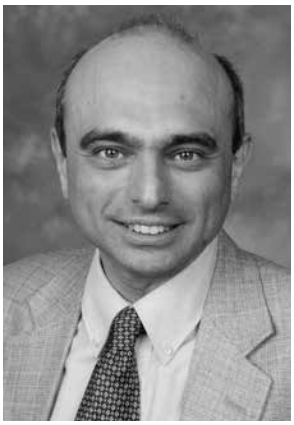
Conduit

A RESEARCH AND ALUMNI NEWS MAGAZINE
Department of Computer Science, Brown University // Vol. 23 No. 1

Our First Hackathon

+ Algorithms Find Genetic Cancer Networks
+ BrownCS 35th Anniversary Timeline
+ Keep Artemis Running Strong

Roberto Tamassia Steps Down As BrownCS Department Chair



Roberto Tamassia is stepping down. At the end of his seven-year tenure as BrownCS Department Chair (two terms, plus a transitional year as Professor Ugur Cetintemel prepares to take on the role), he takes a moment to look back on the years past from his office on the fourth floor of the Center for Information Technology.

A look around Roberto's habitat reveals little: a vintage Macintosh, orderly shelves displaying copies of his books and translations, an uncluttered desk, an ergonomic computer cart with a large display, a whiteboard filled with formulas and diagrams, the sparseness and simplicity that mark a number of the offices in the building. The lack of décor invites a stereotype: the computer scientist with only one foot in the world, preferring to deal with abstractions, with ones and zeroes. But interviews with Roberto and numerous colleagues demonstrate the exact opposite. They reveal a man who hasn't sought attention, but has worked in concert with his colleagues with subtlety and rare skill, achieving impressive results.

"Now that I've worked closely with him," says Ugur Cetintemel, "I see how Roberto thinks. He works with people, he doesn't make knee-jerk decisions. And he's able to create pragmatic, balanced solutions because he considers all the dimensions, the subtleties and complexities of a problem."

Asked to look back to the beginning of his first term, Roberto modestly explains that many things were the same then as they are now. "We've had great faculty and staff members throughout. Professors and students are doing high-impact work and they believe in the importance of research and education and their synergy. As I stepped into the position," Roberto reminisces, "I felt very grateful to the past Chairs, Andy van Dam, John Savage, Eugene Charniak, Tom Dean, and Eli Upfal, who had built an outstanding department with a strong culture of collegiality."

However, one area that has seen considerable change is recruitment: Roberto notes with pride that one-third of the existing faculty has been hired during his time as Department Chair. In each case, the process was protracted, intense, and challenging. "For instance," explains Roberto, "we first need to decide collegially which areas we hire in. Then, do we hire established senior faculty or junior faculty who will grow with the Department? Recruiting was always one of my highest priorities."

"Roberto put us on a much more professional setting," explains Professor John Savage. "He persuaded the Administration to provide space for faculty expansion, and most importantly, led the effort not only to make terrific new faculty hires but also to retain outstanding colleagues who were the targets of external offers."

Professor Andy van Dam highlights the interpersonal skills that served Roberto well in recruiting as well as other areas: "He very capably steered us through another period of expansion and growth in all dimensions. Roberto deserves high marks for statesmanship, for keeping his various strong-minded constituents together." This cohesion is a source of real pride for Roberto, who says, "I always try to listen. I ask people: how can you be successful at Brown? And that includes our students. We need collective vision, a long conversation."

Professional recognition is part of this. Roberto notes that he personally nominated four of the five junior faculty members who have received Sloan Research Fellowships. "This means visibility," he says. "Verification of our success. It shows the promise of our faculty and the Department."

"The most important thing," Ugur Cetintemel emphasizes, "is how Roberto deals with people. He's always taken the attitude that we have the best people, and it shows when he speaks. He builds a rapport, he's very credible. He's done remarkably well."

Ugur also mentions Roberto's decision to form an Executive Committee that has served as a sounding board for important decisions and allowed the Department Chair to delegate some of the effort needed for new projects. Many colleagues find this ability to collaborate to be one of Roberto's greatest strengths. Andy van Dam comments: "He helped the Department help itself. As a credit to Roberto's diplomatic skills, many efforts were made on the faculty's behalf that we weren't even aware of. That's a feature, not a bug."

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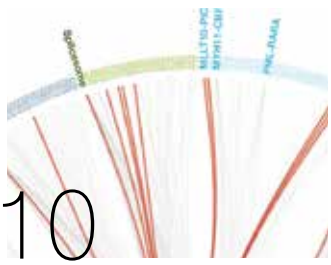

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BROWN

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BUILD SOMETHING AMAZING TOGETHER:

Hack@Brown, Our First Annual Hackathon

PART 1: SO, WHY HACKATHONS?

No matter your skills, interests, or experience, the website says, *there's something to build.*

Almost four months ago, on January 24 and 25, BrownCS held Hack@Brown, the university's first annual hackathon. The event was organized by Molly Long '15 and Mackenzie Clark '14 and a host of student volunteers, sponsored by twenty different companies and organizations, and attended by more than two hundred and fifty people.

So, what's a hackathon?

"At the most basic level," Mackenzie says, "it's an event where programmers and other people get together to create software in a limited period of time."

The story of Hack@Brown begins when Molly and Mackenzie attend their first hackathon: the University Hacker Olympics (UHO), hosted in San Francisco in September of 2013 and described as the "most epic Collegiate Hackathon on the planet." At first, they're daunted by some of the recruiting rhetoric and the prospect of staying up all night programming. However, once they get there, they thrive on the collaborative synergy and excitement from all the other students.

"IT'S AN EVENT WHERE PROGRAMMERS AND OTHER PEOPLE GET TOGETHER TO **CREATE SOFTWARE IN A LIMITED PERIOD OF TIME.**"

In the airport security line on the way back to Providence, Molly and Mackenzie resolve to bring their experience back to Brown. But as the two women set out to create a hackathon of their own, they have something very different in mind.

"We wanted to lose the intimidation factor," Mackenzie says, "and have it be about collaboration, with no barrier to people who don't know how to code. To just let people build something amazing together. Inclusion was the thing we wanted most." Their hope was to make their hackathon much more welcoming for women and minorities who often doubt their abilities to participate in such an event.

PART 2: SPONTANEOUS SOCIAL NETWORKS

The two women quickly start to assemble a core group of organizers that amounts to about a dozen students, then begin scouting out possible locations on campus. Mackenzie lobbies for the spacious Alumnae Hall and is soon running around the building, counting power outlets to make sure that everyone will be able to power their equipment.

Soon after, they go to Department Chair Roberto Tamassia, Professor and Director of the Industrial Partners Program Ugur Cetintemel (Molly and Mackenzie credit him for his ongoing contributions to their decision-making process and numerous practical suggestions, particularly in the area of fundraising), and Faculty and Student Affairs Manager Lauren Clarke.

"We originally started talking in October," Lauren explains, "but by the time they settled on a date in January, we warned them that Mother Nature could get in the way. We were cautious, but I wouldn't say we were really worried about the weather. Actually, we were more nervous about the funding!"

Typically, hackathons are bankrolled by venture capitalists and technology companies that use the events for recruiting purposes. "We didn't want a huge cash prize," Mackenzie explains. "Making things is what matters, not the prizes, but we knew we still needed a sizeable budget to cover everything from food to security to transportation. We looked at other hackathons then created a fundraising plan to get there."

"There was very little time," says Tamassia, "but we told them to go ahead. We knew the funding would come and that we would make up the difference if necessary."

Their goal is to raise $25,000 by December 21, the end of finals.

The core team goes straight to work, holding an informational meeting that fills the Lubrano Conference Room. "There were a lot of skeptical questions!" Molly admits, particularly from people who

had attended hackathons in the past. But students and even alums help by rallying their social networks, assembling a Google Doc that lists more than a hundred potential donors who have a personal connection to BrownCS, to the university, or to a Hack@Brown organizer.

E-mails soliciting donations are drafted, revised, and sent. Successful lobbying of President Christina Paxson's administrative assistant wins Molly and Mackenzie fifteen minutes with the President herself, who provides additional funds. "She was excited," Mackenzie remembers. "And we were thrilled!"

They're also successful. By the end of finals, they've surpassed their fundraising goal.

PART 3: REALLY, WE ALL DID

What enables that success is the joint effort of more than a dozen students working steadily through winter break, supported by legions of their peers. A social media team has been spreading the word through Facebook, Twitter, the Brown Morning Mail, Women In Computer Science (WICS), and numerous other graduate and undergraduate groups all across universities in the northeast.

Teams are forming according to need and working with as little hierarchy as possible. The stunning logo, a stylized bear paw of geometric shapes in pinks and golds and grays, like a fleet of box kites at sunrise, is the work of more than nine people, including two Rhode Island School of Design (RISD) students. It evolves nightly, versions going back and forth via e-mail:

What if we use pentagons on the sides?

Make it look like the sun is shining down from the left.

Try changing that color!

Asked who created it, Molly gives credit to Athyuttam "Atty" Eleti '17 and Chen Ye '17 as leaders of the Design team, but says, "Really, we all did. I can't name just one person. And the Brown/RISD collaboration was wonderful."

Infectious is another word for the teamwork that was occurring. Molly laughs to remember how she promoted the hackathon pretty much everywhere she went: "I met a guy at the Writing Center who was a grad student in Creative Writing, and I told him about Hack@Brown. And he showed up!"

The excitement and the collaboration are hard to miss. "I've been observing Brown students for forty-seven years," says Professor John Savage, "and they're special. They're bright, but they keep their egos in check. They cooperate rather than compete."

And that cooperation isn't confined by the brick-and-glass walls of the CIT or even the spacious quadrangles of Brown University.

The team of Hack@Brown volunteers is intent on building grassroots support for their hackathon anywhere that it can take root. A passage from an e-mail that Molly and Mackenzie send to dozens of WICS groups and similar organizations across the country reads like a manifesto in miniature:

> "When we decided to start Hack@Brown, we wanted to create a hackathon where everyone feels welcome and has an empowering experience learning from other students and engineers. It's really important to us that minorities in computer science feel comfortable attending hackathons... One thing that makes Hack@Brown different is that students will work on teams side-by-side with engineers from sponsoring companies. We're also encouraging students to form teams at the event with people from other schools, building lasting relationships... We believe our focus on mentorship and learning makes Hack@Brown a fun and approachable event for everyone."

Do they get the results they're looking for? Molly and Mackenzie are hoping to get a hundred to a hundred and fifty students. Over five hundred apply.

PART 4: NOT JUST PIZZA

But now it's January. In Providence. As the day of the hackathon arrives, there's almost an entire atrium full of food, snacks, and swag (free items given to attendees) to be transported from the CIT to Alumnae Hall. Uphill.

Of course it starts snowing.

The social networks immediately go to work. Hack@Brown volunteers find Eugenia deGouveia of BrownCS Administrative Staff, who enlists the help of Brown Facilities truck drivers. But there's too much. Students pull the overflow uphill themselves in overburdened wheelbarrows and wagons stacked high. Policemen stop cars for them, asking if some sort of food crisis is occurring.

At one point, boxes topple into the street. This is followed by immediate proof that we live in the age of Instagram. "Wait, can I take a picture first?" someone asks, whipping out a smartphone before the scrambled clean-up begins.

Luckily, the swag is intact. And the collaboration is already beginning. Students are in transit from twenty different schools, from as far away as California, starting to work together while still on their way. Shriya Nevatia (Tufts Computer Science '15) enjoys the ride to Providence on a bus full of students from Harvard, Smith, Tufts, and other schools.

"The event was very beginner-friendly," she says, "and since I consider myself a beginner it was really nice to meet so many other people who were just starting out but very excited to learn. I even met a Brown alum who interned at Khan Academy, which is where I want to work, which was very exciting!"

A half-hour before sunset, flecks of color dart across snow-clogged Pembroke Green as students race to Alumnae Hall to check in and get out of the cold. The registration desk is right there when they open the door. Another table, placed at a right angle, is staffed by someone who does nothing but race back and forth to a room full of swag: water bottles, t-shirts, Square readers that allow anyone with a smart device to process credit card transactions, gloves that are touch-screen compatible.

As people register and sort through their goody bags and mingle, the random collisions between eager beginners and experienced collaborators continue. Mackenzie compares the atmosphere to the community feeling of going to summer camp, where the strange setting and amazing abundance pull people out of themselves and conversations begin naturally.

Atty Eleti says, "Personally, I found Hack@Brown very friendly for beginners, with a very positive and welcoming atmosphere. The volunteers worked hard, the organization was seamless, the food was great!"

Dinner starts promptly at 5:00. "The food had to be really good," Molly points out. "Healthy and tasty, not just pizza!" This was another major departure from most hackathons, where pepperoni and extra cheese reign supreme. Organization was also a key factor.

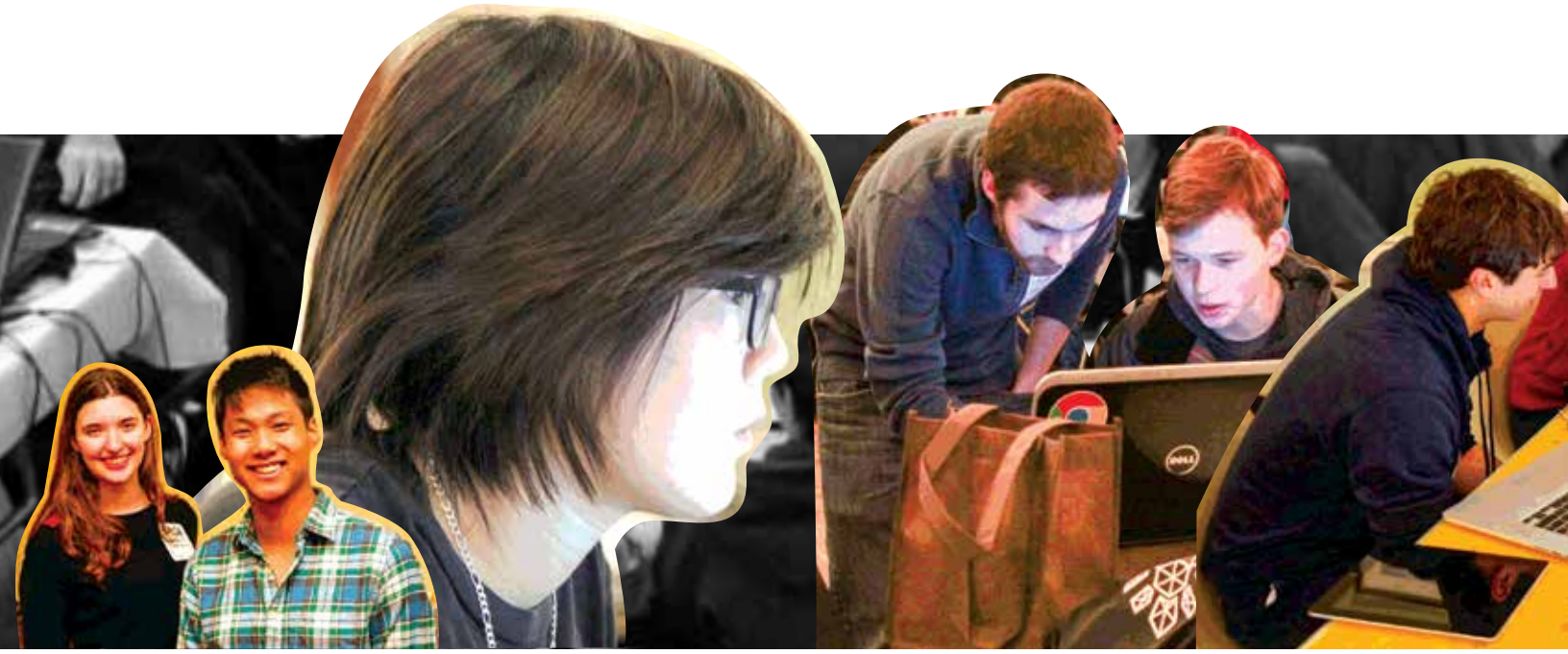
"Big hackathons are so much more disorganized," Eric Jang '16 explains, "and it can be intimidating for newcomers. There are also problems of dishonesty at big hackathons where the high-stakes prizes give teams an incentive to cheat. Concretely, big extravagant hackathons disturb the balance in the Force. If it were up to me, I would rather hackathons have no prizes at all. Then people would go for the sake of building cool things."

This crowd is very ready to build cool things. The hall is filled: some people are still in their winter jackets, some already in their new t-shirts. Conversation is bouncing off the ceiling; people are scrambling for power strips, posing for pictures with stuffed animals, trying to eat and talk and not drop food on their keyboards.

"It was exciting!" says Assistant Professor Jeff Huang, who served as one of the judges. "People were all over the building. Compared to other hackathons, it was more social, more interactive, with people constantly in motion."

Ten minutes before 6:00, Molly and Mackenzie take the stage with a huge Hack@Brown logo projected behind them, kicking off the event and talking about how things will work.

Then the real excitement begins.



PART 5: MENTORSHIP, FROM THE HIGHSCHOOLER TO THE CTO

"I particularly liked the way that we formed teams," says Shriya Nevatia. "I wrote down a few ideas and got interest from a really interesting and diverse group of students from four different schools."

What's happening is that big pieces of paper are appearing, and engineers and students are starting to scribble frantically. They're pitching ideas to each other, spontaneously forming teams. It's pure chaos.

And it works: teams are forming around ideas for Google Glass, stock market simulations, laser tag with cell phones, sharing gas money, playing word games, visualizing course information, reducing your carbon footprint. It's bringing programmers and non-programmers together as equals.

"As a Graphic Design major," says Chelsea Wang (RISD Graphic Design '15), "Hack@Brown was one of the first opportunities where I could work alongside developers to create a real project in a high intensity environment. I was lucky to have other designers and someone skilled in UX on my team so we could relay the programming aspect to the visuals more easily...This was my first hackathon experience and I would definitely go to one again and encourage other designers to attend."

Teams are starting to break off now, working in multiple different locations throughout the building. Chelsea's experience of being part of a diverse group is being replicated again and again: one team consists of a high school student, a PhD student, a RISD designer, a student from Boston University, a Brown student, and the Chief Technology Officer (CTO) of Shelby.tv.

And the conversations continue long into the night as people poke their heads through a doorway or run into somebody while getting coffee or yell something down the hall:

Are you doing OS development?

I'm using Python for the first time, too.

Does anyone know a good library for this?

Sleep is optional, but an hour before midnight, volunteers turn Alumnae Hall into a sea of blue fleece. "How did they guess that free blankets were the secret to my heart?" asks Eric Jang.

Good night, everybody.

PART 6: WE BUILT THIS

Morning brings breakfast for the hungry, coffee for those just waking up (or those who haven't slept), and a Tech Talk by Robert Blumofe '88, Executive Vice-President of Platform at Akamai. Then, it's back to work for a couple of hours.

The first round of judging is informal. Working in pairs, the judges are circulating, asking teams for demonstrations and choosing finalists. To give just three examples, how are they supposed to choose between Google Intros (never forget someone's name again), Squawk (send instant voice messages to a friend) and Texture (turn plaintext hyperlinks into works of art)?

One thing is clear: the engineers are having as much fun as the students.

Ian White, CTO of Sailthru, says, "I got into programming by building simple games, so it was a fun throwback for me... One of the best things about it for us was that sponsor company engineers were working directly with the student hackathon teams, instead of hovering around trying to advise on the proper use of an application-programmer interface."

Eric Jang's experience was similar. "The sponsor presentations were genuine," he says. "In bigger hackathons, sponsors usually play a background role, but at this one, the engineers basically mentored teams on their projects. The whole experience felt very cozy and non-competitive."

After dinner and a move to MacMillan 117, finalists are announced. Backpacks and laptops have been scattered everywhere. Most students have their blankets nearby, and a few are half-cocooned in their sleeping bags. Eyes are bleary. Some of these folks have been awake for twenty-four hours or more, and things seem a little unreal. But as the demos begin, it starts to sink in:

We built this!

Thais Correia enters trip data, then the make and model of a car, and shared gas costs are automatically calculated. Atty's team types in plain text, clicks a button, and their app creates a link worthy of Facebook, complete with an image and description. Robin Martens '14 throws his hands up in surrender: he's been "tagged" by a teammate who just took a picture of the QR code on his chest.

These things actually work!

In the end, Squawk takes first place, earning iPad Minis for all team members. (A partnership with Brown Venture Labs will follow later.) Eight other awards bring sponsor-donated prizes ranging from Google headphones to Incase backpacks.

If you need one thing to remind you that the prizes aren't what's really important, try this: twenty-four hours ago, none of this existed. A couple of numbers don't hurt, either:

35% of attendees identified as female.

75% had never been to a hackathon before.

100% said they would return to Hack@Brown next year.

PART 7: RETURNING TO THE ROOTS

Three months later, it's been a slow start to spring in Providence, so the blue Hack@Brown blankets are still a common sight on local couches. The donated water bottles are in frequent use. Best of all, the social networks are intact, and the collaborations are going strong. Photographs of delicious Hot Pockets are still being eaten by virtual pets. Squawk is in the App Store, and Windows Phone development has begun.

Attendees still have the highest praise for Hack@Brown. Julia Wu '17 says, "This was the most rewarding Friday night I've had at Brown. My three biggest takeaways from my first hackathon experience were the power of spontaneous ideas, picking up knowledge quickly and applying it, and how inspiring it is to be among passionate and hardworking coders. To me, this was an example of achievement being merely a fraction of the entire experience."

"I really look forward to next year," says Department Chair Tamassia. "This was a huge success."

Lauren Clarke agrees: "For me, this was just incredibly cool. There are so many stories in the media about how few women are active in our field, but Molly and Mackenzie spearheaded this project with the most diverse group of volunteers you can imagine. If there are women like this at every other college, women doing amazing things like this, we'll be fine."

Long and Clark are still a bit taken aback at the attention they've received. "Everybody asks us for advice now," says Mackenzie, "as if we're suddenly experts! But it's really gratifying to see other people using our best practices."

She'll be graduating this spring, but Molly and others are already bouncing around ideas for next year's Hack@Brown: a bigger space, solutions for the travel challenges, new ways to collaborate before and after the event itself.

The first hackathons were small, Molly reminds us. Then they got big. But it's not about the number of people.

It's not about the dollar value of the prizes.

It's not about the hours not slept.

It's not about being big for the sake of being big.

Today, hackathons are big and collaborative. They're more diverse. In the face of a changing world and a changing industry, they're returning to the roots of computer science and of science itself: working together to build cool stuff.

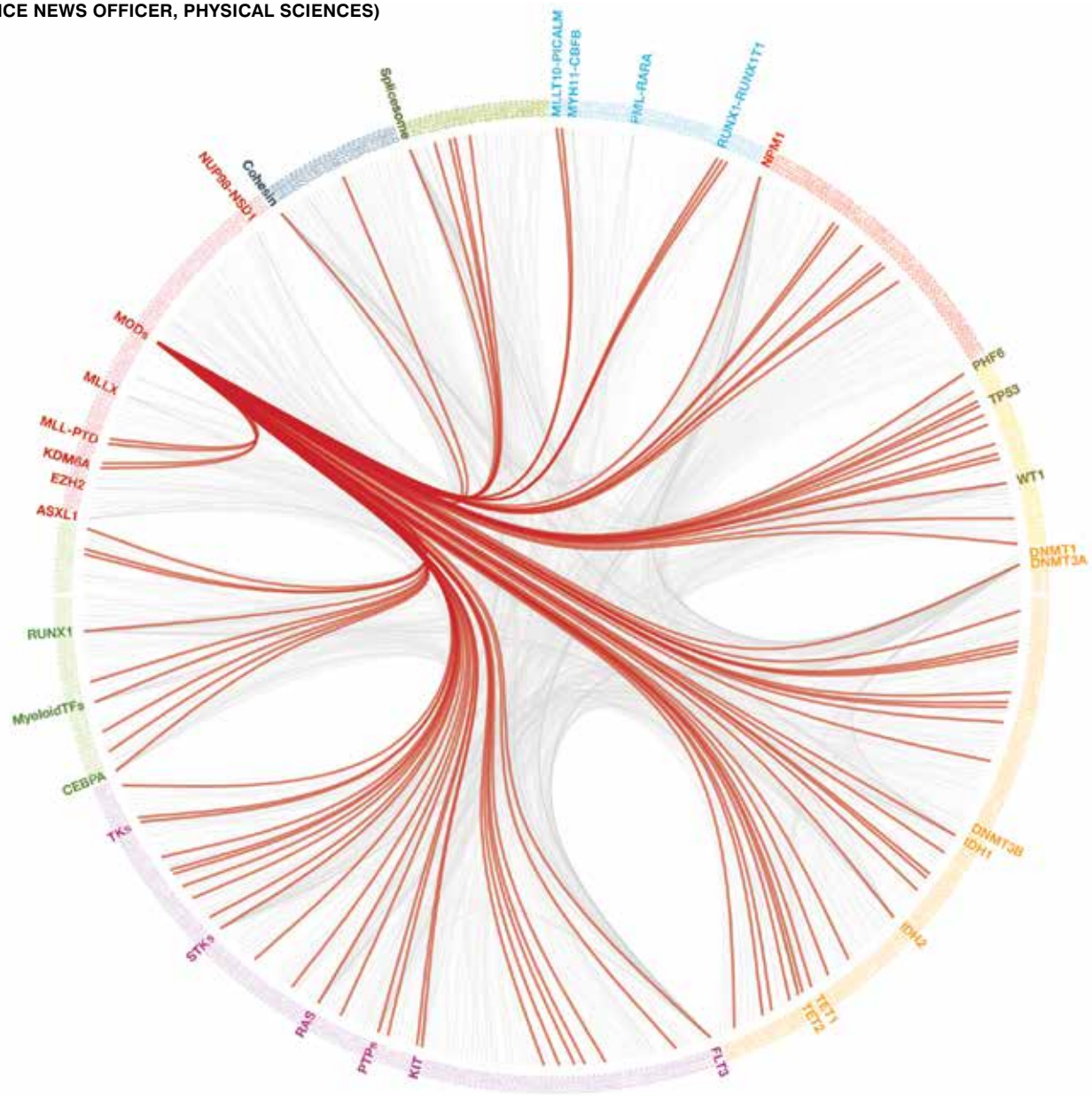
So, the average hackathon is changing, not just here at Brown?

Molly grins. "I hope there's no such thing as an average hackathon!"

The happy attendees of the first annual Hack@Brown and countless collaborators yet to come undoubtedly agree.

ALGORITHMS FIND GENETIC CANCER NETWORKS

BY KEVIN STACEY (SCIENCE NEWS OFFICER, PHYSICAL SCIENCES)



In a study reported in the *New England Journal of Medicine*, researchers from Washington University in St. Louis used two algorithms developed at Brown to assemble the most complete genetic profile yet of acute myeloid leukemia (AML), an aggressive form of blood cancer. The researchers hope the work will lead to new AML treatments based on the genetics of each patient's disease.

The algorithms, developed by Ben Raphael, Eli Upfal, and Fabio Vandin from the Department of Computer Science and the Center for Computational Molecular Biology (CCMB), played a key role in making sense of the giant datasets required for the study. The work was part of The Cancer Genome Atlas project, which aims to catalog the genetic mutations that cause cells to become cancerous. Developing the catalog requires sequencing the entire genome of cancer cells and comparing it to the genome of healthy cells. Without computational tools like those the Brown team has developed, analyzing the dataset would be impossible.

The AML study used two algorithms developed by the Brown team: HotNet and Dendrix. Both aim to find networks of genes that are important in creating cancerous cells. To understand how they work and why they are important, it helps to know a little about the genetics of cancer.

"We hope that the algorithms produce actionable information that is clinically important. Genes don't usually act on their own, but instead act together in pathways or networks," said Raphael, an associate professor of computer science. "Cancer-causing mutations often target these networks and pathways." This presents a problem for researchers trying to find important mutations, because these mutations are often spread across the network and hidden in the genetic data.

Imagine a cellular pathway containing five genes. If any one of those genes acquires a mutation, the pathway fails and the cell becomes cancerous. That means five patients with the same cancer can have any one of five different mutations. That makes life difficult for researchers trying to find the mutations that cancer cells have in common. The algorithms developed by Raphael and his team are designed to connect those dots and identify the important pathways, rather than looking only at individual genes.

The HotNet algorithm works by plotting mutation data from patients onto a map of known gene interactions and looking for connected networks that are mutated more often than would be expected by chance. The program represents frequently mutated genes as heat sources. By looking at the way heat is distributed and clustered across the map, the program finds the "hot" networks involved in cancer.

HotNet picked out several networks that seem to be active in the AML genome. In a study published in 2011, HotNet identified networks important to ovarian cancer as well.

Dendrix, the newest algorithm developed at Brown, takes the power of HotNet one step further. HotNet works by looking for mutations in networks that are already known to researchers. However, there are countless gene networks that researchers have not yet identified. Dendrix is designed to look for mutations in those previously unknown networks.

To find new networks, Dendrix takes advantage of the fact that cancer-causing mutations are relatively rare. A patient with a mutation in one gene in a network is unlikely to have a concurrent mutation in another gene in that network. Dendrix looks for combinations of mutations that happen frequently across patients but rarely happen together in a single patient.

Put another way: imagine that a substantial number of patients with a given cancer have a mutation in gene X. Another large group of patients has a mutation in gene Y. But very few patients have mutations in both X and Y at the same time. Dendrix looks for these patterns of exclusivity and predicts that groups of genes with high exclusivity are probably working together.

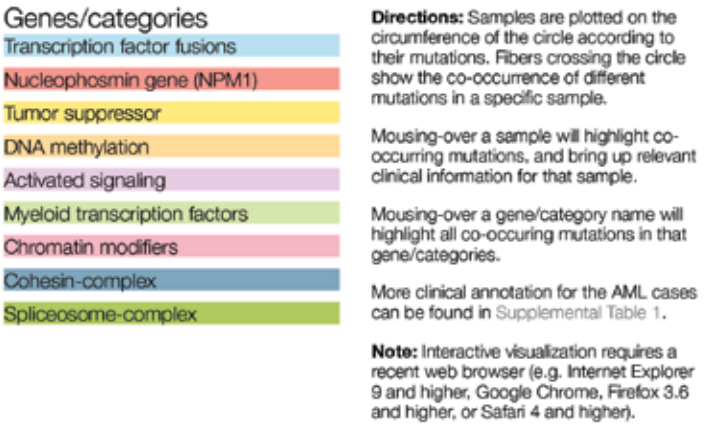
"Where we see those patterns of exclusivity," Raphael said, "it suggests a possible pathway." The group has tested Dendrix on cancers in which the pathways were already known, just to see if the program would find them. Indeed, the pathways "just fall right out of the data," Raphael said.

For the AML paper, Raphael's group developed an improved algorithm, Dendrix++, which better handles extremely rare mutations. Dendrix++ picked out three potential new pathways in AML for doctors to investigate.

Raphael and Vandin, along with computational biology graduate students Max Leiserson and Hsin-Ta Wu, are continuing to improve their algorithms and to apply them to new datasets. The group recently started putting the algorithms to work on what's called the Pan-Cancer project, which looks for commonalities in mutations across cancer types.

"For us as computational people, it's fun to push these algorithms and apply them to new datasets," Raphael said. "At the same time, in analyzing cancer data we hope that the algorithms produce actionable information that is clinically important."

Co-occurrence of mutations in 200 AML samples



BROWNCS 35TH ANNIVERSARY TIMELINE

1980s

The Foxboro Auditorium

Kathy Kirman

Above // Peter Wegner

Right // Tom Doeppner, Bob Sedgewick, Peter Wegner, Andy van Dam, John Savage, Eugene Charniak, Steve Reiss

1980s

Norm Meyrowitz

CS Theory faculty:
Jeff Vitter, Paris Kanellakis,
Roberto Tamassia,
John Savage, Philip Klein

Dawn Reed

David Laidlaw, Nancy Pollard

1980s

CONTINUED ON PAGE 20

Cybersecurity Education At Brown

BY JOHN E. SAVAGE

Cybersecurity is in the news!

Edward Snowden's revelations of NSA secrets have drawn attention to the impact of surveillance on privacy and civil liberties, weak computer security, and the importance of computer science. His revelations are also being felt in academe. A recent BBC News article reports that the U.S. Bureau of Labor expects demand for graduate-level information security workers to rise by 37% in the next decade. General student interest in computer science is certainly increasing; course enrollments are soaring nationally and at Brown. Our total course enrollments have increased by 38% in one year alone. All levels are impacted except for the graduate level. In addition, students are showing an eagerness to participate in external competitions involving cybersecurity policy and technology.

The BrownCS team celebrates their award

CYBERSECURITY INSTRUCTION

Five courses dealing with cybersecurity technology and/or policy are being offered in the department this year: CSCI 1510 Introduction to Cryptography and Computer Security, taught by Anna Lysyanskaya; CSCI 1660 Introduction to Computer Security, taught by Bernardo Palazzi; CSCI 1800 Cybersecurity and International Relations, taught by me; CSCI 1951B Virtual Citizens or Subjects? The Global Battle Over Governing Your Internet, a new course on Internet governance taught by Tim Edgar, a Visiting Fellow at the Watson Institute; and CSCI 2951E Topics in Computer Systems Security, taught by Roberto Tamassia. Enrollments in existing undergraduate courses have at least doubled in one year.

In addition, material on security is taught in eight other courses: CSCI 0330 Introduction to Computer Systems and CSCI 0167 Operating Systems, both taught by Tom Doeppner; CSCI 0190 Accelerated Introduction to Computer Science and CSCI 1730 Introduction to Programming Languages, both taught by Shriram Krishnamurthi; CSCI 1680 Computer Networks, taught by Rodrigo Fonseca; CSCI 1950Y Logic for Hackers, taught by a postdoc, Tim Nelson; CSCI 1310 Fundamentals of Computer Systems, taught by Ugur Cetintemel; and CSCI 1320 Creating Modern Web Applications, taught by Steve Reiss.

GRADUATE EDUCATION

Seven PhD students are doing theses in the area of cybersecurity: Foteini Baldimtsi, Alexandra Berkoff, Esha Ghosh, James Kelley, Evgenios Kornaropoulos, Olya Ohrimenko, and Hannah Quay-de la Vallee. For two others, Joe Politz and Justin Pombrio, cybersecurity is an important consideration in their research.

Dazheng Zhang, Jessica Fu, and Benjamin Koatz debate cybersecurity issues

PROFESSIONAL ACTIVITIES

Seminars and colloquia have brought many distinguished speakers to campus. In just the current academic year we have had **Trustworthy Hardened Code** by Greg Morrisett of Harvard, **Searching on Encrypted Data** by Seny Kamara of Microsoft, **Private Personal Data: Protection or Profit?** by Gerome Miklau of UMass, **Internet Privacy: Towards More Transparency** by Balachander Krishnamurthy of AT&T Labs, **Biometrics or Bust? India's Identity Crisis** by Malavika Jayaram of Harvard University's Berkman Center, **Forensic Triage for Mobile Phones** by Robert Walls of UMass Amherst, and **Killing the Golden Goose: The Dangers of Strengthening Trade Secret Rights to Combat Cyber-Misappropriation** by Zoe Argento of Roger Williams University Law School. Several other visitors who spoke on non-cybersecurity topics also have ties to the area (such as Justin Cappos of NYU Polytechnic, Emery Berger of UMass Amherst, and David Choffnes of Northeastern University) and discussed topics in it with members of our department.

STUDENTS ATTEND THE ATLANTIC COUNCIL STUDENT CHALLENGE

by Samuel Brebner, Jason Ginsberg, Daniel Meyers and Jared Schober

The Atlantic Council held its second annual student challenge in Washington D.C. on February 7 and 8. Twenty-two teams participated, representing 24 prominent universities from as far away as Turkey and Estonia. Teams were asked to imagine that they were cyber-security specialists summoned to advise the US National Intelligence Council on policies that the American president should adopt in response to a massive cyber attack within the financial sector.

A team of four sophomores represented Brown University in a competition that brought together undergraduates, graduate students, and PhD students. In addition to advancing to the semifinal stage, the young team won the prize for Best Teamwork. Team "Brown Secure" consisted of Samuel Brebner, Jason Ginsberg, Daniel Meyers, and Jared Schober. Samuel and Daniel are both Computer Science concentrators while Jared and Jason are both concentrating in Political Science. All four students took the Cybersecurity and International Relations course in the Department of Computer Science last spring. John Savage travelled with the team to Washington D.C. and served as the coach, offering advice and expertise.

The competition was designed to address a critical problem in response of governments to real emergencies—making sure that the makers of cyber policies and the technical specialists who implement them understand each other. In the real world of cyber security, policy makers and technical operators too often are not prepared to work together.

The competition consisted of three rounds in which students formulated four alternative responses to a crisis described in an intelligence brief. Each round consisted of a new intelligence brief that significantly altered the situation by providing more information on the source of the attacks while still opening new possibilities and attacks. In each round, teams had ten minutes to present their responses and took ten minutes of questions. Preparation time for the first round lasted two weeks and included an additional five-page written policy response. Second round preparation lasted twelve hours overnight and the third round preparation lasted fifteen minutes.

Experts from the White House, the Pentagon, the Department of Homeland Security, and other notable think tanks, security companies, and government departments participated as judges. They evaluated the oral presentations by identifying key points in responses and questioning presenters. These evaluations were used in conjunction with the more detailed written policy brief in the first round to determine team scores.

The Brown students benefited greatly from the trip, met prominent national security experts, and established a strong reputation for Brown at this event.

New Edition Of Computer Graphics: Principles and Practice

BY JOHN HUGHES

Nearly a decade in the writing, the new edition of *Computer Graphics: Principles and Practice* has finally been published.

The book is 1209 pages, which is slightly shorter than the second edition, but it's in a larger format, which more than compensates for the difference. Several topics (the extensive discussion of user interfaces, the long chapters on spline curves and surfaces) have been substantially trimmed down, since there are now whole fields (computer-human interaction, computer-aided design) in which these topics find their natural home. The discussion of rendering—especially Monte Carlo methods—has been enlarged a good deal.

There's a big BrownCS representation in the book—Andy van Dam and I here at Brown, my former Ph.D. student Morgan McGuire of Williams, former adjunct faculty member David Sklar of Vizify, Andy's former Ph.D. student Steve Feiner of Columbia—along with Jim Foley of Georgia Tech and Kurt Akeley of Lytro.

As the lead author on this edition, I'm (a) exhausted, and (b) very happy with the final product. The text is almost entirely new, although it's strongly influenced, of course, by the presentation and order of the earlier editions.

WHAT'S DIFFERENT? HARDWARE BY A WORLD EXPERT

The third edition contains a chapter on *Modern Graphics Hardware* by Kurt Akeley, the cofounder of Silicon Graphics, designer of the Reality Engine and GL/OpenGL, and now CTO of Lytro. Kurt uses a recent NVIDIA GPU as a model for analyzing the tradeoffs involved in designing a graphics processor, including the cost/benefit choices involved in parallelizing graphics tasks, and extensive discussion of memory, concentrating on locality of reference and its relationship to caching, and the consequences of the differing constants in the Moore's-Law-like improvements in memory, computation, and bandwidth. He also discusses the tradeoff between implementation simplicity and power provided to the user, and identifies a principle —*The art of architecture design includes identifying conflicts between the interests of implementors and users, and making the best tradeoffs* —early in the chapter, and then illustrates it with numerous examples.

PRINCIPLES GALORE

That design tradeoff principle illustrates something about the book as well: as we designed and revised chapters, we found ourselves repeatedly explaining a single idea in multiple contexts, and began to extract *principles* that we've found ourselves using over the years.

These principles range over many levels of detail. The "average height principle" says that the average height of a point on the upper hemisphere of the unit sphere is 1/2, for example. That seems pretty specific, but it's remarkable how often it comes up in discussing rendering topics. At the other extreme, the "meaning principle"—which says that for every number that appears in a graphics program, you need to know the semantics, the meaning, of that number—applies very widely. This principle might seem completely obvious to you—of *course* you need to know what numbers mean!

If you're thinking that, let me ask you this: suppose the top left pixel of your color image has colors (r, g, b) = (245, 13, 11). What does that "245" mean? If you think the pixel values are describing light as a physical phenomenon, what are the units?

WRITING A BOOK IN A NEW CENTURY

The world's changed a lot since our last edition. Students are used to grabbing code from the internet. The language of choice has changed from Pascal and/or C to... well, to what? C++? Scheme? Java? C#? Haskell? OCaml? The great thing is that it doesn't really matter. If you want to learn about, say, ray-intersect-plane computations, you can probably find implementations in any of those languages. That meant two things for us as authors:

- We don't actually have to include code for many algorithms. The student can grab code from the web in whatever language works best for him or her.
- When we do write code, we can feel free to do it in almost any language. In the book, there's C, C++, C#, GLSL, pseudocode, and possibly some others I've forgotten. The C-like languages are all similar enough that a student who knows one can generally read the others. Much of the early part of the book introduces 2D and basic 3D graphics via Windows Presentation Foundation (WPF), a graphics library accessible through an XML-like format and via C# code, but essentially the same ideas are usable via other libraries.

These two mean that if the main ideas are explained simply and clearly enough—which is, after all, our strength—then the student can make the most of them.

STRUCTURE

The second edition started with 2D graphics in great detail, including extensive coverage of low-level topics like scan-conversion. Since the modern version of scan-conversion, rasterization, is now generally done in the GPU, it's no longer the central topic it once was. It's also usually based on spatial subdivision approaches, which are most naturally delayed until later in the book.

In the new edition, we've taken a different approach, briefly describing in the first chapter many of the main ideas of graphics, which are then treated in successively greater detail and mathematical sophistication in multiple later chapters.

PICTURES EARLY!

We start with WPF's 2D features, which give students a chance to make pictures—indeed animated pictures—in the second chapter, and learn about hierarchical modeling as they build a model of a clock-face. This same 2D foundation is used, in Chapter 3, to produce output for a very basic raytracer based on the famous Durer etching. Almost immediately the student then learns about WPF 3D, and its basic Blinn-Phong shading model, after which we describe a couple of test-bed programs in WPF that the student can use to perform exercises throughout the book.

ONION PEELING

At the end of the introduction we lay out a few basic facts about light, a little mathematics, and something about representation of shape in graphics—just enough to let a student make a first renderer. As we work through the first several chapters, topics like clipping and transformations arise naturally, and efficiency considerations lead to discussion of how best to represent shapes with meshes. A few chapters further along, we revisit many of these ideas with greater sophistication. Morgan McGuire provides a wonderful mid-book chapter that summarizes the main current representations of light, of shape, and of light-transport, covering each in enough detail to let the student begin to see the big picture of how efficiency in one area may complicate another, etc. It's the most "computer-sciency" chapter the students have seen at this point. It goes into detail on fixed- and floating-point representations of numbers, memory structure in Z-buffers (and other buffers), precomputation and caching for geometric models, etc. The next chapter puts much of this information to use in building a slightly more sophisticated (but not recursive) raytracer, a rasterizing renderer, and a hardware-based renderer, and showing how the three produce identical results, thus emphasizing the critical difference between raytracing and rasterization in the reordering of two main loops, and the consequences this has on caching, memory access patterns, etc. In later chapters, we return to raytracing in its recursive form, together with more sophisticated scattering models for light-surface interaction, and develop a path-tracer and photon-mapping renderer. And in the final chapter, on graphics hardware, we return to hardware-based rendering.

This repeated treatment of the same topic allows the student to develop sophistication before facing the full complexities of the topic in its greatest generality. It also lets a teacher select how deeply to address a topic by including some chapters in the syllabus and omitting others.

EXTRA MATERIAL

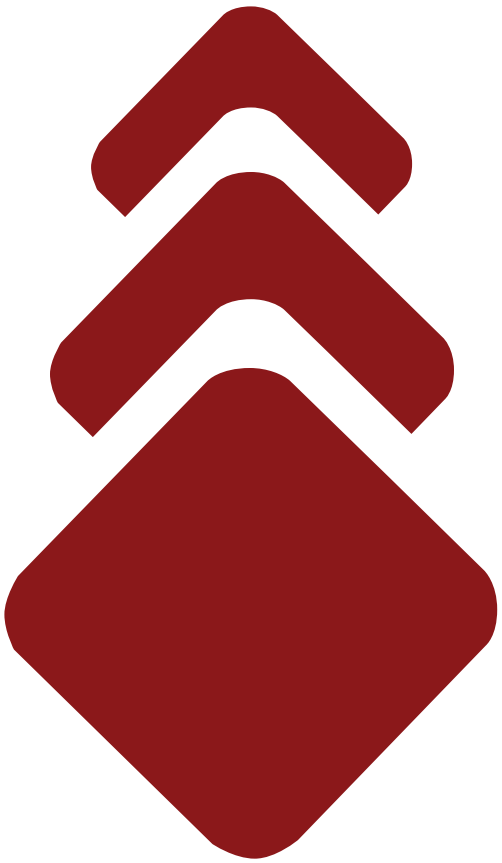
Another feature of writing a book in the internet age is that we can provide lots more to our readers. We're working on releasing source code for many of the illustrations in the book, many of which (like the one illustrating that the Fourier transform of a box-filter is a sinc-function, shamelessly adapted from Bracewell's Fourier Analysis book) were generated by programs in Matlab and other environments. We also provide example programs for download, and the basic ideas in WPF are explained using "Browser Apps" (created by David Sklar) in which the student can edit, in a browser, WPF2D XAML code and get instant feedback on the results without ever installing any software on his/her computer at all.

LAUNCHING THE BOOK

The new edition was launched at SIGGRAPH 2013, with a launch party followed by a book-signing on the show floor. As of this date, we've sold more than 2000 copies... we're off to a good start!

Tupleware: Redefining Modern Analytics

BY ANDREW CROTTY AND ALEX GALAKATOS



Up until a decade ago, most companies sufficed with simple statistics and offline reporting, relying on traditional database management systems (DBMSs) to meet their basic business intelligence needs. This model prevailed in a time when data was small and analysis was simple.

But data has gone from being scarce to superabundant, and now companies want to leverage this wealth of information in order to make smarter business decisions. This data explosion has given rise to a host of new analytics platforms aimed at flexible processing in the cloud. Well-known systems like Hadoop and Spark are built upon the MapReduce paradigm and fulfill a role beyond the capabilities of traditional DBMSs. However, these systems are engineered for deployment on hundreds or thousands of cheap commodity machines, but non-tech companies like banks or retailers rarely operate clusters larger than a few dozen nodes. Analytics platforms, then, should no longer be built specifically to accommodate the bottlenecks of large cloud deployments, focusing instead on small clusters with more reliable hardware.

Furthermore, computational complexity is rapidly increasing, as companies seek to incorporate advanced data mining and probabilistic models into their business intelligence repertoire. Users commonly express these types of tasks as a workflow of user-defined functions (UDFs), and they want the ability to compose jobs in their favorite programming language. Yet, existing analytics systems fail to adequately serve this new generation of highly complex, UDF-centric jobs, especially when companies have limited resources or require sub-second response times. So what is the next logical step?

It's time for a new breed of systems. In particular, a platform geared toward modern analytics needs to (1) concisely express complex workflows, (2) optimize specifically around UDFs, and (3) leverage the characteristics of the underlying hardware. To meet these requirements, the Database Group at Brown University is

Algorithm	Distributed						Single Machine	
	Hadoop			Spark			System X	Spark
	1GB	10GB	100GB	1GB	10GB	100GB		
K-means	3298×	2379×	TO	29×	23×	FAIL	1790×	29×
Logistic Regression	6334×	2181×	TO	51×	49×	55×	416×	10×
Linear Regression	5534×	2071×	TO	48×	48×	58×	486×	12×
Naive Bayes	1709×	544×	203×	341×	210×	FAIL	57×	76×

Speedup over other systems (TO = timed out, FAIL = memory failure)

developing Tupleware, a parallel high-performance UDF processing system that considers the data, computations, and hardware together to produce results as efficiently as possible.

CONCISELY EXPRESS WORKFLOWS

Existing systems based upon the MapReduce paradigm require users to write hundreds of lines of code to express even basic analytics tasks. Tupleware takes a new approach that merges traditional SQL with functional programming to obtain the best of both worlds; we retain the optimization potential and familiarity of SQL while incorporating the flexibility and expressiveness of functional languages. Furthermore, Tupleware users are not bound to a single programming language. By building upon the popular LLVM compiler framework, the system can integrate UDFs written in any language that has an LLVM compiler, even mixing languages to compose a single job. Presently, C/C++, Python, Ruby, Haskell, Julia, R, and many other languages already have LLVM compilers, and we expect other languages to adopt LLVM in the near future.

OPTIMIZE AROUND UDFS

Since the advent of DBMS research, a considerable amount of work has been devoted to the problem of SQL query optimization, but relatively little has been done to optimize custom UDF workflows. All traditional systems treat UDFs as black boxes, and thus they can never make informed decisions about how best to execute a given workflow. On the other hand, Tupleware combines ideas from the database and compiler communities by performing UDF introspection, which allows the system to reason about the expected behavior of individual UDFs in order to achieve optimal performance. Thus, our system can optimize workflows without borders between UDFs, seamlessly integrating user-specified computations with the overarching control flow.

LEVERAGE UNDERLYING HARDWARE

Modern analytics requires a variety of CPU-intensive computations. Whereas other systems neglect to efficiently utilize the available computing resources, Tupleware optimizes around all of the low-level characteristics of the underlying hardware, including SIMD vectorization, memory bandwidth, CPU caches, and branch prediction. In a process called program synthesis, our system translates workflows directly into compact and highly optimized distributed executables. This approach is built for maximum performance per node and avoids all of the overhead inherent to traditional systems.

Our initial benchmarks, based on real datasets and common machine learning algorithms, demonstrate the superior performance of Tupleware relative to alternative analytics platforms. In particular, we compare our system to the industry standard Hadoop, the cluster-computing framework Spark, and a commercial column store DBMS (System X). Tupleware outperforms these systems by up to three orders of magnitude in both a distributed and single machine setup.

Tupleware is a research project under development by the Database Group at Brown University. For more information, please visit our website at tupleware.cs.brown.edu.

1990s

Jeff Coady and
Mike Shapiro

Timothy and John Savage

AStaff

1990s

Above // Marc and Ellen Brown

Left // Paris Kanellakis

1990s

Tom Dean and students

1990s

Mihalis Yannakakis,
Gabriel Kuper, Moshe Vardi,
Stan Zdonik, Alex Shvartzman,
Pascal van Hentenryck,
Serge Abiteboul

1990s

Robin Neustein, Tom Dean,
John Savage, and Goldman
Sachs representatives

Eugene Charniak,
Roberto Tamassia,
Philip Klein

1990s

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Faculty Notes

BARBARA MEIER

As David and I cycled through the French and German countryside with our teenage boys last summer, I discovered two new advantages to traveling with adolescents. First, they can carry a lot of stuff which is important when bike-camping! And second, the underdeveloped frontal lobe of teenagers allows for fewer behavioral inhibitions. While I could spend two hours of biking time trying to formulate the best way to say, "Coffee, please," in German, the kids were happy to blurt out anything remotely close. Of course, traveling with teenagers also meant that a good portion of each day was spent searching out food sources to refuel their bottomless stomachs.

While we racked up the kilometers, a record four Brown students spent their 2013 summers at Pixar as interns and as a resident. We continue to have an excellent Brown to Pixar pipeline in place, but we're always looking for more studios to recruit at Brown for both internships and longer term positions. An internship can even be a particular project that the student works on a day or two a week. It can be too much overhead to accommodate a full-time intern, but consider this project-based model.

DAVID LAIDLAW

David reports some travels in the last year. He just returned from Japan. Who knew that it was possible to take two consecutive red-eyes with the second one taking off 18 hours after the first, but 30 minutes earlier in local time. He attended a research seminar at the NII Shonan Village research center, where he made his first public presentation about the new retina-resolution virtual-reality cave at Brown. The new cave is getting super close to completion, with just a few parts missing. He and Barbara Meier also spent several weeks bicycling with their two sons in France and Germany this summer, visiting Michael Black in Tuebingen along the way.

ERIK SUDDERTH

Erik continues to have strong interests in the application of statistical machine learning to scientific problems. Together with collaborators at UC Berkeley, he has developed new probabilistic models for the generation and acoustic propagation of real-world seismic events. A paper describing their NET-VISA system, for network-based vertically integrated seismic analysis, appeared in the April 2013 Bulletin of the Seismological Society of America. Their prototype system is undergoing testing and evaluation for deployment by the United Nations' Comprehensive Test Ban Treaty Organization (CTBTO) in Vienna, Austria.

In May, Microsoft Research organized a very popular "New England Machine Learning Day" in Boston, Massachusetts. Erik gave an invited talk on his recent efforts to improve the effectiveness, scalability, and reliability of "Bayesian nonparametric" learning algorithms. His group also presented some of their recent work in this area at the December 2013 Conference on Neural Information Processing Systems (NIPS) in Lake Tahoe, Nevada.

On August 29, 2013, Erik and his wife Erika welcomed their daughter, Liana Grace Sudderth. She and her big brother, Kyler, continue to find plenty of new things for their family to learn.

SHRIRAM KRISHNAMURTHI

Shriram has been deep in the creation of two new programming languages. One, Pyret (pyret.org), is for programming education, and was tested on unsuspecting CSCI 0190 and 1730 students last fall. The other, Flowlog, is for programming software-defined networks.

In the spring, post-doc Tim Nelson is running a new course, "Logic for Hackers", that Shriram has wished he had the cycles to teach for about ten years now. As a result, Shriram gets giddy with joy for an hour every MWF at 10am.

Shriram's 5yo daughter is taken up with constructing and decoding Caesar ciphers.

SORIN ISTRAIL

Sorin lectured in Shanghai at the Chinese National Academy of Sciences/Partners Institute for Computational Biology and at Tongji University. He also lectured at University "Al. I Cuza" Iasi, Romania. As co-founder of the International Annual Conference on Research in Computational Biology (RECOMB), he was delighted to participate in the 17th RECOMB Conference held in Beijing in 2013. He received three grants: one from NSF (PI), the Brown University OVPR Inaugural Translational Seed Award (Co-PI), and one from NIH, part of the Brown Institute for Brain Science COBRE Center, as a mentor to assistant professor Eric Morrow, MD, PhD.

His PhD student, Derek Aguiar, had a superb research year, a sort of grand slam for the year, presenting papers at the top two most competitive conferences in computational biology: ISMB 2013 in Berlin and RECOMB 2014 in Pittsburgh. In particular, the work resolved a long-standing open problem of the Li-Stephens statistical framework (2003), namely achieving "exchangeability" of the statistical process. The Li-Stephens model has been a most influential framework that enabled some of the most practical genome-wide association study (GWAS) software tools to date.

Sorin's work with former undergraduates and 2013 honor theses authors progressed successfully and first research papers are getting ready for submission: with Doug McErlean (now at Google) on the "combinatorialization" of maximization of likelihood polynomials for a rich class of maximum likelihood optimizations, including haplotype phasing; and with Kshitij Lauria (now at D.E. Shaw Research) on optimal self-assembly lattice models. Work with Hammurabi Mendes (PhD student of Maurice Herlihy) on applying mathematical economics methods such as voting theory and von Neumann-Morgenstern utility theory to protein folding energy function inference ("Thermodynamic hypothesis as social choice") is also getting ready for publication. Two undergraduates were successful as well: Ning Hou received a "Randy Pausch" Computer Science Summer Research Award for work on cis-regulatory genome analysis, and Nicholas Goelz received a UTRA for working on algorithms for the HP side chain model of protein folding.

In October 2013, Sorin had the honor to be part of the committee awarding Professor Kenneth Arrow, Nobel Laureate in Economics, the Doctor Honoris Causa title from the University "Al. I Cuza" Iasi, Romania. The event officially opened the Grigore Moisil Institute for Advanced Study jointly affiliated with the University of Iasi and University of Bucharest, Romania; Sorin is honored to be one of the founding directors of the Institute. Finally, Professor Leon Cooper (Physics Department) and Sorin are discussing with President Paxson the details of organizing part of Brown University's 250th Anniversary celebration.

Nobel Laureate Kenneth Arrow (Stanford University) (with hat) at the University "Al. I. Cuza" Iasi, Romania in October 2013 when he was awarded the title of "Doctor Honoris Causa." Like Sorin, sitting to his right, Professor Arrow's parents were born in Romania.

STAN ZDONIK

Stan Zdonik is on sabbatical at MIT this semester working with colleagues there on topics related to their jointly-funded Intel Science and Technology Center.

Department Awards and Honors

Faculty Honors

AMY GREENWALD WINS UNDERGRADUATE TEACHING AND ADVISING AWARD

It can be said in three words from a very enthusiastic student: "Amy destroys it."

Each year, a committee formed by the Undergraduate Council of Students solicits nominations for professors and teaching assistants who have demonstrated an outstanding commitment to student advising and mentorship. This year, BrownCS Professor Amy Greenwald was nominated by students Gabriel Bankman-Fried, Kelly Buckley, Eli Rosenthal, Brendan Wallace, and Ian Wyszynski.

They gave her their highest praise: "She cares so much and does such a good job... Amy works on projects with so many undergrads!" One student deliberately switched to Professor Greenwald from a first-year advisor in another Department; another credited her as the reason behind a decision to pursue computer science.

Out of more than two hundred candidates, Amy and six other individuals (five professors and one teaching assistant) were selected as winners. "Amy received so many nominations," reports Luke Camery, who served on the committee. "She was easily a finalist, and her students wrote so much about her that she was a clear choice to win the award."

ANNA LYSYANSKAYA APPOINTED TO EPIC ADVISORY BOARD

ANNA LYSYANSKAYA RECEIVES GOOGLE FACULTY RESEARCH AWARD

BARBARA MEIER RECEIVES PHILIP J. BRAY AWARD FOR TEACHING EXCELLENCE IN THE PHYSICAL SCIENCES

Barbara Meier has received the Philip J. Bray Award for Excellence in Undergraduate Teaching in the Physical Sciences. The Faculty Teaching Excellence Awards recognize Brown faculty members for sustained and continued excellence in undergraduate teaching. Awards are made in each of the four major areas of the curriculum: humanities, life, physical and social sciences. The awards are named for past faculty members recognized for their teaching achievements: John Rowe Workman (Humanities), Elizabeth LeDuc (Life Sciences), Philip J. Bray (Physical Sciences), and William G. McLoughlin (Social Sciences).

"I couldn't be more thrilled to receive the Bray Award," says Barbara, "but the real honor goes to my smart, dedicated, and industrious animation students who go to infinity and beyond again and again. Their humor, enthusiasm, and enduring friendships inspire me to explore new ways to share my passion. I'm grateful to the Department of Computer Science for taking the risk to support my work at the ever-growing intersection of art and science, and to Brown for their recognition of my teaching practice with this award."

CHAD JENKINS NAMED NATIONAL GEOGRAPHIC EMERGING EXPLORER

DAVID LAIDLAW NAMED IEEE FELLOW

Professor David Laidlaw has recently been named a 2014 IEEE Fellow for contributions to data visualization and analytics. His main contributions to computer science are threefold: developing scientific data visualization solutions, pioneering evaluation of visualization software for scientific inquiry, and transitioning visualization insights to quantitative evidence.

The software systems and techniques developed by Laidlaw's group have helped collaborators in many disciplines, including

bioengineers studying fluid flow in coronary arteries, archeologists studying their finds in a virtual reality model of their site, and brain researchers studying the complex 3D geometry that makes up the wiring in human brains. Additionally, Laidlaw's work in diffusion MRI is widely known and cited, and he has published dozens of papers and abstracts and acquired two patents in this area.

"The award is a fitting recognition of David's achievements in scientific visualization and his internationally recognized leadership stature in that important field," explains Professor Andries van Dam.

IEEE Fellow awards are bestowed on select IEEE members with extraordinary accomplishments in any of the IEEE fields of interest. Less than 0.1% of voting members are awarded this distinction annually. David joins five other IEEE Fellows from BrownCS: Franco Preparata, John Savage, Roberto Tamassia, Eli Upfal and Andries van Dam.

ERIK SUDDERTH WINS NSF CAREER AWARD

Assistant Professor Erik Sudderth of Brown University's Department of Computer Science has just won a National Science Foundation CAREER Award for his work on Bayesian nonparametric learning for large-scale structure discovery. He joins multiple previous BrownCS faculty winners, including (most recently) James Hays, Ben Raphael, and Chad Jenkins. CAREER Awards are the most prestigious awards given by the National Science Foundation (NSF) in support of outstanding junior faculty teacher-scholars who excel at research, education, and integration of the two within the context of an organizational mission.

The motivations for Sudderth's research start with very large datasets, which could include anything from the videos available on YouTube to the complete corpus of *New York Times* articles. Parametric statistical learning algorithms work by tuning model parameters to match a user-specified list of properties, or "statistics," of the data. When these algorithms are used to analyze images and video, for instance, humans are required to laboriously collect examples of objects of interest (for example, people, cars, and buildings). "This puts real limits on what can be learned from even very big datasets," Erik explains, "because the model's structure has to be manually specified by experts."

A nonparametric model, however, allows its structure and complexity to be determined from the data itself, so it can grow naturally as the data grows. This allows for algorithms that are capable of "unsupervised" learning, and because less manual supervision is needed, such methods are much more broadly applicable. The real-world applications for models of this kind are almost limitless: helping computers analyze photographs to differentiate objects from their surroundings, or allowing robots to determine human cognitive states based on facial expressions, or finding communities within social networks by analyzing patterns of collaboration.

"Erik's innovative research is highly regarded in both computer science and statistics," comments BrownCS Department Chair Roberto Tamassia. "The prestigious NSF CAREER award is one more indication that Erik is a leader in the important field of Bayesian nonparametric statistical methods."

If laypeople find the mathematical and computational methods underlying this work a bit daunting, Sudderth already has their needs in mind. "We're very eager," he says, "to put useful tools into the hands of people who don't yet know what nonparametric methods can provide. The five-year term of the grant lets us take a long-term perspective and address the full data analysis process, from models to algorithms to usable software." In addition to supporting research, the CAREER grant funds a three-pronged outreach and education plan that includes: (1) an accessible Python software package to allow for easier data analysis, (2) interdisciplinary research projects involving undergraduate students with training in other sciences or the humanities, and (3) two week-long summer schools on Bayesian nonparametrics to be held at Brown's Institute for Computational and Experimental Research in Mathematics (ICERM).

Sudderth's colleagues are eager to see the project begin. "Erik does excellent work on all aspects of Bayesian nonparametric models," says Professor Michael Littman, "from devising new mathematical structures, to applying them to interesting problems in text and vision processing, to developing faster algorithms that handle larger and more complex problems, to providing toolkits so others can leverage these advances in their own work. I'm delighted that the NSF recognized his contributions and promise with a prestigious CAREER award."

"This is a big honor," Erik concludes. "This award is about making interdisciplinary links. It's vital for computer scientists to understand how our code and algorithms are challenged by complicated, messy datasets, and it's equally important for those in other fields to see how computer science can be used to help understand their data. I'm extremely excited."

MAURICE HERLIHY GIVEN IEEE COMPUTER SOCIETY WALLACE MCDOWELL AWARD

MAURICE HERLIHY NAMED MEMBER OF THE NATIONAL ACADEMY OF ENGINEERING

2000s

BrownCS 25th Anniversary

Justin Boyan, Michael Littman, Amy Greenwald

Eli Upfal, Walter Feldman, Franco Preparata

2000s

Ugur Cetintemel

Tom Dean, Norm Meyrowitz, Ed Lazowska

Deidre Ann Perry

2000s

President Ruth Simmons, John Savage, Anna Lysyanskaya

Eugene Charniak, Stan Zdonik

2000s

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MICHAEL LITTMAN HONORED WITH 2013 AAAI CLASSIC PAPER AWARD

The Association for the Advancement of Artificial Intelligence (AAAI) has selected the 1994 paper **Acting Optimally in Partially Observable Stochastic Domains** by Anthony R. Cassandra, Leslie Pack Kaelbling, and Michael Littman, then a BrownCS graduate student, for a 2013 AAAI Classic Paper Award. This award was established in 1999 to honor author(s) of paper(s) deemed most influential from a specific conference year. This year's award recognizes papers from the Twelfth National Conference on Artificial Intelligence that took place in 1994 in Seattle, Washington.

"Back in 1994," Michael explains, "we were fascinated by the idea that an agent can make optimal decisions in spite of not knowing all the facts. The math was originally developed in the operations research community, but we found that it was a perfect fit for the kinds of problems AI people are interested in addressing. These days, the notion of partial observability is a standard part of the AI vernacular."

"In academia, a 'classic paper' is one that changes the direction of the field," says Professor Eugene Charniak, "typically because it identifies a 'sweet spot'—a place where one can accomplish a lot without incurring overwhelming complexity. This paper is a classic 'classic paper.'"

PAUL VALIANT RECEIVES SLOAN RESEARCH FELLOWSHIP

Assistant Professor Paul Valiant of the Department of Computer Science has been named an Alfred P. Sloan Research Fellow in one of the oldest and most competitive fellowship programs in the country. He joins multiple Sloan Research Fellows in the Department, including recent winners Ben Raphael and Chad Jenkins. The fellowships are awarded to honor and promote the science of outstanding researchers early in their academic careers in physics, chemistry, ocean sciences, computational and evolutionary molecular biology, computer science, economics, mathematics, and neuroscience.

Selection procedures for the Sloan Research Fellowships are designed to identify individuals who show the most outstanding promise for fundamental contributions to new knowledge. For Paul, this takes the form of research at the interdisciplinary frontiers of what's come to be known as the "Big Data" revolution.

In contrast to the early years of computing, he explains, where processing speed was a severe limiting factor, we are now in an era where data is arguably the most powerful computational resource. Acquiring data is the one of the most expensive parts of science, and the potential contribution of computer science to these other scientific fields, from Paul's perspective, is through developing algorithms that make more efficient use of limited data.

This has considerable ramifications for, as just one example, genome sequencing: if new algorithms let scientists make the same inferences from one million dollars of genome data for which previous "data-inefficient" computational techniques needed five million dollars of genome data, then these new algorithms might significantly improve the pace of scientific discovery.

"In general," Paul says, "I'm led by my background in mathematics and physics to try and understand the intersection of computer science and other fields. How can we use the concepts and structures of information processing as broader investigative tools? For example, examining evolution as a computational process may help us understand the extraordinary reliability of biological mechanisms. I'm greatly interested in what computers can tell us about complicated problems in other sciences."

Sloan Research Fellowships have been awarded since 1955, and past recipients have gone on to win more than 38 Nobel Prizes, 14 Fields Medals (mathematics), and eight John Bates Clark Awards (economics). "I'm very grateful to receive a Sloan Research Fellowship at this point in my career and my research," says Paul. "The grant will enable me to continue to focus on new ways of conceptualizing the challenges of data, across a broad swath of challenges from theory to practice."

PEDRO FELZENSZWALB WINS IEEE COMPUTER SOCIETY TECHNICAL ACHIEVEMENT AWARD

Pedro Felzenszwalb, Associate Professor of Engineering and Computer Science, has been selected to receive a 2014 Technical Achievement Award from the IEEE Computer Society. Felzenszwalb will be honored "for the deformable parts model method of detecting objects in images and video."

The IEEE Computer Society Technical Achievement Award is given for outstanding and innovative contributions to the fields of computer and information science and engineering or computer technology, usually within the past ten (and not more than 15) years. Contributions must have significantly promoted technical progress in the field.

Previous Brown University recipients of the award include Roberto Tamassia, Plastech Professor of Computer Science and Chair of the Department of Computer Science.

STEFANIE TELLEX NAMED TO AI'S 10 TO WATCH

Assistant Professor Stefanie Tellex has been named to the 2013 **IEEE Intelligent Systems** list of AI's 10 To Watch. Stefanie's selection to this list was based on her research in probabilistic graphical models, human-robot interaction, and grounded language understanding.

In the home, in the factory, and in the field, robots have been deployed for tasks such as vacuuming, assembling cars, and disarming explosives. As robots become more powerful and more autonomous, it's crucial to develop ways for people to communicate with them. By combining methods from robotics and computational linguistics, Dr. Tellex has developed new ways to attack the problem of language understanding, leading toward robots that can flexibly communicate with people using ordinary language. The aim of her research program is to construct robots that use language to seamlessly meet people's needs.

"Stefanie's research exemplifies many of the best qualities of advancements in human-robot interaction," explains Professor Chad Jenkins. "Her work has broken new ground in its strong technical and computation contributions for crowdsourced natural language processing for robots married with a considerable emphasis on human-centered design and empiricism. Her talent for research is equally matched by her friendly, collegial, and thoughtful personality. I could think of neither a more deserving person for this recognition nor a better fit for the BrownCS community."

Stefanie also cites the importance of community: "The resources and potential collaborators make Brown a unique environment for creating robots that communicate with people using natural language."

The AI's 10 to Watch list was published in the January-February 2013 issue of **IEEE Intelligent Systems** to acknowledge and celebrate young stars in the field. The list is announced by the journal every other year. Nominations are sought from a wide range of senior AI researchers, and a short list of top candidates is voted on by the award committee. Decisions are finalized with the entire advisory and editorial boards of **IEEE Intelligent Systems**.

STEFANIE TELLEX RECEIVES SALOMON AWARD

TOM DOEPPNER RECEIVES PRESIDENT'S AWARD FOR EXCELLENCE IN FACULTY GOVERNANCE

The themes of collegiality and collaboration were unavoidable as colleagues and friends reflected on the news that Thomas W. Doeppner, Associate Professor (Research) and Vice Chair of the Department of Computer Science, had just received Brown University's President's Award for Excellence in Faculty Governance. He joins previous winner John Savage, who was honored in 2009.

"Tom is one of the elders of BrownCS," explains Department Chair Roberto Tamassia, "and this award really celebrates his vision. He has a tremendous understanding of Brown's educational and research mission, and it's led him to work individually with hundreds of students every year, getting to know their goals and ensuring that they're successful."

Over decades of service, Tom's commitment to students has inspired him to work with colleagues on numerous councils, committees, and boards, including the Information Technology Advisory Board (he served as Vice Chair), the Committee on Academic Standing, the College Curriculum Council (two two-year terms as Vice Chair), and the Academic Code Committee, which he chaired. The award recognizes this outstanding effort. It was established by President Simmons in 2007-08 to celebrate faculty contributions, past and/or present, to the University through service on faculty committees and advisory boards.

"Winning this award is humbling, and it comes as a surprise," Doeppner comments. "I just see myself as someone who enjoys new ideas, regardless of which Department they come from. I'm interested in the undergraduate program in general, and working on these committees has helped me get a better understanding of what's going on across the entire university."

Longtime colleague, Andries van Dam, praised Tom's concern for undergraduates as well as other members of BrownCS: "Tom is a tireless mainstay of both the physical and human 'plant' of the Department. Few people are aware of everything he does to keep us going."

If history is any indication, this award represents just another milestone as Doeppner continues onward to the next challenge. Citing just one example, he says, "I'm immensely proud of our undergraduate teaching assistant program. It gets students involved, and it teaches them an entirely different set of skills. I'd like to see the rest of the university adopt what we've done."

Department Chair Tamassia finds this pride to be completely justifiable: "If you ask an undergraduate who's running BrownCS, they might pick Tom! I hope he never retires, because I can't imagine the Department without him."

Faculty Milestones

ANNA LYSYANSKAYA PROMOTED TO PROFESSOR

Even after twelve years with BrownCS, the occasion of Anna Lysyanskaya's promotion to Professor is prompting colleagues and friends to look forward, not back. "Anna does high-impact work with incredible energy," says Department Chair Roberto Tamassia. "She's already been well-recognized in the early days of her career by the National Science Foundation, the Sloan Foundation, *Technology Review*, and

many others, and more great things are in store for her."

Interviewed in her office, Anna was excited by the promotion but spoke with equal passion about her subject: "The math behind my work is exciting. The only way to demonstrate the security of a cryptographic system is to prove it secure. It's also more important than ever. As we enter the age of Big Data, it's so tempting to let privacy fall by the wayside when figuring out things like genetic predisposition to illness is within our reach. But we have to think through this. We can make the same scientific discoveries while keeping privacy intact: we just need to use privacy-preserving protocols such as secure multi-party computation."

Anna's discovery of computer science began at Smith College, where she took a class in the subject and was later asked to become a teaching assistant. Cryptography became a major interest in graduate school at MIT. "I was delighted with the rigor of it," she says. "I fell in love."

Love of another kind followed when Anna went to a conference organized by Professor John Savage and met Timothy Edgar (currently a Visiting Fellow at the Watson Institute), who had worked for both the Bush and Obama administrations as a privacy lawyer. Wanting to impress him to ensure that public policy reflected state-of-the-art cryptography, she evidently did: the two went out for a drink, began dating afterward, and were eventually engaged. 2013 was a year of remarkable milestones for the couple: marriage, a baby, Anna's promotion, and a move to a new house on College Hill!

Over the past decade, Lysyanskaya has taught more than a half-dozen different courses, from CS 22 (Discrete Mathematics) and CS 151 (Introduction to Cryptography and Computer Security) to CS 256 (Advanced Complexity) and CS 259 (Advanced Topics in Cryptography). Awards for her teaching and research include an NSF CAREER grant, a Sloan Fellowship, a Google Faculty Research Award, and numerous others.

However, when asked to look back on her years at BrownCS, Anna picks something else: "Relationships and research are the most important thing. I'm proud of the research I've done and especially my mentoring. In particular, I think that women are looking for female mentors because they want to break self-perpetuating stereotypes that computer science is inward-looking and focused on gadgets, dominated by men. The reality is that women are drawn just as strongly to a life of action. We're motivated by making the world a better place."

Her relationships with colleagues have been equally important. Professor John Savage responded via e-mail: "Anna is a highly valued member of the cryptographic research community and of the Brown Computer Science faculty. In her research she has taught us that it is possible to create anonymous credentials, a highly secure system in which a person can demonstrate that they have the authority to access sensitive information without having to reveal their identity. Work such as this has become very important in the security conscience age. Anna is also a most effective teacher who works at the highest levels of scholarship and rigor. She is a great asset to Brown and the department."

Asked for any additional comments, Anna spoke eloquently on a topic that often doesn't receive much attention: "I want people to know that theory is cool. It should be becoming more important, not less. You can't demonstrate security through experimentation, you need theory. It points toward the best we can do, toward what's possible." We congratulate Anna as she looks ahead to many possibilities of her own.

FRANCO PREPARATA RETIRES

"Everything has to have a life cycle," says An Wang Professor of Computer Science Franco P. Preparata, speaking at his farewell address on December 5, 2013. "This is the first official step of my walk into the sunset."

Preparata's career spans more than a half-century, including twenty-three years with Brown University alone. It includes the publication of three books that have been translated into five languages; more than two hundred papers; numerous pioneering contributions to coding theory, computational geometry, design and analysis of algorithms, parallel computing, very-large-scale integration (VLSI) computation, and computational biology, including personal responsibility for the genesis of that last field at Brown.

Interviewed after the event, Franco notes with pride that he also co-created a monthly seminar that bridged the humanities and the sciences at Brown, featuring some of the most visible people on campus for an entire decade. On the night of his address, this love of interdisciplinary work, his many achievements in the field, and his passion for social change were all evident.

Department Chair Roberto Tamassia spoke first, expressing thanks to Preparata as a mentor (Tamassia was one of his PhD students) and colleague: "We are hugely grateful to Franco for his research and his educational leadership...we have greatly benefited from his strategic vision and academic wisdom." Franco, he explains, "sets such a high bar in multiple ways. Not only in his incredible research productivity, but as an amazing individual in many other dimensions... I am thankful to Franco for being a role model for me."

Preparata began by offering gratitude for the "hospitable home in which I have dealt with very congenial colleagues" for so many years. His remarks that follow trace the "extraordinary journey" that the field has experienced, highlighting technological and sociological issues through lenses that include memory, culture, and art. Franco frames his discussion as a narrative of the evolution of computer hardware: "The development of computer science was punctuated at all times, in my view, by the development of the corresponding physical support."

Preparata's experience with hardware began in the 1950's with his work on one of the first floating-point machines, the Mercury computer of Ferranti, Ltd. Its circuits consisted of thousands of vacuum tubes, Franco explains, "and the probability that things could go wrong was very high. Mean time between failures was

measured in terms of hours... How rudimentary, and yet how exciting it was, the computer at that time! It caught the public imagination and was popularly referred to as an 'electronic brain.'"

The era that followed, he maintains, was that of "differentiation" from computer science's two progenitors, electrical engineering and mathematics. Transistors emerged, providing much greater reliability. Higher-level languages and compilers freed programmers from writing in machine language, allowing algorithmic portability. "I remember the excitement," Franco recalls, when a distinct Department of Computer Science emerged at University of Illinois, where the ILLIACs had been conceived.

Next was the advent of the semiconductor and the integrated circuit, merging together vast assemblies of transistors and resistors, and giving birth to Moore's Law. Here Preparata pauses for a moment, returning to the theme of memory: "In our field, when a technology becomes superseded, there is no remnant, not even a memory of it."

The next twenty years, he explains, "could be described as the careful construction of the scientific profile of the field." Highlighting the concept of algorithm complexity and the "pivotal milestone" offered by the work of Stephen Cook, he maintains that Computer Science "came of age in the seventies, emancipated from its tutors, assuming the profile of a mature science."

Franco provides an interesting perspective on the era of the personal computer, in which very large-scale integration was coming onto the scene. Often remembered purely in terms of its potential, the 1980's also held considerable challenges for computer scientists. "Parallel computation at that time," he explains, "was funded by the federal government. When the Cold War came to an end, the funds dried up. There was an inflection of the community...it was a very somber moment."

The current age, Preparata says, is characterized by a cultural divide: "Anything that has a societal aspect is affected by the Internet, by this new technology. Computer science, while continuing to build its own structure, has become an enabler for any discipline... The question now: is it all good?" A desire for speed, for example, can become a threat to the intellectual quality of scientific results. The tremendous facility of e-mail, Franco believes, is available to us only after sacrificing a substantial amount of privacy.

These problems, he maintains, require action: "Income inequality is an incredible societal problem, and solutions don't exist or are ineffective... Computer science is playing a central role in society today. I have no answers, but I'm exhorting my colleagues to consider themselves as actors in society, not just providers of tools and services... Take an active role!"

At the end of his remarks, Franco returns to the happiness he found in hard work and collaboration: "I remember the satisfaction at the long hours in the classroom, the long hours with my students, and the honest and respectful debate with congenial and like-minded colleagues." He also mentions a cultural contribution to BrownCS, explaining that he "instigated" the artwork hanging in the CIT to this day.

"See it," he requests, "and remember that I was at some time a member of this department."

After a few questions, the address is over, the exhortation to remember still hanging in the air. It's all the more poignant in light of his earlier words: "In our field, when a technology becomes superseded, there is no remnant, not even a memory of it."

In just a few months, at the start of the semester, a new cohort of students will arrive ready to act, to address the challenges that Franco outlined. They'll sit in atrium sunlight; they'll gather at tables and in classrooms. They'll see the artwork. If they don't yet know who Franco Preparata is, their professors will tell them.

FRANCO PREPARATA RETIRES: A TOAST TO PROFESSOR FRANCO PREPARATA WITH THE OCCASION OF HIS FAREWELL LECTURE ON DECEMBER 5, 2013

by Sorin Istrail

We professors have a very privileged life. To be part of the Brown University faculty and to teach Brown students it is an honor. To realize what an intellectual Camelot Brown is, and the Department of Computer Science in particular, with a crystal clear measure of success in hand, one could just look at Brown alumni leaders of this world. To be precise, I define the "Brown number" for an institution/corporation as the position closest to the top of an employee with a Brown University degree; the president/CEO gets Brown number 0; the vice president gets Brown number 1, and so on. In my eight years at Brown, I have been enjoying discovering the statistics of the beautiful "Law of Small Brown Numbers." Together with privilege, however, comes responsibility. What are the values that our Department should transmit to the next generation? What is in the DNA of our Department of Computer Science so to speak? The occasion of this Farewell Lecture is a proper time for such a reflection.

I turn often to our national asset, my dear friend and mentor, and colleague next-door, Franco. He is our guardian of highest standards. With his gentle, Renaissance approach and intellectual honesty as critical commentary, he makes it clear to me, always, that we are here not because it is easy, but because it is hard. Franco's work principles should inspire some of the ones that we aspire to encode in our Department DNA.

So what are Franco's Axioms:

Axiom 0. Be in love with Algorithms
Axiom 1. Champion Rigor: Know a lot—really a lot—of mathematics
Axiom 2. Be a first-class scientist in at least one of the disciplines of your interdisciplinary research
Axiom 3. If you can't say anything good about someone don't say anything at all
Axiom 4. Art is important: build cross-culture bridges between the Mathematical and Physical Sciences, Humanities and Social Sciences
Axiom 5. Be the guardian of the highest standards

But these axioms are also John von Neumann's axioms. The two are Renaissance scientists of highest stature, with singular technical achievements that inspire us and our students, through their life work, to work hard, so one day when we grow up, to be like them.

Dear Franco: Thank you for everything!

JAMES HAYS NAMED MANNING ASSISTANT PROFESSOR

BrownCS is delighted to announce that James Hays has been appointed Manning Assistant Professor of Computer Science. The University's endowed assistant professorships recognize the achievements of promising junior faculty members.

"I am honored to be named a Manning Assistant Professor," says James. "This endowed position will help support new research directions for me and my students."

Hays' research interests span computer graphics, computer vision, and computational photography. His research focuses on using "Internet-scale" data and crowd-sourcing to improve scene understanding and allow smarter image synthesis. Examples of recent research projects include: recognizing human sketched objects by learning from crowdsourced training data, restoring blurry photographs by modeling natural image statistics, and localizing photographs by predicting their overhead appearance and searching satellite imagery.

As Professor John Hughes explains, "James Hays has been doing really exciting work in both computational photography and at the boundary between computer graphics and computer vision, on areas as diverse as determining the age of color images, writing a program that can recognize human sketches (think 'Pictionary'), and learning to determine image attributes like 'indoors' or 'man-made' or 'socializing'. At the same time, James has developed courses in these areas that have energized students and led to multiple publications for them in top-rate venues. He's really the model of a Brown professor, balancing teaching, research, and service, and he's the ideal choice for the Manning Assistant Professorship."

JEFF HUANG JOINS BROWNCS FACULTY

A few months shy of his one-year anniversary as assistant professor, Jeff Huang sat down with us to reflect on his experiences as the newest member of the BrownCS faculty. In the brief sketch below, he walks *Conduit* readers through the opportunities and choices that have helped him navigate an unconventional path between the corporate and the academic, the theoretical and the practical.

An interest in computer science began early for Jeff, when his father decided to pursue a PhD at the University of Saskatchewan. (A well-worn Artificial Intelligence textbook by Eugene Charniak was on the family bookshelf.) "Getting exposure to the early Internet had a huge impact for me," Jeff says. "These were the days when a site talking about '15 Cool Links For Kids' was probably listing everything kid-related on the entire Internet!"

Jeff explains that his current interests are largely based on the opportunities he was presented with early on in his studies. As a sophomore at University of Illinois, a friend was doing research in human-computer interaction (HCI), and asked Jeff to collaborate. Later, a favorite professor's research sparked an interest in data mining and information retrieval.

Even before graduating, Jeff was moving toward the corporate world, interning for Motorola, Microsoft, and then Google. "On the cusp of graduation," he explains, "I felt like my knowledge was very compartmentalized, like I was trying to design an entire house one room at a time. I wanted to get out in the field and see it as a whole. Making something new had a big appeal."

A stint at Yahoo was next. "I had already interned for two of the three big search engines," says Jeff, "so I couldn't pass up the opportunity to understand search like few other people do." But being able to think about problems more deeply was more attractive than chasing deadline after deadline. A desire for permanence, for not having one's work routinely thrown away at the end of a business cycle, sent him back to academia.

"I applied to PhD programs at eight schools and was rejected by all of them!" he laughs, crediting a 2007 paper ("Graphstract: Minimal Graphical Help for Computers") written with Professor Michael Twidale of University of Illinois with helping him eventually gain admission to University of Washington a year later.

What has kept Jeff's interest in the academic world? "Having the flexibility of choosing problems," he says. "More than anything else, working with smart people. What I'm doing now is really a convergence of my past experiences: HCI from my undergraduate and early graduate work, and search from my industrial background with Google, Microsoft, and Yahoo."

The decision to sign on with BrownCS after receiving offers from several competitors is something that he's never regretted. "I'm comfortable here. I had Andy van Dam's support, which meant a lot, and I knew the collegiality was real. Every school says that they're excited about teaching, but Brown actually had policies in place that made the claim true. People are excited about their work. It's not bean-counting."

Professor Steve Reiss feels the same excitement. "It went extremely well," he says about partnering on CS1950i (Designing, Developing, and Evaluating User Interfaces) with Jeff. "I hadn't co-taught in a while, and I really enjoyed working with him. He's very visual, and he gets students interested and keeps them interacting throughout the lecture."

Why are students participating so eagerly? The heavily-accessed "Ph.D. 2.0" resources on Jeff's web page ("Rethinking the Ph.D. Application" and "Adopting the Startup Culture for Research") may offer a glimpse of the insight won through an unconventional career and the benefits it has for future computer scientists. According to Jeff, the academic world isn't a startup, nor are its rules the same, but the energy and the desire to focus on the most challenging problems are identical. "Opportunities come here," Jeff explains. "Opportunities are created here."

STEFANIE TELLEX JOINS BROWNCS FACULTY

She wants the computer to talk.

In the year when Tim Berners-Lee first conceived the World Wide Web, the year of the first unofficial text message, a brown-haired girl is programming in BASIC on her father's Intel 486 by typing verbatim out of a book. More than two decades later, in 2013, she'll join BrownCS as an assistant professor, but for now, her goal is the program known as ELIZA, one of the earliest examples of natural language processing.

"It never worked!" laughs Stefanie Tellex. Like many of us, her early programming efforts were hampered by syntax errors sometimes caused by a single typo buried in hundreds of lines of code. Unlike most, she stuck with it.

"I wanted to make the world a better place," Tellex explains. From her early childhood, her approach was intensely pragmatic. "I assessed my skills to find out how I could break new ground, and I thought my engineering and programming skills were the strongest. Then I thought about what I wanted to research. When you look at the progression from mainframes to desktop computers to smart devices, these things help us observe the physical world. Robots help us change that world. It's staggering when you internalize this."

Stefanie came to BrownCS after completing a PhD at the MIT Media Lab and doing postdoctoral work in the MIT Computer Science and Artificial Intelligence Laboratory. Her first six months in Providence have been busy: she's currently teaching CSCI 1410 (Introduction to Artificial Intelligence), and recently won a Salomon Faculty Research Award to fund the creation of an entire prototype perceptual system that she sees as a necessary first step before robots can assist with childcare or perform other key tasks.

Asked about her BrownCS experience, Tellex is enthusiastic: "I love it here. I came from MIT, and I feel like people talk about it with this sense of awe, but MIT is more of a bubble. At Brown, I talk to other people, I think about things in different ways. That wouldn't happen elsewhere." More specifically? "Look at our undergrads! They're excited, mature problem-solvers already contributing to my lab. UTAs are a huge resource for someone new to teaching, because they let me bounce ideas off people. It's a beautiful, unique program."

Stefanie also cites the "energy" around robotics and human-robot interaction that comes from colleagues like Michael Littman and Chad Jenkins. Interviewed in his office, Littman is equally excited: "Stefanie brings a fantastic blend of skills that span the entire space of artificial intelligence, from perception to natural language to robotics. She helps guide the community back to the grand vision of the field while making full use of modern techniques and perspectives. She's accomplished incredible things already."

We think the ten-year-old Stefanie Tellex would agree.

Eugene Charniak and members of the Class of 2011

2010s

Jane McIlmail

2010s

2010s

Chinua Achebe, Eugene Charniak, Ike Achebe, and students

Members of the BrownCS faculty, 2014

2010s

Anna Lysyanskaya and Marie Edgar

Help Keep Artemis Running Strong

BY KARISHMA BHATIA AND APRIL TRAN

Project Artemis needs your help!

Professor Amy Greenwald is looking for donations to help fund the nineteenth year of Brown's free, five-week summer day camp in which Brown women undergraduates teach rising 9th grade girls about the wonders of computer science and technology.

"Please read the testimonial to the right," she says. "We're looking for annual supporters, and every contribution helps. This program is a leadership opportunity for our Brown women, who hone their computer science skills through teaching. But more importantly, it's a uniquely intensive computing program for the girls. We provide five weeks of quality education, and an opportunity for girls to connect with other girls who like computers."

Please contact Lauren Clarke (lauren_clarke@brown.edu, 401-863-7655) with donations or any questions.

OUR ARTEMIS EXPERIENCE

On the surface, Artemis is a summer program geared towards teaching young girls computer skills, programming, and computer science concepts through a challenging curriculum. Yet to the individuals that actually go through the Artemis experience, we learn that Artemis is much, much more.

Yes, the program is about learning the science behind the modern machines we use every day, but perhaps just as important, it helps the amazing young ladies that attend Artemis to build confidence in themselves, in their ability to build relationships with others, and their capacity to self-learn. Though we can only possibly glimpse a portion of what the Artemis experience is like for its students, as directors we have learned life lessons and gleaned inspiration from our young students.

As college undergraduates, in the midst of juggling multiple exams, papers, and projects, we often forget what it means to learn. Gone are the days in which making a small mistake for the sake of learning doesn't cost you a letter grade. Many of us no longer have the privilege or courage to test a teacher's or parent's patience with question upon question. We may never again have the opportunity or time to take complete advantage of our curiosity by letting our minds wander for hours or even days.

Looking back, we realize just how valuable and precious such experiences were in our growth as students, innovators, and individuals. More broadly, we realize how important it is for our society—especially in academic institutions—to create such learning environments for youth in the community while continuing to encourage them to pursue their interests.

Artemis started as a program for inner-city girls entering ninth grade to learn computer science. This year, we focused on making Artemis a program that helped students not only discover computer science, but discover a creative way to use the concepts they learned in their own hobbies and interests.

Sometimes that meant a student realizing she had a knack for web-design and building a website featuring the work of her favorite artist. Other times, it meant a student realizing she was a poet and building a website featuring her own work. Artemis helped these girls build confidence in their own skills and talents while adding to them.

How can we put into words the beauty of Iris's glowing smile when her friends praised the personal works she put on her website? The sense of accomplishment Jamie had watching the game she built in Scratch run perfectly? Or the surge of confidence Desiree felt presenting her final project to a crowd of parents? How can we describe the satisfaction of seeing the understanding on our girls' faces after we explained a difficult concept?

By creating a positive association to computer science for our Artemis students, we ensure that they will not shy away from using technology to build creative solutions to relevant problems. They will not forgo their passions, they will not forget that they are capable of finding friends in the most unlikely people, and most importantly, they will not fear the challenge of learning something new.

Kanellakis Fellows Visit Argyroula Kanellaki

Roberto Tamassia, lecturer John Kleinberg of Cornell University, Evgenios Kornaropoulos (Brown), Irina Calciu (Brown), Alexandra Papoutsaki (Brown), Georgios Papachristoudis (MIT), Yola Katsargyri (MIT), and Michail Michailidis (Brown) at the Kanellakis Memorial Lecture

Current and former Kanellakis Fellows maintain the fond tradition of visiting their benefactor, Argyroula Kanellaki, whenever they are in Athens. "Mrs. Argyroula," who likes to call the fellows "her kids," always welcomes them heartily and shares stories of Paris's life.

The Paris C. Kanellakis Memorial Fellowships and the Kanellakis Memorial Lecture honor Paris Kanellakis, a distinguished computer scientist who was an esteemed and beloved member of the Brown University Department of Computer Science. Paris joined the Department in 1981 and became a full professor in 1990. His research area was theoretical computer science, with emphasis on the principles of database systems, logic in computer science, the principles of distributed computing, and combinatorial optimization. He died in an airplane crash on December 20, 1995, along with his wife, Maria Teresa Otoya, and their two young children, Alexandra and Stephanos Kanellakis.

Record Number Of BrownCS Students Attend Growing Grace Hopper Conference

BY LAYLA OESPER

This past October thirteen Brown undergraduate and graduate students attended the Grace Hopper Celebration of Women in Computing (GHC) in Minneapolis, MN. The conference has grown tremendously in recent years with ~4800 people gathering at the Minneapolis convention center for the 2013 edition.

"GHC was an amazing opportunity for women of all ages (ranging from first years interested in potentially majoring in computer science to experienced professionals) to meet, encourage, and exchange ideas with one another," says current master's student Jackey Lane. Even though the conference is aimed at celebrating women in computing, men are also welcome to attend.

"It was an illuminating experience (and a lot of fun)," says Connor Gramazio. "It is not often that I feel like a minority as a white male computer science PhD student. That feeling alone was powerful, but the stronger lessons were somewhat more basic and fundamental: be inclusive, be thoughtful, be considerate."

The students from Brown received funding to attend GHC from a variety of different sources, including four scholarships handed out by the department diversity committee as part of a new initiative where scholarships are awarded to students to attend conferences that are either aimed at underrepresented groups or address issues related to increasing diversity in the field. Due to the hard work (and networking skills) of a few current students (Betsy Hilliard, Molly Long and Julie Mond) several other students were supported by generous fellowships for BrownCS students from Yahoo! Labs, Adobe and Microsoft.

In addition to sending a large contingent of students, 2013 was the first year that Brown hosted a booth at the GHC career fair. The booth, sponsored by the Brown Department for Institutional Diversity, was completely staffed by current students who handed out informational material about the department and collected resumes from potential applicants to the graduate program.

All students who submitted a resume were entered in a drawing to win Brunetta the Brown Bear (and her fashionable Department of Computer Science t-shirt). Brunetta (distant relation to Bruno) was easily the most popular bear at the conference. "I think the Brown booth was a success. Several of the women who stopped by our booth applied and got accepted to the PhD program! Brunetta may be returning to Brown!" says Betsy Hilliard. The booth also provided a great meeting place for current students to meet and catch up with alumni.

Current graduate students Irina Calciu, Betsy Hilliard, Hannah Quay-de la Vallee, Jackey Lane, and Layla Oesper hanging out at the Grace Hopper Conference dance party

The 2014 Grace Hopper Conference marks the twentieth anniversary of the inaugural conference and will be held in Phoenix, AZ. The department diversity committee plans to once again offer scholarships for students interested in attending. With all the success of last year's conference, we hope to send even more students this year and to reconnect with even more Brown graduates.

Recent PhDs

CLOCKWISE FROM TOP LEFT

Andy Pavlo, David Eisenstat, Andrew Ferguson, Aggeliki Tsoli, Olya Ohrimenko, James Jablin.

NOT PICTURED

Jadrian Miles, Matteo Riondato, Eric Sodomka

Roberto Tamassia Steps Down *Continued*

Christos Kapoutsis, Evgenios Kornaropoulos, Alexandra Papoutsaki, Nikos Triandopoulos, Roberto Tamassia, Maurice Herlihy, Cynthia Dwork, Bruno Harris, Foteini Baldimtsi, Michail Michailidis

Associate Professor (Research) Tom Doeppner has worked more closely with Roberto than most, recently serving as Vice Chair. "Roberto is successful as a diplomat," he explains, "because he's amazingly precise, so good with spreadsheets. He does his homework and builds such a strong case with the data that it's impossible to argue with him."

The seven years weren't without their struggles. "The competition for talent is global now," says Roberto. "The world is realizing that America is not a default destination for academic excellence." In addition to seeing enrollment almost triple, BrownCS has faced financial challenges: "We've had to increase revenue generation and manage costs. I had to conduct a difficult experiment: can we reduce significantly our expenditures? It was done for the right reasons as soon as I started as Chair in 2007-08, as clouds were thickening on the financial horizon, and it worked. When the crisis hit, BrownCS was ready to withstand a prolonged financially challenging period."

Ugur agrees: "Roberto is very competent with finances. He built a very strong base, with two separate streams: the Master's program and the Industrial Partners Program. His leadership was key."

Tom Doeppner credits Roberto's thoroughness for his financial success: "He takes everything seriously, and he has a concern for detail. We've already looked at multiple floor samples for the renovation of Room 368, but instead of going ahead with something inferior, he's asking to see more." Roberto is also unafraid to get his hands dirty. Tom relays the story of how Roberto personally removed a large set of built-in bookshelves in the 4th floor Library to avoid the cost of having the work done professionally.

But there's an additional dimension to these financial achievements. "I've championed diversity," Roberto explains. "We managed to keep the Artemis program alive, even when support was hard to come by. It's vital that we counter the stereotypes and continue encouraging young women to join our field." Other successes are personal: "I'm proud that I've kept my research program active. Since I became Department Chair, I've published five books, over three dozen research articles, and continued teaching throughout. But most importantly, during this period, I had the privilege to work with six great PhD students: Danfeng Yao, Charalampos Papamanthou, James Kelley, Olya Ohrimenko, Esha Ghosh, and Evgenios Kornaropoulos. I am grateful to them for brightening my days with engaging research discussions and for patiently adjusting to my ever-shifting schedule."

What does the future hold for Roberto? First, a sabbatical, and then he's looking forward to more research and teaching. "I want to thank all of BrownCS and all of Brown," he says. "The faculty and students, our AStaff and TStaff."

Franco Preparata and Roberto Tamassia

"I am especially grateful to Franco Preparata, John Savage, and Andy van Dam," adds Roberto, "for their invaluable advice and support. I am also indebted to Ugur Cetintemel, Maurice Herlihy, David Laidlaw, and John Savage for serving as Executive Committee members. Additional thanks go to Ugur Cetintemel, Amy Greenwald, John Hughes, and Shriram Krishnamurthi for their contributions to our Industrial Partners Program, Artemis program, faculty recruitment, and PhD Program, respectively." Roberto continues, noting that "Tom Doeppner has been an outstanding collaborator as Vice Chair, Director of Undergraduate Studies, and Director of the Master's Program. Tom and our wonderful staff members, expertly led by Jane McIlmail and Jeff Coady, deserve major credit for the success of the Department. I particularly enjoyed working closely with Jane, Jeff, John Bazik, Lauren Clarke, Mark Dieterich, Jesse Polhemus, and Amy Tarbox. Finally, a huge thanks goes to Janet Eager and Angel Murakami, who have been super-efficient executive assistants."

Roberto's tenure as Department Chair has spanned two generations of University leaders. He thanks them as well, stating, "I had a great relationship with Deans of the Faculty Rajiv Vohra and Kevin McLaughlin, Vice Presidents for Research Clyde Briant and David Savitz, Dean of the College Katherine Bergeron, Deans of the Graduate School Sheila Bonde and Peter Weber, Provosts David Kertzer and Mark Schlissel, and Presidents Ruth Simmons and Christina Paxson. The Department has benefited from their steady support over the years. I would like to also thank Associate Deans of the Faculty Janet Blume and Carolyn Dean, Chief Information Officers Mike Pickett and Ravi Pendse, and Dean of Continuing Education Karen Sibley."

Roberto's colleagues return the sentiment with true warmth. Professor Franco Preparata, commenting on decades of friendship and collaboration, says, "First, he is a good scientist, enterprising and well-prepared. But he enjoys whatever he devotes himself to. Even I was surprised by the extreme energy and enthusiasm that he brought to this role." John Savage agrees: "Roberto is to be congratulated, especially since he has retained his good humor and perseverance throughout."

When asked to look ahead to Ugur's term as Department Chair, Roberto finds a moment for a little levity. He points to the simple wheeled cart that supports his computer monitor: "Other than buying that, I didn't renovate the Chair's office. Ugur is probably disappointed!"

He declines the offer of giving any advice to his successor: "I'm thrilled that Ugur has agreed to serve as the next Department Chair. It's his vision: he has a lot of wisdom, is scientifically highly accomplished, and is a stellar teacher. He has all the right qualities, and he's a great collaborator with collegial spirit."

"I'd like to thank Roberto," Ugur responds. "I benefited so much from his open door throughout this extra year. We're all in a much better position. Even after my term starts, I'll e-mail him, I'll knock on his door." He pauses for a moment, then makes a statement that many have echoed recently: "Roberto is someone I always want to work with."

Around the Department

Above // Students celebrate Pi Day (3.14)

Guided by Professor Steven Reiss, his sartorial choices reflecting the holiday, CS 132 students present posters and evaluate each other's work on Saint Patrick's Day, 2014

The BrownCS family at the 2013 Holiday Party

Alumni Update

ALUMNA DANAH BOYD PUBLISHES A NEW BOOK: IT'S COMPLICATED

Sprawled on a couch in his office, Professor Andries van Dam looks out the window. "Our grads break the mold," he explains. "We don't just produce academics, or software engineers."

Along with other successful alumni, van Dam is describing danah boyd, whose new book (**It's Complicated: The Social Lives of Networked Teens**) has just been published by Yale University Press. Already widely praised, it offers a carefully-researched and nuanced look at the online social behavior of young adults, informed by boyd's background in both technology and sociology.

Reached by phone, danah explains that she began her studies in math but branched out into the social sciences. "I came to Brown," she says, "looking for a place to do whatever I wanted. It wasn't an obvious choice, and I remember being less than totally supported. When I first came home with a Brown t-shirt, people thought it was a color, not a school!" Professor van Dam, randomly assigned as her first-year advisor, was the "critical character" who provided support. "Andy pointed me to people he thought I'd find interesting. He yelled at me to go back to grad school and put me in touch with Peter Lyman at Berkeley."

danah's work with Professor Lyman and the Digital Youth Project was an important foundation for **It's Complicated**, whose title reflects the book's insistence on nuance. "It's easy to reduce complexities," she says, "but so unhelpful. My research wasn't just about destroying myths, because myths have their roots somewhere. But I couldn't responsibly say that these issues are easy issues."

Her book, boyd writes, is an "attempt to describe the networked lives of teens to the people who worry about them." That final verb is significant: her knowledge of youth culture, acquired through seven years of research, allows her to pare away the irrational fears, media exaggerations, and stereotypes that could otherwise contaminate that depiction. As a society, boyd argues, instead of addressing issues such as bullying, self-harm, or racism, there's a constant temptation to focus on the technology of social media and not its content. "Technology doesn't make all these issues worse," she explains, "it makes them more visible. Technology is a frame, and we've become obsessed with the frame."

The insights gleaned from boyd's experience with designers and developers of social media technology are equally intriguing. They offer some implicit lessons for computer scientists: "All these technology-mediated tools will complicate every aspect of our lives. We should be aware of how the technology we build helps shape society. It should impact our design." There's an educational aspect as well. "Teaching algorithm theory is very important," danah explains. "Saying 'oh, it's just math' doesn't do it. Search engine results play a strong role, for example, in determining how you get an offer for your health insurance. We need people who understand the cultural work of algorithms."

Professor van Dam is unstinting in his praise of danah and her efforts: "She's a leader in her field and I'm proud to consider her a friend." *Conduit* readers who share boyd's technological background and her concern for young people may well find **It's Complicated** a perfect place to begin that cultural work.

ALUMNUS DICK BULTERMAN RECEIVES SIGMM AWARD

Conduit congratulates alumnus Dick Bulterman for winning the Association for Computing Machinery (ACM) Special Interest Group on Multimedia (SIGMM) award for Outstanding Technical Contributions to Multimedia Computing, Communications and Applications in 2013. "I'm really charmed to be part of this notable collection of winners," says Bulterman. "It's an honor."

Currently a Professor of Computer Science at Vrije Universiteit and Research Group Head of the Distributed and Interactive Systems at Centrum Wiskunde & Informatica (CWI) in Amsterdam, Bulterman attended Brown toward the beginning of his career, earning an Sc.M. in applied mathematics in 1977 and a Ph.D. in computer science in 1982. What were those early days of BrownCS like? "Oh, the sense that all things were possible. It was smaller, of course, and very personable," he notes, "with great access to faculty. I remember the long walk up to the third floor to see Andy van Dam, then the adrenaline rush from his rapid-fire comments."

Professor Andries van Dam has followed Bulterman's career closely over the years: "He's a true pioneer. He's done extraordinary work with multimedia and is extremely visible in the field."

Asked about his research, Dick explains that he started out in computer graphics but was always interested in the temporal component. "We're confronted with parallelism," he says. "Even when you're building a circuit, time is not an abstraction." This interest has led to wide-ranging contributions to the field of multimedia, from media annotation to social sharing to promoting international standards for authoring and presentation. The SIGMM award recognizes his contributions in these areas, including development of the CMIF document structure and CMIFed authoring environment, the Amsterdam Hypermedia Model, and the GRiNS editor and player, among many others.

"This really provides recognition for my Amsterdam group," Bulterman explains. "Systems-based multimedia is getting some attention, and it's so important. We're no longer lone wolves crying in the night." Not content to rest on his laurels, he's returning to the United States in July to lead the Fuji Xerox Palo Alto Laboratory (FXPAL). "It's a good incentive to renew my ties to Brown," he says.

Andy van Dam is looking forward to seeing more of his colleague and old friend: "Dick richly deserves this award. He's the personification of achievement and the engaged life."

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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.

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