

Significant BITS

Newsletter of the
School of Computer Science



Senator Rosenberg presents citation during new Schoolhood/50th anniversary celebration

During the School of Computer Science’s celebration dinner on Friday, October 18, 2013, Massachusetts Senate Majority Leader Stanley Rosenberg presented School Chair Lori Clarke with a legislative citation “in Recognition of: The Celebration of the 50th anniversary of the founding of the graduate program in computer science at University of Massachusetts Amherst and fifty years of excellence that makes Massachusetts proud.”

The dinner, attended by a hundred alums, faculty, and guests, was one of the many events held during the three-day celebration of UMass Amherst Computer Science becoming a School and coinciding with the 50th anniversary of its founding.

“Becoming a School is recognition of where we believe computer science is going in the future,” says Clarke. “It recognizes that computing has become very interdisciplinary, enhancing and opening up new avenues of investigation in just about every discipline. It is not just the use of computing power for crunching numbers and obtaining new results, but the application of computational thinking that allows new ways of exploring problems and seeking new insights. As a school, we have interactions with every other school and college on campus and with various departments and disciplines around the world.”

Hundreds attended the “Broadening the Impact of Computing” festivities during October 17th - 19th. On Thursday, October 17th, many CS alums returned to campus for the Computer Science Career Fair and “Careers in Computing Panel.” Students packed the conference room to meet with prospective employers.

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Computer Science Chair Lori Clarke accepts a legislative citation from Senator Stan Rosenberg



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A Mobility-Centric, Trustworthy Next-Generation Internet

Mobile devices and apps have seen a phenomenal growth in the last few years and have transformed our daily lives. Today, the number of smartphones alone far exceeds the number of wired computers on the Internet, and Internet traffic from mobile devices (roughly doubling every year) is poised to exceed wired Internet traffic in a couple of years. Although the Internet has adapted remarkably to accommodate this growth, its core technology remains a legacy of its wired origins and suffers from several shortcomings. “From a mobile user’s perspective, the Internet fails to satisfy seemingly straightforward expectations: a file download does not resume gracefully when moving from home to work; a smartphone voice-over-IP call does not seamlessly switch from WiFi at home to cellular on the road;



Arun Venkataramani

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Lori A. Clarke

The big event this past fall was the Schoolhood Celebration on October 17 – 19, where students, alumni, campus and community members celebrated the creation of the new School of Computer Science and the 50th anniversary of the founding of our Department. Jim Kurose chaired the event, and with the support of many faculty (Rick Adrion, James Allan, Emery Berger, Bruce Croft, David Jensen, Robbie Moll, Lee

Osterweil, Prashant Shenoy, Don Towsley, and Michelle Trim) and many staff members (especially Deb Comeau, Donna Falcetti, Jean Joyce, Terrie Kellogg, Leeanne Leclerc, and Adam Tabaka) put together a terrific program.

The afternoon of the 17th was a Career Fair, where students visited with company representatives, many of whom were our former students. The room was abuzz with activity. The 18th was a day of panels and discussion about the impact of computing on computer science research, on research in other disciplines, on education, and on society. State Senator Stan Rosenberg attended and presented our new School with a citation from the state, recognizing our many contributions to the Commonwealth. Senator Rosenberg also attended the banquet that evening where alumni, faculty, and friends of the School enjoyed a trip down memory lane with a photo review of the department over the years. Saturday morning was family day, where Rod Grupen and Rui Wang, and some of their students, led hands-on robotics and wearable computing activities. Some of the photos displayed during the banquet are shown in the center section of this newsletter (Many of us have certainly changed quite a bit over the years!).

One of the major events at the banquet was the launch of our Community Drive. Now that we are a School, there is an expectation at UMass Amherst that each school be active in alumni outreach and fundraising. As you all know, CS prides itself on pursuing excellence and being in the top ranks on every measure of quality. Well, we were all disappointed to learn that when it comes to fundraising, we have a long way to go. We have lost contact with many of our nearly three thousand alumni, and only a small percentage of our alumni make donations – which puts us pretty much near the bottom in these categories. And correspondingly, we do not have as many scholarships and fellowships for our students as our peer top CS departments around the country. But there has been progress. In the last few years, we have added seven endowed fellowships for students (see www.cs.umass.edu/donate/) – which is a terrific start – but the level of support provided by these fellowships is modest and the overall number is still small for a School as large and diverse as ours. In discussions with some of our active alumni, we decided to use the Schoolhood Celebration as a springboard for a Community Drive, whose goal is to reach more of our alumni and increase their participation in our community. We laid out what we hope are signifi-

cant but achievable goals, including increasing the number of up-to-date alumni email addresses that we have and increasing the number of donors to the School, especially the number of first time donors. Of course, large donations are nice and get the attention of the administration, but our primary goal is to broaden our community and deepen alumni involvement; donations of any size indicate a sense of belonging to our community. As a catalyst to energize the community, Steve Vinter, Engineering and Site Director at Google Cambridge and esteemed alum, pledged to match contributions up to a total of \$50,000. We are deeply appreciative of the support that Steve has given CS over the years, and greatly appreciate this very generous contribution to our community-building drive. We hope alumni will join with Steve and our many other deeply-involved alumni to help us make our 50th anniversary the year that alumni, students, and faculty all come together to build the strong foundation of support that will make our School a leader in all categories.

Over the years, a number of alumni have asked about keeping their UMass email account. So this month, we are introducing an alum email address program. This email address will be yours forever. It will basically forward mail to whatever address you provide, so that as you change jobs or providers, your alum email will remain the same. Information about how to sign up for an alum email address is given on page 13.

Finally, let me end by pointing out some highlights described elsewhere in this newsletter. We are delighted to report that Brigadier General Jody Daniels will be receiving the UMass Alumni Award April 2nd at a ceremony at the State House in Boston. Graduate student Yunmeng Ban was just awarded a Microsoft Research Graduate Women's Scholarship (one of ten awards given), and undergraduate student Daniel Stubbs was just awarded the Computing Research Association's Outstanding Undergraduate Research Award (one of two awards given to the top undergraduate researchers within the U.S. and Canada, one for the top male and one for the top female student). And Emeritus Professor Andrew Barto was awarded the 2014 International Neural Network Society Hebb Award, which will be presented in Beijing this summer; Distinguished Professor Bruce Croft was awarded the Tony Kent Strix Award; Distinguished Professor Jim Kurose was selected to give a University Distinguished Lecture (scheduled for April 9); and Assistant Professor Yuriy Brun received the 2013 IEEE TCSC Young Achievers Award. This is an impressive, but only partial, list of the awards and recognitions received by our students, faculty, and alumni during the last six months.

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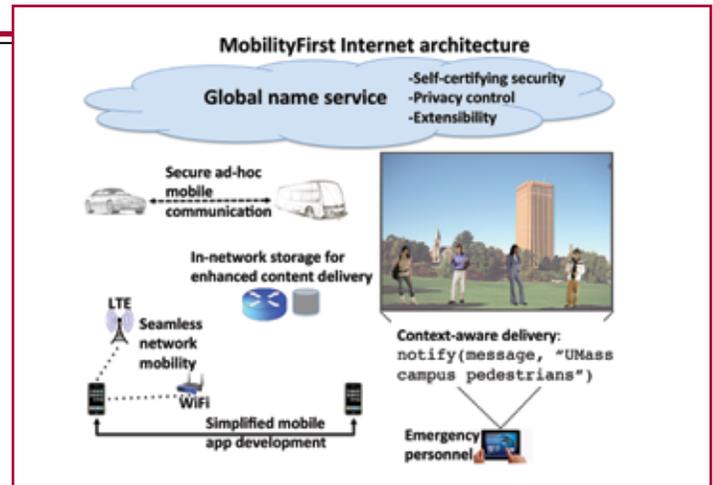
NEXT-GENERATION INTERNET - - - - - cont. from page 1

and ad hoc mobile-to-mobile communication cannot be easily used to exchange data when the infrastructure network is congested or unavailable,” says Associate Professor Arun Venkataramani. In fact, mobile data communication today is a one-way street wherein mobiles can initiate communication to fixed Internet servers but not the other way around. Existing on-paper approaches for Internet mobility (like Mobile IP) are based on an outdated cellular worldview that users have a single network home, are connected to a single access network at any time, require only device-to-device communication (rather than to content or other services), and move infrequently across networks.

Venkataramani’s ongoing research on MobilityFirst, a next-generation Internet architecture, is addressing these shortcomings. As the Lead Architect of MobilityFirst, Venkataramani is coordinating this collaborative effort across seven other participating universities. MobilityFirst is driven by two critical high-level design goals: *seamless mobility*, i.e., the ability for devices, services, and content to communicate in a location-independent manner, and *trustworthiness*, i.e., assurance of security and privacy properties despite malicious behavior on part of a small fraction of endpoint or network nodes. “A key mechanism that helps enhance mobility as well as security is a clean separation of *names* or endpoint identifiers from *addresses* or their network locations,” says Venkataramani. “By conflating the two in the form of IP addresses, the current Internet poorly supports mobility (same identity, changing locations), multihoming (single identity, multiple locations), and security because IP addresses can be easily hijacked or spoofed.” In contrast, MobilityFirst uses distinct, self-certifying identifiers based on public key cryptography principles to represent endpoints and their network locations.

Although conceptually simple, realizing the above vision requires a massively scalable global name service to rapidly resolve arbitrary endpoint identifiers to network addresses. This resolution is somewhat similar in spirit to how the Internet’s Domain Name System (DNS) resolves domain names (like “www.cs.umass.edu”) to IP addresses (like 128.119.240.84). However, unlike DNS that is designed for a world where name-to-address mappings rarely change and any updates take hours or days to propagate, MobilityFirst’s global name service must address the challenge of designing a geo-distributed system that allows tens of billions of endpoint identifiers to update their network addresses many times a day. Venkataramani and his collaborators have addressed this difficult challenge and, in the process, established a key architectural insight, namely that a logically centralized (but physically distributed) global name service can dramatically enhance not only mobility and security but also basic network communication primitives.

An example of an enhanced network communication primitive in MobilityFirst is *context-aware delivery* that enables sending a message to abstract contextual descriptors of the form “all pedestrians on the UMass Amherst campus.” Unlike the Internet that only supports the ability to send a message to an IP address, context-aware delivery allows app developers to use group communication primitives without



having to explicitly manage the group or even know of the members of the group, says Venkataramani. The global name service in MobilityFirst also enhances several other functions such as content retrieval, multihomed traffic engineering, locating the nearest replica of a service, network management, etc. thereby simplifying the job of app developers and network operators while improving end-user experience. An app developer portal for MobilityFirst is at <http://gns.name>.

The next-generation Internet insights, illustrated above, build upon Venkataramani’s research on mobile and wireless systems as well as content delivery. His prior research has developed strategies to augment cellular connectivity with WiFi in vehicular scenarios. He has analyzed tradeoffs between performance, data usage cost, and battery power consumption in such multiplexed wireless access scenarios. His work has also shown the feasibility, performance, and robustness benefits of using in-network storage in routing and transport protocols in vehicular networks where nodes may be only intermittently connected.

Venkataramani’s ongoing and recent work on content delivery is the first to formally study the rapidly growing phenomenon of “content distribution networks (CDNs)”. The traditional way of delivering content on the Internet used to be for *content providers* (like Netflix or nytimes.com) to outsource delivery to *CDNs* (like Akamai or Limelight) that deliver content over *networks* (ISPs like Comcast or AT&T). Recent and potentially disruptive industry trends are pushing the growth of network CDN wherein the network also owns and manages a CDN service. Such content-aware networks not only enhance user-perceived performance but also significantly increase opportunities for network operators to reduce their costs as they can place content at strategic locations and redirect users’ traffic accordingly instead of having to manage “dumb bits” over which they have little control. Venkataramani’s research has been developing strategies for content-aware networking in ISP-scale networks as well as data center networks.

Venkataramani joined UMass Amherst in 2005 after completing his Ph.D. in Computer Sciences at the University of Texas at Austin in 2004 and a Visiting Faculty appointment at the University of Washington. He received his bachelor’s degree in Computer Science and Engineering at IIT Bombay in 1999. He is a recipient of an NSF CAREER award and his work has received several best paper awards at venues including USENIX NSDI and ACM SIGCOMM CoNEXT.

Daniel Stubbs wins national and campus research awards

Undergrad Daniel Stubbs has received the 2014 Outstanding Undergraduate Researcher Award from the Computing Research Association (CRA), a group of more than 200 North American academic departments of computer science and related fields. He was also honored with the UMass Amherst Rising Researcher Award.

The CRA national honor recognizes Stubbs' "exemplary record of research in theoretical computer science, specifically in algorithms for data stream processing," the award states. Stubbs, a senior CS and mathematics major and Commonwealth Honors College student, is co-teaching a one-credit undergraduate computer science course for honors students.

The Rising Researcher Award was established last year as a way to bring to the forefront outstanding young researchers who have demonstrated leadership and impact in their chosen area of study. Stubbs is one of four to receive the award this year.

"Dan is an exceptional researcher who is already making significant contributions in theoretical computer science," says Stubbs' advisor, Assistant Professor Andrew McGregor. "His work is being published at international conferences and read by the top researchers in the area. We're very proud that he has received this award and excited to

see what he does next."

Stubbs said that he is very excited about this award. "It's great to have this recognition for the work I have been doing, and the mentorship and support provided by Prof. Andrew McGregor and the UMass School of Computer Science. Hopefully this award will help me as I apply to Ph.D. programs so I can be a professor myself someday."

The CRA award selection committee noted, "This year's nominees were a very impressive group. A number of them were commended for making significant contributions to more than one research project, several were authors or coauthors on multiple papers, others had made presentations at major conferences, and some had produced software artifacts that were in widespread use. Many of our nominees had been involved in successful summer research or internship programs, many had been teaching assistants, tutors, or mentors, and a number had significant involvement in community volunteer efforts. It is quite an honor to be selected as a winner."



Key features of Apple's OS based on research from Berger and Kaplan

Apple's new operating system, Mavericks, includes components based on the research of Associate Professor Emery Berger and Adjunct Professor Scott Kaplan.

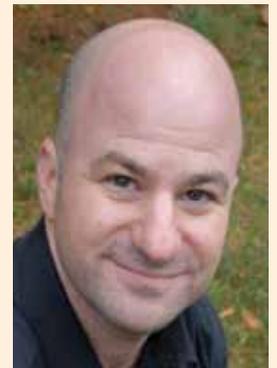
Their contributions will significantly improve performance and extend the battery life of Apple computers around the world with the new OS. It uses an algorithm by Berger that lets it manage internal memory resources more efficiently. Modern computers have multiple 'cores,' each a bit like an individual brain, he explains. "Like people, when they can operate independently, those brains can run at full speed, but if they have to have a meeting to discuss something, things slow down."

His "Hoard" algorithm adopted by Apple manages memory resources in a way that reduces this communication and lets the computer make decisions faster. "Not only does this make the system faster overall, it also extends battery life because it spends less power to do the same job," Berger notes.

Meanwhile the new "compressed memory" feature in Mavericks, described somewhat cryptically by Apple as the "WKdm" algorithm, is directly based on Kaplan's research. "I'm the 'K,'" he laughs. Compressed memory works by taking some of the least-used part of a program's data and shrinking it as much as possible. Doing so makes the computer run as though it has extra memory. Apple says that this technique not only makes applications run faster, it also extends battery life.

Berger's and Kaplan's works have already been included in other systems. The Linux operating system has incorporated Kaplan's compressed caching algorithms for several years. Both Windows 7 and 8 use algorithms directly inspired by work from Berger's research group to improve reliability and security. But the latest Mac OS is the first that includes algorithms by both researchers.

For their next collaboration, Kaplan, a professor at Amherst College, and Berger are currently working to advance what they call "the operating system of the future," that is, web browsers.



Emery Berger, above, and Scott Kaplan, below

Croft receives Tony Kent Strix Award

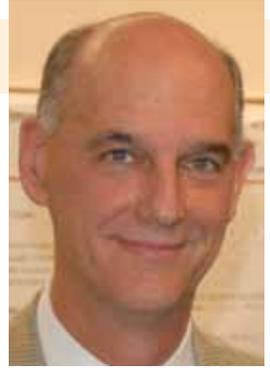
Distinguished Professor W. Bruce Croft is the 2013 winner of the Tony Kent Strix Award, which was presented on October 16 at the Internet Librarian International in London. Presented by U.K. eInformation Group (UKeiG) in memory of Tony Kent, a past Fellow of the Institute of Information Scientists, the lifetime achievement award recognizes Croft for his outstanding contribution to the field of information retrieval.

According to UKeiG, “Bruce Croft has made major contributions to most areas of information retrieval, including his pioneering work in clustering, passage retrieval, sentence retrieval, and distributed search. One of the most important areas of work for Croft relates to ranking functions and retrieval models, where he has led the development of one of the major approaches to modeling search: language modeling. In later years, Croft also led the way in the development of feature-based ranking functions. Croft and his research group have also developed a series of search engines: In-Query, the Lemur toolkit, Indri, and Galago. These search engines are open source and offer unique capabilities that are not replicated in other research retrieval platforms source – consequently they are downloaded by hundreds of researchers worldwide. As a consequence of his work, Croft is one

of the most cited researchers in information retrieval.”

Croft formed the Center for Intelligent Information Retrieval in 1991. He and his students have worked with more than 90 industry and government partners on research and technology projects and have produced more than 900 papers. Croft was a member of the National Research Council Computer Science and Telecommunications Board from 2000-03, and editor-in-chief of *ACM Transactions on Information Systems* from 1995 to 2002. He was elected a Fellow of ACM in 1997, and received the Research Award from the American Society for Information Science and Technology in 2000. He has also received the Gerard Salton Award from the ACM Special Interest Group in Information Retrieval.

The Tony Kent Strix Award is presented by UKeiG in partnership with the Chemical Information and Computer Applications Group of the Royal Society of Chemistry, the International Society for Knowledge Organization UK Chapter and the British Computer Society Information Retrieval Specialist Group.



Barto to receive 2014 INNS Hebb Award

Professor Emeritus Andrew Barto was selected as the 2014 recipient of the International Neural Network Society (INNS) Hebb Award “in recognition of long-standing contribution and achievements in biological and computational learning.”

According to the INNS awards committee, the Hebb award is “presented annually to senior, highly accomplished researchers for outstanding contributions made in the field of Neural Networks.” It is named after the psychologist Donald O. Hebb, a pioneer in neuropsychology. The award will be presented by the INNS President at the 2014 International Joint Conference on Neural Networks in Beijing in July.

Barto’s primary research contributions are in the field of Machine Learning, in particular in *Reinforcement Learning*, a framework inspired from its study in biology and psychology. Barto continues to co-direct the Autonomous Learning Laboratory, formerly known as the Adaptive Networks Laboratory. His current research centers on what psychologists call intrinsically motivated behavior, meaning behavior that is done for its own sake rather than as a step toward solving a specific problem. Barto has over one hundred publications, and he is a co-author with alum Richard Sutton (Ph.D. ’84) of the book *Reinforcement Learning: An Introduction*, (MIT Press 1998), that has been cited over 15,000 times.

Barto, who retired from UMass Amherst Computer Science in 2012, received the 2004 IEEE Neural Network Society Pio-

neer Award for his contributions to the field of Reinforcement Learning. He is a Fellow of the American Association for the Advancement of Science, a Fellow and Senior Member of the IEEE, and a member of the American Association for Artificial Intelligence and the Society for Neuroscience.

Kurose selected for distinguished faculty lecture

Distinguished Professor Jim Kurose is one of four faculty chosen for the 2013-2014 UMass Amherst Distinguished Faculty Lecture Series.

On April 9, 2014, Kurose will speak on “Design and Analysis of a Content-oriented Internet.” He will present an overview of the evolution of Internet architecture and discuss challenges and approaches for the next transformation of the Internet.

In its 40th year, this lecture series recognizes the distinguished achievements of faculty. Following his lecture, Kurose will receive a Chancellor’s Medal, the highest honor bestowed on individuals for exemplary and extraordinary service to the campus.



Ben Barnhart photo

CAITE/ECEP expands computing education outreach

The Commonwealth Alliance for Information Technology Education (CAITE), and its successor project, the Expanding Computing Education Pathways alliance (ECEP), both National Science Foundation-funded alliances to broaden participation in computing, spent the fall semester engaging students and teachers in computing education.

In October, CAITE helped to facilitate the Women in Engineering and Computing Career Day, an event held for high school girls to become familiar with engineering and computing at UMass Amherst. Some 300 girls from across the state participated in hands-on activities, including a computer science session designed by Assistant Professor Benjamin Marlin using Scratch, a programming language designed for its ease of use. In the session, girls enjoyed creating animations in small groups while being exposed to computer science concepts. CS student volunteers were on hand to assist and serve as role models. High school teachers and counselors in attendance learned about the UMass Amherst computing curriculum from Associate Professor Yanlei Diao. “The girls also toured computing and engineering labs on campus, so they left with both firsthand knowledge of the great resources at UMass Amherst, as well as with greater confidence in their ability to pursue these careers,” says Renee Fall, ECEP co-PI and co-organizer of the event.

In September, Professor Emeritus Rick Adrion, CAITE/ECEP PI, presented “Reforming K20 Computer Science Education in Massachusetts: Issues, Options, and Challenges” as part of the UMass STEM Ed Seminar series. Adrion described the current state of computing education in Massachusetts and outlined efforts underway to develop standards, teacher licensure, and other state- and district-level policy changes that would allow all students to learn computing.

In November, also as part of its effort to improve computing education in Massachusetts and other key states, CAITE/ECEP hosted a gathering of faculty and other educators who provide professional development (PD) to computing teachers in Massachusetts. The project will be assessing teacher needs and supporting a range of PD workshops in the summer.

CAITE continues its partnership through ECEP (www.ecepalliance.org) with organizations such as GeorgiaComputes!, South Carolina’s IT-ology, and the Alliance for California Computing Education for Students and Schools, to advance change in computer science education. “With events to encourage the growth of underrepresented students in the field, ECEP seeks to level the playing field for students preparing for an increasingly technology-driven workforce,” says Fall.

MGHPCC awarded LEED platinum certification

The Massachusetts Green High Performance Computing Center (MGHPCC) in Holyoke has become the first university research data center, and one of only 13 data centers in the country, to receive a LEED Platinum certification, the highest green building ranking. Computing centers are typically large users of energy.

“As our name indicates, environmental sustainability and stewardship are a huge part of who we are,” said John Goodhue, executive director of the MGHPCC. “They also reflect an environmental commitment shared by our founding universities, the Commonwealth of Massachusetts, our private-sector partners, and our host community of Holyoke.”

The LEED rating system, developed by the U.S. Green Building Council (USGBC), is the foremost program for buildings, homes and communities that are designed, constructed, maintained and operated for improved environmental performance.

“The Massachusetts Green High Performance Computing Center is helping researchers break new ground in understanding the mysteries of our world and universe,” said Rick Fedrizzi, president, CEO and founding chair of the USGBC. “It is only fitting that the center is also on the cutting edge of sustainability with a LEED Platinum certification — a fantastic achievement for any project, but particularly notable for one with intensive energy and water needs.”

The MGHPCC, which opened in November 2012, received LEED Platinum certification in the new construction category for implementing practical and measurable strate-



Prashant Shenoy
outside
MGHPCC

gies and solutions aimed at achieving high performance in sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

Funding for the center was provided by the five member universities—Boston University, Harvard University, the Massachusetts Institute of Technology, Northeastern University and UMass, the Commonwealth of Massachusetts, Cisco, EMC, and the Federal New Markets Tax Credit program. The member universities are funding the ongoing operation of the MGHPCC. UMass Amherst School of Computer Science faculty who were involved in the project planning include Distinguished Professor Jim Kurose and Professors Rick Adrion and Prashant Shenoy.

Latest research - from microgenetic learning to space exploration

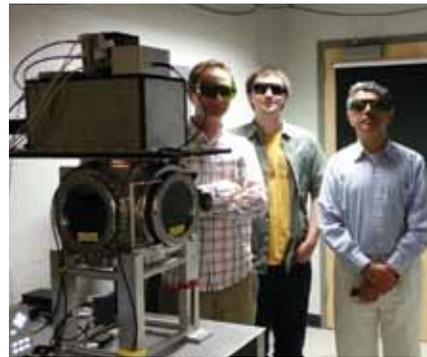
A few of the school's many research projects are highlighted below.

Microgenetic Learning Analytics - Professor Emeritus Rick Adrion is collaborating with Education Associate Professor Florence Sullivan on a National Science Foundation (NSF) project to develop and pilot a new research method that combines microgenetic analysis techniques derived from developmental psychology with learning analytic techniques from the field of computer science. They will use the new method, termed "Microgenetic Learning Analytics," to engage in research on the development of computational thinking among underrepresented students, particularly girls, as they interact in a robotics learning environment, with the goal of increasing the diversity of individuals who enter the field of computing.

Effectiveness of Video Ads - Associate Professor Ramesh Sitaraman and research partner S. Shunmuga Krishnan of Akamai recently completed perhaps the largest-ever scientific study of the effectiveness of video ads, a fundamental question for business. Sitaraman, who led the study, says a simple, well-accepted measure of ad effectiveness is whether viewers watch the video ads to completion or not. "Our goal was to scientifically understand what factors influence people to complete watching video ads and what contributes to them abandoning the ad before it completes." Sitaraman presented their findings at the ACM Internet Measurement Conference in Barcelona on Oct. 24. See the study results at www.umass.edu/newsoffice/article/umass-amherst-researcher-quantifies.

Meditation Use in Treating Addiction - CS alum Yariv Levy (Ph.D. '13), Professor Emeritus Andrew Barto, and Neuroscience Researcher Jerrold Meyer use a computational model of addiction, a literature review, and an in silico experiment to suggest that rehabilitation strategies coupling meditation-like practices with drug and behavior couplings are more helpful than drug-plus-talk therapy alone when helping people overcome addiction. Levy, who conducted this investigation while a doctoral student, says the goal is to translate what has been learned from animal and human studies to better understand addiction and explore new approaches to treatment. Levy reported results of his survey in a special section on addictive disorders in the current issue of the journal *Frontiers in Psychiatry*. Another member of the team is Tel Aviv University Neuroeconomist Dino Levy. See www.umass.edu/newsoffice/article/addiction-meditation-helpful-when-coupled.

Understanding the Composition of Mars - Professor Sridhar Mahadevan and Mt. Holyoke Professor Darby Dyar are collaborating on an NSF project combining machine learning (ML) and astronomy to understand the composition of substances on Mars from laser spectrometry data collected by the Curiosity rover on Mars. They examine the spectra of Martian rocks that Curiosity zaps with a laser, and use high-dimensional ML techniques to study their elemental composition. The researchers hope such analyses will one day shed light on the eternal question of whether there ever was life on other planets.



Shown at left with their laser safety goggles, grad students Thomas Boucher and CJ Carey and Prof. Sridhar Mahadevan (l. to r.) stand in Mt. Holyoke's Laser-Induced Breakdown Spectroscopy Lab near a laser instrument identical to one on the Mars rover Curiosity (below).



In a separate project, Mahadevan is working with a multi-institutional team of researchers on a National Aeronautics and Space Administration (NASA) Solar System Exploration Research Virtual Institute (SSERVI) project led by Stony Brook University to analyze samples from the Moon, Near Earth Asteroids, and Martian moons Phobos and Deimos. The research goal is to facilitate possible human exploration and colonization of these planetary bodies.

CS researchers among ICB3 competition winners

The Institute for Computational Biology, Biostatistics, and Bioinformatics (ICB3) has awarded prizes to CS researchers in its 2013 Open Source Software Innovation (OSSI) competition.

Laura Dietz, CS Postdoctoral Researcher, was a member of the first-place team that won Best Integrated Software System for "Hardware and software for single molecule fluorescence analysis."

A project led by graduate student Siddharth Gupta, "mCrowd: Data Collection and Visualization," received honorable mention. Team members are graduate students Abhinav Parate and Moaj Musthag, and Associate Professor Deepak Ganesan.

Peter Krafft, CS Alum (BS '10, MS '12) and current doctoral student at MIT, was a member of a team that received honorable mention for their entry "Website to estimate energy expenditure from accelerometer data and WebDevelopR."

"The OSSI competition is an exciting new mechanism to stimulate the development and dissemination of innovative software tools that play an important role in enabling new life science and biomedical discoveries," says Associate Professor David Jensen, coordinator of the competition.

ICB3 was established in 2012 to create research oriented and educational activities that facilitate trans-disciplinary collaborations involving high-level analytic and computational methods, as they apply to biomedical and life sciences research.

CS 50th CELEBRATION – – – – – cont. from page 1



CS Alums meet with students at the Career Fair

Professor Robbie Moll moderated the panel session which included panelists Ken Schmidt of Yahoo!, and UMass Amherst alums Paul Hake of HitPoint Studios (BA '03), Brent Heeringa of Williams College (Ph.D. '06), Irene Ros of Bo-coup (B.S. '06), and Steve Vinter of Google (Ph.D. '85).

On Friday, October 18th, a full day of panel discussions organized by Distinguished Professor Jim Kurose, chair of the computer science celebration committee, attracted a large audience. Steve Goodwin, Dean of the College of Natural Sciences, Michael Malone, Vice Chancellor of Research and Engagement, Massachusetts State Senator Stanley Rosenberg, and CS Chair Lori Clarke welcomed the group with a bit of the CS history. The day's talks included:

“Expanding Horizons in Computing” with Jim Kurose; alum Henning Schulzrinne (Ph.D. '92), CTO of the Federal Communications Commission; Bob Sproull, chair of the National Academies Computer Science and Telecommunications Board; and alum Steve Vinter (Ph.D. '85), engineering director at Google. National Science Foundation Assistant Director Farnam Jahanian was slated to participate, but was unable to attend.

“Computing as a Core Subject in a 21st Century Education” with former CS faculty Jan Cuny of NSF; Ann Drobnis, director of Computing Community Consortium at Computing Research Association; Kelly Powers, chair of the computer science department at Boston's Advanced Math and Science Academy; and Cameron Wilson of the Association for Computing Machinery, also CEO of Code.org. Rick



Panelists Peter Bloniarz, Ed Durfee, and Patricia Galvis-Assmus

Adrian, professor emeritus, moderated the session.

“Computing Across the Campus” with Peter Bloniarz, dean of the College of Computing and Information at the University of Albany-SUNY; alum Edmund Durfee (Ph.D. '84) of the University of Michigan; and Patricia Galvis-Assmus, professor of art at UMass Amherst. Professor Prashant Shenoy was the moderator of this session.

“Computing Research” with alum Eric Brown (Ph.D. '96), director, Watson Technologies at IBM Research; Yanlei Diao, associate professor of computer science at UMass Amherst; and alum Matt Rattigan (Ph.D. '12), Obama for America analytics team. Professor David Jensen moderated the panel.

On Friday evening, Senator Rosenberg presented the citation during dinner. Alumnus Vinter gave a keynote speech launching the Computer Science community drive to encourage more CS alums to become engaged with the School.

On Saturday, October 19th, children and adults spent the morning with Associate Professor Rui Wang working on their wearable computing creations and with Professor Rod Grupen interacting with the U-bot robot.

“The event was a great success,” says Clarke. “Many came from across campus, across the Commonwealth, and, for one alum, from across the world to attend our celebration events. We are looking forward to the next 50 years.”



Alums, faculty, and friends celebrate CS during the banquet

The early years at UMass Amherst Computer Science



Computing came to the University of Massachusetts Amherst in the early 1960s, as a result of the needs of the Chemistry Department. What had started as a departmental operation became formalized as the Research Computing Center (RCC), under the Directorship of Robert Rowell, and with crucial guidance from the Computer Committee, chaired by Richard Stein of Chemistry. In addition to providing computing services a center could provide, it was necessary to establish an academic program to provide students with a deeper knowledge of the computer than basic programming. In 1963 the Computer Committee recommended to the Dean of the Graduate School (then Edward C. Moore) that a search for a Program Head be undertaken. As a result of that search, J.A.N. Lee was appointed Program Head in September of 1964. He was also asked to direct the RCC and to undertake the selection and installation of a new computer system. In 1964, there were four faculty: J.A.N. Lee (CS), John Goda, Sidney Rubenstein (joint appointment with RCC), and Fred Stockton (Dept. of Civil Engineering). Susan Stidham joined in 1966. “The CS program at UMass Amherst was one of the first separated programs in the United States,” says Lee. “At that time, programming was being taught in classes in Chemistry, Mathematics, and Civil Engineering at UMass Amherst primarily as graduate courses. The prime mover for creating a unified institute was Moore, with the support of those departments.”

In June 1965, the Board of Trustees approved an M.S. program in Computer Science (after receiving unanimous approval by the campus Curriculum Committee in May). In September of 1965, the Program moved to new quarters and admitted its first graduate student. Lee stepped down as Director of the RCC, so that he could focus on program development.

Computing came to the University of Massachusetts Amherst in the early 1960s, as a result of the needs of the Chemistry Department. What had started as a departmental operation became formalized as the Research

Center (RCC), under the Directorship of Robert Rowell, and with crucial guidance from the Computer Committee, chaired by Richard Stein of Chemistry. In addition to providing computing services a center could provide, it was necessary to establish an academic program to provide students with a deeper knowledge of the computer than basic programming. In 1963 the Computer Committee recommended to the Dean of the Graduate School (then Edward C. Moore) that a search for a Program Head be undertaken. As a result of that search, J.A.N. Lee was appointed Program Head in September of 1964. He was also asked to direct the RCC and to undertake the selection and installation of a new computer system. In 1964, there were four faculty: J.A.N. Lee (CS), John Goda, Sidney Rubenstein (joint appointment with RCC), and Fred Stockton (Dept. of Civil Engineering). Susan Stidham joined in 1966. “The CS program at UMass Amherst was one of the first separated programs in the United States,” says Lee. “At that time, programming was being taught in classes in Chemistry, Mathematics, and Civil Engineering at UMass Amherst primarily as graduate courses. The prime mover for creating a unified institute was Moore, with the support of those departments.”

A Look Back...

In 1965: “It is the opinion of the Association of Computing Manufacturers education committee that there should be a strenuous effort to produce 50 Ph.D.s in computer science per year in this country to fulfill this need.”

[Source: proposal for M.S. in CS at UMass Amherst]



Conrad Wogrin became the Director of the renamed University Computing Center (UCC), succeeding Foster in 1967, and also held a professorship in the Department. In 1967, James Bouhana became the first M.S. graduate. A major factor in putting the University of Massachusetts on the map in the computer world was the development, under Foster’s guidance, of a timesharing system acronymically known as UMASS (Unlimited Machine Access from Scattered Sites). Along with Foster, David Stemple and Bob Hambleton were instrumental in getting the first timesharing system operational in 1967. With the increasing demands on RCC computer time, however, it became clear that the students could not get sufficient “hands-on” experience using the RCC machines. To this end, a Computer Science Laboratory was established in 1968, as a facility run jointly with the Computer Systems Engineering faculty in the Department of Electrical Engineering. The PDP-1B of those early days was soon replaced by three PDP-11s and a PDP-15 with a graphics system.

In November 1969, Lee stepped down as Head, having directed the creation of a first-rate, highly practical, industry-oriented M.S. Program in Computer Science. “Those first five years did set the base for a developing activity which eventually led to departmental status and new degree programs,” says Lee. “Our reputation in the industry and academia was excellent.”





The time seemed ripe to push for approval of a Ph.D. Program, but the first proposal failed to gain approval. Wogrin assumed the Acting Headship, and the search was on for a new Chair to oversee a successful second try.

Michael A. Arbib became Chair in September 1970. The Ph.D. proposal was approved in January of 1972, a change from an M.S. Program in Computer Science in the Graduate School to a Ph.D. Program in Computer and Information Science (COINS) in the Faculty of Natural Sciences and Mathematics. In 1972, there were nine COINS faculty: Michael Arbib, Richard Eckhouse, Caxton Foster, William Kilmer, J.A.N. Lee, Edward Riseman, Susan.N. Stidham, Robert Taylor, and Conrad Wogrin.



Grant activity in FY73 was \$169,588. A letter to grad students described the housing costs in 1972: "Generally, apartments are very expensive — \$150 for a one bedroom apartment is a typical price."

In an article celebrating the program's 25th anniversary, Wogrin noted, "We had an identity even back in our early years. When the ACM was celebrating their 25th anniversary in the early 70s,

A Look Back...

"Estimated that the production rate of computers is reaching a 500 machines per month total. So that with the 15,000 electronic digital computers presently in use, there is an estimated need for 35,000 new personnel each year to deal with the equipment and its application. [Excerpt from a 1964 CS report]"

Cax Foster, Dave Stemple, and J.A.N. Lee all had articles in the journal. This was a strong showing as there were only a very select group of invited articles."

The Department moved to the (Lederle) Graduate Research Center in 1972 and graduated its first Ph.D. student, Suad Alagic, in February of 1974. In 1978, the undergraduate major in COINS was established under the leadership of Robert M. Graham, who succeeded Arbib as Chair in September of 1975.

In 1980, there were 90 graduate students, 80 undergraduates, 12 faculty, and a Research Computing Facility based on Digital Equipment Corporation's VAX 11/780. Enrollment in COINS courses was 2180 in FY80 and grant income was \$665,608. Under the leadership of Edward Riseman (Chair from 1981-1985), the Department had phenomenal growth during the 1980s. Riseman's strategy for recruiting new faculty whose research overlapped with the research of others in the Department had tremendous bearing on the success and camaraderie that CS enjoys today. Wogrin became

Acting Chair in 1985 until Rick Adrion was recruited in 1986 to become the next COINS Chair, a position that he held until 1994.



Highlights of the 1990s and 2000s

Below are some brief highlights of the 1990s and 2000s, with more details coming in subsequent issues.

In 1990, COINS, in collaboration with the computer science departments of all the State colleges and universities, formed the Massachusetts Computer Science Education Consortium (MCSEC) to improve computer science education throughout the Commonwealth. Also in 1990, the first Issue of the Department's newsletter, *Loose Change*, was published.

In 1991-1992, over \$23 million in federal/state/industry support was secured for a number of programs: the Center for Intelligent Information

Retrieval (CIIR), the Center for Autonomous, Real-Time Systems (CARTS), Project Pilgrim, and a DoD/URI Center of Excellence in Artificial Intelligence. Each of these projects was initially under the umbrella of the Center for Real-Time and Intelligent Complex Computing Systems (CRICCS), which began with an NSF/CII grant in 1991.

The Computer and Information Science Department changed its name to the Department of Computer Science in March 1992. In 1997, the Sidney Topol Distinguished Lecturer Series was started, and the following year, the Department initiated the Bay State Fellows program.

UMass Amherst CS Equipment then and now:

1964:	CDC 3600 computer
	IBM 1620 computer
2014:	over 1000 computer systems
	450 desktop and laptop computers
	5 Large Clusters

CS History

In Fall 1999, the Department of Computer Science moved to its current home, the Computer Science Research Center, located at 140 Governors Drive. At the time of the move, the Department had 37 faculty (tenure track plus research), 164 graduate students, 403 undergraduates, and 97 technical and administrative staff. Grant activity was \$13 million in FY2000.

In 2000, the Board of Higher Education funded the Commonwealth Information Technology Initiative (CITI) with UMass Amherst in the lead. CITI works to improve IT education across MA public higher education and promote "IT across the curriculum." That same year, The UMass IT Program was established with the IT minor as its major education program.

In Fall 2012, the Department of Computer Science became the School of Computer Science, signaling the recognition by

the campus both of the excellence of the computer science faculty as well as the increasingly central role that computer science plays within UMass, the Commonwealth of Massachusetts, and the nation.

In 2014, there are 42 faculty (tenure track plus research), 244 graduate students (including 63 MS-only), 601 undergraduates, and 62 technical and administrative staff. Five of the faculty are University Distinguished Professors. Our grant activity was over \$17.6 million in FY2013.

[History Source: 1980 CS Annual Report]



UMass Amherst CS Chairs

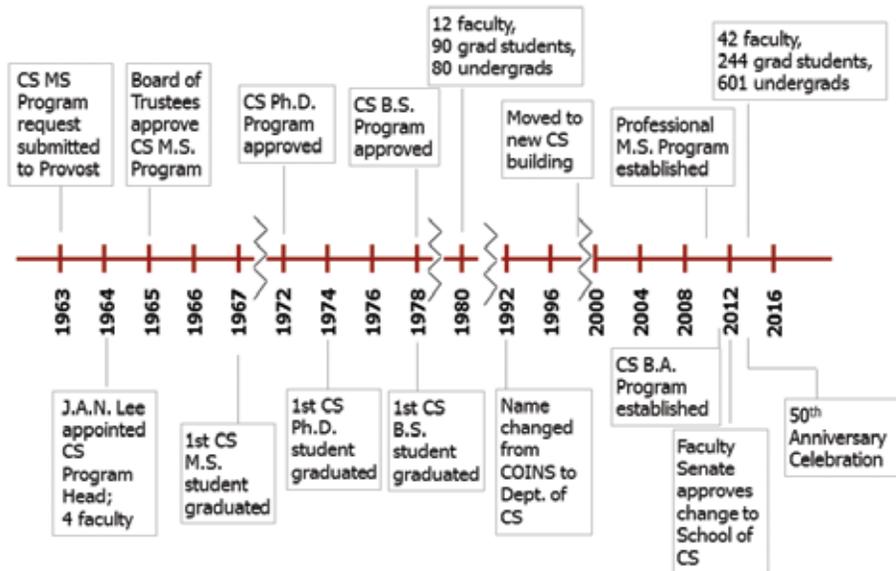
J.A.N. Lee	1964 – 1969
Conrad Wogrin	1969 – 1970 *
Michael Arbib	1970 – 1975
Robert Graham	1975 – 1981
Edward Riseman	1981 – 1985
Conrad Wogrin	1985 – 1986 *
W. Richards Adrion	1986 – 1994
Arnold Rosenberg	1992 – 1993 *
David Stemple	1994 – 1998
James Kurose	1998 – 2001
W. Bruce Croft	2001 – 2007
Andrew Barto	2004 *
Andrew Barto	2007 – 2011
Lori Clarke	2011 – Present

* Acting Chair



CS Chairs gathered during the 2005 Fall CS homecoming event. Left to right: Arnold Rosenberg, Edward Riseman Andrew Barto, Michael Arbib, David Stemple, Jim Kurose, Robert Graham, Rick Adrion, Bruce Croft, and Connie Wogrin. The first CS Chair, J.A.N. Lee, and the current CS Chair, Lori Clarke, are shown to the left.

UMass Amherst Computer Science through the years



CS Faculty then and now



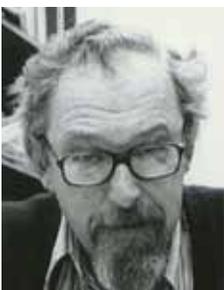
Photo provided by Special Collections and Archives, W.E.B.DuBois Library, UMass Amherst

CS faculty in 1978: Back Row (l. to r.): Robert Graham, Conrad Wogrin, Assaf Kfoury, Allen Hanson, Caxton Foster, Andrew Barto, Jack Wileden, Michael Arbib. Front Row (l. to r.): William Kilmer, Victor Lesser, Elliot Soloway, Lori Clarke, Nico Spinelli, Robert Moll. Faculty missing from photo: Edward Riseman.



CS faculty gather in October 2013 for the CS Schoolhood/ 50th anniversary celebration.

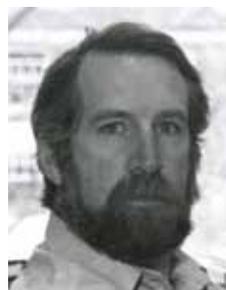
Faculty Passings



Caxton Foster
1929-1999



Robin Popplestone
1938-2004



David Stemple
1937-2006



Edward Riseman
1942-2007



Paul Utgoff
1951-2008



Steve Constantine
1955-2013

CS Community Drive launched; Why it matters

We know that you, our CS alumni, are strong and capable individuals—nearly 3,000 all over the world who are innovating, creating, and leading in a wide range of career pursuits. Although different in age and location, you share a common bond that helped to shape who you are today. And together with the dedicated CS faculty and staff, we are a Community. Now that we're 50 years old, we think it is time we took on the task of making the CS Community more connected, stronger, and more relevant for our alumni.

There are some easy ways for you to help us build our CS Community into the best it can be. Please consider one or all of the following ways you can help:

1. **Share your email address.** As of this writing, we are missing 900 alumni e-mail addresses. Please submit or update your email address so that we can keep you up-to-date with CS news and events. www.cs.umass.edu/forms/email-address-form.

2. **Attend a CS alumni event.** Reminisce with old friends, catch up with faculty and make new connections. Upcoming events include our Sixth Annual Outstanding Achievement and Advocacy Awards Banquet on May 2, 2014 (www.cs.umass.edu/oaa2014) and alumni socials planned for the east and west (CA Bay area) coasts.

3. **Give us news and updates** about your career and life to be included in *Significant Bits*. You can send them to Jean Joyce at jean@cs.umass.edu.

And finally,

4. **Donate in any amount to CS.** We know it's annoying to be asked for money. We know you probably get asked A LOT. But it really is important that you consider giving to CS. In order for us to remain competitive, we should be offering more scholarships to CS students. And, one of the factors used in determining our School's annual ranking is the Alumni Participation Rate (APR). The more alumni who donate, the higher the APR. The value of your CS degree increases when UMass and CS achieve high rankings.

Distinguished Professor Jim Kurose, chair of the CS 50th celebration committee, said it best: "Every contribution really *is* valued. When faculty and staff look through our list of donors in each issue of *Significant Bits* (and we *do*), it's really great to see the names of students we taught or knew. It tells us that they really value and appreciate their time with us. It means a lot to us and to UMass Amherst."



Steve Vinter (left)
and Jim Kurose

Matching gift challenge

Thanks to CS alum Steve Vinter (Ph.D. '85), your gift to Computer Science during our 50th anniversary year will be doubled! He has agreed to match gifts made before July 1, 2014 (up to \$50,000) in order to encourage fellow alumni to donate. "Now is the time YOU can help us make our wonderful school an even greater place," says Vinter. "Get involved! Let's join together and build the best foundation for our community that we can."

Why I give

No matter how large or how small, every single gift to CS is appreciated and put to good use. Here is why one CS alum chose to give...

In the mid-eighties, while taking a graduate course under Prof. Krithivasan Ramamritham, I read an IBM 1979 technical report, "Notes on Database Operating Systems" – precursor to the bible on Transaction Processing. Since then I've been hooked on building database systems. Later, at DEC and Microsoft, I was fortunate to get to know Jim Gray. As many of you know, he was lost at sea in 2007.

I set up the Jim Gray Scholarship at UMass Amherst to support first-year CS graduate students pursuing systems research. I did it because I want to encourage the next generation to join our field and keep it thriving. But I also did it because I want to honor and remember the sage of our science.

Hanuma
Kodavalla (MS '88)



Lifetime email addresses for CS alums

We are pleased to announce that Computer Science alum email forwarding addresses are now available for any of our UMass Amherst CS alums. Although you might change employers or Internet providers, your CS alum email address will always stay the same and will forward your email to whatever address you choose. The email address will generally be firstname.lastname@alum.cs.umass.edu. To sign up for your email forwarding address, go to www.cs.umass.edu/lifetime-email-forwarding.

Beveridge and Draper team up on vision research

Colorado State University (CSU) Computer Science Professors Ross Beveridge and Bruce Draper did their Ph.D. work in the UMass Amherst Computer Vision Group, under the joint direction of Professors Ed Riseman and Al Hanson, and both graduated with Ph.D.s in 1993. The pair currently codirect the Computer Vision Research Group at CSU, following in the footsteps of Riseman and Hanson, leading the next generation of vision researchers.



Bruce Draper (left) and Ross Beveridge

At UMass Amherst, Beveridge and Draper saw firsthand an unusual model for academic research: namely, two good friends with very different personalities jointly coordinating a research group with multiple different projects. “At UMass, graduate students in the Vision group quickly learned that they didn’t have one advisor, they had two,” says Beveridge. “Whether Ed or Al was leading a particular project, the other was always following the work carefully and would quickly jump in with ideas of his own. Graduate students working in the CSU Computer Vision Group today learn a similar lesson, and the group is stronger for it.”

Major accomplishments by Beveridge’s and Draper’s CSU Computer Vision Group include advanced analysis of algorithms that perform human face recognition and real-time activity recognition in video. In face recognition, the group has taken a leading role in the evaluation of algorithms, working closely since 2003 with Dr. Jonathon Phillips at NIST on a series of public face recognition challenge problems. In joint work with Geof Givens in the CSU Statistics Department, they have carried out the most detailed studies of interacting factors that influence face recognition algorithm performance.

Beveridge’s and Draper’s team also releases and maintains a suite of open source software packages that support labs around the world that want common face recognition baseline algorithm implementations and software for carrying performance studies according to standardized protocols. Most recently the researchers have taken the lead in a competition associated with the 2014 International Joint Conference on Biometrics where different labs and groups will work on a common video face recognition dataset.

Beveridge and Draper also work closely with CSU Mathematics Professors Michael Kirby and Chris Peterson on problems at the intersection of computer vision and algebraic topology. This work blends mathematics with practical utility in some surprising ways, including fundamental advancements in how to approach the problem of recognizing people’s actions in video.

Their Vision Group is also known for its work on biomimetic approaches to computer vision, with an emphasis on

unsupervised learning. “At its heart, this approach represents a commitment to developing systems that learn important internal representation without detailed guidance by people,” says Draper. To express this in practical terms, the common approach to many computer vision tasks today is to require humans to hand label thousands of images, e.g. “That is a cat. That is a truck.” This is tedious, and ultimately visually intelligent systems should not require such extraordinary hand-holding.

Recently, Beveridge’s and Draper’s group’s work on biomimetic approaches to vision has been combined with the work on high-dimensional manifolds in the context of real-time activity recognition in video. This work was supported by the DARPA Minds Eye Program. A major component of their work was incorporated into a larger system that was then demonstrated by iRobot. The system learned quickly and then recognized actions such as running, walking, picking objects, carrying objects, etc. A video highlight of this effort is available at: www.cs.colostate.edu/~draper/.

Beveridge, Draper, and their team are now merging the video understanding and face recognition work. More generally, they remain committed to the same goals set out by Riseman and Hanson at UMass Amherst: machines should be using their eyes to watch, should be making sense of what they see, and then should be stepping in to help people in the myriad tasks that arise in all aspects of life.

A screen capture from a video where software developed by CSU and iRobot recognizes that a person is carrying something - in this case a shovel



We’re on Facebook and LinkedIn

Keep up-to-date on the School’s latest events and announcements. Join us on

Facebook (UMASS CS)
and

LinkedIn (UMass Amherst Computer Science)

John E. and Alice M. Flynn Scholarship established

Thanks to generous contributions from CS alum Daniel E. Flynn (BS '87), the **John E. and Alice M. Flynn Scholarship** was established in 2013 to honor his parents. The Scholarship will provide support to undergraduate students majoring in Computer Science. Preference will be given to students with financial need. According to Daniel, both John and Alice were “blue collar, hard-working, good people” with six children and eight grandchildren. They were lifelong residents of Massachusetts. Alice passed away in 1997 and John in 2007.

For more information or to contribute to the School of Computer Science, contact Jennifer Cooper at 413-545-2771 or jcooper@cns.umass.edu. You can also make a gift online at www.cs.umass.edu/donate, or by check made out to UMass Amherst Computer Science and mailed to Donna Falcetti, School of Computer Science, UMass Amherst, 140 Governors Drive, Amherst, MA 01003-9264.

Join us on May 2, 2014

The sixth annual Outstanding Achievement and Advocacy (OAA) Awards banquet will be held on Friday, May 2, 2014 in the Massachusetts Room of the UMass Amherst Mullins Center. During the banquet, awards will be presented to recognize the remarkable accomplishments of graduates of the School's degree programs and to acknowledge the support of important friends of the school. Current student awards will also be presented. For details and to register for the event, go to: www.cs.umass.edu/oaa2014.

CIIR west coast alum reunion

In October, Distinguished Professor Bruce Croft gathered for dinner with Center for Intelligent Information Retrieval (CIIR) alums and current students/staff during the CIKM conference in San Francisco, CA.

Front Row (left to right): Shiri Dori-Hacohen, Laura Dietz, Weize Kong, Xing Yi (Ph.D. '11), Wei Li (Ph.D. '07);
2nd Row: Jay Ponte (Ph.D. '98), Vanessa Murdock (Ph.D. '06), Jiwoon Jeon (Ph.D. '07), Yun Zhou (Ph.D. '08), Fernando Diaz (Ph.D. '07), Jie Bing (M.S. '13), Jangwon Seo (Ph.D. '11);
3rd Row: Michael Bendersky (Ph.D. '12), Jeff Dalton, Xiaobing Xue (Ph.D. '12), Mostafa Keikha, Pranav Mirajkar (M.S. '13), Trevor Strohmman (Ph.D. '08), Greg Druck (Ph.D. '11);
Back Row: Jinyoung Kim (Ph.D. '12), Anton Leuski (Ph.D. '01), Paul Ogilvie (B.S. '00), Bruce Croft, and Ethem Can.



Brigadier General Jody Daniels (Ph.D. '97) will receive the 2014 campus Distinguished Alumni Service Award at the Massachusetts State House in April. She is a Deputy Director (J2 Intelligence and Knowledge Development) currently on active duty. More details on her award in our next issue.

Carla Brodley (Ph.D. '94), was named to the Defense Advanced Research Projects Agency (DARPA) Information Science and Technology study group in 2013 for a three-year term. The highly selective ISAT advisory group supports DARPA's technology offices, providing continuing and independent assessment of the state of advanced information science and technology, and their relationship to Department of Defense issues. Brodley is a Professor of Computer Science at Tufts University. She was Chair of the Department in the years 2010-2013.

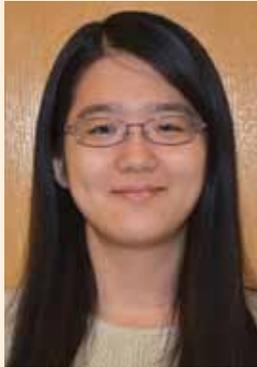
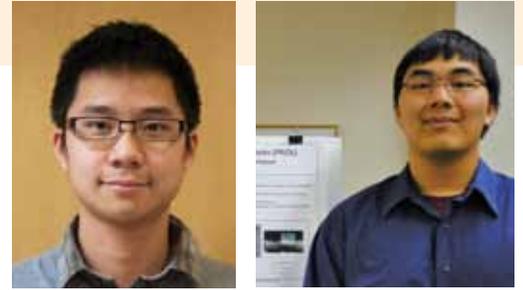
Byron Wallace's (B.S. '06) thesis, “Machine Learning in Health Informatics: Making Better use of Domain Experts,” was selected as the runner up for the 2013 ACM SIGKDD Doctoral Dissertation Award. He received his Ph.D. from Tufts University in 2012 and was advised by Carla Brodley. He is an Assistant Research Professor in the Department of Health Services and Public Policy, Center for Evidence-based Medicine, at Brown University.

CS alum and CSCF staffer David Korpiewski (B.S. '00) has started TransAerial, an aerial photography business (www.transaerial.com), which uses radio controlled drones to capture high definition video and pictures from the air. Korpiewski, a remote control model pilot, shot the photo of the CS building below.



Pham and Szeto receive research award

Undergraduates Tung Pham (left) and Ryan Szeto received Commonwealth Honors College Research Assistant Fellowship Awards for their project “Presentations Automatically Organized from Lectures (PAOL),” a system that not only automates the entirety of the capturing process, but also allows professors to maintain their preferred style of teaching. For this project, they were advised by Rick Adrion and Tim Richards.



Ban chosen as Microsoft Scholar

Doctoral student Yunmeng Ban is the recipient of a 2014 Microsoft Research Graduate Women’s Scholarship. She is one of ten scholars chosen from 101 applicants.

The Microsoft Research Graduate Women’s Scholarship is a one-year scholarship program for outstanding women graduate students and is designed to help increase the number of women pursuing a PhD. Along with the scholarship funds, she will also receive a travel award to attend a research conference in her field of study.

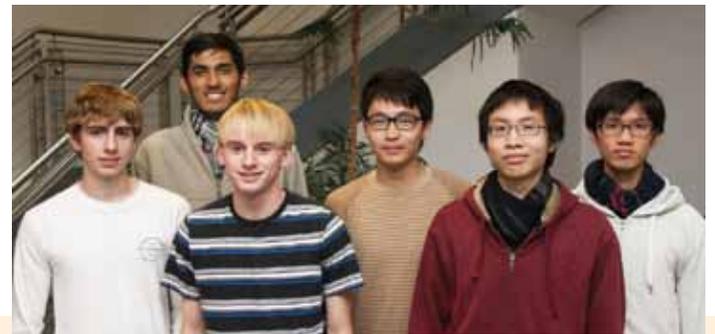
Ban is advised by Associate Professor Yanlei Diao and is a member of the Database and Information Management Lab. Her research interest is distributed database management systems, with a focus on data streams, big data analytics, and storage. This Fall, Ban received the Jim Gray Scholarship in Computer Science, awarded by the UMass Amherst School of Computer Science.

First place in ACM competition

In the Northeast Regional Preliminary Contest of the 2013 Association for Computing Machinery (ACM) International Collegiate Programming Competition, the UMass Amherst Computer Science team, “Execution Time,” placed first, qualifying them for the regional finals.

The first place team, consisting of Anthony Moh, Khanh Nguyen, and Vijay Pemmaraju, competed against 12 other teams at the event held in October. Another CS team, “The Halting Problem,” placed third. Members of the third place team included Batkuyag Batsaikhan, Ryan Mullens, and Adam Roy. During the Northeast North America Regional Finals in November at Rochester Institute of Technology, “Execution Time” placed fifth.

First and third place team members (shown below l. to r.): Adam Roy, Vijay Pemmaraju, Ryan Mullens, Batkuyag Batsaikhan, Anthony Moh, and Khanh Nguyen.



Students attend GHC

In October, 2013, CS students attended the Grace Hopper Celebration of Women in Computing (GHC). Thanks to travel support provided by Yahoo! and GHC, these students joined over 4,500 women at the event held in Minneapolis, MN.

GHC attendees (shown l. to r.): Front row: Ashley Campo, Shiri Dori-Hacohen, Rae Recto, Huong Phan, Elizabeth Staruk, and Pinar Ozisik. Back row: Ranysha Ware, Chelsea Grossman, Jennie Steshenko, and Ravali Pochampally. Missing from photo: Lauren Breitenbach, Anastasia McTaggart, and Xiaozheng Tie.



Faculty News



Assistant Professors **Alexandra Meliou** and **Andrew McGregor** each received a 2013 Google Faculty Research Award for structured data research. Meliou's research project is "Bidirectional Data Cleaning" and McGregor's is "Summarizing and Sketching Massive Graphs."



Assistant Professor **Benjamin Marlin** received a Yahoo! Faculty Research and Engagement Award for his research on "Identifying and Exploiting Temporal Patterns in Online Recommender Systems."

Assistant Professor **Yuriy Brun**'s paper, "Early Detection of Collaboration Conflicts and Risks" was featured as the Spotlight Paper in the October 2013 issue of *IEEE Transactions on Software Engineering*.



Associate Professor **Erik Learned-Miller** will be a Program Co-Chair for the 2015 IEEE Conference on Computer Vision and Pattern Recognition.



Distinguished Professor **Don Towsley**, Adjunct Professor **Weibo Gong**, and ECE alum Sheng Xiao published the book *Dynamic Secrets in Communication Security* (Springer Publishers). The book presents unique security properties and application studies for this technology.



Professor Emeritus **Andrew Barto** gave the opening address at the First Multidisciplinary Conference on Reinforcement Learning and Decision Making (RLDM2013) held in October in Princeton, New Jersey. CS alum, **Richard Sutton** (Ph.D. '84) gave the closing address.

Another CS alum, **Satinder Singh** (Ph.D. '94) was on the organizing committee with Barto and Sutton.



Adjunct Professor **Ileana Streinu** just completed a visiting professorship at Technische Universitaet in Munich, Germany. Her visit was funded by a grant of the German Science Foundation.

Jenna Marquard, UMass Amherst Mechanical and Industrial Engineering Associate Professor, joined the School this fall as an Adjunct Associate Professor.



Adjunct Professor **Jane Fountain** was promoted to Distinguished Professor by the UMass Board of Trustees. "I have been so happy to work with Rick Adrion on CITI and CAITE, with Andrew McCallum and David Jensen on CSS, with Bev Woolf on ethics in STEM, with Lee Osterweil on process improvements, and with others - although not nearly with as much time as one would like," notes Fountain.

On October 4, Professor **Brian Levine** and his wife Amy welcomed the birth of their son Zachary.



Researcher News

CS alum **George Bissias** (Ph.D. '10) has joined the Center for Forensics as a Postdoctoral Research Associate.

IESL's **David Soergel** was promoted to Research Scientist this fall. **Benjamin Roth** joined IESL in January as a Research Fellow.

From Xi'an Jiaotong University, **Weixuan Mao** is a Visiting Scholar in the NETWORKS lab.

Student News

Graduate students **David Wemhoener** and **Zeki Yalniz** and Research Professor **R. Manmatha** received the Best Poster Award at the 2013 International Conference on Document Analysis and Retrieval.

CIIR doctoral student **Shiri Dori-Hacohen** and her husband Gonen announced that their daughter Gavahn was born on December 21.

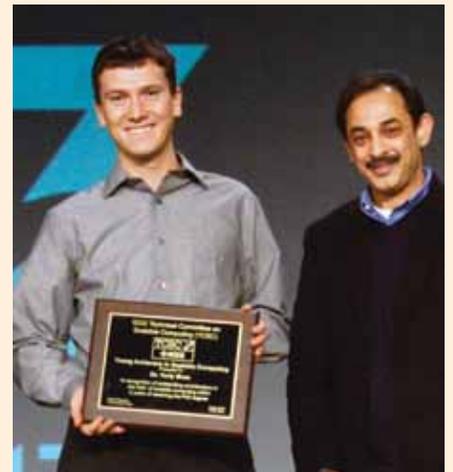
Staff News

CS welcomes **Adam Tabaka** as the Executive Assistant to the Chair and **George Baitinger**, who joined the staff as a Grant Administrator.

Yuriy Brun receives IEEE TCSC Young Achievers Award

Assistant Professor Yuriy Brun received a 2013 IEEE TCSC (Technical Committee on Scalable Computing) Young Achievers in Scalable Computing Award during the Supercomputing Conference in Denver, CO in November. According to IEEE, the award recognizes individuals who have made outstanding, influential, and potentially long-lasting contributions in the field of scalable computing within five years of receiving their Ph.D. degree.

Brun (left) accepts the award from Manish Parashar, award committee chair, during the Supercomputing Conference.



Correction In the Summer 2013 issue of Significant Bits, in the "CS Scholarships Established" article on page 9, we should have listed our CS alum Hanuma Kodavalla as receiving an M.S. degree in Computer Science at UMass Amherst in 1988.



Marc-Allen Cartright; *Query-Time Optimization Techniques for Structured Queries in Information Retrieval*; (James Allan, Advisor); Sept. 2013; Software Engineer, Google, Inc.

Information retrieval (IR) systems are evolving towards larger, more complicated queries.

From an operational perspective, larger queries translate into an increasing computational cost to respond to a query. This causes an increasing tension in the trade-off between retrieval effectiveness and efficiency. This tension creates a strong need for optimization techniques to improve the efficiency of ranking with respect to these more complex retrieval models. This thesis presents three new optimization techniques designed to deal with different aspects of structured queries: 1) manipulation of interpolated subqueries, a commonly used query structure; 2) development of an alternative scoring formulation to make retrieval models more responsive to dynamic pruning techniques; and 3) introduction of delayed execution, which focuses on the class of queries that utilize term dependencies and term conjunction operations. In each case we empirically show that these optimizations can significantly improve query processing efficiency without impacting retrieval effectiveness.



Shane Clark; *The Security and Privacy Implications of Energy-Proportional Computing*; (Kevin Fu, Advisor); Sept. 2013; Research Scientist, BBN Technologies

The parallel trends of greater energy-efficiency and more aggressive power management are yielding computers that inch closer to energy-proportional computing with every generation. Energy-proportional computing, in which power consumption scales closely with workload, has unintended side effects for security and privacy. This thesis demonstrates the potential for system-level power analysis—the inference of a computer’s internal states based on power observation at the “plug.” It also examines which hardware components and software workloads have the greatest impact on information leakage. This work identifies the potential for privacy violations by demonstrating that a malicious party could identify which webpage from a given corpus a user is viewing. It also identifies constructive applications for power analysis, evaluating its use as an anomaly detection mechanism for embedded devices. Finally, this thesis includes modeling work that correlates AC and DC power consumption to pinpoint which components contribute most to information leakage.



Henry Feild; *Exploring Privacy and Personalization in Select Information Retrieval Applications*; (James Allan, Advisor); Sept. 2013; Assistant Professor, Dept. of Computer Science, Endicott College

The goal of this work is to explore the effects of personalization and privacy preservation methods on three information retrieval applications, namely search task identification, task-aware query recommendation, and searcher frustration detection. We pursue this goal by first introducing a novel framework called CrowdLogging for logging and aggregating data privately over a distributed set of users. We then describe several privacy mechanisms for sanitizing global data, including one novel mechanism based on differential privacy. We present a template for describing how local user data and global aggregate data are collected, processed, and

used within an application, and apply this template to our three applications. We then introduce an open source system called CrowdLogger that implements the CrowdLogging framework and also serves as a platform for conducting in-situ user studies of search behavior, prototyping and evaluating information retrieval applications, and collecting labeled data.



Jacqueline Feild; *Improving Text Recognition in Images of Natural Scenes*; (Erik Learned-Miller, Advisor); Feb. 2014; Data Scientist, McGraw-Hill Education

This thesis develops methods for improving scene text recognition. We do this by incorporating new types of information into models and by exploring how to compose simple components into highly effective systems. First, we introduce two techniques for character recognition. We describe a character recognition system that incorporates similarity information in a novel way and a new language model that models syllables in a word to produce word labels that can be pronounced in English. Next we look at word recognition and we develop a new technique for segmenting text for these images called bilateral regression segmentation. We also introduce an open-vocabulary word recognition system that uses a very large web-based lexicon to achieve state of the art recognition performance. Lastly, we remove the assumption that words have been located and describe an end-to-end system that detects and recognizes text in any natural scene image.



Samuel Huston; *Indexing Proximity Based Dependencies for Information Retrieval*; (W. Bruce Croft, Advisor); Feb. 2014; Software Engineer, Google, Inc.

Research into term dependencies for information retrieval has demonstrated that dependency retrieval models are able to consistently improve retrieval effectiveness over bag-of-words models. However, the computation of term dependency statistics is a major efficiency bottleneck in the execution of these retrieval models. Further, despite the large number of published comparisons between dependency models and bag-of-words approaches, there has been a lack of direct comparisons between alternate dependency models. This thesis investigates the problem of improving the efficiency of dependency retrieval models without compromising the effectiveness benefits of the term dependency features. The major contributions presented in this thesis includes a systematic comparison of ad-hoc dependency models; the presentation and analysis of two new index data structures for term dependency data; and finally a comparison of the efficiency of these data structure for the most effective term dependency models identified by the systematic comparison.



Phillip Kirlin; *A Probabilistic Model of Hierarchical Music Analysis*; (David Jensen, Advisor); Feb. 2014; Assistant Professor, Dept. of Mathematics and Computer Science, Rhodes College

Schenkerian music theory supposes that Western tonal compositions can be viewed as hierarchies of musical objects. The process of Schenkerian analysis reveals this hierarchy by identifying connections between notes or chords of a composition that illustrate both the small- and large-scale construction of the music. We present a new probabilistic model of this variety of music analysis,

details of how the parameters of the model can be learned from a corpus, an algorithm for deriving the most probable analysis for a given piece of music, and both quantitative and human-based evaluations of the algorithm's performance. In addition, we describe the creation of the corpus, the first publicly available data set to contain both musical excerpts and corresponding computer-readable Schenkerian analyses. Combining this corpus with the probabilistic model gives us the first completely data-driven computational approach to hierarchical music analysis.



Chao Li; *Optimizing Linear Queries Under Differential Privacy*; (Gerome Miklau, Advisor); Sept. 2013; Software Engineer, Google, Inc.

Statistical data analysis on large collections of personal data can lead to fascinating results but also raises the privacy risk unwanted information disclosure. Differential privacy is a rigorous privacy definition that protects individuals' information during statistical data analysis. While it is straightforward to construct differentially private algorithms for many common tasks, methods to design error-optimal algorithms for most non-trivial tasks are still unknown. This thesis proposes the matrix mechanism, which answers sets of linear counting queries under differential privacy. Such queries cover the scope of many aggregation tasks, including count, sum and histogram. The thesis also contains an analysis of the matrix mechanism, including a closed-form error formulation and optimization programs to minimize the error. Further, it presents two algorithms. One based on the matrix mechanism and the other combining the matrix mechanism with other novel techniques, both of which answer various sets of queries with error lower than state-of-art algorithms.



Manjunath Narayana; *Probabilistic Models for Motion Segmentation in Image Sequences*; (Allen Hanson and Erik Learned-Miller, Advisors); Feb. 2014; Research Engineer, Metaio, Inc.

Motion segmentation, or labeling image pixels as moving or stationary, is an important task in computer vision. This thesis makes contributions towards segmentation with both stationary and moving cameras. For stationary cameras, we develop a probabilistic model that intuitively combines the various aspects of the problem in a system that is easy to interpret and to extend. For moving cameras, segmentation is commonly performed using the image plane motion of pixels, or optical flow. However, objects that are at different depths from the camera can exhibit different optical flows, causing a depth-dependent scene segmentation. We achieve a depth-independent segmentation that is consistent with real-world motion in the scene by using optical flow orientations instead of complete vectors. We propose a non-parametric probabilistic model that automatically estimates the number of motions and a rotation compensation algorithm that enables segmentation in a wide range of challenging hand-held camera videos



Scott Niekum; *Semantically Grounded Learning from Unstructured Demonstrations*; (Andrew Barto, Advisor); Sept. 2013; Postdoctoral Researcher, Carnegie Mellon University

Robots exhibit flexible behavior largely in proportion to their degree of semantic knowl-

edge about the world. Such knowledge is often meticulously hand-coded for a narrow class of tasks, limiting the scope of possible robot competencies. For this reason, learning from demonstration (LfD) has become a popular alternative to traditional robot programming methods, aiming to provide a natural mechanism for quickly teaching robots. Unfortunately, LfD often yields little semantic knowledge about the world, and thus lacks robust generalization capabilities, especially for complex, multi-step tasks. To address this shortcoming of LfD, we present a series of algorithms that automatically detect and leverage repeated structure at multiple levels of abstraction in demonstration data, providing critical insights into task invariants, features of importance, and high-level task structure. This culminates in the discovery of semantically meaningful skills that are flexible and reusable, providing robust generalization and transfer in complex, multi-step robotic tasks.



James Partan; *Characterization and Network Consequences of Low Spreading Loss in Underwater Acoustic Networks*; (Brian Levine, Advisor); Sept. 2013; Research Engineer, Woods Hole Oceanographic Institution

The focus of this thesis is packet detection in interference in underwater acoustic wireless networks (UANs), and its role in the effectiveness of collision-avoidance medium-access control (MAC) protocols. Spreading-loss measures the decrease in received energy as a function of range, and determines the level of long-range interference. We present a new spreading model, the mixed-exponent spreading model, for UAN nodes using a matched-filter detector as a low-power wakeup detector. Under this model, there are distinct spreading-loss exponents for packet detection and interference. We validate this spreading model numerically, and with measurements of the spreading exponents from shallow-water experimental data. Our results suggest caution for use of the poorly grounded, but widely used, standard spreading model. We next analyze the effectiveness of collision-avoidance MAC protocols in UANs. The low spreading loss in UANs, in particular with the mixed-exponent spreading model, can lead to low collision-avoidance effectiveness compared with radio networks.



Ismet (Zeki) Yalniz; *Efficient Representation and Matching of Texts and Images in Scanned Book Collections*; (R. Manmatha, Advisor); Feb. 2014; Software Engineer, Amazon, A9.com

Several research problems are investigated over large collections of scanned books given their page images and corresponding optical character recognition (OCR) outputs. First, we propose general framework which can be used to efficiently align and compare the textual content of the books at various coarseness levels and even across languages. The framework uses the sequence of words which appear only once in the entire book ("the sequence of unique words") to represent the text. This approach is used for aligning long noisy texts, detecting partial duplicates and translations of books, and, aligning texts written in different languages. In the second part, the global font feature along with the letter sequence information is used for facilitating and/or improving text search in noisy page images using visual features. The effectiveness is demonstrated for books printed in different scripts for which there is no OCR engine available or the recognition accuracy is low.

Significant Bits

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