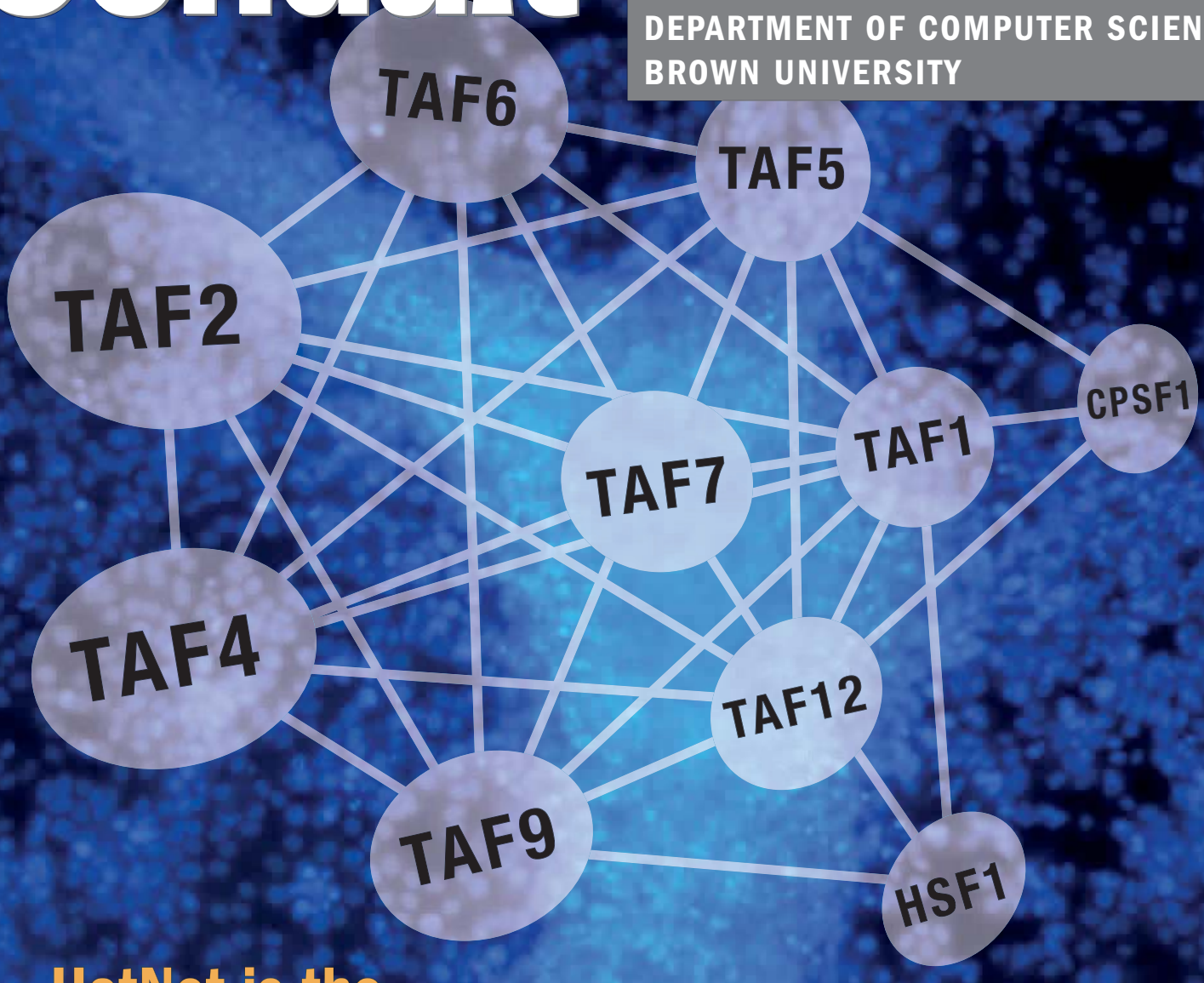
Conduit

A RESEARCH AND ALUMNI NEWS MAGAZINE
DEPARTMENT OF COMPUTER SCIENCE
BROWN UNIVERSITY



HotNet is the heat-seeker of cancer

ALSO INSIDE:

- Robot Lab Unpacks New Partner
- 2011 Artemis Project

Notes from the Chair: the Latest News from 115 Waterman

Greetings to all CS alums, supporters and friends.

The fall semester is well underway and the CIT continues to bustle with activity. I am excited to share the highlights with you.

Congratulations are in order for John Savage, who has been appointed An Wang Professor of Computer Science. Throughout his distinguished career, John has made fundamental contributions to theoretical computer science. Also, he has played influential leadership roles in the department and the university. On a personal level, I am particularly thrilled that John was given this honor because he was the department chair when I joined Brown in 1988. Therefore, I had the opportunity to admire his scholarship, leadership and vision early on.

In addition, Ben Raphael was promoted to Associate Professor with tenure. Ben's research focuses on structural variation in human and cancer genomes, network analysis of somatic mutations in cancer, and next-generation DNA sequencing technologies. He is the recipient of a National Science Foundation CAREER Award and an Alfred P. Sloan Research Fellowship.

In July, Eugene Charniak was presented with the 2011 ACL Lifetime Achievement Award at the Annual Meeting of the Association for Computational Linguistics. Eugene is the ninth recipient of this prestigious award which is given for scientific achievement, of both theoretical and applied nature, in the field of Computational Linguistics.

The faculty is growing and the department is pleased to announce several additions:

- Associate professor Pedro Felzenszwalb is a new faculty member jointly appointed to the CS Department and the School of Engineering. Pedro's research is focused on computer vision, a field that uses algorithms and modeling to teach machines how to see.
- Along with Pedro, we also welcome his wife, Caroline Klivans, who has a joint adjunct assistant professor appointment with Applied Mathematics, Computer Science and Mathematics. Her research interests are in algebraic, geometric, and topological combinatorics. She will be teaching CS22 in the spring semester.

- Fabio Vandin has been appointed research assistant professor of Computer Science. His work focuses on computational biology and randomized algorithms. He is the principal investigator for an NSF-sponsored project on algorithmic problems in protein structure studies.

In May, we awarded 53 bachelor's degrees, 41 Master of Science degrees and 8 PhDs. Congratulations to our fantastic graduates – we hope you'll keep us updated on your careers and life experiences.

I am also excited to report that enrollment in our introductory classes continues to rise. Total enrollments for both undergraduate and graduate students have grown 60% since 2007. Especially impressive is that the number of students taking our fall-semester introductory courses (CS15, CS17 & CS19) has grown by 135% since 2007 and by 40% since last year.

Franco Preparata spearheaded the establishment of a second concurrent degree program with the National University of Singapore (NUS), this time in computer science. Participants are selected from the top ten percent of NUS computer science concentrators and on completion of the program, will concurrently receive degrees from NUS and Brown: a bachelor's degree in computer science from NUS and a master's degree in computer science from Brown. This new program follows up the concurrent computational biology degree program.

Finally, we urge you to contribute your research and personal stories for inclusion in upcoming issues of the Conduit. Your support of and participation in department activities is much appreciated and we are thankful to have such a close community—thank you!

Roberto Tamassia
Plastech Professor of Computer Science
Chair, Department of Computer Science

Volume 20, Number 2

Fall | Winter 2012

Published twice yearly by the Department of Computer Science at Brown University, *Conduit* is distributed free to all computer science alumni, faculty, staff, students and industrial partners.

Queries about this publication can be directed to: conduit@cs.brown.edu or
115 Waterman Street
Campus Box 1910
Providence, RI 02912

PUBLISHER
Industrial Partners Program,
Department of Computer Science

EDITOR-IN-CHIEF
Amy Tarbox

GRAPHIC DESIGN
Brown Graphic Services

FEATURED COLUMNISTS
Richard Lewis
Tom Doeppner
Steve Reiss
Shriram Krishnamurthi

CONDUIT ON THE WEB
John Bazik
Kathy Kirman

PRINTING AND DISTRIBUTION
Brett Turner, Information Services
Brown Graphic Services



BROWN

Conduit is printed on Burgo's ChorusArt, an acid free and elemental chlorine free paper containing 50% recycled content and 15% post-consumer waste. You are the difference – reduce, reuse, recycle.

HOTNET IS THE HEAT-SEEKER OF CANCER

By Richard Lewis, Brown PAUR

Computer scientists Eli Upfal, Fabio Vandin, and Ben Raphael designed software to focus on groups of genes. "Instead of identifying individual players," Raphael asked, "can we identify the conspiracy?"

This summer, more than a hundred scientists from dozens of research institutions published a landmark paper that identified a single gene responsible for the most prevalent form of ovarian cancer. Their success hinged in no small part on an ingenious algorithm developed by computer scientists at Brown University.

The human genome is a dense jungle of genes. Five genes can be combined in more than 1019 ways. Even worse, scientists cannot look at the human genome in one piece and instead must look at fragments and then try to piece the genome together as if it were an immense jigsaw puzzle.

Ben Raphael, Eli Upfal, and Fabio Vandin in the Department of Computer Science had been working on various ways to allow biologists to locate mutating genes and to determine which of those mutations could lead to cancer — "to find those mistakes," as Raphael put it. With ovarian cancer, there were dozens, possibly hundreds, of genes that could cause cancer. The trick was to find which genes partner with other genes to carry out the cancer-causing sequence.

"Instead of identifying individual players, can we identify the conspiracy?" said Raphael, associate professor of computer science at the Center for Computational Molecular Biology.

"That's an algorithmic problem now," Raphael said. "You have these individual genes, now identify the conspirators."

But finding the target in any good conspiracy is never easy. So the team at Brown created a heat-seeker of sorts, which they call HotNet.

The algorithm treats mutated genes as heat sources and measures the intensity of the heat. When mutated genes cluster together, the "heat" generated by the group is more intense than the heat from a pair of mutated genes. This helps researchers to distinguish random mutated genes from concentrated groupings and to determine whether clusters "are other than random mutations," Raphael said. "Are these hotspots in my data different than what I'd find with random data? Am I surprised by it?"

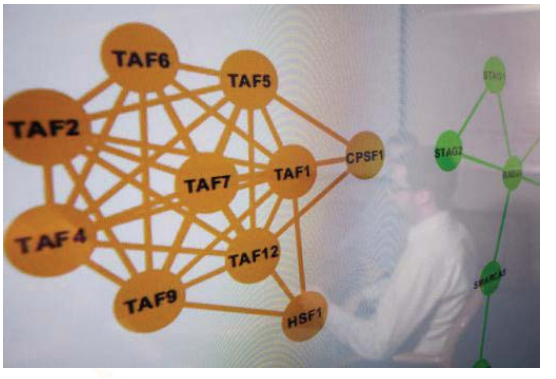
Vandin began developing HotNet as a class project as a visiting graduate student from the University of Padua, Italy. After earning his doctorate, Vandin returned to Brown as a postdoctoral researcher to continue refining the algorithm, supported by a grant from the National Science Foundation.

"I found the problem of identifying the significant mutations not only extremely important, but also challenging and fascinating," Vandin said. "Looking at previous approaches, what was missing was a clever way to combine the interaction information with the mutation data and an efficient statistical test — two of the main features of HotNet."

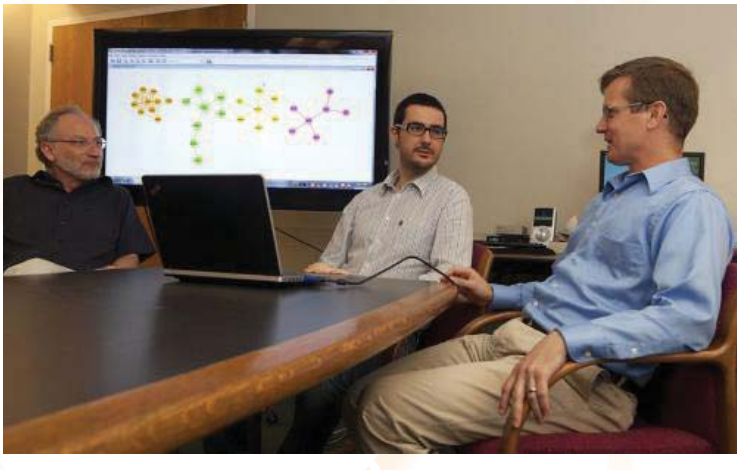
The paper, published in Nature in late June by the Cancer Genome Atlas Research Network, confirmed that mutations in a single gene — TP53 — are present in more than 96 percent of serous adenocarcinoma, the most prevalent form of ovarian cancer.

"Since TP53 is mutated in so many tumors, the gene is easy to identify on its own," Raphael said. "HotNet is geared toward finding more subtle signals in the data that result from mutations across multiple genes. In the ovarian cancer study, HotNet pinpointed the Notch signaling pathway and the cohesin protein complex (involved in DNA repair) as significantly mutated. Neither of these was apparent by examining individual genes."

Raphael said HotNet can be used to hunt for the genes responsible for causing other types of cancer. "We can use (the algorithm) in theory on any type of data, including non-biological," he added.



Needle, haystack
Finding one genetic bad actor isn't really the point. HotNet software helps researchers find clusters of interacting genes that include mutations — candidates for further study. *Credit: Mike Cohea/Brown University*



Identifying the conspiracy
Computer scientists Eli Upfal, Fabio Vandin, and Ben Raphael designed software to focus on groups of genes. "Instead of identifying individual players," Raphael asked, "can we identify the conspiracy?" *Credit: Mike Cohea/Brown University*

CS Robotics Lab Unpacks its New Partner

By: Richard Lewis, Brown PAUR

New arrival Brian Thomas, Chad Jenkins, and Chris Crick welcome PR2 to its new home in the robotics lab. The robot is designed to help researchers explore the capabilities of robots and refine the quality of their interactions with humans.
Credit: Mike Cohea/Brown University

Say hello to PR2, the latest in robot test beds, now ready to participate in whatever research projects the Computer Science robotics lab might wish to send its way.

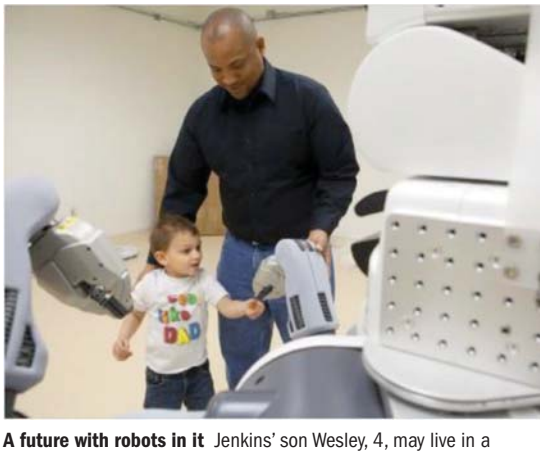
Christmas arrived on a Thursday in mid-May for Chad Jenkins and his robotics research group. Inside a six-foot-tall crate was the latest-generation personal robot, purchased by Jenkins for $280,000.

The PR2 robot, one of about a dozen made available by the company Willow Garage to higher-education institutions and companies worldwide, is equipped with movable arms and pincer-like hands to grasp and manipulate objects. Like the movie character Wall-E, the PR2 has laser-range vision that allows it to scan for obstacles and objects so it can move around freely.

"I'm just thrilled," said a beaming Jenkins, associate professor of computer science. "It's the first time we have a serious robot with which we can do big experiments locally."

Jenkins said his lab wants to advance the capability of robots to navigate their environment and to perform domestic-service functions. He and his group want to explore what the PR2 can do in the kitchen, be it loading a dishwasher, setting the table or even preparing a meal. "We want to think about interesting problems," he said, noting the findings would be available for other researchers to scrutinize and build upon.

On hand to witness the robot's arrival at Brown were two members of Jenkins' robotics group, postdoctoral research associate Chris Crick and first-year graduate student Brian Thomas. Jenkins's wife and two of his children also came out for the unveiling.



A future with robots in it Jenkins' son Wesley, 4, may live in a world where robots are useful and commonplace.
Credit: Mike Cohea/Brown University

"Say nice to meet you, robot," Jenkins instructed his 4-year-old son, Wesley, who eyed the robot warily.

"Nice to meet you, robot," Wesley said.

2011 Artemis Project

Kelly Buckley '14, Joanna Lustig '13, Sophie Qiu '14, and Kelly Winter '12

The Artemis Project, a free five-week summer program for rising ninth grade girls, has completed its 16th successful summer! This year, advisor Philip Klein and four Brown undergraduates, Kelly Buckley '14, Joanna Lustig '13, Sophie Qiu '14, and Kelly Winter '12, planned and taught topics ranging from HTML/CSS to Photoshop to Python and minimum spanning trees. The goal of Artemis is to expose the girls to a wide variety of topics within computer science in hopes that each girl will find at least one area particularly fascinating. The greatest decrease in female participation in the sciences occurs just before

girls enter high school; Artemis hopes to combat that statistic by showing girls that computer science can be fun and exciting and that they are capable of great achievements in a male-dominated field.

This year's Artemis program incorporated a wide variety of topics to show that computer science is anything but a narrow field. In the computer lab, the lessons were very hands-on, with many follow-along tutorials and projects. The girls got to show off their creativity by creating a movie poster using Photoshop and learning HTML and CSS in order to create their own websites. One of the biggest changes in Artemis this year was that the girls learned programming through Scratch, a graphical and kid-friendly programming language developed by MIT. The girls got to program their own games and animations, and many found this to be the highlight of the summer. The girls then learned Python, which was made easier by their understanding of programming concepts they learned from Scratch. In the last week, the girls got to use Scratch to program robots to participate in a dance competition and do line following. Outside of the computer lab, the girls were introduced to the topics of binary and boolean logic, sort and search algorithms, cryptography, and even complex topics in graph theory. The coordinators used a combination of handouts and interactive demonstrations to explain these topics and give the girls an understanding of the math that goes behind what they make happen on the screen.

In addition to intensive but interesting classes, this year's Artemis program offered four field trips. In the first week, the girls participated in the Wheeler School ropes course. Through this activity, they got to know each another better, and, more importantly, learned how to work as a team. In the following weeks, the girls visited the Boston Museum of Science, the MIT museum and Media Lab, Microsoft and United Skates of America. They talked to female high school students who were summer interns at Microsoft, and were shown interactive robots at the MIT Media Lab. Additionally, the girls were given the opportunity to tour the lab where Scratch was developed. These field trips gave the girls a first-hand look at both the computer science industry and current research being done in computer science, and served to foster their interest in the sciences.

Between classes, guest speakers were invited to give presentations to the girls. Many Brown University professors gave presentations, including Artemis founder Andries van Dam and program advisor Philip Klein. Speakers from such companies as Google, Microsoft and Adobe also presented to the girls. The presentations covered a wide variety of topics including being a woman in computer science, advanced scientific research and daily data security. Though the topics were varied, the overall message was clear: computer science is much more than just coding and being a woman is not a disadvantage in the cyber world.

After four weeks of taking classes, meeting professors and professionals, and going on field trips, the girls were required to present to parents and faculty on a topic that had been covered during the camp. Presentation topics included Colors and Computing, Minimum-Spanning Trees, NP-Hard Problems, Cryptography, Arrays, Loops, and Boolean Logic. Each group was required to create a short PowerPoint on their topic that included an overview of the topic, why it is important, and what aspects they enjoyed about it most. Both the faculty and parents were impressed by the quality of the presentations and the girls' aptitude.

Have ideas or questions or interested in being a coordinator next summer? Email the current coordinators at artemis@cs.brown.edu!

Faculty Notes

Maurice Herlihy

Maurice Herlihy is back from his sabbatical. He spent one month visiting Tsinghua University in Beijing, and nine months visiting the Technion in Haifa.

Sorin Istrail

In March, Sorin traveled along with his Ph.D. students Ryan Tarpine and Derek Aguiar to Vancouver for the Fifteenth International Conference on Research in Computational Biology (RECOMB). Ryan presented the RECOMB paper titled "Conservative Extensions of Linkage Disequilibrium Measures from Pairwise to Multi-Loci and Algorithms for Optimal Tagging SNP Selection" co-authored also with Sorin's former postdoc Fumei Lam.

The annual Developmental Biology of the Sea Urchin XX Meeting at the Marine Biological Laboratory in Woods Hole, MA was held April 27–30, 2011. Ryan and Derek, along with the undergraduate leaders of Sorin's small army of Cyrene annotators, James Hart and Timothy Johnstone presented a poster and attended the meeting. Ryan presented an invited paper at the meeting: "Report on the Cyrene Project: A cis-Lexicon containing the regulatory architecture of 557 regulatory genes experimentally validated using the 'Davidson Criteria.'" The Cyrene cisGRN-Browser software system was released at the meeting. Ryan's CLOSE (cis Lexicon Ontology Search Engine) was a hit in its rigorous estimation of the completeness of the Cyrene database (95%) with respect to the Davidson Criteria papers universe.

In May, Sorin co-hosted a Center for Computational Molecular Biology, "Genome Assembly Special Forces Workshop," co-organized with fellow Brown professor Casey Dunn from the Department of Ecology and Evolutionary Biology. The three day workshop had the highest attendance of any CCMB event and placed CCMB as a central environment for education and research in this phase of genomics focused on Next-Generation Sequencing Technologies.

Sorin's postdoctoral student Austin Huang co-advised with Rami Kantor and Joe Hogan advanced to Assistant Professor (research) in the Division of Infectious Disease at Brown Med. Austin's QColors algorithm, based on graph coloring of next generation sequencing graphs, advanced the state-of-the-art of HIV patient metagenome reconstruction leading to important genomic clues regarding HIV drug resistance.

Sorin traveled to Romania in June to take part in the computer science summer course at the Alexandru Ioan Cuza University in Iasi. As part of his duties related to his honorary professorship (professor honoris causa) bestowed on him in June 2010, he gave lectures in the summer school and also at the School of Medicine. The lecture at the School of Medicine took place in the doctors pavilion where his former beloved professor, Calin Ignat spent his last days of his life unsuccessfully fighting lung cancer.

In July, Sorin and Derek Aguiar participated in the Gordon Research Conference on Human Genetics and Genomics at Salve Regina University in Newport, RI. Derek presented a poster entitled Long-Range Haplotype Phasing by Multi-Assembly of Shared Haplotypes: Phase-Dependent Interactions Between Rare Variants" (Derek Aguiar, Ryan Tarpine, Fumei Lam, Bjarni Halldorsson, Eric Morrow, and Sorin Istrail). The poster included the first Autism Human Genome Deletion Map generated by Derek's DELISHUS algorithm.

Sorin traveled to Hinxton, Cambridge in the United Kingdom in August to attend the conference Genomics of Common Diseases hosted by the Wellcome Trust. While in the UK, he gave a lecture at Illumina – the industry leader of next generation sequencing technology -- entitled "Long-Range Next-Gen Haplotype Phasing and Assembly: Phase-Dependent Interaction Between Rare Variants."

Sorin's former PhD advisor, Professor Solomon Marcus (Romanian Academy of Science) visited him for a three week research visit devoted to continuing John von Neumann's research program towards a new computation and information theory for modeling information processing in the biological cell. Professor Marcus gave also four memorable lectures ("From the Euclidean to the Non-Euclidean Paradigm", "Correctness and Meaning: Cooperation or Conflict?", "Symmetry in Mathematics and Beyond", and "Mathematics, Between Semiosis and Cognition"). These lectures, together with the other eight lectures he gave at Brown in 2008 (all lecture videos available from Sorin's webpage) are inspiring in their call for computational and mathematical sciences research and education to go deeper into intra-mathematics, inter-sciences, and cross-cultures problems.

In August, Sorin completed his five-year term as Director of the Center for Computational Molecular Biology. His vision, inspired by Steve Jobs, for the center, for the Department of Computer Science, and for Brown is: *inVision: "Engaging the world, one inspiring course, one innovative student, one influential research leader at a time."*

Philip Klein

In February, Philip participated in a workshop on graph algorithms and combinatorial optimization at the Shonan Village Center, a conference center outside of Tokyo. This was the first Shonan workshop sponsored by Japan's National Institute of Informatics (NII). The NII Shonan workshops are billed as "the first Dagstuhl-style meetings in Asia".

In June, Philip participated in a workshop at Princeton, "Approximation Algorithms: The Last Decade and the Next," sponsored by Princeton's Center for Computational Intractability.

Philip's book draft, "Flatworlds: Optimization Algorithms for Planar Graphs", is being used in a graduate seminar at MIT in Fall 2011 (despite the fact that the book is not yet finished).

A new algorithm for maximum flow in planar graphs with multiple sources and multiple sinks will be presented in October at the IEEE Symposium on Foundations of Computer Science. The authors include Philip, Brown Ph.D. student Shay Mozes, and former Brown Ph.D. student Glencora Borradaile.

The 2012 ACM-SIAM Symposium on Discrete Algorithms, to be held in January in Kyoto, will include six papers that include Brown authors, including two coauthored by Shay Mozes, one coauthored by Eli Upfal and his former Ph.D. student, Gopal Pandurangan, one coauthored by Roberto Tamassia and his current Ph.D. student Olga Ohrimenko, and two by two coauthored by Claire and Philip, one of these with Ph.D. student David Eisenstat.

Shriram Krishnamurthi

Shriram is delighted to welcome new PhD student Hannah Quay-de la Vallee and new post-doc Ben Lerner. During the summer, undergrads Jeanette Miranda, William Turtle, and William Zimrin built a bunch of interesting new systems that should be seeing a lot of use over the coming years.

The personal highlight of Shriram's summer was noticing that his Germany trip coincided perfectly with the first round of the Frauen-Weltmeisterschaft. So, at the last minute, he shifted around several reservations so Kathi, Tara, and he were able to visit the Fanmeile in Frankfurt for Germany's opening match, and watch broadcasts of several other encounters, all amidst battering heat.

David Laidlaw

David's summer included an awesome bicycle touring trip with his family on Prince Edward Island and an additional week car camping on Nova Scotia's Cape Breton. Both islands offered many beautiful sights, and the family logged

over 200 miles of loaded touring. It's a great way to travel; slow enough to see things, fast enough to get somewhere, and satisfyingly self-sufficient. Coupled with a week at the beach on Block Island, reentry to the fall semester was quite a contrast! The summer and fall were intermittently interrupted by conference-planning activities for the annual IEEE VisWeek set of conferences. 1000 of David's visualization-researcher colleagues arrived in Providence to visit during the last week of October. This semester David is teaching a graduate seminar which is studying how ideas from cognition can help software developers build and understand better scientific analysis tools. It's been a lot of fun so far, and he hopes that it will lead to some innovative future research.

Claire Mathieu

During the summer of 2011, Claire Mathieu spent some time visiting Microsoft Research, where she worked with the numerous visitors on weekdays and hiked up nearby mountains on the weekends. Then she spent some time in France, where she worked on algorithms for matching in the streaming model of computation, in collaboration with Parisian researchers. Finally she spent a few days working on her ice axe technique in Chamonix.

John Savage

On April 12 John gave congressional testimony before the Subcommittee on Crime and Terrorism of the Senate Judiciary Committee. The hearing was entitled Cyber Security: Responding to the Threat of Cyber Crime and Terrorism. In his testimony, "The Technology/Policy Intersection," he spoke about the challenges of coping with insecurity in cyberspace. In August, a paper he co-authored with Les Bloom of the DoD CIO's office entitled "On Cyber Peace" was published as an Issue Brief by the Atlantic Council in their Cyber Statecraft Initiative series. He also gave two invited talks on this general topic at the University of Rhode Island and the National Intelligence Council.

He continued his interest in I/O complexity by publishing two conference papers with Mohammad Zubair and Desh Ranjan of Old Dominion University in which they derive bounds on the number of I/O operations needed for computations encountered in doing financial computations.

In the spring he taught a new course entitled "Cybersecurity and International Relations" to an audience of 24 students evenly divided between computer science concentrators on the one hand and international relations and political science concentrators on the other. The course provided an introduction to techniques for violating the security of computers and disrupting networks as well as methods to prevent these attacks. It also gave an overview of international efforts to manage the Internet and control cybercrime, explained the current thinking about cyber conflict, discussed anonymity and trusted identities on the Internet, described approaches to understanding the economics of cybersecurity, and described steps that have been taken to formulate domestic cybersecurity legislation.

The course was designed to bridge the gap between technology and policy in cyberspace. Today too few policymakers are adequately informed about the technology of cyberspace to acquire knowledge they need from technologists who are themselves insufficiently conversant with the policy issues to be helpful to the policymakers or direct their policy formulation. The course succeeded in acquainting students with both points of view.

Erik Sudderth

Erik continues to enjoy his ongoing research collaborations with Brown students, both graduate and undergraduate. In June, Donglai Wei's senior research project was presented at the Eighth Workshop on Bayesian Nonparametrics in Veracruz, Mexico. Erik is currently distracted by his overflowing graduate machine learning seminar, and the more unpredictable learning of his 1.5 year old son, Kyler.

(From the Cape Cod Times, October 3, 2011)

WOODS HOLE — For Andy van Dam of Barrington, R.I., it took six hours to ride 75 miles and travel a half-century back in time.

"I lived on Oyster Pond Road," van Dam, 72, said Sunday at Quissett Harbor minutes after completing the Buzzards Bay Coalition 5th Annual Watershed Ride.

In the early 1950s, van Dam had a paper route and mowed lawns in the area, he said. His father worked at Woods Hole Oceanographic Institution after the family immigrated from the Netherlands.

"I know this bike path," he said, adding that he also knows the pressures facing the Buzzards Bay watershed.

The fundraising ride from Westport on the west shore of the bay north to the Bourne Bridge and south to Woods Hole was beautiful, van Dam said. "It's a great way to raise money for the coalition and to raise awareness."

More than 100 riders were welcomed across the finish line at Quissett Harbor with a live band, cowbells, burgers and beer. On one side, dories and sailboats filled the calm harbor waters. On the other, the bay sparkled like a field of diamonds in Sunday's unexpected sunshine.

The roughly $60,000 raised will go to efforts by the Buzzards Bay Coalition to protect the watershed, according to organizers. A $10,000 donation from Keeper Springs, an organization cofounded by Robert F. Kennedy Jr., will help increase protections against oil spills from tankers in the bay.

Andy van Dam

Andy van Dam had a busy travel year thus far:

In April, he and Debbie toured scenic Yunnan Province in China for 8 days, after he had given lectures on natural user interfaces and touch-computing at Microsoft Research in Beijing. They then finished up with an eating marathon weekend in Hong Kong, including dim sum with Karen Tai, president of the Hong Kong Brown club -- food and scenery as good as ever, he reports.

In May, he, Brown's Sam Fulcomer, and former NSF and DOE program monitor for the Graphics Center, John van Rosendale, did their fourth backpacking trip to the Grand Canyon together, again on the North Rim for the second year in a row.

In August, first came SIGGRAPH in Vancouver followed by a long weekend in beautiful Vancouver Island with good friends and former students William Poole and Janet Levinger-Poole, whose son is now a Brown student. At the end of August, he and Debbie celebrated their 50th wedding anniversary by going to Paris for a long weekend with their three daughters, and their husbands, and three grandkids; a fine time eating well and sightseeing was had by all.

In September, Andy started training for the Buzzard's Bay Watershed ride, a fundraising 75 mile bike ride that was successfully completed on Oct 2nd (See Sidebar)

John Savage Honored with Named Professorship

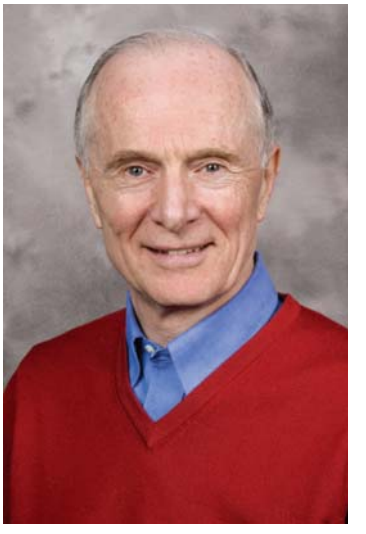
The department is thrilled to announce that John Savage has been appointed An Wang Professor of Computer Science, effective July 1, 2011. "Throughout his distinguished career, John has made fundamental contributions to theoretical computer science and has played influential leadership roles in the department and the university," said Department Chair Roberto Tamassia.

John's work over several decades has had a profound and broad impact on multiple fields within computer science and engineering, including complexity theory, computational nanotechnology, information theory, and VLSI design, analysis and synthesis. His current research interests include cybersecurity, computational nanotechnology, computer architecture, and coded computation. His work has been recognized by his selection as a Guggenheim Fellow, a Fellow of the AAAS and ACM, a Life Fellow of IEEE, a Jefferson Science Fellow, and a Fulbright-Hays Research Awardee. After earning his PhD in electrical engineering at MIT and working at Bell Laboratories for two years, John joined the faculty of the Division of Engineering at Brown in 1967. In 1979 he co-founded the Department of Computer Science and served as its second chair from 1985 to 1991. His many contributions to university and departmental affairs include founding the Computer Science Industrial Partners Program and extensive service to the University, including as Chair of the Faculty and of the Task Force on Faculty Governance. The latter service has been recognized by the President's Award for Excellence in Faculty Governance.

"John Savage has had a brilliant academic career, said Brown President Ruth Simmons. " His teaching, scholarship, and service to Brown and the nation offer an outstanding example to all of us. As the An Wang Professor of Computer Science, he will carry on this exemplary work."

"I am very appreciative of the recognition that this appointment represents for my contributions to Brown and my profession," said John.

John joins the department's other named professors: Eugene Charniak, University Professor of Computer Science, Sorin Istrail, Julie Nguyen Brown Professor of Computational and Mathematical Science, Franco Preparata, An Wang Professor of Computer Science, Roberto Tamassia, Plastech Professor of Computer Science and Andy van Dam, Thomas J. Watson Jr. University Professor of Technology and Education.



John Savage

Eugene Charniak Honored with Lifetime Achievement Award from the ACL

At the 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies in Portland Oregon, Eugene Charniak was presented with the 2011 ACL Lifetime Achievement Award.

The award, presented annually since 2002, is given for scientific achievement, of both theoretical and applied nature, in the field of Computational Linguistics. Each year's winner is a well-kept secret until the closing plenary session of the Annual Conference, held this year on June 24. The recipient then gives the closing talk of the conference.

Eugene is the ninth recipient of this prestigious award.

Typically, award recipients give talks about what guided their research over the course of their career. Instead, Eugene gave a talk titled, "The Brain as a Statistical Information Processor" for more than 1,000 attendees. His presentation made a case for the idea that computational linguistics has become cognitive psychology of higher level functioning.

Here's an excerpt from Eugene's award talk. The full text can be found at: http://www.mitpressjournals.org/doi/pdf/10.1162/COLI_a_00080

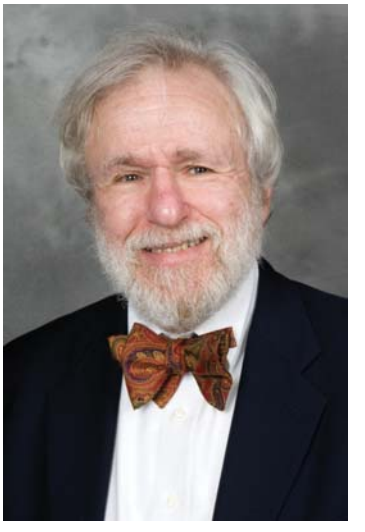
The Brain as an Statistical Inference Engine— and You Can Too

There are several possible templates for award talks. The most common is an intellectual history — how I came to make all these wonderful discoveries. However, I am never completely happy with my work, as it seems a pale shadow of what I think it should have been. Thus I am picking a different model—things we all know but do not say out loud because we have no evidence to support them, and besides making such bold claims sounds pretentious.

Thus I do not expect to say anything too novel here. I hope all my readers already know that the brain exploits statistics, and most of them suspect that we in statistical computational linguistics have something to say about how this works out in the case of language. My goal is therefore not to say anything you do not believe, but to cause you to believe it more passionately.

This talk argued that the brain is a statistical information processor and as such we should see it as operating according to Bayes' Law. On this basis we can see that learning depends both on a prior probability over models (our innate biases about how the world works) and a joint generative model of the world. Lastly, I noted that Bayes' Law says nothing about inference mechanisms, and hence I assume that this mechanism is not learned — that it too is innate. I suggested that particle filtering, a beam search method based upon a probability evaluation function, seems a good bet. Well, I said at the beginning that I would say little that most of my audience does not already believe.

But I also have had a subtext. I am not arguing that we as a field need to change our focus. Just the opposite. Our present focus has made statistical computational linguistics one of the most vibrant intellectual endeavors of our time. Rather, my argument is that we are already part-time cognitive scientists and together we are building a path to a new basis for the science of higher cognitive processes. I intend to follow that path. You can too.



Eugene is the ninth recipient of this prestigious award.

Department News and Happenings

Pedro Felzenszwalb Given Joint Faculty Appointment with Computer Science and Engineering

The Department is pleased to announce the addition of Associate Professor Pedro Felzenszwalb as a new faculty member jointly appointed to the CS Department and the School of Engineering. He started at Brown in September after serving as a Associate Professor of Computer Science at the University of Chicago. Pedro's research is focused on computer vision, a field that uses algorithms and modeling to teach machines how to see. Computer vision has important applications, including robotics and artificial intelligence, medical image analysis and computer graphics, as well as aiding our understanding of human perception and intelligence.

"We are thrilled that Pedro has joined Brown and will be spending some of his time in our department," said Department Chair Roberto Tamassia.

Pedro received his undergraduate degree from Cornell and earned his master's and PhD degrees in computer science at the Massachusetts Institute of Technology. He joined the faculty at Chicago in 2004 and was elevated to associate professor four years later.

"I am very excited to be joining Brown," Pedro said. "I look forward to building new collaborations and to contribute to the excellent research and educational environment of the university."

Rodrigo Fonseca Receives Salomon Award & STAC Collaborative Research Award

Rodrigo Fonseca recently received a $15,000 Richard B. Salomon Faculty Research Award from Brown University and a $148,000 Collaborative Research Award from the Rhode Island Science and Technology Advisory Council (STAC).

Rodrigo's project funded by the Salomon Award is in on the subject of "Energy Efficiency Exploration in Sensory Network Protocols." Wireless sensor networks are a class of small, battery-powered computers embedded in the environment and useful in many settings, including industrial, health, urban, and environmental monitoring, home and building automation, agriculture, and disaster warning. The most critical resource when designing and deploying wireless sensor networks is energy, as it is generally infeasible to replace or recharge their batteries once they are deployed. While much research into energy measurement for these systems has depended on simulations, Rodrigo's previous project involved building Quanto, a system that allows energy measurement of a live network, and evaluating its usefulness on small-scale experiments. This project seeks to address limitations in Quanto's initial design, and ultimately propose optimizations to new and existing protocols that improve the usefulness and energy efficiency of these networks.

The Richard B. Salomon Faculty Research Awards were established to support excellence in scholarly work by providing funding for selected faculty research projects deemed to be of exceptional merit.

For the STAC award, Rodrigo is collaborating with Tracelytics, a local startup co-founded by PhD student Chris Erway. The aim of this project is to develop techniques to measure the performance of modern web applications. Using real client data, the team will develop and bring to market better tools to trace and clear data bottlenecks that impede cyber functionality and efficiency.

Brown researchers are involved in four of the eight collaborative research awards given by STAC this year. The four projects will receive more than $742,000 out of this year's $1.44 million in awards. Overall, the 2011 STAC awards will support projects representing the efforts of 23 scientists from 13 educational institutions, hospitals and private companies throughout Rhode Island.

Ben Raphael Promoted to Associate Professor

The Department is excited to announce the promotion of Ben Raphael to Associate Professor with tenure, effective July 1, 2011. "Ben's promotion recognizes his extraordinary research work and excellent teaching," said Department Chair Roberto Tamassia.

David Rand, Director of the CCMB added, "This is wonderful news. Ben's work is really at the forefront of several fields - computer science, evolutionary genomics and cancer biology - all of which are moving very rapidly. The CCMB and Brown are very fortunate to have him on the faculty, and I really look forward to working with him in the years ahead."

Ben joined Brown University in September 2006 as an Assistant Professor in the Department of Computer Science and Center for Computational Molecular Biology. His research focuses on the design of algorithms for the interpretation of genomes. Current research in Ben's group focuses on structural variation in human and cancer genomes, network analysis of somatic mutations in cancer, and next-generation DNA sequencing technologies. He is the recipient of a National Science Foundation CAREER Award and an Alfred P. Sloan Research Fellowship. Ben's research is also supported by an R01 grant from the National Institutes of Health and by a Career Award at the Scientific Interface from the Burroughs Wellcome Fund.

Prior to joining the department, Ben was a postdoctoral fellow in Computer Science and Bioinformatics at the University of California, San Diego, and a recipient of a postdoctoral fellowship in Computational Molecular Biology from the Alfred P. Sloan Foundation. Ben received a PhD in Mathematics from the University of California, San Diego in 2002 and a S.B. in Mathematics from the Massachusetts Institute of Technology in 1996.

"I am grateful to be a member of the Brown Computer Science Department," said Ben. "One of the most rewarding aspects of my job is the opportunity to work with an extremely talented group of graduate students, postdocs, undergraduates and faculty collaborators – both inside and outside the department. Our accomplishments thus far are only the beginning, and I am excited to continue our current research projects and to address new scientific challenges."

John Savage Testifies Before Senate Committee on Cyber Security

On April 12, 2011, John Savage served as a witness and gave testimony before a Senate Judiciary Committee on "Cyber Security: Responding to the Threat of Cyber Crime and Terrorism."

According to John, "The problem of making our computers, networks and applications safe from attack is unsolved and probably will remain so for several reasons. First, human innovation is relentless, and especially if there is money to be made or an enemy to defeat. Second, security has been notoriously difficult to define. This is illustrated by the fact that a single bit error can result in a system intrusion."

"Given the above, can the cyber security problem be made manageable? My answer is "Yes." I liken our computers to our homes. A determined attacker can easily break into them. So why aren't most of our homes invaded more often? Apparently because the locks are good enough, the neighbors sufficiently vigilant, uniformed police officers sufficiently visible, and the punishment, if caught and convicted, sufficiently onerous to deter attackers. We need to arrive at a similar state in cyber. However, it cannot be done without more secure hardware and software, surveillance of the abuse of computers and networks, government regulation, international engagement and, possibly, the creation of an intergovernmental organization. Since it is better to build in security rather than try to add it after the fact (such as firewalls and intrusion detection),

hardware and software vendors and network providers should be required to conform to reasonable cyber security guidelines," he concluded.

John Savage Interviewed on the Silver Bullet Security Podcast

John Savage was featured on the 58th episode of The Silver Bullet Security Podcast with Gary McGraw, which is sponsored by Cigital and IEEE Security & Privacy. Gary and John discuss whether Wikileaks is a terrorist organization, if the use of a cyber-weapon like Stuxnet can be a morally justified act, and the implications of computational nanotechnology on cybersecurity.

A transcript of the episode can be found here: http://www.cigital.com/silverbullet/shows/silverbullet-058-jsavage.pdf

The podcast can be found here: http://www.cigital.com/silverbullet/shows/silverbullet-058.mp3

Eli Upfal Receives Faculty Research Grant from Yahoo! Research

Eli Upfal was awarded a research grant from Yahoo! for his research on "Rigorous and Efficient Statistical Tools for Large Data Sets."

This project focuses on developing rigorous statistical tools for processing and analyzing massive data sets. This work aims at enhancing and complementing the core experimental and heuristics work in machine learning and data mining. Rigorous statistical evaluation of discoveries is particularly important when analyzing relatively rare events in applications such as identifying system abnormalities, predicting system faults and fraud detection.

Sharp Labs Provides Grant to Andy van Dam and his Research Team

Sharp Laboratories of America has recently provided a grant and a just released commercial product, a 60 inch touch LCD display, to Andy van Dam and his research team to foster a collaboration in research on touch-enabled user interfaces. Brown's LADS application (Large Artwork Displayed on the Surface) designed to showcase such large format artworks as the enormous Garibaldi Panorama ran without any changes on this Windows 7 supported device. Work is underway to prototype a small-team collaboration scenario to take advantage of the Sharp interactive whiteboard. The scenario uses WorkTop, another application being developed in the group that focuses on the organization of knowledge work and provides an integrated environment for annotating and linking a variety of document types such as text, images, and video with fine-grained, bi-directional hyperlinks. The current version of WorkTop is being enhanced with touch-based gestures, digital ink and character recognition to allow input and manipulation by touch and marker at the white board.

Stan Zdonik and Ugur Cetintemel Receive NSF Grant to Develop Data Management System for Massive Scale Scientific Data

The National Science Foundation (NSF) awarded a grant, in the expected amount of $736,987, to Stan Zdonik and Ugur Cetintemel to conduct research towards building a scientific database (SciDB), a system designed and optimized to support data-driven scientific applications. The aim of SciDB is to do for science what relational databases did for the business world, namely to provide a high performance, commercial-quality and scalable data management system appropriate for many science domains.

In contrast to existing database systems, SciDB is based on a multidimensional array data model and includes multiple features specific to and critical for science: provenance, uncertainty, versions, time travel, science-specific operations, and in situ data processing. No existing system offers all these features in a general, highly scalable and usable engine. SciDB will thus significantly advance the state-of-the-art in data management in addition to supporting domain scientists in data-driven discovery.

This grant is part of a $2.4M Large NSF grant that also funds research teams in University of Washington, MIT, Portland State University and University of Wisconsin-Madison.

Andrew Ferguson Receives NDSEG Fellowship

PhD student Andrew Ferguson was recently selected for a National Defense Science and Engineering Graduate (NDSEG) Fellowship for his research in computer networks. He is advised by Rodrigo Fonseca. Andrew's proposed plan of research is to develop new methods for applications to collaboratively configure datacenter and enterprise networks. He is currently developing a technique for network traffic measurement using the IP Timestamps option, and presented initial results from the technique at the CoNEXT Student Workshop in November 2010.

NDSEG fellowships are highly competitive, with about 8% of the applicants receiving awards. They provide a stipend and full tuition and fees for three years.

PhD Students Michael Hughes and Layla Oesper Receive NSF Graduate Fellowships

Computer Science PhD students Michael Hughes and Layla Oesper recently received fellowships from the National Science Foundation's Graduate Research Fellowship Program, a prestigious and highly competitive program. In addition, two other PhD students, Andrew Ferguson and Brian Thomas, received honorable mentions.

Michael Hughes investigates machine learning algorithms for processing multimedia such as text documents and video clips. His research develops hierarchical Bayesian models for supervised tasks as well as inference procedures for these models via Markov Chain Monte Carlo methods. His current project attempts to automatically classify human activities such as running, eating, or answering the phone in short video clips from Hollywood movies. Mike conducts his research as part of the Learning, Inference, and Vision group advised by Erik Sudderth.

Layla Oesper designs algorithms to identify and analyze genetic variants associated with complex human diseases. Individuals are susceptible to particular diseases due to genetic variation in their genome. Identification of these causal genetic variants provides vital information for the development of new and more effective forms of treatment and prevention for these disorders. Layla presented recent work on "Reconstructing Cancer Genome Organization" at the RECOMB Satellite Workshop on Computational Cancer Biology in March 2011. She is a member of Ben Raphael's research group.

Andrew Ferguson received an honorable mention for his research in computer networks as discussed in the NDSEG Fellowship announcement above.

Brian Thomas's proposed research aims to facilitate user interaction with robots through dialog. He plans to explore the question of grounding verbs in robot actions, with consideration to the future scalability of the approach. Additionally, he plans to develop an interface which uses an expressive subset of natural language for this interaction. Brian is advised by Chad Jenkins.

The NSF Graduate Research Fellowships provide three years of support leading to research-based master's or doctoral degrees and are intended for individuals in the early stages of their graduate study in the fields of science, technology, engineering and mathematics. Awards are granted based on previous research experience, the proposed plan of research, and the student's ability to make a "broader impact" in their program of study in terms of educational, industrial, and societal relevance. NSF Fellows are expected to become experts who can contribute significantly to research, teaching, and innovations in science and engineering.

Since 1952, NSF has funded 43,000 Graduate Research Fellowships out of more than 500,000 applicants.

Brown University and National University of Singapore Launch Second Concurrent Degree Program

Brown University and the National University of Singapore (NUS) have established a concurrent degree program in computer science. Participants are selected from the top ten percent of NUS computer science concentrators and on completion of the program, will concurrently receive degrees from NUS and Brown: a bachelor's degree in computer science from NUS and a master's degree in computer science from Brown.

This new program follows up the concurrent computational biology degree program, the first concurrent degree launched by Brown and NUS, which awards students a bachelor's degree in computational biology from NUS and a master's degree in computer science with a special designation in computational biology from Brown.

Franco Preparata, who has been a visiting faculty at NUS for several years, is the main architect of both programs and will provide vision and leadership for them at Brown.

"We are pleased to expand our educational collaboration with a prestigious world-class institution and we look forward to welcoming to the department the first participants in the program," said Department Chair Roberto Tamassia.

Women in Computer Science Receive Funding from the National Center for Women & Information Technology

The department's Women in Computer Science (WiCS) group has been selected to receive a grant from the NCWIT Student Seed Funds. The WiCS work to increase the participation of women in computer science through social, mentoring, and outreach programs. The grant will be used to support these programs as well as new academic support, outreach, and scholarship programs that have been in the works for some time.

Four Undergrads Take First Place at First LinkedIn Intern HackDay

Dylan Field '13, Devin Finzer '13, David Trejo '13, and Evan Wallace '12 took first place at LinkedIn's First Intern HackDay with Rocks: a real-time, 3d, multiplayer, in-browser game similar to capture the flag with some impressive feats of WebGL and hardware acceleration. Congratulations!

http://www.youtube.com/watch?v=tfwrG1-Zke8

Yuri Malitsky's 3S Takes Gold Medal at 2011 SAT Competition

3S, the Satisfiability Solver Selector, has won seven medals at this year's SAT solver competition, including gold in the random generated instances and a gold medal in the hand crafted instance category. The competition was part of The International Conference on Theory and Applications of Satisfiability Testing (SAT).

The solver was the collaborative effort of Yuri Malitsky (currently PhD student at Brown), Ashish Sabharwal (IBM), Horst Samulowitz (IBM), and Meinolf Sellmann (IBM).

Maintaining the UTA Program

By: Tom Doeppner

It's not all that unlikely that if you are reading this article, you were at some point an undergraduate teaching assistant (UTA) in the CS department. It's been a vital part of the department since Andy van Dam started the program in 1965. Many of its alums have gone on to academic careers and have started similar programs at their new schools. In the spring of 2009 we checked and found that well over 60% of current concentrators had been a UTA at least once. We hear from many of our alums how much they value having been a UTA. We faculty members find the program essential. Each semester UTAs as a group are enthusiastic, hard-working, and amazingly competent.

I'd like to hear from those of you who have stories to tell about your UTA experiences; I'll put them together for a future Conduit article. However, the purpose of this article is not to give the history of our UTA program or to extol its virtues, but to discuss the events of the past two and a half years — these have been interesting times.

As we all know, there was a major economic crisis beginning in the fall of 2008. Brown certainly was not immune to it and the University, very sensibly, tightened up its finances. Part of this tightening was an April 2009 directive to our chair, Roberto Tamassia, to reduce the UTA budget by 40%. This would have devastated the program; it would have required major changes in how we teach many of our courses. Roberto was able to negotiate a compromise requiring only a 15% cut, which we implemented by reducing UTA numbers in advanced courses but keeping the numbers roughly constant in the introductory courses. However, despite the miserable economy, our introductory-course enrollments soared the following fall. Roberto found other funds to pay for additional UTAs. Though it was a bit of a stretch, we managed to keep the program

going at reasonable strength. Our enrollments in intro courses continued to soar last fall (2010) and, once again, Roberto found more money to pay for more UTAs.

It had been the department's 45+-year practice to treat UTAs essentially as professionals, just as we treat grad TAs. While a few UTAs may have occasionally grumbled about the time commitment, few, if any, went into it unwittingly.

In December 2009 the dark clouds began to gather. Brown's Internal Audit was reviewing Brown's compliance with the Fair Labor Standards Act (FLSA). Word was sent out that not only would undergraduate student workers have to be paid on an hourly basis, but that strict time-keeping was required. It seemed pretty clear that this would apply to our UTAs. Jane McIlmail (the CS department manager) and I met with the university's comptroller to discuss it in January 2010. He indicated that they hadn't reached a firm conclusion yet, so we were free to maintain the status quo for at least another semester. When it came time to hire UTAs for the fall semester, there still was no word, nor was there in mid-summer. Finally, shortly after the fall 2010 semester had started, a meeting was set up between me and not only the comptroller but the university's general counsel.

The point put across at this meeting was unambiguous: UTAs must be paid as hourly workers. What's more, they must be paid at least Brown's minimum wage, which was then $8.20 per hour. There are severe federal penalties for non-compliance. Thus we couldn't wait till the current semester was over. We had to put this into place immediately.

I tried to argue that our UTAs do the same work as graduate TAs in many departments: grad TAs are (legally) paid a stipend, so why not UTAs? The legal argument is that grad TAs are in training to become academics, TAing is part of their training, thus they benefit from the work at least as much as their students. But most of our UTAs do not intend to become academics and thus they are not being trained for their future jobs. (When some of our recent alums heard this argument, they explained what great training the TAing experience had been for their jobs in industry.) No argument I could muster would sway them. They were greatly concerned about putting the university at risk of federal prosecution.

We had always made it clear to UTAs that there's not a whole lot of money in it. You do it for the educational experience and for the satisfaction of helping fellow students. UTA pay used to range from $885/semester to $1400/semester. Under the new rules, assuming a 10-hour work week, a UTA working 15 weeks (a 14-week semester plus the exam period) at $8.20/hour would make $1230; a TA working 20-hour weeks would make $2460. While we think our UTAs are worth at least that, probably a lot more, we simply did not have the budget to pay them (we have 75 to 120 UTAs per semester).

So, Andy, Roberto, and I worked out a plan to get us through the semester. We would pay UTAs in most courses on an hourly basis, at $8.20/hour. However,

UTAs in a few courses typically worked well over ten hours per week. In these courses we decided to pay the students only for grading, which we felt (with reason) would be about ten hours per week. We would give them course credit for the remainder of their UTA hours. There was the minor issue that we were beyond the deadline for signing up for a course without penalty, but the Dean of College's office agreed to waive the penalty. This worked for most of the UTAs in these courses, but a few were already taking five courses, and Brown limits students to no more than five courses per semester. (These students exemplify the hard-working, high-achieving CS student: taking the maximum course load and TAing a very time-intensive course.) So these students received full hourly pay for the hours they put in.

We presented this plan to a meeting of all our UTAs. What seemed clear at the meeting was that no one was in favor of going to hourly wages — essentially all preferred the stipend system to being treated as mere employees. The students' biggest concern was whether we had pursued all possible arguments for staying with the stipend system. However, the change was unavoidable, and thus last fall (2010), starting on October 1, all UTAs had to record their hours. UTA time sheets were signed by their head TAs; head TA time sheets were signed by the meta-TAs; I signed the meta-TA time sheets.

There was, of course much discussion by our UTAs about all this. I think the following excerpt from email from one of our UTAs — Alexandra Schultz '11 — to many other UTAs gets to the heart of the matter:

"I think with all this talk about money and wages and hours it's easy to forget why we TA. It upsets me that we have to waste time thinking about and logging the number of hours we work, which in turn makes us think about how much we are paid for those hours, but we can't do anything about it. What upsets me much more is that we're thinking about it even more than we need to and casting blame and getting upset about something that is totally unimportant to me, although you are free to disagree. If Tom had said, 'The department had a huge budget cut, and we are trying to maintain the very expensive UTA program, but this means all your stipends will be halved,' I have no doubt that courses would get the same number of TA applications and life would go on as usual. TAing isn't about making money or placing some specific value on the hours and love you pour into a course. TAing is about making a course that changed your life just as amazing for the next generation of students. It's about showing a student close to tears how to solve a challenging problem by giving him/her the tools to tackle hard problems, and changing that student's experience in CS from feeling frustrated and stuck and lost and angry, to feeling inspired and happy and powerful because of CS. It's about being proud of your students and watching them do brilliant work and feeling amazing because you were a part of that."

Later that semester, Andy, Roberto, and I met with the Dean of the College, Katherine Bergeron, and Associate Provost Rod Beresford about the problem. They suggested the possibility of creating a teaching-fellow (TF) position, modeled somewhat on the existing writing-fellow position, which would be paid by stipend. Though a lot of details would have to be worked out, this seemed a good idea to us. Writing fellows are required to take a semester's worth of training before they could become a fellow. Thus we would have to come up with some sort of training program for TFs.

The next day the three of worked out a plan for the following semester and presented it to the students. It was actually two plans, A and B. Plan A was that students with at least one semester of TA experience would be hired as TFs. New TAs would be hired as hourly employees. We also had a plan B, just in case the teaching-fellow position didn't get approved: that all TAs would be paid hourly, but that individual TAs could elect to do the TA work for course credit and not get paid. There was no movement on getting approval of the teaching-fellow position, so we went through the spring 2011 semester with plan B.

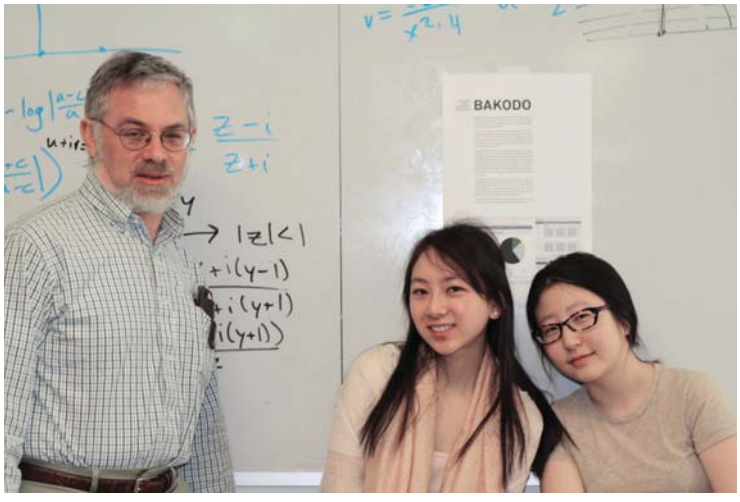
Early in the summer we met again with people from the Dean of the College's office, the Provost's office, and the General Counsel's office. They tried to work with us on a rationale for some version of the TF idea, but our conclusion was it simply couldn't be done. It really was imperative that we pay TAs as hourly workers. However, they did endorse our plan B (now amended to start at $8.45/hour, as Brown raised its minimum wage).

So, as of this fall semester, most of our TAs are being paid hourly, though some are TAing for course credit. (And our enrollments are soaring again!) We've created two new courses for which TAs may register if they choose to TA for credit — CSCI 81 (full credit) and CSCI 82 (half credit). They may TA for course credit for a maximum of two credits over their time at Brown.

While we don't view this solution as ideal, it is workable. Our invaluable (and almost 50-year-old) UTA program now passes legal scrutiny and can continue.

Creating Modern Web Applications

By: Steve Reiss



The spring of 2011 saw the introduction of a new course in computer science, CSCI1320, Creating Modern Web Applications, that taught a combination of user interfaces, web programming, web design, and software engineering. The course attempted to reach a variety of students interested in web applications and introduce them to the real world of software development.

The course was designed to attract two types of students. The first was Computer Science majors that had previously taken CSCI0320 and wanted to learn how to apply their programming skills to web applications. The second were students with a background in web design who were interested in learning how to extend design techniques to incorporate the technologies needed in modern web applications.

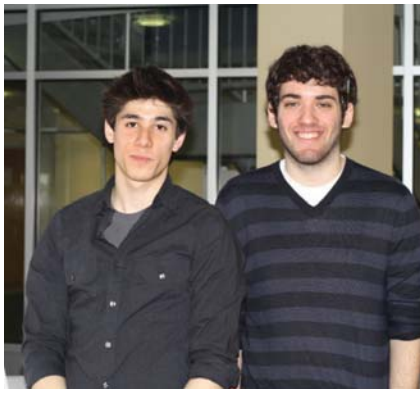
The course covered a large number of topics relevant to web applications including software engineering (requirements, specifications, testing, team development, working with clients), design (page design, site design, server design), front-end implementation (JavaScript, HTML5, animation), server implementation (PHP, frameworks such as Django and Ruby), back-end implementations (databases, cloud computing, distributed processing), and issues such as security, privacy, accessibility and internationalization. Students were required to complete assignments on html, animation, php, and security.

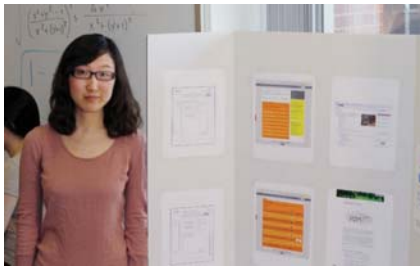
The course, however, was centered on real-world applications. Before the course began, we solicited clients who wanted web applications built from a variety of sources including the Brown entrepreneurial program, local charities, other departments, and local industries. At the start of the course we asked students about their backgrounds and interests and then we formed mixed teams of approximately four students each, attempting to ensure that each team included both strong designers and strong programmers. Teams then had to select one of the projects and spent the semester working with their client building the targeted application.

The students had to present their initial design, describe the feedback they got from their clients, and generally provide periodic reports on their progress. In addition, we had a poster day where each team presented a poster describing their project and the class and anyone else was welcome to walk around, view the posters, and ask questions. Finally, we had a day of final presentations where each team got to present their working application and relate their experiences.

The projects were quite varied, and included blog support for the BDH; an application for finding off-campus housing; crowd-sourced writing correction; a campus dating site; a social network for musicians at Brown; a theater reservation system; a textbook exchange service; a site for NBA math hoops, a learning tool for inner city youth; a web site for a non-profit addressing water problems in urban India; and a personal inventory and shopping system.

We are planning to teach the course again this spring and would be interested in any one who would like to propose and sponsor a client group with an interesting and practical web application.





Next Generation Database Systems @ Brown CS

By: The Database Management Group [database.cs.brown.edu]

Starting with the requirements of business data processing, the design of database management systems (DBMSs) have been traditionally guided by the need to ensure consistency and persistence of structured, scalar data in the presence of short-lived data processing tasks with hard integrity requirements. While this design has served business applications well for more than two decades, many data-intensive applications that recently emerged have different goals and requirements, and are thus not satisfactorily supported by this prevailing database model.

The past decade has seen various proposals for new DBMSs designed to better meet the demands of various new application domains, such as web databases and scientific computing, while taking advantage of the advances in hardware platforms. The rest of the article discusses primary examples of these new DBMS breeds and how Brown researchers and alumni are contributing to these efforts.

NoSQL Systems

The advent of affordable, shared-nothing computing systems portends a new class of parallel DBMSs for web applications. The difficulty of scaling front-end applications is well known for workload-intensive DBMSs. One approach to this problem employed by many web-based companies is to shard the data and workload across a large number of commodity, shared nothing servers using a cost-effective, parallel DBMS. Many of these companies have adopted various new DBMSs, colloquially referred to as *NoSQL* systems, that give up certain guarantees provided by traditional databases (e.g., atomicity) in favor of availability and scalability. This approach is desirable if the consistency requirements of the data is "soft" (e.g., status updates on a social networking site that do not need to be immediately propagated throughout the application).

One notable NoSQL DBMS is MongoDB from 10Gen, a New York City-based start-up co-founded by Brown alum Eliot Horowitz'03. MongoDB is an open source, document-oriented (i.e., JSON) DBMS that is increasingly popular with both large and small companies, and is noted particularly for its ease of use and scalability. Notable users of MongoDB include Craigslist, The New York Times, FourSquare, and Shutterfly.

The performance of NoSQL systems like MongoDB is predicated on the existence of an optimal database design that is tailored for the unique characteristics of the workloads and cloud computing environments. Such a design defines how an application's data and workload is sharded across nodes in a cluster. The choice of one design over another determines the number of operations that can execute to completion on just a single node without needing to communicate with other nodes, as well as how evenly work is distributed across nodes. Hence, without a proper design, a NoSQL DBMS running on multiple nodes will perform no better than a single-node system.

The Brown Data Management Group are working with 10Gen to research new methods to improve the performance of MongoDB. The Brown alumni love fest includes 10Gen engineers Spencer Brody'10 and Dan Pasette'95 MS'96, while the student group includes graduate students Andrew Pavlo PhD'25 and Christopher Keith MS'13, and undergraduates Andrew Scheff'13 and Emanuel Buzek'13. This team is developing an automatic database design tool that analyzes an existing MySQL or MongoDB application, and then automatically generates an optimal configuration tailored to that application and improves the application's performance on MongoDB.

NewSQL Systems

Many enterprise systems that handle high-profile data (e.g., financial and order processing systems) also need to be able to scale but are unable to use NoSQL solutions because they cannot give up strong transactional and consistency requirements. The only options previously available for these organizations were to either purchase a more powerful single-node machine or develop custom middleware that distributes queries over traditional DBMS nodes. Both approaches are prohibitively expensive and thus are not an option for many.

As an alternative to NoSQL and custom deployments, a new emerging class of parallel DBMSs, called NewSQL, are designed to take advantage of the partitionable workloads of enterprise applications to achieve scalability without sacrificing ACID guarantees. The applications targeted by these *NewSQL* systems are characterized as having a large number of transactions that (i) are short-lived (i.e., no user stalls), (ii) touch a small subset of data using index look-ups (i.e., no full table scans or large distributed joins), and (iii) are repetitive (i.e., executing the same queries with different inputs). Such transactions in enterprise applications are also typically executed as pre-defined transaction templates or stored procedures in order to reduce DBMS overhead.

The first NewSQL system, called H-Store[hstore.cs.brown.edu], is being developed as a joint project between the Brown Data Management Group, MIT, and Yale. Under the direction of the Prof. Stan Zdonik and Andrew Pavlo PhD'25, Brown has been leading the development of the H-Store project for the last three years. The H-Store design is also being commercialized into the open-source database VoltDB.

Unlike a traditional database, such as MySQL or Oracle, H-Store stores all of its data in main memory across multiple machines, allowing it to achieve very high-throughput for transactional workloads. But exploiting this novel operating paradigm is non-trivial for many applications; certain information must be known before the DBMS begins executing some piece of work. Hence, the Brown group is developing new algorithms and techniques to overcome this barrier and make it easier for administrators to use NewSQL systems. Like a pack of dogs fighting over the contents of the dumpster behind Gordito Burrito, Zdonik and Pavlo's research has been relentless at improving H-Store's performance on cloud-based systems, such as Amazon EC2, through intelligent data partitioning and placement. With the help of undergraduate Charles Lee'12, the duo are also working optimizing H-Store to execute on a next generation "many-core" processor prototype provided to Brown from Intel.

Scientific Databases

Research and innovation in many parts of science have become a data-driven endeavour. As scientific data have gone from scarce to superabundant with data generation rates doubling yearly, scientists now spend increasingly more time and effort managing their data than doing real science.

A major part of the problem is the lack of re-usable, effective tools for data storage and processing. Scientific data management has traditionally been performed using low-level file-based solutions, at best using files structured according to a low-level data format. Higher-level data management infrastructures developed so far have been mostly task-specific and thus non-reusable in different domains, resulting in significant duplicated implementation effort by scientists.

In order to improve this poor state of affairs, several scientific DBMSs projects are currently underway to address the inherent limitations of conventional relational DBMSs when applied to scientific data and applications. One major effort is SciDB#, an open-source DBMS designed and optimized for scientific applications. The overarching goal of SciDB is to do for science what relational databases did for the business world, namely to provide a high performance, commercial quality and scalable DBMS appropriate for many science domains.

In contrast to a conventional DBMS that uses relations to represent its data, SciDB is based on a multidimensional array data model. In addition, SciDB includes multiple features specific to and critical for science: these include (i) automatic provenance tracking and querying, (ii) support for uncertain data storage and processing, (iii) automatic versioning, (iv) native support for science-specific operations (such as matrix multiplication), and (v) in situ data processing. Currently, no existing system offers these features in a single, highly scalable engine, requiring scientists to spend a lot of time and effort rolling their own solutions through low-level custom coding.

The Brown Data Management Group has been helping make SciDB a reality, in collaboration with colleagues from MIT, Portland State, University of Washington, and University of Wisconsin. This extended group has been working together for the last three years and recently received a large NSF grant to fund their research on scientific data management.

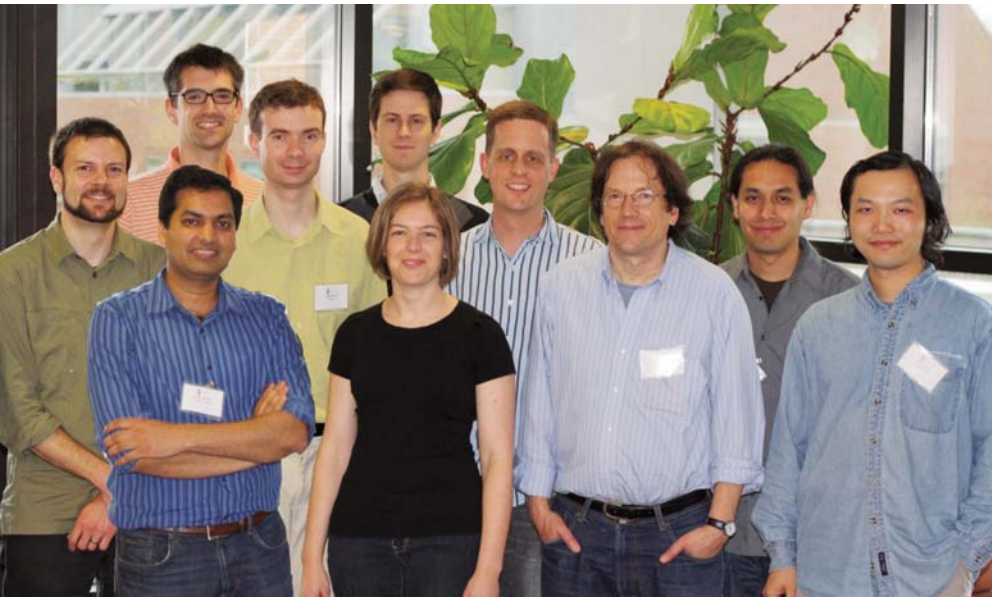
The Brown team's current focus is on providing support for interactive data analysis and exploration, especially in the presence of very large underlying data sets. To this end, the team has been working on a number of complementary research threads to simplify and speed up data-driven exploration, while enhancing the overall user experience through personalization and automation.

One such thread involves user and workload modeling: PhD student Justin DeBrabant (PhD'16) has been applying learning and mining algorithms to build predictive user-database interaction models that facilitate query recommendations and optimizations such as pre-fetching and pre-computation. Alex Kalinin PhD'16, another graduate student, has been working on goal-oriented data exploration interfaces to allow users to characterize the type of answer they are looking for without precise query specifications. On a related effort, undergraduate Joe Shapiro'13 spent last summer developing a visual front-end for SciDB, which highlighted a number of open research challenges regarding the visual display and manipulation of large data sets. On the automation front, PhD student Jennie Duggan PhD'12 has been developing advanced techniques for for automatically finding the best data representation and compression formats for large evolving scientific data sets.

Spring Symposium: Visual Computing

By: James Hays & Erik Sudderth

On April 28, 2011, the Brown University Department of Computer Science held the latest in its long-running series of Industrial Partners Program (IPP) symposia. The focus was visual computing, and in particular an in-depth exploration of recent developments in computer vision, graphics, and imaging. The program brought together experts from industry and academia to discuss how data-driven visual learning is improving recognition and scene understanding, and how this helps us synthesize and interact with visual media.



Left to Right: Lawrence Zitnick, Sanjiv Kumar, Andrew Gallagher, Sylvain Paris, James Hays, Caroline Pantofaru, Erik Sudderth, Bill Freeman, Bryan Russell, Xianfeng Ren.

Computational vision and graphics has a long and active history at Brown. Currently there are over a dozen faculty in these areas from the Department of Computer Science; the Division of Applied Mathematics; the Department of Cognitive, Linguistic, and Psychological Sciences; and the School of Engineering. Related studies of human vision and perception are carried out within Brown's Center for Vision Research, and the Brown Institute for Brain Science. A crowd of over seventy attendees included a diverse cross-section of the Brown community, partners from a wide range of companies, and academic visitors from such places as MIT, Harvard, UC Berkeley, and the Toyota Technological Institute (TTI) at Chicago.

INNOVATIONS IN VISUAL COMPUTING

The wide range of industrial applications for visual computing is best illustrated via some examples.

Andrew Gallagher, from Kodak Research, discussed "The Loop: People and computer vision." Humans interpret photos based not just on what we see, but also using a lifetime of experience interacting with other people. Gallagher proposed contextual features for capturing human relationships in recognition algorithms, and also illustrated fascinating patterns of human behavior mined from large photo collections. A complementary investigation by Google's Sanjiv Kumar explored the low-dimensional non-linear structure, or manifold, of human facial appearance. Although computational innovations allowed analysis of extremely large datasets, it turns out that even Google doesn't have enough images to densely sample the space of possible pictures of faces.

Turning to a wider range of object categories, the University of Washington's Bryan Russell discussed "LabelMe: Online image annotation and applications." Their interactive website has become a standard tool that computer vision practitioners use to collect detailed, polygonal annotations of objects (e.g., cars, pedestrians, buildings) in complex natural scenes. By crowd-sourcing this annotation process to interested contributors across the globe, their platform accelerates the collection of training data for statistical learning, and even allows some 3D scene structure to be reconstructed. Microsoft's Lawrence Zitnick described related efforts as "Helping each other to see: Humans and machines." By assessing human performance at sub-tasks in widely used object recognition pipelines, they can effectively isolate the weakest links in existing systems. In a more artistic vein, Zitnick's collaborators also developed an interactive system which recognizes objects in partial sketches and suggests completions, effectively teaching users to draw.

Photography was the focus of two talks. Bill Freeman of MIT discussed "Photographing events over time." Freeman highlighted photographic techniques for capturing events at dramatically different time scales – from picoseconds to centuries. At long timescales, computational methods are often required to create meaningful images out of noisy inputs. For instance, Freeman's work on "motion denoising" generates time-lapse videos by intelligently counteracting high frequency motions. Adobe's Sylvain Paris talked about "Learning to adjust photographs." Photographers often manipulate their shots to improve aesthetics, but this adjustment requires expertise and artistry. Sylvain and colleagues create methods to perform such manipulations automatically by learning from the first database of expert artist manipulations.

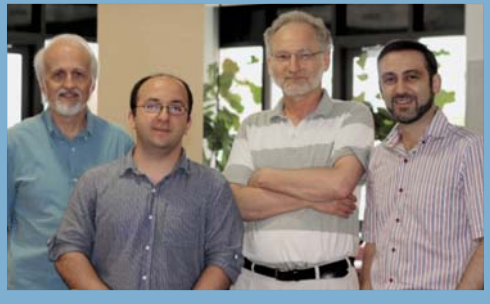
Beyond traditional photography, Intel Research's Xiaofeng Ren presented "RGB-D perception: Depth camera usages beyond gesture and gaming." Depth cameras are suddenly cheap and widespread thanks to Microsoft's Kinect. Ren demonstrated how this depth information can improve the state-of-the-art in 3d reconstruction and object recognition. In "Perception for robotics," Willow Garage's Caroline Pantofaru demonstrated the value of computer vision for robotic platforms, and in particular the PR2 robot which operates in human environments. Understanding the locations, actions, and intentions of humans in its proximity will allow a robot to more successfully interact with the world.

OUTLOOK

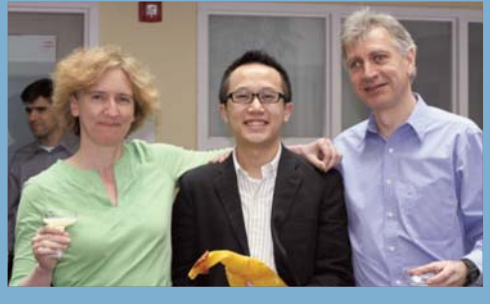
The dominant (and unexpected!) theme which emerged from these eight excellent presentations was the human-centric nature of the research. Nearly every talk focused on modeling the tendencies, preferences, or appearances of humans. Humans are also the focus of recent crowdsourcing efforts, such as Russell's LabelMe annotation platform and Zitnick's interactive debugging. Statistical learning algorithms provide new and scalable methods for handling the "big data" produced by these efforts, opening new horizons for visual computing.

Recent PhDs

Jie Mao



Mert Akdere



Yue Kwen Justin Yip

C. Chris Erway

Charalampos Papamanthou

Parenthetically Speaking

By: Shriram Krishnamurthi

In February 2011, the CDC conducted a national Risk Factors survey in collaboration with the states, including Rhode Island:

http://cdc.gov/brfss/

Our household has been chosen at random to participate, so we were called to take the survey. Of course, anyone who is trying to phish for data would be wise to use this time to make calls masquerading as a survey information collector. Take a look at the questions that are on this survey:

http://cdc.gov/brfss/questionnaires/pdf-ques/2010brfss.pdf

This would be a gold mine in the wrong hands.

I therefore told the caller that I'd like to make sure I am speaking to a legitimate agent. His response was, "Oh, don't worry, we code the answers so they are not identifiable", which indicated that he had misunderstood my concern. Once I explained it more clearly, he told me that I could call the agency that employs him to verify.

I called the number, which is for ICF Macro, a telephone survey company. Interestingly, searching for "ICF Macro" and the provided number did not yield any authoritative Google hits (such as a page on their own site that listed the number), which meant I could, in principle be calling *anyone*. A very helpful operator took my call, understood my question, and attempted to provide me with information.

First, she directed me to the CDC site mentioned above. I asked here where on the site to look, and she indicated the FAQ:

http://cdc.gov/brfss/faqs.htm

Unfortunately, this company is not listed on that page. She said, "Well, I know we were listed three years ago, and I really can't tell you why we're not there!" She laughed, given this unfortunate turn in her attempt to validate her company.

At the bottom of that FAQ is this q&a:

> **I have other questions. Whom should I ask?**
>
> All questions should be directed to your BRFSS state coordinator. Up-to-date contact information can be found on the BRFSS State Coordinator list.

This includes a link to:

http://apps.nccd.cdc.gov/BRFSSCoordinators/coordinator.asp

The entry for Rhode Island pointed to:

http://www.health.ri.gov/chic/statistics/brfss.php

which (you've guessed by now) produced a 404 error. (They've since fixed the link, perhaps because I passed this information on to John Savage, who conveyed it to our state congressional representative staffers.)

Meanwhile we were still on the phone. The lady now laughed harder and put me on hold, and eventually gave me the name of an employee of their company, "Piper", who lives in Burlington, VT, and, I was told, would answer a 802-area (Burlington, VT) number the next afternoon. I was told Piper could give me the company's OMB number.

I pointed out that I could be calling just anyone, and simply having an OMB number in hand didn't actually mean much. She agreed. I said that one way people validate callers is to call them back, but when I'd asked the original surveyor where I could call back to take the survey, he had said that was not possible. She said that information was absolutely incorrect, and gave me a number I could call, and that she would inform my surveyor that he was wrong.

Since I had her on the line, I explained that having a callback number was great but it still didn't address my original issue, because I had no way of knowing who that number was connected to. I had googled the number as we spoke, and got only eight hits, all to strange websites. It was not, for instance, giving me a hit on their own corporate website. She admitted that they had acquired this number only in January 2011, and had been slow to update their information...as a result, I was right and the number could not, in fact, be validated. She and I were both finding this quite funny by this point.

In short, after expending a good chunk of an evening, I was still unable to obtain any kind of credible validation for a survey that is meant to ask extremely personal information.

I also spent a few minutes on the RI DoH site. Traversing up from that broken link did not yield anything. But when you get to the top-level page, one of the most prominent links is to this:

http://www.ri.gov/press/view/12796

Press Releases

HEALTH Warns Restaurants of Phone Scam

The Rhode Island Department of Health (HEALTH) has received reports that several restaurants throughout the state have received telephone calls from someone stating he or she is from the Department of Health. The caller often is requesting personal information so an inspection can be scheduled. The information being requested could be used for identity theft. These phone calls are a scam.

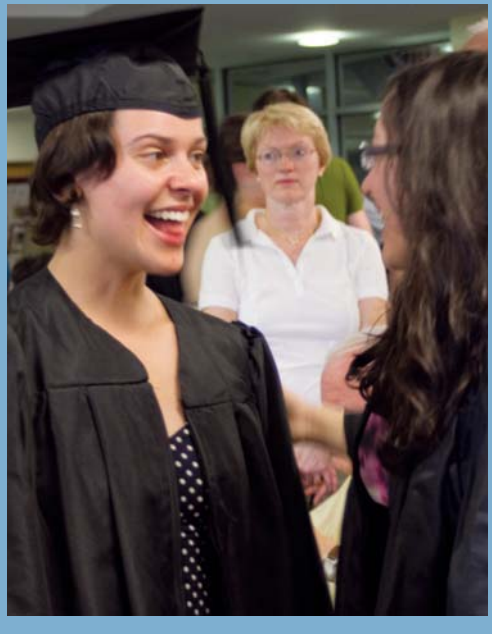
Oh, the irony, the irony!

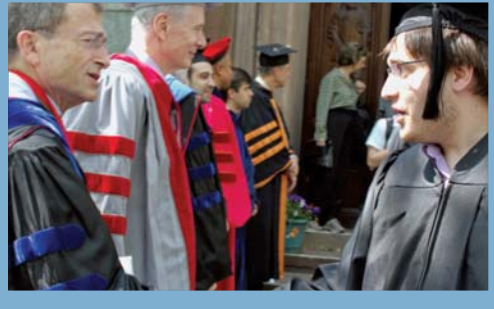
The state has a compelling interest in making sure people are not victims of identity theft. The period of an intrusive survey would be the ideal time for a data thief to strike. I was surprised that there was no attempt at, say, two-factor authentication at least on demand. There does not seem to have been any attempt to think about identity theft concerns at all (notice that the CDC's FAQ is entirely silent on this point). And when someone does probe the system, like I did, the result is farcical—I can only feel *less* confident now than when I began.

Commencement

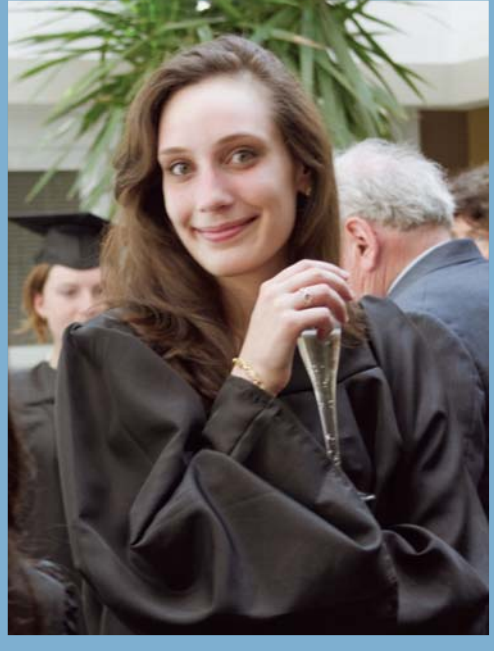













Don Engel, ScM 2001

Don Engel, (also Math-Physics ScB 2000) was recently married Marianne and we have purchased our first home in Baltimore. He Started as Assistant Vice President for Research at the University of Maryland, Baltimore County at the end of March. He can be reached at donengel at gmail.

Hilary Mason

Grad alum Hilary Mason has been in the news quite a bit in recent months. She is the Chief Scientist at bitly where she spends her days playing with data. Her work crosses pure research, math, and development of product-focused systems. She's also a co-founder of HackNY, a non-profit organization that connects talented student hackers from around the world with startups in NYC.

She was recently listed in Fortune Magazine's 40 Under 40: Ones to Watch and featured in Glamour Magazine's article, "Women in Tech: We Really Do Need More!"

Dan Spinosa '05 (Founder & CTO), Reece Pacheco (Founder & CEO) & Mark Johnson '05 Launch Shelby.tv to the public at http://shelby.tv

(reprinted from Huffington Post)

Shelby.tv is a one-stop-shop for all your online video pleasures. The service pulls in video links from your Twitter and Facebook to create a customized channel filled with videos your friends think are worth watching.

"There are three major problems," said Reece Pacheco, CEO of Shelby.tv, of online video. "Discovery sucks, the community sucks and we wanted to timeshift to watch whenever we wanted."

While many people are inundated with a steady flow of video sharing throughout the day, most don't actually have the opportunity to watch everything they get, or the patience to sort through it later. Moreover, the world of online video tends to be fragmented, with users going to YouTube to watch a video at a time. Shelby.tv's goal is to make it less difficult to enjoy online video.

"You should be able to turn on your computer like a TV and be able to watch something right away," said Pacheco.

As for community, well, if you've been on the video page for Rebecca Black's "Friday" recently, you'll know YouTube members tend not to be the most welcoming sector of the online world.

How it works: To use Shelby.tv, people authorize Twitter or Facebook, and a stream analyzer goes through and picks out the links with video in them to pull in to Shelby's site, so that users can watch all their videos in one centralized location. Note: these links need to be direct links to a video service like YouTube or Vimeo; the stream analyzer won't pick up an embedded video on Tumblr.

"That's our whole thesis: you watch video because your friend tells you to," said Pacheco. "I don't go to YouTube and hang out and surf for video. My friend sends me and then maybe I stick around. A lot of content consumption is socially driven."

Shelby users can then re-tweet links directly from the site (or share them elsewhere), which uses Shelby's URL shortener so that non-users who encounter the links will be pulled onto the site. Why you'd use it: Do you really need a reason to procrastinate more efficiently? With Shelby, you won't miss that YouTube video of a cat riding a turtle just because it's buried in the depths of your social network.

"I'd sit down with a bowl of cereal and say, 'I know there's video somewhere in my network, but where is it?" said Pacheco. "I'd log into Facebook and be digging through a thousand updates."

But Shelby's social channels, customized by content that your friends recommend, means that watching video online is nothing more complicated than going to one website.

"I turn it on and it's on right away," said Pacheco. "It's like TV - it's on – it may not be the right thing, but it's on. The computer is replacing TV in some sense."

In the future, Shelby could also include a learning component that will record and make use of your interests to create a better stream, noticing, for example, which friends' videos you skip, and which you always watch through. For now though, Shelby believes less is more.

"We want to do what's right for the user experience," said Pacheco. "We really believe in simple, and doing less. We want to build the simplest possible solution because we think that's going to win this space."

Guy Eddon, PhD

Guy Eddon PhD

My six years at the computer science department were formative. I learned about academia, research, and myself. Prof. Herlihy, who helped shepherd my dissertation to completion, was generous with his time and intellectual curiosity while still adhering to rigorous scientific standards. After graduating from Brown (and completing a law degree at Fordham), I moved to Houston to clerk for U.S. District Judge Melinda Harmon.

As a law clerk, I draft opinions and orders, and write bench memos in advance of hearings. Federal judges hear both civil and criminal cases, so there's always something interesting happening I even had the opportunity to see a few good jury trials, like the case of the cop who held up a bank. And by virtue of its location, Houston has lots of immigration and oil cases. Perhaps unexpectedly, I find the skills developed in grad school apply considerably to my work as a lawyer.

This fall I joined the New York office of Quinn Emanuel Urquhart & Sullivan, LLP, a litigation firm with a significant intellectual property practice. While it hasn't been quite the path I envisioned, going to Brown was one of the best things I ever did.

CS Reunion

Andy van Dam with Michael Marcil '76

Michael Shim '07, Caitlyn Shim '06, Eric Tamura '06, Bill Pijewski'07

Ashley Tuccero '11, Alex Unger '11

Roberto Tamassia with Paul Howard, PhD'93

Greg Cooper PhD '07, Ugur Cetintemel, Rodrigo Fonseca

Sam Ocko '09, James Stout '09

Paul Anagno-Stopoulas '74, Bill Rothman '73

Adam Cath, Adam Leventhal

Trina Avery, Tom Doeppner, Brian Cantrill '96, Shamsi Moussai ScM'94

Department of Computer Science
Brown University
Box 1910
Providence, RI 02912
USA

Industrial Partners Program

The IPP provides a formal mechanism for interactions between companies and students in the CS Department. Member companies benefit from superior visibility in the Department, exclusive access to event/interview space in the CIT Building and assistance with recruiting events; students benefit from specific information about opportunities for summer internships and permanent employment.

The department wishes to thank our Industrial Partners for their support:

Premier Partner

Adobe

Affiliates

Facebook
Google
GTECH
Jane Street Capital
Microsoft
NABsys, Inc.
Oracle
TripAdvisor
VMware

Start Ups

Cloudera
Delphix
DropBox
Mozilla
NING
Vertica Systems Inc.

Individuals

Paul Edelman,
Edelman & Associates

Computer Science at Brown University

For more information about the Industrial Partners Program, contact:

Amy Tarbox
Program Manager
Tel: (401) 863-7610
abt@cs.brown.edu

Ugur Cetintemel
Professor and IPP Director
Tel: (401) 863-7600
ugur@cs.brown.edu

To learn more about the IPP visit:
http://www.cs.brown.edu/industry

Connect with the CS Department:

Join the 'Brown University Computer Science' group on Facebook.

Regional Groups:

Brown CS in Boston
Brown CS in Seattle
Brown CS in SF Bay Area
Brown CS in NYC
Brown CS in LA/Southern California

LinkedIn
Computer Science at Brown University

Ping!

Where are you and what are you doing?

Let us know what's happening in your life! New job? Received an award? Recently engaged or married? Submit your news by email conduit@cs.brown.edu, or by mail to:

Conduit
Department of Computer Science
Brown University
Box 1910
Providence, RI 02912