# Conduit

## Middle-Schoolers Are Ready, Ready, Ready for Programming Adventure

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# Notes from the Chair: the Latest News from 115 Waterman

Greetings to all CS alums, supporters and friends.

The spring semester is flying by and the CIT is bustling with activity. Wonderful things continue to happen in the department and I am thrilled to be able to share the highlights with you.

As part of a review of all departments and centers being conducted by the university, our department underwent a review late last semester. We are encouraged that strengths were found in all major dimensions of research, teaching, administration, and outreach. Based on feedback from the reviewers and from the university's Academic Priorities Committee, we plan to broaden the horizon of our strategic planning efforts and to experiment with new models of departmental governance.

I am excited to report that our enrollments continue to climb. Overall enrollment is up 12% from the previous academic year and up a whopping 38% from the 2007-08 academic year. We are thrilled that so many students have taken an interest in our program and hope to continue to see that number climb over time.

Congratulations are in order for Philip Klein, who has been named a Fellow of the Association for Computing Machinery for his work on graph and network algorithms. We are delighted to see his research leadership recognized by this prestigious honor.

Several new courses are being offered this semester, including Computational Topology with John "Spike" Hughes, Creating Modern Web Applications with Steve Reiss, and Cybersecurity and International Relations with John Savage. Also, Pascal Van Hentenryck's course on Solving Hard Problems in Combinatorial Optimization has been redesigned. You can read more about Pascal's and Spike's courses on page 20. Look for more information on John's course in the next issue of Conduit.

Congratulations to Tom Doeppner and Pascal

Van Hentenryck on their new books: Tom's Operating Systems in Depth: Design and Programming and Pascal's Hybrid Optimization: The Ten Years of CPAIOR. My book Introduction to Computer Security (coauthored with Michael Goodrich) was also recently published.

We are thrilled to add these three volumes to the department's library of faculty-penned books. More on Pascal and Tom's books can be found on page 14.

It is with mixed feelings that I announce the departures of Michael Black and Meinolf Sellmann. Both have moved on to exciting opportunities: Michael is a Director of a newly established Max Planck Institute in Tübingen, Germany and Meinolf is the Group Leader of AI for Optimization at IBM Research in Yorktown Heights, New York. We will miss them as colleagues and we wish them continued success in their new endeavors.

We'd also like to congratulate Lawrence Larson on his appointment as the School of Engineering's founding Dean, effective July 1, 2011. Dr. Larson is currently the Chair of the Department of Electrical and Computer Engineering at the University of California, San Diego and is the first holder of the Communications Industry Chair. He is an expert in microelectronics technology and wireless communications. The department looks forward to a strong partnership with the School of Engineering.

Finally, please share your professional and personal stories for inclusion in upcoming issues of Conduit. Your support of and participation in departmental activities are always appreciated and we are grateful to have such a close community—thank you!

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

## FEATURES

## FACULTY

## DEPARTMENT NEWS AND HAPPENINGS

## ALUMNI

# CS WOMEN TAKE EXCEPTION TO BEING TYPECAST By Nell Elliott and Alexandra Schultz

(We wrote this piece to address misconceptions in the *Brown Daily Herald*'s February 16 article *"Algorithms Can't Solve CS Gender Gap,"* by Sahil Luthra. Note that "we" refers to the co-authors, not "every woman in Brown's CS department"—we two don't claim that all female computer scientists feel exactly the way we do. However, the number of professors and students who asked us to write this, as well as the amount of positive response we received, speak to the widespread discontent at the *Herald*'s gross misrepresentation of Brown's CS department, being a female computer scientist, and the field of Computer Science in general.)

The Herald illustrates a national deficit of women in computer science by citing the CS enrollments at Brown and other schools. There's no arguing with the numbers, but speculating about the cause of the problem through numbers alone is an inherently misguided and error-prone approach. Thus, it's not surprising that the *Herald's* article lacked an eye-opening, fair, or even accurate depiction of being a female CS student. Like many writings on this topic, the article discusses the underrepresentation of women in the sciences, and how it can be difficult to be a woman in a field largely comprised of men. Yet it says nothing about the positive experiences of female CS students – students like us.

Before we address the "women in CS" topic, it's important that readers understand what exactly CS is. Put simply, CS is problem solving that is carried out through the use of computing power. It's much more than sitting at a computer and programming – it requires an understanding of how to store and manipulate information; how to model both real-world and abstract, theoretical problems; and techniques to solve these problems in practice. In discussing an introductory CS class at Harvey Mudd, Luthra claims that "the focus of the class switched from Java programming to computer-based problem solving." This misguided statement only perpetuates the misconception that CS is equivalent to programming, and that programming and problem solving are discrete entities. In fact, one writes programs as a *problem-solving tool*; for example, students in CSCI0150, Brown's largest introductory CS class, formulate and implement problem solutions as programs in Java.

Next, we want to clarify what it's actually like to study Computer Science at Brown; fantastic! Being a computer scientist is incredibly challenging, fun, and rewarding. Despite the widely propagated stereotype that programmers are Mountain Dew-guzzling, Dorito-inhaling, anti-social hermits, our department is a close-knit group of genuinely friendly, passionate people. Between the two of us we have TAed nearly every incoming student over the past three years, and an overwhelming number of our students have remarked upon the department's sense of community. When surrounded by such a welcoming atmosphere and immersed in fascinating projects, why should it matter that fellow females are few and far between?

Which brings us to the question: what is it like

to be a woman in CS at Brown? Honestly, being women in the department simply does not define our experiences here. In fact, the top five groups within the CS department with which we identify do not include "women in CS." We two identify more strongly with, for example, other TAs and Microsoft interns: engaged and passionate members of the department. Only things like the Herald's distorted characterization of the gender imbalance make us feel stigmatized or like outsiders. Rather than heeding a reporter who has no personal experience as a woman in science or as a CS concentrator, but who nevertheless labels women as people fighting to belong in a field where they are underrepresented, we encourage you to consider some facts:

The eight women graduating from the CS department this year have 33 total semesters of TA-ing experience. All eight have been a TA for at least one CS class, five have been a Head TA at least once, and for the last two years one has been a "Meta TA," responsible for facilitating the program of ninety TAs. Additionally, three work as consultants who fix technical problems that students encounter in the computer lab. This is not to say that our department lowers its standards for women and other minorities – all eight have accepted jobs at major tech companies for next year, and all are esteemed by peers and professors alike as noteworthy department members. This substantiates our claim that being a woman isn't a handicap: our fellow female CS students all excel and stand out as high-achievers in one way or another.



Nell Elliot and Alex Schultz have been known to consume Doritos and Mountain Dew on Occasion.

There are fewer women than men in Brown's CS department. Yet, quantity and quality are not one and the same. The excellence of female students' departmental contributions is in no way limited by the number of female students—nor is our love for the subject. Articles that broadcast the unflattering statistics regarding women in CS and fixate on the trials and tribulations they face, but that do not also mention their joys and successes, is a damaging and reactionary way to dishearten potential computer scientists. The two of us love what we do and want others to join us, not for the sake of boosting the numbers, but so that they can experience first-hand a subject that is uniquely exciting and rewarding. We sincerely hope that after reading this piece, no student – male or female – feels discouraged from exploring the fascinating field of CS.

# Middle-schoolers are ready, ready, ready

school children.

By: Richard Lewis, Brown PAUR



**The thing about video games: they're complicated** Kurt Spindler, right, and Shaopeng Zhang work with Diamon Curry, a student at Gilbert Stuart Middle School, during a lesson on programming. *Credit: Mike Cohea/Brown University*

## for programming adventure

Bootstrap, a nonprofit educational organization, pairs Brown undergraduates with middle-school students in Brown computer classrooms. The kids show up after school to learn how to make animations, video games, and other cool stuff. What they're actually getting is substantial help with mathematics.

Madavin Vong's eyes lit up as the blue rocket spewed a puff of cartoonish smoke and lifted off on her computer screen.

"Yeah!" she exclaimed. "We did it!"

The 11-year-old Vong was excited because she had mastered the computer and math skills necessary to make the rocket soar. She was doing the programming on the Brown University campus through a class taught by Brown undergraduate students for Providence-area



Madavin Vong, a student at Gilbert Stuart Middle School, wanted to see how video game characters are made — and made to move. *Credit: Mike Cohea/Brown University*

Vong loves video games. Her favorites are ones styled on adventure, fighting, and—perhaps in an odd twist for someone so young—on time management. Now, through a program run by a nonprofit educational outfit called **Bootstrap**, she was getting a chance to create her own video game.

"Basically, I want to see how they make them," said Vong, who is in sixth grade at Gilbert Stuart Middle School. "To make [characters] move is a really cool thing."

## The creative possibilities of programming

For about 10 weeks, up to a dozen middle-school students from Providence-area schools ride a bus after school to Brown to fulfill their dreams of creating their own superheroes, villains, monsters, stellar athletes, or super-organized geniuses. The video game, while real, is the hook to expose the children to computer science and to deepen their mathematics skills, according to Shriram Krishnamurthi, associate professor of computer science at Brown and a pivotal backer of the Bootstrap class. Enticing them with a straight-on programming class would be "a hindrance, rather than a help," he says.

"The pitch is, Wouldn't you like to write your own video game?" said Krishnamurthi, who made Bootstrap's video-game software accessible via the Web and has helped with fundraising.

For the students who filed into a computer room at the Center for Information Technology for the first class last month, the answer would appear to be yes. These kids, with backgrounds from Cambodia, Haiti and El Salvador, were eager to get started. Their teacher, Brown sophomore Kurt Spindler, urged caution. "We're here to make video games," he assured them, "but the thing about video games, is they're complicated."

The students soon learn that's the case. They get drilled on x and y coordinates and, in a later class, are introduced to programming code



Kidai Kwon, right, works with middle-school students Devante King, left, and Wesley Cabral during an after-school Bootstrap session. *Credit: Mike Cohea/Brown University*

needed to create shapes and animation. They seem vaguely aware of, yet little deterred, by the algebra and computer science as they furiously complete exercises in their workbooks.

## Focused on programming, unfazed by algebra

That's the goal behind Bootstrap, said Emmanuel Schanzer, a Providence native and the program's creator. While teaching math and computer science classes in Boston-area schools, Schanzer found that his students reacted coolly to algebra and computer programming. So Schanzer, who studied computer science in college and worked for a while at Microsoft, devised a curriculum that effectively masked the fact that his students were tackling heavy math and computer programming. That curriculum led to Bootstrap, now in its fifth year and running after-school classes for urban schoolchildren in Austin, Texas, the Bay Area in California, Boston, New York, and Providence. "I had my life plan," Schanzer related. "I'd make my millions and

# Tunnels, Bunkers and Nukes:
# My Underground Vacation

By Jennie Duggan, PhD Student

In the first two weeks of September 2010, my husband Matthew and I took a trip to the Ukraine and Moscow, Russia. We started in Chernobyl, progressed south until we reached the Black Sea and continued on to the Russian capital. I was determined to experience as much of the culture as possible, so I extensively researched where we were going and planned everything possible by myself. It was a tight schedule traversing most of the largest country in Europe and experiencing Moscow in the time allotted, but very rewarding.

We started with a two-day stay in Chernobyl, the site of the 1986 soviet nuclear disaster. Chernobyl is neighbored by Pripyat, a city for 50,000 people that was slated to be the example of an "atomic city". Everything was very modern for the time and built around the power plants. After Reactor 4 melted down, everyone was forced to vacate in under 48 hours, leaving a veritable time capsule of the mid '80s Russia.

It was exciting to get to explore this city at our own pace. My husband and I took rooftop photos from abandoned skyscrapers, checked out period literature in the schools and wandered through an amusement park that was slated to open just 3 days after the disaster. We even got to meet some of the wildlife that has now taken over the 30 km exclusion zone around the disaster. Przewalksi's horses were extinct in nature for years, but as we found, now thrive in the zone.

We then spent a couple of days in Kiev and then progressed on to Odessa. Here we ventured into the world's largest man-made tunnel system, the Odessa Catacombs. The catacombs are estimated to be about 2500 km long (the maps no longer exist) and are a product of limestone mining. They form a spider web under the city and surrounding villages.


Visiting the amusement park at Pripyat in the Chernobyl Exclusion Zone.

We met up with a local man who maps and explores the former mines, Eugene Lata. We spent a day hiking through a hundred years of mining as he told us about the local history. It is amazing how mining technology has progressed from the era of pulling stones out of the ground with hand saws and horses. We saw many artifacts of old mining equipment that had been abandoned and even photographed hundred-year old graffiti from miners depicting early locomotives. We camped for one night on furniture constructed from limestone within the caverns. It is the quietest place I have ever slept.


Boiling tea at our campsite in the Odessa Catacombs.

The catacombs also played a part for many WWII battles in the area. On our second day, we saw where the soldiers had created makeshift beds in the mines, meeting places and a well. We finished at our friend's other camp where a second catacomber showed us some of their finds from within the mines. They have a personal collection of war artifacts including period Stahlhelms (steel helmets), a rifle and grenades from both sides of the conflict.

We next took an overnight train to the Republic of Crimea. Our destination was the city of Sevastopol, which includes Balaklava. Balaklava is a town built around a secret submarine base. Until the late 1990's, the entire area was off-limits to people outside of the workers at the base and their immediate families.

The submarine base itself is an engineering marvel. From the outside it looks like a normal mountain, but inside it is a teeming mini-city. It was built by carving channels into a mountain.

Chernobyl Music Hall


Odessa Catacomb WWII Artifacts


Balaklava Bunker Train Station

The system was designed such that a submarine could return to Balaklava and reach its port without ever surfacing. The inner channel has a lock designed to bring the submarines into dry dock for maintenance. The complex also has an internal train network and a nuclear bunker. This complex has been used as the inspiration for a video game and after walking through it, I can appreciate why.

In the final leg of the journey, we flew to Moscow. This was the more relaxing part of our trip after spending so much time on the road. We saw Red Square and the Kremlin and spent con-



The submarine channel in the Balaklava Base

siderable time admiring the massive metro system. Moscow has one of the grandest subway stations on the planet. Most of them are also buried very deeply (up to 100 meters!). Consequently, they also have some of the fastest escalators in the world, which required some getting used to.

These deep subway stations are also designed to double as nuclear shelters in the case of attack. One of the stations is adjacent to a nuclear bunker used by the soviet air command during the cold war that has recently been opened to tourists. Naturally, I could not resist. Its 75,000 square feet consisted of winding tunnels that were punctuated by four cylindrical bunkers. It was so secretive that each of the bunkers was autonomous and barely knew about the existence of the others. The museum was furnished with artifacts from its lifetime that we were allowed to experiment with, including a radiation detector and protective equipment.

During our stay in Moscow, we also attended the Yury Nikulin circus. In Moscow the circuses are still primarily run by a small set of families, where performers pass down the expertise



The border guard statue in the Revolution Square metro station. It is said that if you rub the dog's nose, you will have good luck on your next exam.

to their children. Some of the acts we saw were multigenerational, including acrobats, trained wild cats, dancing dogs and a strongman.

After this whirlwind week and a half, I grew to appreciate what the cold war had been like for the opposing side. Having worked for years for the US Navy had allowed me to see how business was done here (and how we are still reacting to some of its affects), but it was good to learn that the other side was just as worried as we were. Their methods were different, but at the end of the day we all just wanted the same thing: to live safely and be regarded with respect.

Tiger cub at the circus
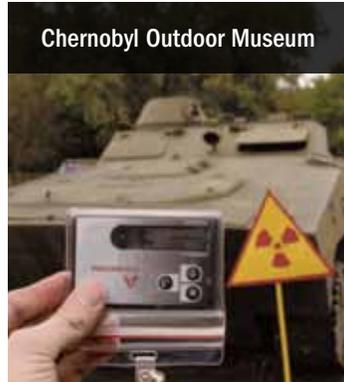

Chernobyl Outdoor Museum
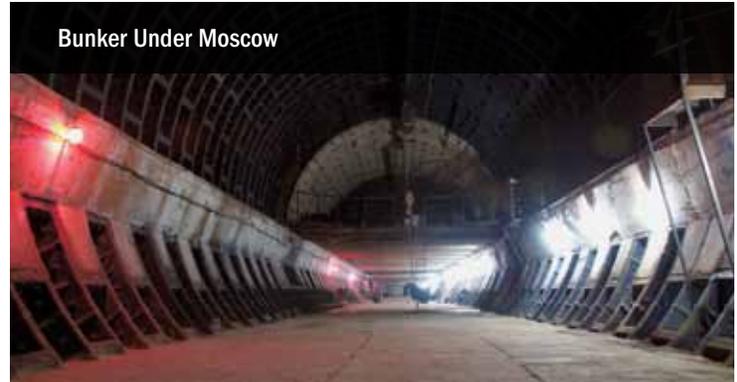

Bunker Under Moscow


St. Basil's Cathedral, Red Square
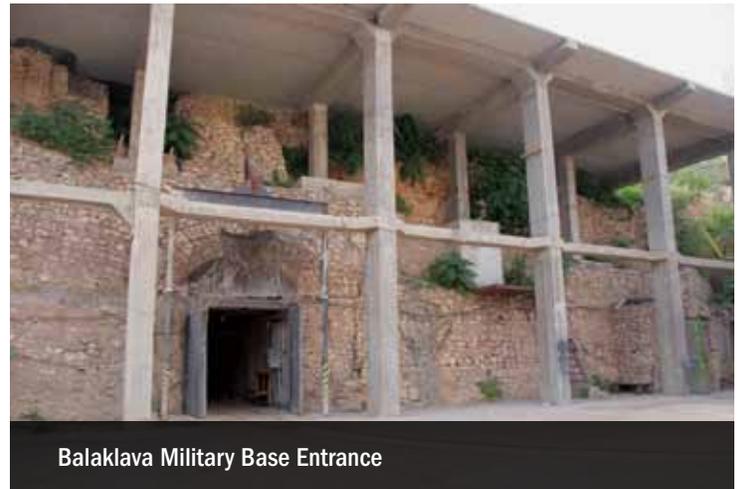

Balaklava Military Base Entrance

## Travel Fiascos of the Faculty

Tom Doeppner:

We had made the reservations months ahead of time, and it was sheer coincidence that we were to be changing planes in Hong Kong the day their new airport was to open (in July 1998). The first sign of any problem was when we landed. It took a half hour or so for the plane to get to the gate, then another half hour for the jet bridge to be positioned so they could let us out. We had landed more or less on time, and we had a five-hour layover, so we didn't feel pressed for time. We found some comfortable chairs to sit in (we had already been informed that the airport lounges weren't yet open) and prepared to wait for our next flight. We watched, with some bemusement, the hordes of people hurrying back and forth and listened to the numerous announcements of gate changes. After a while, it became clear that we were watching many of the same people hurrying back and forth. The first clear sign that something was wrong was when we tried to find a restroom and discovered that they weren't working. Any of them. We went to a few restaurants seeking food, but not only were they all out of food, they couldn't handle cleaning up all the trays and dishes that were scattered about.

Around two hours before our scheduled departure I thought it might be prudent to get closer to our gate. It was at this point that we discovered that none of the monitors were working – there was no indication from what gate our flight would depart. Not only that, there were zero airline employees available to ask. So, being a computer scientist, I embarked on a depth-first search of the airport, looking for a gate that claimed to have our flight. The new Hong Kong airport is not only beautiful, it's large. After close to an hour I found the gate. So we took our carry-ons over to it and encamped ourselves there. After a half hour or so, an airline employee arrived and made an announcement (by yelling – no PA system) that our gate had been changed. So all 300 or so people surged to the new gate. A bit later he came by again to announce that it had moved again. It turned out that this was something like the fifth time the gate was being changed and a rebellion broke out. The poor guy was surrounded by irate passengers who were asking such tough questions as "do you know where your airplane is?". He survived by promising that this would be the last gate change. It was, primarily because the new gate was in an area where you board buses to be taken to a plane that was some distance away. There was a mob scene when we got on the buses, but we finally got on the plane and

left, only a couple hours late. On the plane, they gave us a certificate saying that we were there on the airport's opening day...

They neglected to tell the people at the arriving airport (LAX) that there might be problems. To a first approximation, no one's luggage was on its flight (it's not clear whose luggage was on the flight). They had one agent standing by to deal with missing luggage, and pretty much everyone on the flight lined up to talk to him. The good news was that we didn't have to deal with our luggage on the flights back to Providence – it was finally delivered several days later.

I carefully read news reports of the opening when we got back home. As it turns out, we were among the lucky ones. Some arriving flights had to wait many hours before letting people off the plane. One report said that someone on one of these planes used his cell phone to call the police to say he'd been kidnapped. If Hong Kong was your final destination, you didn't see your bags until, in some cases, weeks thereafter.

Avoid version 1.0 of airports...

*Note from the editor: Please send any of your own travel fiascos you'd like to share to conduit at cs.brown.edu*

# The Faculty Speak Out

Q&A with Eli Upfal

### How did you first become interested in computer science?

My undergraduate majors were in Mathematics and Statistics. Both subjects were taught in the most abstract, formal form with few examples or applications, and obviously no experiments. Programming was a refreshing "practical" subject, where one could actually see some concrete results. That was in the late 70's, there were no personal computers, the university had one mainframe computer and having access to that machine was a great privilege. In my senior year I took an inspiring theory of computing course that convinced me to move to that relatively new and exiting field. Years later I learned that the instructor of that course was one of the most influential founders of computer science.

### How do you pick your research problems?

Most of my work has been in theory of algorithms, where the goal is to design efficient algorithms and give rigorous mathematical analysis of their performance. I have been mostly interested in randomized algorithms, stochastic analysis of algorithm, and related applications of probability and statistics theory to computing.

Working in theoretical computer science is not very different than working in pure mathematics. The quality of the work is mostly judged by the sophistication and beauty of the mathematical argument and by its application to other theory work.

In recent years I became more interested in practical applications of algorithms, and, in particular applications of probabilistic and statistical techniques to real life computing problems. In this line of research I have benefited from joint work with great colleagues in the department, collaborations with industry research labs and some consulting engagements with companies at the frontiers of computing applications.

### Do you have a favorite project that you've worked on?

I'm always excited about the project I'm currently involved in, and easily switch interest to the next one. I'm particularly happy about the outcome of a recent collaboration with my colleague Ben Raphael and our outstanding post-doc Fabio Vandin. Our work focuses on advance statistical/machine learning techniques to identify mutations in sets of gens with statistically significant correlation to a particular disease. The ultimate goal of research in Computational Biology is to develop theoretically sound tools that are practically useful for biologists. It was very encouraging to see the interest of lab biologists in applying our tools to their data and incorporating it into their publication.

### How have you seen your field evolving over the course of your career?

Technically, theory of algorithm has become much more mathematically sophisticated. In the early 80's most results were based on elementary combinatorics and graph theory. Today, algorithm design and analysis employs advance techniques borrowed and adapted from almost any sub-field in mathematics, ranging from probability theory to number theory, group theory and modern algebra.

The second important change is the growing relevance of the theory research to industry. Prior to the emergence of the web, the Human Genome Project and other large scale data applications, theoretical computer science was just theory. Students who specialized in theory could only work in academia, teaching theory courses. All that changed in the last 10–15 years. With applications that handled huge magnitudes of data, the asymptotic analysis of theory of algorithms, which studies the performance of algorithms on very large data sets, became important commercial questions. Thus, commercial applications for web search or large data analysis use sophisticated mathematical tools designed by theoreticians. The most noticeable consequence of this change is in the employment of theoretically trained computer scientists. You see them holding leading positions is many successful companies, and you see theory professors in research collaboration with industry.

### If you had enough extra time to study one additional area, what would it be?

Music - my Calavinova is waiting for better times...

# Faculty Notes

### Rodrigo Fonseca

Rodrigo received two grants this semester - a $15,000 Salomon Faculty Research award for research in the area of "Energy Efficiency Exploration in Sensory Network Protocols and a $148,000 grant from the Rhode Island Science and Technology Advisory Council to develop techniques to measure the performance of modern web applications.

### Maurice Herlihy

Maurice Herlihy is on sabbatical at the Technion, in Haifa Israel. He just finished teaching a class on applications of combinatorial topology to distributed computing, and is working on a book on the same subject.



(The family picture was taken at Petra, Jordan.)

### Sorin Istrail

This past June, Sorin Istrail traveled to his native Romania to receive an honorary professorship (professor honoris causa) from Alexandru Ioan Cuza University, where Sorin earned his B.S. in computer science in 1975. The university, which was celebrating its 150th anniversary, was also celebrating the centennial of its Alexandru Myller Mathematical Seminar. (Myller earned his doctorate at Gottingen University, where he worked with some of the greatest mathematicians of the time under the supervision of David Hilbert and a Ph.D. committee of Herman Minkowski and Felix Klein. He modeled the eponymous seminar after one at Gottingen, which offered a 24-hour oasis of mathematics

and a comprehensive library.) Sorin helped commemorate the centennial by participating in the seminar as an invited lecturer, delivering an invited talk titled "Concepts of Mathematical Rigor for Algorithms in De-randomization, Statistical Physics, and Molecular Biology."

In honor of one of his most beloved professors, Sorin created the Calin Ignat Fellowship – a research bridge between his alma mater and Brown University. Ignat was the founding professor of his alma mater's Department of Computer Science. The first recipients of the fellowship are Ph.D. student Vasile Alaiba and his advisor, Professor Cristian Masalagiu. The pair made their first research visit to Brown last October. After this note was sent for publication, Sorin found out that Professor Calin Ignat just passed away. The above picture, the last picture with Professor Ignat, was taken in 2005 when Sorin, who just arrived at Brown, visited Romania for the first time 22 years after his emigration to US.

With his graduate students Ryan Tarpine and Derek Aguiar and undergraduate student Kyle Schutter, Sorin co-authored "Practical Computational Methods for Regulatory Genomics: A cis-Lexicon and cis-Browser for Gene Regulatory Networks," a chapter in the newly-released Computational Biology of Transcription Factor Binding (Methods in Molecular Biology) (Humana Press/ Spring Verlag). Kyle, a bioengineering major, is the first undergraduate Sorin has collaborated with on a paper/chapter, and his contribution was significant: He led Sorin's "small army of undergraduate biologists" working on the Cyrene project's cisGRN Lexicon. This lexicon is devoted to the regulatory architecture of transcription factor encoding genes that were validated experimentally using the most stringent experimental tests, known as the Davidson criteria. Working with Sorin, Kyle also finished a very successful honors thesis. This past summer, Sorin welcomed computational biology undergraduate James Hart to his lab. James succeeds Kyle as the new leader of the Cyrene project's "small army."



Sorin Istrail with Professor Ignat

In August 2010, Sorin, Ryan and Derek traveled to Lisbon for the Fourteenth International Conference on Research in Computational Biology (RECOMB). The two doctoral students are the co-first authors of a RECOMB paper titled "The Clark Phase-able Sample Size Problem: Long-range Phasing and Loss of Heterozygosity in GWAS." Derek did a great job presenting the paper.

In September, Ryan traveled to Germany where, as the winner of the grand prize of the 2010 Worldwide APL Programming Contest, he delivered a lecture at the APL Conference. Ryan, the lead Ph.D. student on the Cyrene project, has been working also on the CLOSE (cis Lexicon Ontology Search Engine) software system. This system focuses on literature extraction of all published papers that report the results of cis-regulatory analysis of transcription factors encoding genes based on the Davidson criteria.

In January, Sorin traveled to Hawaii for the Pacific Symposium on Biocomputing. His lab contributed the paper, "Haplotype Phasing by Multi-Assembly of Shared Haplotypes: Phase-Dependent Interactions Between Rare Variants" coauthored with Derek and Sorin's long-term collaborator Bjarni Halldorsson. Derek also completed the first Loss of Heterozygosity genome-wide map of the Multiple Sclerosis GWAS data set. Working with a matrix of 3 billion entries containing data from 1,000 MS patients, each with their two parents, Derek's algorithm uses backtracking to construct the LOH map.

August proved to be a successful month for Sorin's research projects: The National Science Foundation funded his proposal "Haplotype Phasing Algorithms and Clark Consistency Graphs," and the NSF IGERT funded "Reverse Ecology: Computational Integration of Genomes, Organisms, and Environments" (David Rand – PI, Sorin Co-PI).

Also in August, Sorin welcomed new staff members: executive assistant Angel Murakami and (with the CCMB faculty) Nathaniel Gill, the new CCMB coordinator.

### David Laidlaw

David continues to mourn the end of his sabbatical year, where he discovered it is possible to have an entire thought without multiple interruptions. This year has been a bit like a very long Monday. This semester he is teaching CS16 for the first time, compounding the Monday effect somewhat. It's been really fun working with and getting to know the TA team that makes Brown CS classes what they are. It has also been a chance for some personal growth, learning how to produce 3 hours of class content for 60 students every week. Whew! In the remaining 3 minutes each week, he continues to work with his graduate students on applications of visualization and interaction to scientific areas. Tools for studying wrist bones will be the subject of funding to begin in April. Tools for studying gene-expression data continue to advance. And tools for studying brain white matter are the focus of several students getting close to finishing their dissertations. In the remaining 10 seconds each week, David is heading up the team building a replacement for the 1998 virtual reality room known as The Cave. The new "Cave" will be brighter, crisper, more contrasty, faster, and able to leap tall buildings in a single bound. If nothing else, it will make for some killer demos! In the remaining 5 milliseconds each week, David is coordinating everything for the upcoming VisWeek 2011 set of conferences, to be held in Providence in October. Maybe he'll see you at the Rhode Island Convention Center then!

# Faculty

## Claire Mathieu

Claire spent the Winter break at Institut Henri Poincare in Paris, where she taught a mini-course on semi-definite programming in approximation algorithms, and attended an exciting workshop on metric embeddings, algorithms and the hardness of approximation. There have been a series of breakthroughs recently, bringing algorithmic design and lower bounds ever closer to each other. The object that seems to lie smack at the meeting point, and is currently the object of intense study, is the unique games conjecture. Given a collection of linear equations whose variables are integers mod p, and where each equation is of the form $x_i - x_j = a \bmod p$, what fraction of the equations can simultaneously be satisfied, at best?

According to that conjecture, it is NP-hard to distinguish between instances that are 90% feasible or more, and instances that are 10% feasible or less. The research community seems evenly split on whether the conjecture holds.

The work on this question weaves together the most sophisticated tools currently at our disposal, revealing previously hidden connections. It's an exciting time for theoretical computer science!

## Barb Meier

I'm back to teaching the second course in my two-semester animation sequence after taking a break from it last spring. My students are busy putting together demo reels for job and internship applications. One of their frequent questions is, "Why don't more production studios, especially smaller ones, recruit at Brown?" We love the attention from Pixar and Sony, our main recruiters, but the students' question is a good one. Campus visits and recruiting in general are expensive and hosting internships requires a variety of resources, but I would urge our friends and alumni in industry to consider giving a student the chance to experience your world. Get in touch if you'd like to discuss this further: bjm at cs.brown.edu.

## John Savage

In the fall, John Savage returned to campus after spending an exciting and rewarding year in the U.S. State Department as a Jefferson Science Fellow. He served in the Cyber Affairs Office in the Bureau of Intelligence and Research and on a variety of committees including two that coordinate research within the Federal government, one for classified work and another for unclassified work. He also sat on a White House committee that drafted a national strategy for trusted identities in cyberspace (NSTIC) and served as a subject matter expert on cybersecurity and identity management as a member of the US delegation to a meeting of Study Group 17 of the International Telecommunications Union in Geneva. The work was very interesting, broad-ranging and provided many opportunities to develop a good sense of the functioning of the Federal government. It was a great experience and left him with a very favorable impression of government service and admiration for Federal employees.

In the spring of 2011 he is profiting from his year in DC by offering a new course entitled "Cybersecurity and International Relations" to an audience of 24 students evenly divided between computer science and policy concentrators.

## Peter Wegner

Peter Wegner, who continues as Editor of the Faculty Bulletin, has contributed a personal appreciation of the late Sir Maurice Wilkes, who was his thesis supervisor at Cambridge, and an article on Stephen Hawking's recent book on scientific design. He is the current chair of the ACM committee to select the winner of the 2011 Kanellakis prize, to be awarded this summer. He is working on an autobiography that will include a discussion of his Holocaust experience as a child, as well as his technical research on Curriculum 68, programming languages, object-oriented programming and interactive computing. ◉

# Books

## Operating Systems In Depth: Design and Programming

Thomas W. Doeppner
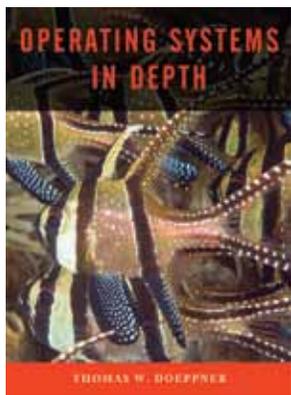
This book is designed for a one-semester operating-systems course for advanced undergraduates and beginning graduate students. Prerequisites for the course generally include an introductory course on computer architecture and an advanced programming course.

The goal of this book is to bring together and explain current practice in operating systems. This includes much of what is traditionally covered in operating-system textbooks: concurrency, scheduling, linking and loading, storage management (both real and virtual), file systems, and security. However, the book also covers issues that come up every day in operating-systems design and implementation but are not often taught in undergraduate courses. For example, the text includes:

· Deferred work, which includes deferred and asynchronous procedure calls in Windows, tasklets in Linux, and interrupt threads in Solaris.

· The intricacies of thread switching, on both uniprocessor and multiprocessor systems.

· Modern file systems, such as ZFS and WAFL.

· Distributed file systems, including CIFS and NFS version 4.

The book and its accompanying significant programming projects make students come to grips with current operating systems and their major operating-system components and to attain an intimate understanding of how they work.

## Hybrid Optimization

van Hentenryck, Pascal; Milano, Michela (Eds.)
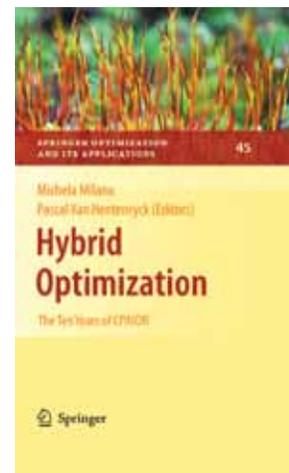
This volume focuses on the integration of artificial intelligence and constraint programming to solve problems in operations research and combinatorial optimization. This volume collects the contributions of experts from various research areas including decision theory, systems engineering, propositional satisfiability, mathematical optimization, and artificial intelligence. These invited scholars describe and demonstrate some of the most important topics and results from the last ten years of research related to hybrid optimization. *Hybrid Optimization* can serve as a valuable resource for graduate students, researchers and practitioners studying artificial intelligence or operations research who are interested in investigating or applying constraint programming techniques. ◉

# Department Awards and Honors

## Sorin Istrail awarded NSF grant to develop graph models and algorithms for genome-wide haplotype phasing

"Improving data quality is crucial, because if a human genome cannot be independently assembled then the sequence data cannot be sorted into the two sets of parental chromosomes, or haplotypes. This process; haplotype phasing will become one of the most useful tools in genomic medicine. Establishing the complete set of genetic information that we received from each parent is crucial to understanding the links between heritability, gene function, regulatory sequences and our predisposition to disease." J. C. Venter, "Multiple personal genomes await," Nature, April 2010

For more than a decade, Sorin has been a research leader in the area of haplotype phasing and inference.

In 2001, his group at Celera published the first paper on haplotype assembly. (The phasing algorithms developed by his Celera group were instrumental in the genome-wide haplotype phasing of the first diploid individual genome in 2007.) In 2002, he proposed a research program on the haplotype phasing problem akin to one in computer science that resolved the problem of characterizing the class of computable functions. The goal was to develop a unifying statistical-algorithmic theory of the haplotype phasing models proposed in the literature: parsimony phasing, maximum likelihood phasing, coalescent phasing, and Bayesian phasing.

Sorin's latest NSF grant supports his work on "Clark Consistency Graphs and Haplotype Phasing Algorithms"—a project devoted to unifying algorithmic strategies for the long-range haplotype phasing problem, i.e., the computational inference of the mother and father haplotypes for each genotyped member in a sample from a population of individuals. The goal of the project is to develop practical haplotype phasing algorithms applicable to a very large sample of individuals. The algorithms will employ the graph theory structure of long common haplotype regions, identical by descent, that are shared by the individuals in the sample. This approach is based on the algorithmic model pioneered by Andy Clark (1990) and elaborated through graph theory via Clark Consistency Graphs introduced by Sharan, Halldorsson and Istrail (2006) and the long-range phasing graphs employed by deCODE Genetics (Kong et al., 2008).

One major application for haplotype phasing is in genome-wide association studies (GWAS), whose current samples have data sets with billions of items, i.e., containing thousands of individuals genotyped at a half-million to one million single-nucleotide polymorphisms each. Unlike the Icelandic population, for example, which was successfully phased due to its well-recorded pedigree structure, the U.S. population, with its very complex and less-known pedigree structure, requires practical phasing algorithms for a sample of about one million individuals. The first beneficiary of this project's outcome is expected to be the International Multiple Sclerosis Genetic Consortium, whose GWAS Analysis Group includes Sorin's lab.

Sorin Istrail

## Philip Klein, Claire Mathieu and Ph.D. Alum Glencora Borradaile Receive NSF Grant to Develop New Algorithms for Solving Optimization Problems on Planar Networks

The National Science Foundation (NSF) has awarded a research grant, in the expected amount of $800,000, to Philip Klein, Claire Mathieu and Ph.D. alum Glencora Borradaile (now Assistant Professor in the School of Electrical Engineering and Computer Science at Oregon State University), to develop new algorithms for solving fundamental optimization problems on planar networks. Many optimization problems in networks are considered computationally

Philip Klein



Claire Mathieu



Ben Raphael

difficult; some are even difficult to solve approximately. However, problems often become easier when the input network is restricted to be planar, i.e., when it can be drawn on the plane so that no edges cross each other. Such planar instances of optimization problems arise in several application areas, including logistics and route planning in road maps, image processing and computer vision, and VLSI chip design.

The team plans to develop algorithms that achieve faster running times or better approximations by exploiting the planarity of the input networks. In addition, in order to address the use of optimization in the discovery of some ground truth, the investigators will develop algorithms not just for the traditional worst-case input model but also for models in which there is an unusually good planted solution; for a model of this kind, the investigators expect to find algorithms that produce even more accurate answers.

In addition, new algorithms and techniques resulting from this research might enable people to quickly compute better solutions to problems arising in diverse application areas such as computer vision. Further research has the potential to be useful, for example, in the design of networks, the planning of routes in road maps, and the processing of images.

## Philip Klein Named ACM Fellow

The Association for Computing Machinery (ACM) recently elevated Philip Klein to Fellow for his work in graph and network algorithms.

Philip, who joined the department in 1989, focuses on algorithms, especially for optimization and for graphs. He is the recipient of the 2007 Philip J. Bray Award for Excellence in Teaching in the Sciences. He created six courses for the department: The Matrix in Computer Science, Computer Science: An Integrated Introduction I and II (with Leslie P. Kaelbling), Design and Analysis of Algorithms, Topics in Advanced Algorithms, Solving Hard Problems in Combinatorial

Optimization: Theory and Systems (with Pascal Van Hentenryck) and Secrets and Promises: A Course on Cryptography for Non-Majors.)

Philip received his Ph.D. and S.M. in Computer Science from Massachusetts Institute of Technology and his A.B., summa cum laude in Applied Mathematics, from Harvard College. He has worked with several startup companies, served as a consultant for NEC Research Institute and Xerox Palo Alto Research Center and was a visiting scholar/scientist at MIT and Princeton. He was also a post-doctoral fellow at Harvard University.

The ACM Fellows Program was established in 1993 to recognize and honor outstanding ACM members for their achievements in computer science and information technology and for their significant contributions to the mission of the ACM. The ACM Fellows serve as distinguished colleagues to whom the ACM and its members look for guidance and leadership as the world of information technology evolves.

Philip joins the department's eight other ACM Fellows: Tom Dean, Maurice Herlihy, Franco Preparata, John Savage, Eli Upfal, Andy van Dam, Peter Wegner and Stan Zdonik.

## Ben Raphael Awarded NSF CAREER Grant

Ben Raphael is the latest faculty recipient of an NSF CAREER award, a highly selective grant that the National Science Foundation awards to junior faculty members who are likely to become academic leaders of the future.

The project funded by Ben's CAREER grant aims to develop algorithms for new and emerging high-throughput DNA sequencing technologies. These technologies are lowering the cost of DNA sequencing by orders of magnitude, thereby enabling a variety of new biological applications. Ben plans to:

- Develop novel algorithms for assembling complete genome sequences from billions of shorter DNA sequences produced by high-throughput DNA sequencing machines.

- Design robust algorithms to characterize differences between individual genomes within a species using an available reference genome of the species.

- Introduce combinatorial algorithms for the study of genome rearrangements in heterogeneous mixtures of DNA sequences. Examples of such mixtures are a community of microbes from an environmental sample, or a collection of cancer cells within a tumor.

The proposed research will be integrated with an educational component that includes the development of an undergraduate seminar in personal genomics, a summer research experience in computational biology for high-school students, and the incorporation of a computational biology module into the Artemis summer computing camp for 9th grade girls.

The Faculty Early Career Development (CAREER) Program is a Foundation-wide activity that offers the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations. Such activities should build a firm foundation for a lifetime of leadership in integrating education and research.

Besides his CAREER award, Ben has also received a Sloan Research Fellowship and a Career Award at the Scientific Interface from the Burroughs Wellcome Fund.

## Ben Raphael Awarded NIH Grant to Develop Computational Techniques to Study Structural Variation

Ben Raphael and his collaborators at Washington University in St. Louis have been awarded a five-year year grant from the National Institutes of Health (NIH), in the expected amount of $2.5 million, for their project "Computational Approaches For Structural Variation Studies

In Genomes." The proposed project will develop novel computational techniques to study structural variation, an important class of differences that distinguish individual genome sequences. Structural variants include duplications, insertions, deletions, inversions, and translocations of large blocks of DNA sequence. These differences have been implicated in several human diseases including autism and cancer. New genome technologies are enabling large-scale measurement of these variants, but application of these technologies demand new methods to interpret the resulting data.

Ben and his collaborators will develop computational approaches to facilitate the identification and characterization of structural variants. These approaches will be applied to data from human, cancer, mouse, and pathogen genomes in collaboration with several biomedical researchers. The proposed research will aid in the discovery of genetic variants associated with various human diseases, which in turn could lead to better diagnostics and/or personalized treatments for these diseases.

## PhD Student Carleton Coffrin Finalist in INFORMS Student Competition

Carleton Coffrin, a Ph.D. student working with Pascal Van Hentenryck, was chosen as one of six finalists in the INFORMS 2010 Doing Good with Good OR Student Paper Competition for his work on "Strategic Planning for Disaster Recovery with Stochastic Last Mile Distribution", which was presented this year as a paper in the Conference on Integration of Artificial Intelligence and Operations Research Techniques in Constraint Programming (CPAIOR) and as a poster in the Conference on Heath and Humanitarian Logistics.

Doing Good with Good OR Student Competition is held each year to identify and honor outstanding projects in the field of operations research and the management sciences conducted by a student or student group that have a significant societal impact. The competition is based both on a written submission and a 25 minute
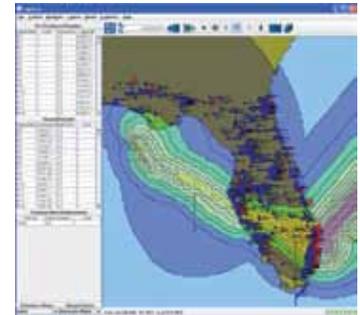


This image depicts the deployment of Carleton's work in Los Alamos National Laboratory's Logi-Sims tool. The image presents the effects of hurricane landfall on Florida's south-east shore. The shaded-concentric lines indicate the hurricane's wind speed, the small blue dots indicate disaster relief shelters and the red bars next to the dots show the amount of relief supplies that are required at each shelter location. The tables on left side of the window provide summary information relating to necessary preparations and recovery actions for this potential disaster scenario, that were calculated using Carleton's work.

talk. Carleton was recognized at the INFORMS 2010 Annual Meeting in Austin, Texas.

This work by Carleton in collaboration with Pascal and PhD alum Russell Bent has been deployed at Los Alamos National Laboratory as part of the LogiSim project and is being used to aid federal organizations such as DHS and DoE to prepare for and recover from national disasters.

## Charalampos (Babis) Papamanthou Visits Mrs. Kanellakis

On December 19th 2010, and while in Greece for the winter break, PhD student and Kanellakis fellow Charalampos (Babis) Papamanthou visited Mrs Kanellakis in Athens. He was joined by previous Brown CS PhD alums Aris Anagnostopoulos and Yiannis Vergados, who were both Kanellakis fellows in the past. All the fellows were delighted to see that Mrs Kanellakis is doing well, despite the recent loss of General Kanellakis.

The visit was very interesting and enjoyable, with Mrs Kanellakis going through many old archives and stories referring to General Kanellakis' life and achievements.

The next day, on December 20th 2010, Babis gave a talk at the Department of Informatics of the University of Athens entitled "Efficient Verification of Outsourced Data and Computations". The talk was dedicated to the memory of Paris, on the occasion of the passing of exactly 15 years since his tragic loss.

## Adrian Vladu Finalist in CRA's 2011 Undergraduate Researcher Award Competition

Undergraduate student Adrian Vladu was recently selected as a finalist in the Computing Research Association's Outstanding Undergraduate Award competition for 2011.

Adrian's main academic interests are centered around theoretical computer science, with a focus on algorithms and data structures. He has researched the problem of producing a global ranking of items given pairwise ranking information, when the items to be ranked arrive in an online fashion. This work resulted in a paper published at the 8th Workshop on Approximation and Online Algorithms. The paper was co-authored with Claire Mathieu.

He has also worked in the area of Computational Biology, which resulted in the paper "An Efficient Algorithm for Alignment of Strobe Reads" (with Anna Ritz, Aparna Das, Benjamin J. Raphael), currently in submission.

Upon graduation in May, Adrian will be working toward a PhD in Theoretical Computer Science. ●
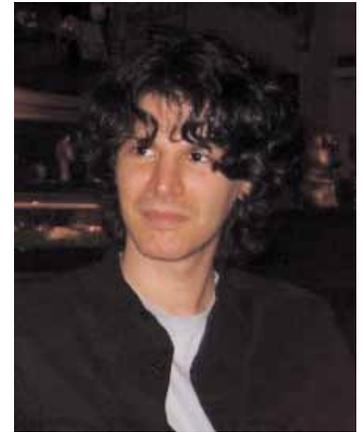


Adrian Vladu



Charalampos (Babis) Papamanthou

# Tenth Annual Paris C. Kanellakis Memorial Lecture
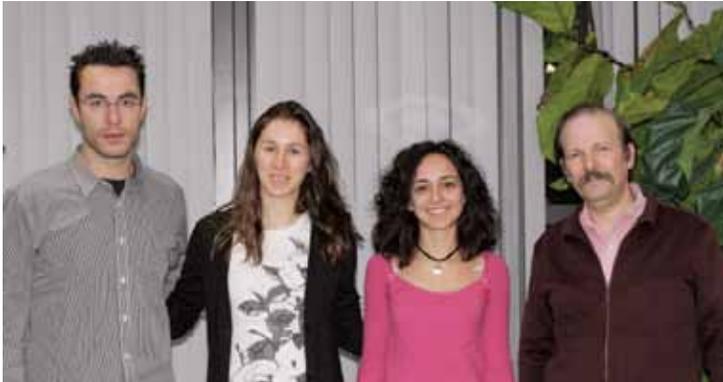


Distinguished Lecturer Moshe Y. Vardi of Rice University gave the 10th Annual lecture. He is shown here with Kanellakis Fellows Aggeliki Tsoli, Foteini Baldimtsi and Charalampos (Babis) Papamanthou.



**Left to Right:** Isabel Cruz, Alex Shvartsman, Dina Goldin, Shriram Krishnamurthi, Scott Smolka, Moshe Vardi, and Roberto Tamassia.

## Recent Ph.D.s



Kiran Pamnay with advisor John Jannotti



Alex Rasin with advisor Stan Zdonik



Micha Elsner

## 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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Mozilla
NING
Vertica Systems Inc.

**Individuals**
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# New Courses

## Computational Topology

Çağatay Demiralp, PhD student and TA for CS195H

CS195H - Computational Topology is a new addition to the department's course offerings by Spike (a.k.a. John F. Hughes) and taught first time this spring (Spring 2011). As its name suggests, the course aims to introduce students to various algorithmic problems that arise in the computational study of topology.

Compared to other branches of mathematics, such as geometry or analysis (e.g., calculus), computer science students are often less familiar with topology. One reason for this is that topology is a relatively new field. Although its roots can be traced back to Euler and Gauss (well, that can be said for almost every other branch of mathematics), topology is primarily a product of the 20th century mathematics and was pioneered by Poincaré. So, what is topology about? It is best understood in a comparison with geometry. In the Euclidean geometry (one of many possible geometries), one studies the congruence (or equivalence) of spaces (e.g., curves and surfaces) under rigid motions, which preserves lengths and angles. On the other hand, in topology we study the congruence of spaces under continuous deformations. This means that we deem changes in lengths and angles to be unimportant. For example, consider the two font curves "**S**" and "**I**"; although they are not congruent in the Euclidean geometry, these two curves considered "the same" in topology (here is a continuous deformation that projects the curve **S** onto **I**: *Pull the endpoints of the curve* **S** *until it is straightened and then shrink it from both ends to match with* **I**). Intuitively, this added "flexibility" in the transformation under which the congruence is considered should make it easier for different spaces to be congruent. So, in topology, one should expect a smaller number of equivalence classes of spaces.

Both topology and computational topology are very active research fields. For example, Grigori Perelman's proof of the Poincaré conjecture and the drama surrounding the subsequent events are very recent memories. Similarly, computational topology has recently started finding increasing number of applications in a wide range of areas such as low-level vision, global (or qualitative) data analysis, and sensor networks.
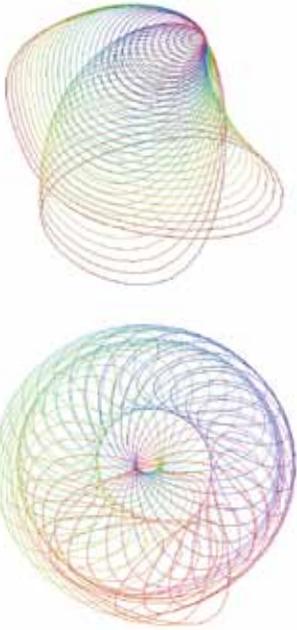


Figure 1: Screenshots from student projects plotting regular homotopy steps between two smooth polygonal curves
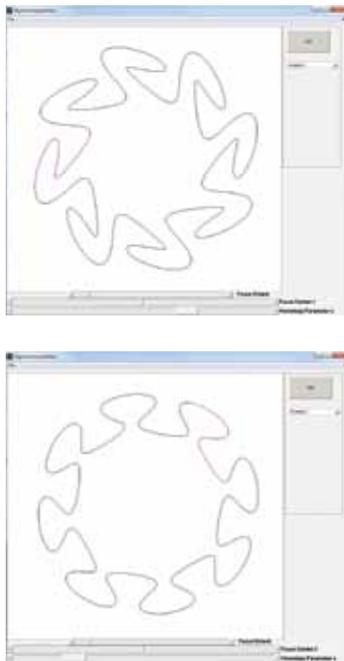




Figure 2: Snapshots from the Thurston corrugations demo used in CS195H.

Like topology, computational topology is a large and diverse field and the course syllabus is just a selection from it, reflecting, in part, Spike's interests. Here are some examples from the course projects (See the course website http://www.cs.brown.edu/courses/csci1950-h/ for further details):

- *Homotopy:* Show that every grid loop (a loop whose vertices are on the integer lattice, and whose edges are all vertical or horizontal) is homotopic to a constant grid loop by writing a program that takes a grid loop as input and produces as output a sequence of grid-homotopy steps. (Grid homotopies are made of discrete steps that model continuous deformations). Modify this program to take any grid loop in the punctured plane (a plane with a missing point) and deform it into one of the "standard" loops (or the constant loop if it doesn't wind around the missing point).

- *Whitney-Graustein Theorem:* Write a program that computes the turning number of a polygon. Given a polygon of n vertices and turning number k, construct a regular homotopy from the given polygon to the standard polygon with n vertices and a turning number k. Figure 1 shows screenshots from student projects plotting regular homotopy steps between two smooth polynomial curves.

- *Immersions:* Write a program that lets the user click a polygon, and then determines whether the polygon bounds an immersed surface. Enhance your program so that if the polygon bounds one or more surfaces, you report the turning number of the polygon and the Euler characteristic of each surface that it bounds.

- *Simplicial Homology:* Write a program that computes the bases for the groups of cycles that do not bound for a given triangulated surface (e.g., torus, Klein bottle, $RP^2$, etc.) or a higher-dimensional simplicial complex with coefficients in $Z/2Z$ (binary numbers) or $Z$ (integers).

The course is primarily aimed at Junior/Senior Math/CS concentrators who have taken a 100-level math course that involves some topology (e.g., MA106, MA141, and MA126) and who know how to program, and preferably have some experience with Matlab. However, in my experience as a TA so far, it is also a great way to learn topology for those who have not taken any related math courses because concepts are

introduced very intuitively and programming projects force students to think about the underlying ideas and theorems at a depth that these ideas and theorems often demand.

Spike is very excited about the course and has already written more demo code than we the TAs (Andrew Furnas, a stellar math concentrator with accumulated accomplishments such as Goldwater and Marshall Scholarships, is the HTA for the course). Figure 1 shows snapshots from the interface for his Matlab code to demonstrate regular homotopy via *Thurston corrugation*s. Well, you will need to take the course to learn what that means.

## CS2580

by Carleton Coffrin, PhD Student & TA for CS2580

Back in the summer of 2007 I was working out of my apartment in NYC and coding web sites for anyone willing to pay. Of course there were advantages to freelancing: sleeping in every day, working in my pajamas, having no boss, but the work just wasn't exciting for me. I spent my afternoons debugging cross-browser css compatibilities and dreamed all night of writing algorithms to "change the world"! (I will admit that just one year out of undergrad, my youthful optimism was as strong as it ever had been.) I had heard whispers in my last year of undergrad of optimization tools, and the prospects of using this technology for solving real-word problems were very exciting. So I decided to return to school and master these optimization technologies. I imagined that my time in academia would focus on toy problems such as sudoku or magic squares, but little did I know that I would be solving real-world problems as soon as I arrived at Brown.

I joined Pascal's lab (Brown's Optimization Laboratory) in the fall of 2008, and before the new student orientation had finished Russell Bent ['05] had already given an exciting talk about a series of disaster recovery problems that his division faces at Los Alamos National Laboratory. This was the beginning of a collaboration between Brown's Optimization Laboratory and Los Alamos's Energy and Infrastructure Analysis division that is still thriving today.

In my first year at the Optimization Laboratory we successfully developed an algorithm for a potable water disaster recovery problem. I was able to spend the summer continuing this work on site at Los Alamos National Laboratory, and integrated it into their fast response pipeline. Each time a category three or higher hurricane is projected to make land fall on US soil, the fast response pipeline is executed and cutting-edge algorithms are used to provided decision support to US government officials. It seems that my dreams of "changing the world" with computer science were coming true within just one year of starting my graduate studies. "Changing the world" maybe a bit of an exaggeration, but I am still excited help save lives during natural disasters.

Providing decision support to the US government is just the beginning. We also must share our knowledge with the broader community. We often do this through academic publications, but we have also chosen to disseminate our research directly to the Brown community through Pascal's graduate course, "Solving Hard Problems." Solving Hard Problems is not new to the course catalogue and the weekly class tournaments remain, but we have adjusted the curriculum to focus on problems in the field of humanitarian logistics. We have added two more projects to the course and changed the others to be focused on decision-support applications. Some of the new projects include: "Supply Chain," where a transportation network must be optimized to deliver relief supplies; "Green Zone," where security forces must be efficiently deployed to cover an urban area; and "Special Operations," where medical supplies must be packaged efficiently while minimizing the risk of contamination. So far the response to the new curriculum has been positive, and we hope that some of the students will have the opportunity to take their experience outside the classroom and use it to solve real-world problems. In fact, two students, Nell Elliott and Ben Simon, are already working in the Optimization Laboratory on disaster-recovery projects.



Results from the weekly class tournament where green boxes highlight the top performers. The competition is fierce!

# On Fantasy Hip Hop, Inc.



### The Problem

For as long as he can remember, Jason Townes French, (Brown Computer Science '08, shown here) has always liked two things: video games and music. His application essay to Brown was in fact written about his fascination with Super Mario Bros., and wanting to figure out what exactly made Mario jump whenever he pressed the "A" button. This question ultimately led him down the path of learning to program, and teaching himself C in 6th grade.

Somewhere along the path to geekism he found time to stimulate the other half of his brain with music. Coming from a family of musicians, song and rhythm have been a part of his life since before he could talk. In particular, the catchy beats and witty rhymes of hip-hop music caught his attention at a young age, and he would frequently play it in the background while defending his virtual ant farm in SimAnt, or racking up frags in Unreal Tournament.

It was only a matter of time before his curiosities led him to seek out hip-hop based video games, but he was sourly disappointed at the offerings. While other genres of music had found their own ways of manifesting in the game industry, the lack of quality hip-hop games stuck out to him like a sore thumb. "If you wanted to play a hip-hop video game, you pretty much had your choice between rhythm games like Parappa the Rapper, fighting games like the Def Jam series, or urban crime sandbox games like Grand Theft Auto: San Andreas." While these games had their appeal (who wouldn't want to play as 50 Cent shooting up terrorists in the Middle East, like in 50 Cent: Blood on the Sand?), there weren't many options outside of awkwardly implemented rhythm games, and

stereotype-promoting violent games. Even when games started taking the turn towards "social" in the Facebook scene, these hip-hop games did little more than encourage the player to get as much "bling" as possible and earn "respect" by dissing others.

Jason's disappointment with the hip-hop game offering quickly turned into the recognition of a big opportunity. To Jason and many other hip-hop fans, hip-hop is so much more than violence and bling. It is a wildly polymorphic form of creative expression, and a multi-billion dollar industry that has spread far beyond the music itself. Hip-hop has inspired global waves of graphic designers, graffiti artists, clothing lines, and other forms of media and merchandise more than any other type of music. With so much subject matter to build off of, surely someone could think of a better game, no?

### Enter Fantasy Hip Hop

While studying at Phillips Academy in Andover, Massachusetts, Jason was itching to create a game. His friends were playing fantasy football obsessively, and Jason, not knowing jack about sports, figured that maybe he could make a game about something he knew — music. It wasn't until after taking Steve Reiss' CS 9: Building a Web Application course that Jason mustered up the skills and courage to build his own web-based fantasy game. He called it Fantasy Hip Hop. It sported a PHP/MySQL backend, and a simple HTML front end. No graphics, no color even — just reading a bunch of hip-hop stats on a screen. His sophomore year, after a long coding session in his dorm room in Grad Center Tower B, Jason published his game live on the Internet at fantasyhiphop.com. What happened afterwards surprised him. Within the first 24 hours of launching the game he got around 2,000 players. Where these players came from, to this day he does not know. No Google Analytics, no marketing strategy (he placed a poster up at Lupo's downtown, and one in the Underground on campus, but that was about it), but somehow the players flooded in.

Seeing that he had something special in his

hands, he submitted to the Brown Entrepreneurship Program's Business Plan competition, taking home second place, as the only competing team that had both a completed product and several thousand dollars in revenue. His player base grew faster than he could actually deal with it, and after amassing over 16,000 players he finally disconnected the servers and figured he'd deal with the game later (afterall — he had to focus on passing CS 167!)

After graduating, Jason moved out to Silicon Valley to work full time for Apple preparing for their Snow Leopard release, and was shortly hired to serve as CTO of a new financial technology startup backed by venture capitalist Tim Draper called Xpert Financial (www.xpertfinancial.com). It was there where he synced up with California native Brent Vale — a University of Chicago alum, and former classmate of Jason at Phillips Academy. After working together for a year learning about how businesses get funded, the duo teamed up to formally found Fantasy Hip Hop and bring it back as a full-screen, 3D visual experience. With Brent's help and support, they received angel funding and set up shop in Silicon Valley's most renowned startup incubator — the Plug and Play Tech Center in Sunnyvale, California.

### Plug and Play

"Working in the Plug and Play Tech Center is like being in the CIT all over again," says Jason — except this time everyone was working on a new startup. It's a massive complex filled with tons of web, mobile, and gaming companies. Hot startups like Addmired and G6 Media are right down the hall from Fantasy Hip Hop, and all the startups get to enjoy Friday lectures from Silicon Valley's top VCs (pizza and beer included!) "It's great being at Plug and Play", says Jason. "It has the right energy and culture to keep you inspired during those long nights of coding. Plus technical help and new hires are just around the corner, pretty much 24 hours a day".

While the next generation of Fantasy Hip Hop is just now getting underway, Jason and Brent are very excited about their

outlook. "Having a previous version of the game to go off of took out a lot of the risk — we know what players liked before, and we know how to make it better." Their desktop computer game is set to release on Windows and Mac OS X late summer 2011.

Hip-hop gamers — get ready for the game you've been waiting for!

## Dana Tenneson, PhD '08

For the last two years I've been working in at the Education
Arcade, an educational games research

lab at MIT within the newly formed 'Media Lab Complex.' My job title is that of Senior Programmer, but this is the sort of place where everyone has to be a bit of a one-man army. I do a fair amount of game design and managing of undergraduates in addition to leading software development projects and generally making Adobe Flex do things it has never done before.

Getting a job here was a really great fit given how my research at Brown was always focused on educational uses of technology (Education was my outside minor sequence) and that I was really interested in games development in my limited spare time. Having been involved in Brown's Fantasy Gaming Society and Chad's Innovating Game Development seminars really helped prepare me for the work I do now.

For the last year, most of my time has been devoted to the upcoming Smithsonian/MIT science mystery, Vanished (http://vanished.mit.edu).

We've been creating a complex two-month scenario where middle school kids across the country will have to collaborate online to solve the mystery. Current MIT students will model good scientific practice for the players and Smithsonian scientists will be available as resources for players trying to learn the science that will help them succeed.

This work is heavily inspired by the success of ARGs (Alternate Reality Games), but we've had to make some serious modifications to the design to make it encourage active engagement from a wide range of players.

This has been a particularly exciting project for me as there are dozens of people involved and dozens of 'moving parts' to the mystery and I'm one of the two primary implementers.

One other exciting project I got to be a part of was working on a game to help populations at risk of predatory lending to understand their finances. I worked with a few of my coworkers to put together a design in our spare hours. Then, in a single code flurry weekend, I wrote a prototype for our game, 'Farm Blitz.' The design and prototype won funding from the Social Security administration and an outside game studio was contracted to make it. When all the funded games were completed, there was a congressional briefing about the games and ours was highlighted as the example for demonstrating how players learn important finance basics through gameplay.

http://financialentertainment.org/play/farmblitz.html

Also, readers might be interested to know that I'm not the only Brown CS alum here. I work with Louisa Rosenheck (class of 2003, BA in CS) who is a Project Manager. She went on to get a master's degree in Education from Harvard and focuses more on game and curriculum design. Lately, she has been developing a series of biology games for high school students to play on smartphones (Android) outside of classroom time.

## Danfeng (Daphne) Yao PhD '07

Danfeng (Daphne) Yao is now an assistant professor at Virginia Tech Computer Science Department.

She moved from Rutgers CS to the beauti-

ful Blacksburg mountains in January 2010, together with her daughter (Radia) who is almost 4 years old. Her husband, Chang Lu, also moved from Purdue University to VT Chemical Engineering as an associate professor. Daphne received her NSF CAREER Award in January 2010 to support her work on human-behavior driven malware detection. She holds a patent (PCT) on the technology developed on this project, which is licensed to Incubation Factory. Some of her other recent work received IT media attention, e.g., NSF news reported her work on activity-based authentication systems in November 2009. She and her graduate students also grabbed a couple of best paper and poster awards in conferences. Most recently, she started a new cyber-security project funded by the Army Research Office (ARO) on designing personalized anomaly detection solutions.

# Ping!

## Where are you and what are you doing?

Let us know what's happening in your life! New job? Received an award?
Recently engaged or married? Use this form to submit your news or email conduit@cs.brown.edu.

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