential research contributions over a distinguished career, the College of Natural Sciences and Mathematics (NSM) presented Distinguished University Professor Arnold Rosenberg with the College Outstanding Research Award at the NSM fall convocation.

This year marks the 40th anniversary of Rosenberg's first publication in computer science: "On n-tape finite state acceptors" in the *Proceedings of the 5th IEEE Symposium on Switching Circuit Theory and Logical Design* (Princeton, NJ, 1964, pp. 76-81). His research over this period has established him as a pioneer and leading scholar in theoretical computer science. He has contributed to automata theory, machine-based complexity, theory of date structures, graph embeddings, parallel computing, and collaborative computing.

Rosenberg was named Distinguished University Professor of Computer Science in 1988. He has received many national awards, including a Fulbright Senior Scholar Research Award and three Association for Computing Machinery (ACM) Recognition of Service Awards. He is a fellow of ACM and the Institute of Electrical and Electronics Engineers (IEEE), and a Golden Core Member of IEEE. He received an NSM Outstanding Teaching Award in 1997. His ~150 publications include a book, two edited books, and scores of high-impact articles. External letters call him "an outstanding researcher, an extremely important person in the computer science community, a wonderful colleague… He is definitely one of the worldwide most respected senior researchers on the theory of parallel computing and networks."

The outstanding faculty research award was established in 2000 to honor faculty members for their research contributions. Departments make nominations for the faculty awards and the selections are made by the college-wide committee appointed by the NSM Dean.

UMass Amherst CS among top cited and top ranked

Our Department touts four of the most highly cited researchers in computer science in the world and ranks in the top 10 in the nation. Professors Neil Immerman, Arnold Rosenberg, and Don Towsley are included in "ISI's Highly Cited Researchers" list. According to ISI (ISIHighlyCited.com^{SM}, a Thomson Scientific Company), individuals on the highly cited list comprise less than one-half of one percent of all publishing researchers. CiteSeer.IST (**http://citeseer.ist.psu.edu/mostcited.html**) also lists two of our professors among the top 250 most cited authors in computer science: Don Towsley and Jim Kurose. In a separate ranking, UMass Amherst Department of Computer Science was ranked 9th in the nation in 2003 by *Science Watch* magazine, the newsletter of the Institute for Scientific Information.

"We always keep our eyes open for information about how the Department is perceived from outside the UMass Amherst campus," said Professor Andrew Barto, Department Chair. "The most recent reports reinforce the great pride we take in our faculty and how they have established themselves as major players in computer science. The Department's goal is to continue the high quality of research and education that has made the Department one of the top ranked in the nation."

NSF ITR grants awarded

In the highly competitive National Science Foundation Information Technology Research (ITR) program, UMass Amherst computer science faculty received two new grants this year. These are the second ITR awards for both of this year's recipients, Professor Lori Clarke of the Laboratory for Advanced Software Engineering Research (LASER) and Associate Professor Andrew McCallum of the Information Extraction and Synthesis Laboratory (IESL). The NSF ITR Program reviewed 1,570 proposals this year and funded approximately 10 percent of the proposed projects.

Recent insights into the extent of medical error, coupled with dramatic increases in healthcare costs and a worsening nursing shortage, provide evidence of the need to develop new healthcare processes. The LASER project, "Improving the Safety and Efficiency of Medical Processes," deals with developing new healthcare processes to combat the problem. The results of this research should help reduce healthcare costs, improve medical outcomes, and support the training of medical personnel. Moreover, the process definitions and analysis capabilities that arise from the work should be applicable for reducing errors and improving efficiency in a wide variety of human-computer application areas. This grant is under the direction of Clarke (PI), Lee Osterweil, George Avrunin (Mathematics), and Beth Henneman (Nursing), in collaboration with Baystate Medical Center. LASER's first ITR grant, "the Analytic Web," is ongoing.

In the other ITR project announced this year, McCallum will lead the effort on the project "Machine Learning for Sequences and Structured Data: Tools for Non-Experts." Sequential and graph-structured data arise naturally in a wide variety of scientific, engineering, and intelligence problems, such as handwriting and speech recognition, text mining, gene finding, and network analysis. McCallum's project is researching methods to advance the state of the art in machine learning for structured data, building on recent work in conditional random fields and weighted transducers. The project, a collaborative effort with Carnegie Mellon University's John Lafferty and University of Pennsylvania's Fernando Pereira, is also developing a software toolkit to make the results of these advances accessible to researchers working in a wide range of disciplines and application domains. McCallum's first ITR, awarded last year, is a five year project titled "Unified Graphical Models of Information Extraction and Data Mining with Application to Social Network Analysis."

A glimpse at new research funding

The Department of Computer Science continues to focus on new research as evidenced by its 79 awards for fiscal year 2004. Some of the new research initiatives and industrial gifts are described below.

Professor Jim Kurose received a gift from Sprint in support of his research on sampling techniques and Assistant Professor David Kulp received a gift from Affymetrix, Inc. for his bioinformatics research. In other industrial support, IBM selected Associate Professor Andrew McCallum for a 2004 IBM Faculty Award and Siemens provided a gift to Professor Lee Osterweil in support of his research.

Osterweil also received an NSF digital government grant for research applying process technology to developing and evaluating dispute resolution processes through online delivery. Professor Lori Clarke and faculty from the UMass Amherst School of Management and Legal Studies are collaborating on the project.

Professor Ed Riseman received funding for two seed research projects with Baystate Medical Center. One deals with the development of a computer-assisted system for analysis of breast specimen radiographs to advance breast cancer research. The other is a project to apply state-of-the art medical imaging techniques from the field of computer vision and mathematics in order to lead to a better understanding of the relationship between general or regional brain atrophy and clinical diagnoses of dementia.

Collaborating with UMass Amherst Engineering Professors, Computer Science Professors Allen Hanson and Jim Kurose are co-PIs on an NSF Collaborative Large-Scale Engineering Analysis Network for Environmental Research (CLEANER) project to prepare a detailed plan for the development of an environmental field facility centered on the Blackstone River Watershed, an approximately 454 square mile basin cutting through central Massachusetts and northern Rhode Island.

New funding to the Commonwealth Information Technology Initiative (CITI) will enable programs to address: information technology teaching and learning at pre-K to 12 grade levels; strengthening Information Technology Across the Curriculum (ITAC) approaches and programs in 2- and 4-year higher education; and increasing the number of students and qualified teachers participating in Science, Technology, Engineering, and Mathematics (STEM) teaching and learning. Professor Rick Adrion is co-PI on this effort led by School of Education Dean Andrew Effratt.

NSF has awarded a four-year grant to Senior Research Scientist Howard Schultz (PI), Professor Allen Hanson, and faculty from Mount Holyoke College and Duke University. The goal of the project is to enhance the ability of biology and geoscience research programs to acquire, analyze, and distribute high-resolution geographical information systems (GIS) databases of important environmental attributes.

Senior Research Fellows Dan Corkill and Gary King have received a contract from the Army Research Lab to research Bayesian Blackboard technology as a tool for situation awareness and intelligence analysis. Corkill has also received a contract from the Defence Research and Development Canada.

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AWARDS

Lesser receives teaching award

At the UMass Amherst College of Natural Science and Mathematics (NSM) fall convocation, Professor Victor Lesser received the Outstanding Teaching Award for his distinguished graduate teaching and mentoring. Lesser came to UMass Amherst in 1977 and last year he graduated his 25th doctoral student, Anita Raja. He has five current Ph.D. students and has advised many masters students throughout his career.

Both students and faculty praise him for his ability to focus on the needs and progress of every student in his group, despite its size, and to support students while allowing them to explore their own initiatives. Roughly one third of Lesser's Ph.D. students have been women, a much higher proportion than is common in computer science generally. From student letters:

"Despite the fact that Victor had a large group of up to 14 students while he was my advisor, he always cared deeply about me, both in professional and personal matters. …He has a great sense of giving some students structure in their projects while letting other students run with their own ideas."

"I believe that a truly outstanding teacher has the ability to help each student realize her full potential, in her own unique way, and in a manner that results in a lifetime of self-confidence and thirst for knowledge. Each of Victor's many students is an individual measure of his success as an outstanding teacher, and I am very proud to be among them."

"Despite everybody's best efforts, there are still many unique challenges that face women in computer science. Victor's record of graduating female Ph.D.s in a field dominated by men is a testament to his openness and sensitivity to gender issues."

The NSM Outstanding Teaching Award is coordinated by the campus' Center for Teaching. The purpose of the award is to honor individual faculty members for their teaching accomplishments within their own colleges. Lesser was recognized at the undergraduate commencement for his award.

Lesser has recently enjoyed the opportunity to discuss his research as an invited speaker at universities and conferences spanning the globe. In February, he spoke on "Seeing Multi-Agent Coordination through the Lens of Decentralized Markov Decision Processes" as a Distinguished Lecturer at Washington University in St. Louis, Missouri. In May, Lesser was the keynote speaker at the First Cuban Symposium on Artificial Intelligence/ 10th International Conference on Informatica 2004. While in Cuba, he was also an invited speaker at Havana University. In another May appearance, Lesser gave the keynote speech at the NRC Artificial Intelligence Conference (IEA 2004) in Ottawa Canada. Lesser appeared in Beijing, China in September as an invited speaker at the 2004 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology. Two out of the three finalists in the competition for Best Paper award at the Beijing conference are from the Lesser's Multi-Agent System Laboratory.

Professor Victor Lesser and Anita Raja (Ph.D. '03), Lesser's 25th Ph.D. graduate, at the Computer Science Alumni Reception in June 2004.

Outstanding employee saluted

John Lombardi, Chancellor (far left), Charlena Seymour, Provost and Senior Vice Chancellor for Academic Affairs (far right), and Professor Robbie Moll, Computer Science Associate Chair for Academic Affairs, are shown above presenting **Claire Christopherson**, Computer Science Business Manager, with the 2004 Chancellor's Citation Award. This award recognizes and honors professional and classified employees who have demonstrated outstanding performance in contributing their time and skills in helping the campus achieve its goals and objectives.

University of Massachusetts Amherst

Fall 2004

Alum Matters

A newsletter for alumni of the Department of Computer Science

A new paradigm of human computer interaction

Multiple people can interact using a display surface together

Chia Shen

If you ask people of all ages to draw a computer, most will draw a monitor, a keyboard, and a mouse. That is the style of human computer interaction that has been ingrained in our recent culture, where each person is immersed in his/her own computer display, removed from the world outside. But what if you can simply reach out and touch your computer, with bare hands, fingers, stylus and pens, just as you work on a table, a desk and a whiteboard? Would the experience one has gained throughout a lifetime of interacting with the physical world be transferred to interacting with the digital world? What are the new usage scenarios if you can interact on the same computational surface simultaneously with colleagues? How would that change the nature of computational applications?

This is the focus of Chia Shen's (Ph. D. '92) research – Human Computer Interaction on large, direct, multi-touch and multi-user co-interact surfaces. Direct multi-touch surfaces, such as a top-projected DiamondTouch (a research prototype from Mitsubishi Electric Research Labs, Cambridge MA USA, see **www.merl.com/projects/DiamondTouch**), are displays with superimposed input sensing and output displays; multiple touches can be detected simultaneously. "By co-interact, we mean that multiple people interact with and on the same contiguous interactive surface," said Shen, Senior Research Scientist and Associate Director, MERL Research Lab. In this environment, the conventional interface metaphors used in today's predominantly desktop computers are not appropriate. Users should be able to focus on what their real world tasks are, not what the computer interface is doing. Tables predate computers, and people have a whole set of preconceptions of how to use and interact with objects on a physical table. This human factor has strong implication on the design of interactive tabletops.

Shen's group faces many interrelated research challenges in studying a new genre of HCI – tabletop computing:

DiamondSpin: Orientation of tabletop documents –

People most often sit *around* a table, face-to-face or corner-to-corner. This is very different from the desktop display or electronic whiteboard usage scenario. "People cannot interact effectively if we simply display a conventional desktop window system on a tabletop," said Shen. Imagine how one would operate a mouse from a 90 degree angle, or how will users read texts upside down all the time! Towards this end, Shen and her post-doc Dr Frederic Vernier, have developed the DiamondSpin Java tool kit (**www.merl.com/projects/diamondspin/**). A real-time Cartesian to Polar coordinate transformation engine is at the heart of DiamondSpin, enabling flexible rotation and translation of documents displayed on the tabletop. Every user sitting at any side of a table can view documents and objects from a comfortable angle, and documents and digital objects can be naturally passed around the tabletop by a simple finger slide.

UbiTable and DiamondSpace: Content-in Content-out –

One of Shen's research foci has been studying tabletops as general purpose display and interaction surfaces, rather than as special purpose computational devices. For example, imagine that tables at Starbucks and airport waiting areas are interactive surfaces. This implies that the digital tabletop must be simple to use for first-time users. UbiTable (Ubiquitous Table) is a project in Shen's group to address the issue of easy, direct, and fluid transfer and movement of documents between personal devices, such as laptops, USB devices, digital camera media, and digital tabletops. They are examining a concept called micro-mobility of digital content – supporting a level of control

A shared table-and-wall multi-surface interactive DiamondSpace

UbiTable

for paper documents, but applied in the digital world. Another key issue in a walk-up environment is privacy – the contents on the table should be treated as transient, when a meeting or a work session ends, the users ought to be able to walk-away, knowing that the table has been 'wiped clean', with no residue of their own personal content for the next group of serendipitous walk-up users to access. This transient model for files and documents used on the tabletop requires new methods for versioning and journaling of documents that have been brought onto the table dynamically from various personal devices. DiamondSpace is a new research project that extends UbiTable into a multi-surface walk-up interactive room with digital tables and walls.

ExpressiveTouch: Multi-style, Multi-tool gestural input techniques –

On a direct multi-touch surface, multi-hand and multi-finger gestures as input methods are feasible. Our hands and fingers have the dexterity to express many levels of interactions, both symmetrically and asymmetrically. But fingers and hands are coarse in resolution when it comes to pointing and interacting with fine, pixel-level data. The mouse, indirect and relative, is one of the most precise pointing input devices. Moreover, people naturally like to use a pen or stylus for writing, scribbling, marking, and annotating. Typing with a keyboard is the most efficient way for text input. Thus, ExpressiveTouch is concerned with integrating mutli-modal input devices. Two-handed bimanual operations hold great potential for human computer interaction in general. However, their appropriate design and effectiveness must be studied systematically. The operational relationship, balance, and symmetry between the dominant and non-dominant hand are subtle, yet have key implications in the feasibility, acceptance and usefulness of bimanual input techniques.

A multiple area work table

"Large direct multi-touch surfaces will soon be a reality. The key is the understanding of their role in the fabric of our overall interactive world," said Shen. "Thus the research question is not how to replicate today's desktop computing on tabletops and electronic walls, but is to ask what are the potentials of these interactive surfaces, what are the appropriate and effective interaction techniques and user interface metaphors for them." In the past few years, together with her colleagues, post doc, and graduate student interns from Stanford, UC Berkeley, University of Toronto, University of Washington, University of Calgary, and University of Paris, Shen's research has addressed some of these research questions and raised new challenges in pursuit of her vision of ubiquitous interactive tabletops.

Shen's research on shared tabletop systems has been presented and published in many major HCI forums including ACM CHI, ACM CSCW and UbiComp. She is leading the research at MERL on shared interactive surfaces (**http://www.merl.com/people/shen**). Before her HCI endeavor, she had over 10 years of research experience in real-time systems. Shen also led the MidART research project which was successfully incorporated into several large distributed industrial plant control systems, contributing to a multimillion dollar industrial control business during 2001-2003. MidART is real-time middleware for applications where humans need to interact, control, and monitor instruments and devices in a network environment through computer interfaces. While at UMass Amherst, Shen was advised by Professor Krithi Ramamritham.

Alumni Connections

Michael Franklin (B.S. '83) was recently promoted to full Professor in the Computer Science Division of the Electrical Engineering and Computer Sciences Department at the University of California, Berkeley. He was also named a Vice Chair of the Department. His main research focus is on databases and data management. Franklin's current projects are exploring the application of database query processing techniques across a wide range of computing environments including wireless sensor networks, digital homes, XML-based message brokers, and scientific grid computing.

Matthew Cornell (M.S. '92) has been promoted to Senior Research Software Engineer in the UMass Amherst Department of Computer Science's Knowledge Discovery Laboratory, under the direction of Associate Professor David Jensen. As part of his new duties, Cornell attended a week-long seminar on Extreme Programming (XP), and has led the effort to apply XP practices to the Laboratory's software development process. The result is an open-source version of the Laboratory's Proximity software.

This fall, Matt Dwyer (Ph.D. '95) joined the Department of Computer Science and Engineering at the University of Nebraska, Lincoln as the Henson Professor of Engineering. Dwyer's UMass Amherst advisor was Professor Lori Clarke.

Tammy R. Fuller (M.S. '92), a former member of the Visions Group advised by Professor Al Hanson, presented "Design-Analysis Centric Method for Creating Sustainable, Stable, Complex Systems" at the 7th IEEE International Conference on Intelligent Transportation Systems in Washington D.C. in October. She is co-author of The *XML Design Handbook* published by WROX Press last year, and is founder and CEO of Concentric Spheres Inc.

Zhao selected as NSF CISE division director

The National Science Foundation recently selected Dr. Wei Zhao (Ph.D. '86) as CISE Division Director of Computer and Network Systems, to be effective January 3, 2005. Zhao will join NSF from Texas A&M University, where he is Associate Vice President for Research and a Professor of Computer Science. As an IEEE Fellow, he has made significant contributions in distributed computing, real-time systems, computer networks, and security and privacy. Zhao is the founding director of the Texas A&M Center of Information Security and Assurance, which has been recognized as the Center of Academic Excellence in Information Assurance Education by the National Security Agency.

"I am very excited about this opportunity. I can still recall my days as a graduate student at UMass Amherst back in the early 1980's," said Zhao. "Computer Science was in a relatively formative stage of development, and the concept of Information Technology was relatively unknown to the world. We are now in the age of IT, at a time when computers have a profound effect on the way the world works. However, Computer Science and Engineering have grown even more complex. I am delighted to have this chance to work with the community on more exciting innovations that will help us succeed in meeting ever increasing challenges."

In addition to Zhao's appointment, Professor Edwina Rissland is currently serving in the CISE Division of Information & Intelligent Systems (IIS) as a program director in the Data, Inference and Understanding Cluster. Professor Bryant York (Ph.D. '81) is a member of the CISE Advisory Committee and an advisor to the CISE directorate on Broadening Participation. Recently, Professor Randy Yuan-Chien Chow (Ph.D. '77) of the University of Florida served as a program director in the CISE Computing & Communications Fundamentals Division, and Professor Rick Adrion served as a senior advisor to CISE Director, Peter Freeman, following three years as Division Director of the CISE Experimental & Integrative Activities Division.

Zhao received his M.S. and Ph.D. degrees in Computer and Information Sciences from the University of Massachusetts Amherst in 1983 and 1986, respectively. In 1990, he joined Texas A&M University where he has been a full professor in the Department of Computer Science since 1996. Between 1997 and 2001, he served as a department head. During his career, he has been a faculty member at Amherst College, the University of Adelaide, and Texas A&M University. Zhao holds two U.S. patents and has published over 220 papers in journals, conferences, and book chapters.

Research funding ...

(from page 6)

In this project, Corkill will perform an architectural study of integrated data fusion and command and control systems for new ships being designed for the Canadian navy.

NASA awarded Professor Rod Grupen with a grant to build representations in dexterous manipulation tasks using multi-modal information. Research Associate Professor Beverly Woolf received three grants in support of inquiry learning, and McCallum is collaborating with Aptima, Inc. on a second phase Air Force Small Business Technology Transfer (STTR) contract to develop an automated diagnosis of usability problems using statistical computational methods.

Where have they gone?

The following students have graduated with Ph.D.s within the past year:

- Victor Lavrenko: "A Generative Theory of Relevance" (James Allan and Bruce Croft, Advisors); Senior Postdoctoral Research Associate, Center for Intelligent Information Retrieval, UMass Amherst.
- Roger Mailler: "A Mediation-Based Approach to Cooperative Distributed Problem Solving" (Victor Lesser, Advisor); Postdoctoral Fellow, Cornell University.
- Jeremy Pickens: "Harmonic Modeling as an Effective Foundation for Polyphonic Music Retrieval" (Bruce Croft, Advisor); Visiting Fellow, King's College, London.
- Balaraman Ravindran: "An Algebraic approach to Abstraction in Reinforcement Learning" (Andrew Barto, Advisor); Assistant Professor, Department of Computer Science and Engineering, Indian Institute of Technology, Madras.
- John Ridgway: "Foundations for Polylingual Systems (Jack Wileden, Advisor); Visiting Assistant Professor, Wesleyan University.
- Matthew Schmill: "Learning the Structure of Activities for a Mobile Robot (Paul Cohen, Advisor); Senior Postdoctoral Research Associate, Experimental Knowledge Systems Lab, UMass Amherst.
- Zhenlin Wang: "Compiler-driven Techniques to Improve Next-generation Cache and Memory Performance" (Kathryn McKinley, Advisor); Assistant Professor, Computer Science, Michigan Technological University.

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!

RESEARCH

Learning to teach: intelligent tutors learn to improve

Human teachers are expected to improve with experience; they should learn how to handle different types of students, and which methods work for which learning difficulties. But how can a computerized teacher improve its skills over time after working with hundreds of students? How can it recognize that certain problems are too difficult for a student or identify which hints should follow other hints? How can it become more skillful over time?

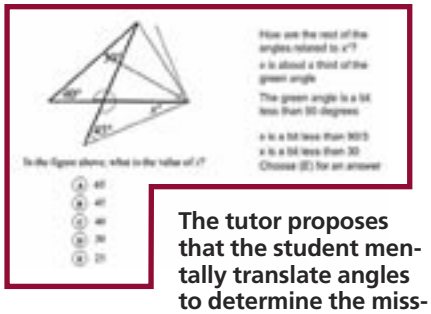
These are the issues raised in a new award from the National Science Foundation's Program for Research on Learning and Education (ROLE), to Beverly Woolf (PI), Andrew Barto, Sridhar Mahadevan, and Ivon Arroyo from Computer Science and Don Fisher from Mechanical and Industrial Engineering. The goal of this research is to use machine learning to model prior student behavior, to learn what is effective, and to develop new and more effective pedagogical strategies. Optimization might be directed at reducing a student's time to achieve mastery or advance through a curriculum.

Intelligent tutoring systems already do customized problems and hints for individual students. They use heuristics to select problems and hints for individual students. However, these tutors do not improve over time. They use the same heuristic methods and all students are treated the same as the very first student. New students fall into the same classification cells based on pre-tests and behavior with the tutor.

This NSF research focuses on designing computer aided tutors to improve their own knowledge about individual students and pedagogy. This improvement is needed for many reasons. Tutors are let loose in a constantly changing environment under conditions that cannot be predicted. It is not feasible to build teaching systems that emulate master teachers given the variety of student interests, abilities and learning styles. Nor is it feasible to build a tutor for every new population of students, e.g., those with low cognitive or spatial ability. Imagine an intelligent tutor that teaches fractions to 8-10 year old children. Such a tutor typically assumes that all incoming students have a fairly standard set of mathematics skills and will acquire new knowledge in a fairly standard way. These assumptions are clearly not valid for all 8-10 year olds, let alone those who are younger (e.g., a mathematics superstar learning algebra at a young age) or older (e.g., a thirty-year old college student studying remedial mathematics).

Researchers have used machine learning with an earlier tutor to predict how each student will react to a variety of teaching actions. Joseph Beck (Ph.D. '01), now at Carnegie Mellon's Center for Automated Learning and Discovery, demonstrated the advantages of machine learning to form a useful student model from a corpus of data obtained from an earlier population of students. In the current research, machine learning techniques are being applied to Wayang Outpost, a tutor developed at UMass Amherst as part of an NSF funded project (Carole Beal, Department of Psychology, P.I.). This tutor for Scholastic Aptitude Test geometry problem-solving uses graphics and animation to motivate students. Hints include animated drawings, rotating triangles and characters pointing to salient portions of the problem. The tutor customizes the choice of hints for individual students based on predetermined algorithms that consider a student's cognitive profile, gender, spatial ability, and math fact retrieval speed. Machine learning will enable this tutor to identify which methods are effective with which students and how to modify its heuristics.

Researchers plan to use a hierarchical probabilistic modeling of the problem-solving activity in the geometry tutor of both individual students and prior users of the tutor. Bayesian networks will provide one underlying language for probabilistic modeling. Hierarchical graphical models and machine learning will automate the creation of student models and enhance the tutor's ability to assess a student's state of mastery, including their moment-to-moment state of engagement, and predict the effect of pedagogical decisions on these states. Then they will extend the optimization process to address longer-term teaching goals, and improve the tutor's ability to make decisions combining both speed of learning and measures of retention. The role of latent and instructional variables, such as the student's knowledge of geometry skills (angles, perimeter, and area) will be represented in the hierarchical structure of topics. Through inclusion of variables estimating the level of a student's engagement in the tutoring process, researchers will investigate how to best select pedagogical actions designed to maintain engagement or re-engage students in the tutoring process.



The tutor proposes that the student mentally translate angles to determine the missing value. Traditional computational hints (right of the figure) are better for students with weak spatial skills.

Large-scale experiments conducted in local high schools will help researchers determine the practical significance of each enhancement to the tutor, as well as the effect of machine learning techniques on students' attitudes towards science, mathematics, and engineering.

Animated Adventures in Wayang Outpost. Scientist Anne leads the student to save three orangutans after a fire breaks out in the forest.

Faculty receive computer security grant

Assistant Professors Mark Corner and Brian Levine, along with four colleagues from the local five colleges have received a two-year grant from the National Science Foundation (NSF) to support expanded teaching offerings in the field of computer security and the protection for networks, hardware, and software. The grant will also allow the regional five-college system to expand its ability to serve graduates and undergraduates in the field, known as "information assurance." Corner and Levine share the grant with Nicholas Howe of Smith College, Scott Kaplan of Amherst College, Sami Rollins of Mount Holyoke College, and Richard Weiss of Hampshire College.

In addition, Levine and Corner have received a grant from the National Security Agency (NSA) to fund activities at the Center of Academic Excellence in Information Assurance Education (CAEIAE) activities, which coordinates research and academic activities in computer security at UMass Amherst. The grant includes funding for a scholarship awarded to an undergraduate attending Commonwealth College, the honors college at UMass Amherst.

The NSF grant bolsters UMass Amherst's resources and status as a center of academic excellence in the field as designated by the NSA, according to Corner and Levine. That grant award also includes matching funding from the dean of the College of Natural Sciences and Mathematics and the Department of Computer Science for two teaching assistant positions.

The NSF grant project is designed to broaden the core of classes in the field, adding supportive material to related classes and a two-year speaker series of external experts from academia and industry. It will also help develop laboratory exercises, providing students with hands-on technical experience in a supervised lab in team projects. Another component, outreach to women, involves producing and sharing educational materials among the five colleges to give female students greater access to computer security courses.

With funding from this program, the Five College Speaker Series on Information Assurance is hosting the following visiting speakers this fall:

October 4: Clay Shields, Georgetown University

October 12: Carla Brodley (Ph.D. '94), Tufts University

November 1: Joan Feigenbaum, Yale University

November 8: George Danezis, Cambridge University

November 15: Steve Zdancewic, University of Pennsylvania

November 29: David Martin, UMass Lowell

December 6: David R. Jefferson, Lawrence Livermore National Labs

December 13: Dan Wallach, Rice University

"We are grateful for this generous support from the NSF, NSA, our dean and chair of our Department," said Levine, the director of CAEIAE. "By cultivating a culture of interest in security-related education and research, we hope to motivate more collaborative research proposals and faculty recruiting. Additionally, undergraduate and graduate students will leave the five-college system with the interests and skills necessary to improve commercial and research computer security systems."

– Patrick Callahan, News Office

Distinguished lecture series

The Department hosted four prominent researchers from industry and academia this fall as part of its distinguished lecture series.

Computer Science Professor Eva Tardos of Cornell University gave a presentation on "Network Games and the Price of Anarchy or Stability." Networks that operate and evolve through interactions of large numbers of participants play a fundamental role in many domains, ranging from communication networks, such as the Internet, to social networks. These networks give rise to a number of challenging algorithmic questions that Dr. Tardos addressed.

Dr. Vinton G. Cerf, this year's Sidney Topol Distinguished Lecturer, spoke on "Convergence and Control in an Internet World." Widely known as one of the "Fathers of the Internet," Cerf is the co-designer of the TCP/IP protocols and the architecture of the Internet. In December 1997, President Clinton presented the U.S. National Medal of Technology to Cerf and his partner, Robert E. Kahn, for founding and developing the Internet. He is currently Senior Vice President of Technology Strategy at MCI and Chairman of the Board of Internet Corporation for Assigned Names (ICANN). The Sidney Topol Distinguished Lecturer Series was established through the generosity of Sidney Topol, UMass Amherst Class of 1947, for whom the lecture series is named. Topol is regarded as a telecommunications pioneer who helped forge the cable-satellite connection that triggered the growth of cable television in the United States.

The third DLS speaker, Professor Joseph Hellerstein of the University of California Berkeley gave a presentation, "Querying and Routing: Data-Centric Forays into Networking," that focused on both global-scale Internet systems and tiny sensor networks. Dr. Hellerstein, an Alfred P. Sloan Research Fellow, is also the Director of Intel Research, Berkeley. His research focuses on data management and networking, including database systems, sensor networks, peer-to-peer and distributed systems.

Dr. Peter Norvig, Director of Search Quality at Google, spoke on "Web Search as a Computational Challenge." During his presentation, Norvig gave an overview of the challenges involved in building and hosting an Internet search engine. His talk covered the computational problems and approaches of both current and next-generation systems, involving issues of information retrieval, computational linguistics, machine learning, and distributed systems.

NEWS

Homeland security workshop held at UMass Amherst

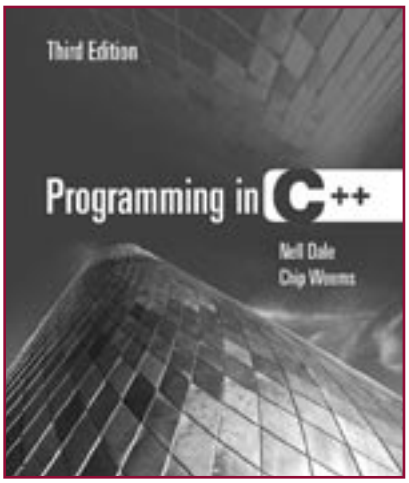
In September, the Department hosted a homeland security (HS) workshop sponsored by U.S. - Israel Science & Technology Foundation (USISTF). Senior Research Fellow Dan Corkill organized the event. The workshop goal was to establish a tangible, collaborative HS experience that will provide a competitive advantage in pursuing future HS research funding. The workshop also gave participants a chance to discover and enhance connections with other faculty who are applying their research to HS areas.

In one of only four awards made by the USISTF, the project "Collaboration toward Integrative Information Systems for Homeland Security" is an effort between UMass Amherst and Technion, Israel Institute of Technology, designed to help New England and Israeli faculty get together with end-users, government, and industry participants in creating specific HS demonstration projects. A second, follow-up workshop will be held in February to share results of these demonstration efforts and to pursue downstream funding and development opportunities.

Weems publishes nineteenth textbook

Associate Professor Chip Weems has just published his nineteenth textbook, the third edition of *Programming in C++,* Jones and Bartlett Publishers (**www.jbpub.com**). The book features a streamlined introduction to the C++ language, as compared to his other C++ text, *Programming and Problem Solving with C++*. "This text addresses the needs of instructors who are primarily concerned with covering the basics of programming and C++ syntax," said Weems. "Our other book includes more of an emphasis on software engineering, along with some fundamentals of computing theory, and historical background that enhances the student's experience. It also goes deeper into data structures, making it possible to use the same book for two quarters. In both books, however, we work very hard to present the difficult concepts in a student-friendly manner," he continued.

Weems has been collaborating with co-author Nell Dale, University Texas at Austin, for twenty years. Dale is the recipient of the ACM Karl V. Karlstrom award for contributions to Computer Science Education, based on their textbooks and her leadership in the ACM Special Interest Group on Computer Science Education. Of their relationship, Weems said, "Nell is wonderful to work with on these books. We've shared the same goal from day one: improving the learning experience for the student. The pedagogical approach always comes first. And we have great fun brainstorming new ways to improve our presentation with each edition."



When asked about the choice of programming language for the introductory courses, Weems responded that, "All of the popular modern languages are designed for use by professionals, in environments that would overwhelm a beginner. That's a huge challenge for textbook authors and instructors. C++ offers unique difficulties that require some very careful treatment in a text. Many books simply present the constructs, and let the students sink or swim. We provide swimming lessons. Our Java book deals with different issues, and is able to go deeper into object-oriented design than our C++ books. But right now, there is no widely used language that is simple for novice programmers to step into easily. That makes it harder to attract and retain computer science majors. Nell and I are working to address this problem by easing the climb up that steep initial learning curve."

Proximity software released

The Knowledge Discovery Laboratory (KDL), under the direction of Associate Professor David Jensen, has released version 3.0 of their Proximity software under an open-source license.

Proximity is a software environment for extracting non-trivial, previously unknown, and useful information from complex data sets. Proximity is particularly well-suited to analyzing highly relational data sets drawn from the web, computer networks, social networks, and relational databases. Proximity incorporates major findings and algorithms from KDL's recent research, including a graphical query language and statistical modeling algorithms that exploit the unique characteristics of relational data. Proximity provides an open-source platform that can be used for both research and practical applications. Visit **http://kdl.cs.umass.edu/proximity** for more details and to download the software.

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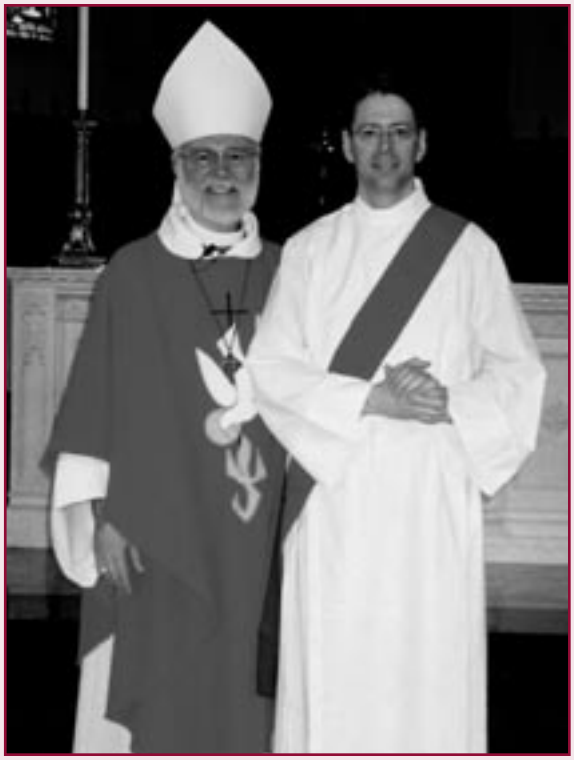

Moss ordained

Associate Professor Eliot Moss acquired a new title: he is now, in church circles anyway, The Reverend Eliot Moss. In June, he was ordained a deacon in the Episcopal Church by Gordon P. Scruton, Bishop of Western Massachusetts (left in photo). He anticipates being ordained priest in another year. "While the dual commitment of professor and clergy makes for 'interesting' time management, I will remain full-time with the Department for the foreseeable future," said Moss. In his current church assignment he assists the rector of Church of the Atonement in Westfield, MA helping lead worship, visiting the sick, preaching about once a month, and lending a hand to various programs as time permits.

We need your continued support

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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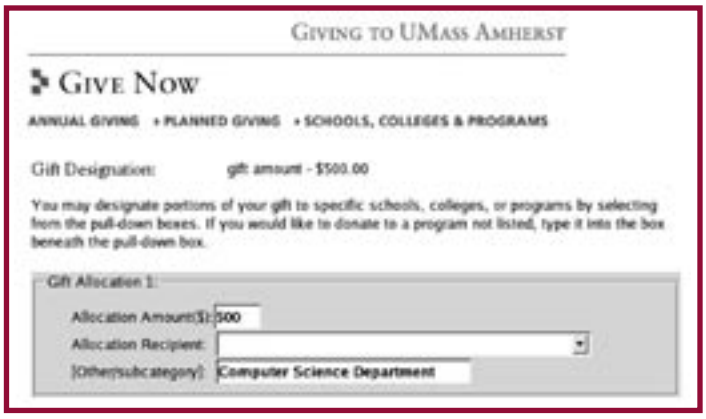

Internet mapping *(from page 4)*

developed better controllers that can be added to routers in order to reduce or eliminate these instabilities.

Fluid models have also proven useful for the study of the spreading behavior of Internet worms, such as that of the SQL Slammer Worm. Towsley and his colleagues have used these models to study different spreading behaviors. For example, the figure shown on page 4 illustrates the spreading behavior of the original SQL Slammer, and how much more virulent it can be with either the addition of a list of 1000 vulnerable computers or routing information that is publicly available in the Internet. These models are also useful for designing worm detection algorithms and mitigation algorithms. For example, these models predict that the traffic generated by a worm grows exponentially at the beginning of an infection. Based on this observation, Towsley and his colleagues have developed a detection algorithm that looks for the presence of such an exponential growth in the appropriate network traffic and, once spotted, provides an accurate estimate of the infection rate. Worms can be detected before one percent of all vulnerable nodes are infected.

Towsley received his Ph.D. in Computer Science from the University of Texas at Austin in 1975. After a postdoc position at UT Austin, he joined the UMass Amherst Department of Electrical & Computer Engineering in 1976. He transferred to the Department of Computer Science in 1985 where he is now a Distinguished Professor and co-director of the Advanced Networks Lab. Towsley is a Fellow of the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) for his work in modeling networks. He has received a number of best conference paper awards and the 1998 IEEE Communications Society William Bennett Award.

Faculty News

Micah Adler, co-director of the Theoretical Aspects of Parallel and Distributed Systems (TAPADS) Group, and **Prashant Shenoy,** director of the Laboratory for Advanced System Software, have been promoted to Associate Professor with tenure. ■ Associate Professor **Andrew McCallum** was Program Co-Chair of the "Second International Conference on Email and Spam." McCallum was also an invited speaker at 2004 Department of Homeland Security Workshop on Data Sciences, and he gave an invited talk in the "Center for Intelligent Systems" series at Berkeley in November. ■ Associate Professor **Sridhar Mahadevan** was nominated for a 2003-2004 Distinguished Teaching Award, the only student-driven recognition of teaching on campus. ■ Professor **Andrew Barto** co-edited the book *Handbook of Learning and Approximate Dynamic Programming* (IEEE Press and Wiley-Interscience, 2004) with Jennie Si, Warren Powell, and Don Wunsch II. ■ Associate Professor **Shlomo Zilberstein** was the co-chair of the Fourteenth International Conference on Automated Planning and Scheduling (ICAPS 2004) held in Whistler (British Columbia). The ICAPS conference series was formed in 2003 by merging two biannual conferences: the International Conference on Artificial Intelligence Planning and Scheduling (AIPS) and the European Conference on Planning (ECP). ■ Professor **Jim Kurose** gave a keynote address, "Networking: successes, new challenges, and an expanding waist as the field approaches 40" at the 2004 IEEE Infocom Conference in Hong Kong. ■ Associate Professor **James Allan** was the program co-chair of ACM's Special Interest Group in Information Retrieval (SIGIR) 2004 conference.

Visitor News

Professor **Shiv Kalyanaraman**, an Associate Professor in the Department of Electrical, Computer and Systems Engineering at Rensselaer Polytechnic Institute, is spending his sabbatical visiting the computer networks group. ■ Working with the Center for Intelligent Information Retrieval (CIIR) as visiting researchers are **Byoung Yeop Choi** and **Jangwon Seo** from NHN Corporation in Korea.■ Visiting scholars from Soongsil University in Seoul Korea, **Kihum Cho** and **Sul Lee** are collaborating with the CIIR. ■ Also visiting the CIIR is Dr. **Harksoo Kim,** Principal research engineer at Diquest, Inc. in Korea.

Research News

Yiping Zhan joined the Department as a Senior Postdoctoral Research Associate working with Assistant Professor David Kulp. ■ Research Scientist **Andrew Fagg** and Senior Postdoctoral Research Associate **Amy McGovern** (Ph. D. '02) will join the faculty in the School of Computer Science at the University of Oklahoma this year, Fagg as Associate Professor and McGovern as Assistant Professor. ■ Previously with the CIIR, Senior Research Fellow **Andrés Corrada-Emmanuel** has joined the Information Extraction and Synthesis Laboratory (IESL).

Student News

Laboratory for Advanced Software Engineering Research (LASER) graduate students **Jamieson Cobleigh** and **Rachel (Smith) Cobleigh** married on August 14. ■ Graduate student **Natasha Mohanty** is one of only eight women across the U.S. selected for the 2004 Google Anita Borg Memorial Scholarship. The scholarship is awarded to female undergraduate and graduate students selected based on academic performance, responses to essay questions, and letters of recommendation. Mohanty also received a Google internship for the summer 2004. ■ Laboratory for Perceptual Robotics graduate student **Stephen Hart** received a NASA Graduate Student Research Program (GSRP) Fellowship for funding of up to three years. ■ **Zhengzhu Feng,** a graduate student of the Resource-Bounded Reasoning (RBR) Lab, won first place in one of the tracks of the International Planning Competition, held as part of ICAPS 2004. The competition is a biannual event that promotes a better understanding of existing planning methods and fosters the exchange of benchmark problems and algorithms within the community. ■ Undergraduate **Amos Wetherbee** received a Commonwealth College Honors Research Grant and a DoD Information Assurance Program Scholarship. During breaks in their academic studies, IA Scholars receive progressive, hands-on experience in information security internships. Information Assurance Scholars serve a period of service as full-time permanent civilian positions with the Department of Defense upon graduation. ■ Undergraduate **Michael Sindelar** accepted a Commonwealth College Research Assistant Fellowship.

Staff News

Vivien Venskowski joined the Department as the Graduate Programs Assistant. ■ Joining the main office staff, **Leeanne Leclerc** is the Undergraduate Programs Assistant. ■ Previously with CCBIT, **Adam Saunders** has joined IESL as an Associate Software Engineer.

Baby News

CSCF Associate Software Specialist **David Korpiewski** and his wife Lisa are the proud parents of Grace Marie, born on May 18. ■ Computer Science Custodians **Shari and Dave LaRock**'s daughter, Emily Rose, was born on July 15. ■ CIIR Senior Research Fellow **Steve Cronen-Townsend** and his wife Rachel had their second daughter, Rory Sophia, on July 16. ■ Associate Professor **Ramesh Sitaraman** and his wife Vidya welcomed their son, Siddarth Kumar, into the world on July 23. ■ **Andrew Fagg** and **Amy McGovern,** now at University of Oklahoma, announced the birth of William Robin McGovern-Fagg on August 10. ■ Caroline Athena was born to Phil and **Wendy Cooper,** RIPPLES Project Manager, on August 18. ■ RBR graduate student **Zhengzhu Feng** and Yu Zeng welcomed Rachel Zirui Feng on September 2. ■ CIIR graduate student **Xiaoyong Liu** and Hudong Wang proudly announced the birth of their son, Jerry Yuyang Wang, on October 9.

Miscellaneous News

The Department was again well-represented in a Valley Light Opera (VLO) production. Gilbert & Sullivan's *Ruddigore*, a supernatural opera, was VLO's 30th fall production. Members of the chorus were CASA graduate student **Armen Babikyan,** Professor **David Mix Barrington,** and LASER graduate students **Rachel and Jamieson Cobleigh.** Cobleigh was also one of the show's producers. Professor **Robert Graham** was the technical director: set construction, and PRISMS graduate student **Allison Clayton** was the stage manager. See photos and more information at **www.vlo.org**.

Significant Bits

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

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Amherst, MA 01003-9264

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